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THE WHICHPLM REPORT \ THE INTERNET OF THINGS ISSUE \ 6TH EDITION

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WELCOME

TO THE WHICHPLM REPORT 6TH EDITION

LAST YEAR WE, AS A TEAM, MADE THE DECISION TO REBRAND AND RE-TOOL OUR LONG-RUNNING ANNUAL REVIEW FORMAT. CONDUCTING EXTENSIVE RESEARCH AND INTERVIEWING KEY FIGURES FROM AROUND THE WORLD WE SET OUT, AS I WROTE IN MY INTRODUCTION TWELVE MONTHS AGO, TO "LOOK IN DETAIL AT A CAREFULLY-SELECTED TOPIC THAT WE CONSIDER TO BE EXERTING THE STRONGEST INFLUENCE ON THE FUTURE OF EXTENDED PRODUCT LIFECYCLES ACROSS THE RFA INDUSTRY".

But although we knew at the time that our analysis was sound, none of us – me included – was sure how the concept of dedicating almost half our page count to 3D working would be received by an audience accustomed to pure PLM content.

As it turned out, people responded more strongly than we'd ever anticipated. Our 5th Edition publication sold well, and feedback from brands, retailers, consultants and other analysts has been extremely encouraging.

It helped, of course, that our choice of topic was timely. Three-dimensional working was on the tips of everyone's tongue in 2015, and has since become even more prominent in the fashion industry. Talking about 3D was the right choice because, at the time, it represented a very real and very different way of working for an industry used to doing things a certain way.

But as you'll soon discover in these pages, our 5th Edition was just the tip of the iceberg. Because as potent and powerful as 3D is, this year we have the challenge – and the privilege – of writing about something that is almost undoubtedly going to change the world.

Depending on who you ask, the Internet of Things ("IoT") means many different things – some pure hype, while others are more grounded in reality. For some commentators it's about wearable technology and fitness trackers. Others will tell you it's about smart industry, with connected machines, preventative maintenance, and a move towards robotics. Others still will talk about a new kind of big data, or a pathway to augmented reality.

While all of the above are technically true, the aim of this publication is not to limit what the IoT can be or to artificially inflate its current state, but rather to present the opinions of industry leaders (including the inventor of the term) and our own research findings to examine how embedded systems, sensor nodes, and algorithms for interpretation are already beginning to bridge the digital and physical worlds – and how this is likely to impact the retail, footwear and apparel industry in the near and longer-term future.

Like most new technologies, the IoT is widely misunderstood and just as widely misrepresented. It can be difficult for anyone not well-versed in the subject to understand precisely where the value lies, because so many players are pulling in so many different directions.

But unlike most new technologies, that value is already there, in plain sight. Although the acronym itself only really appears in B2B applications, the IoT has already irreversibly changed entire consumer markets.

At home our mobile devices, central heating systems, refrigerators, televisions, lights and security systems, automobiles, medical and fitness trackers, and even the clothes we wear are already beginning to lead double lives. They exist in tangible reality, as objects occupying physical space, but also have their own footprints on a global network, and addresses from which they can send, receive, and in the cases of smart devices, process and act upon, large volumes of sensor data.

These are the obvious manifestations of the IoT: literal things connected to the Internet. But less obvious than the Apple Watch and far more significant in their implications are services like Uber – a service that IoT figurehead Kevin Ashton cites in our exclusive interview as "a great Internet of Things application".

Despite some initial friction, Uber has been successful in changing the way people think about transportation in large cities around the world - all through the use of relatively simple geolocation data and advances in mobile data infrastructure.

So even though the bulk of the Internet of Things may not be made up of big, showy devices that consumers can readily understand, the key to understanding its potential for both personal and professional applications is never to think small.

Like many readers, though, a year or two ago I was familiar with the IoT at a high level. With a decades-long background of pushing for standardisation between software solutions, I perhaps knew a little more about the principles of data integration than some people, but I didn't recognise all of the ways the IoT was already changing my life – and I certainly did not understand all of the underlying technologies.

The key lies in understanding that it won't just be smartphones and wearables connecting (although the marketing potential of these for retail is vast), but potentially every single SKU and even the mirrors in our stores.

Around that time, software vendors – from the biggest on the planet to much smaller businesses – started talking about their IoT products. And although some of them had clearly put a lot of thought and research into developing persuasive platforms, others, it must be said, seemed to have latched onto the label as a way of drumming up sales. In the months since, I have seen the acronym applied to everything from line planning to manufacturing.

Whether these vendors were right or wrong, I found myself in the same shoes as the audiences they were talking to: eager to know more about the good applications, certain that in other cases the market was being misled, but in both instances lacking the grounding I felt I needed to make my own determinations and to understand the IoT's potential for WhichPLM's growing international readership.

So, while our analysis and editorial teams tackled the exclusive interviews, features, and industry-leading market intelligence you'll find throughout this publication, I set out to educate myself on precisely how the Internet of Things works – and more importantly how it's likely to change the business of fashion.

As Kevin Ashton (the father of the IoT concept) told us in the exclusive interview that follows this introduction, the critical but often-overlook part of the Internet of Things is the word "Internet".

Even though we think of broadband or fibre connections as a utility equal to water or electricity, people – myself included – tend to look at the Internet as a closed book, or a kind of magic. Until we're reminded, we forget that it's a tremendously complicated, global communications network that is providing the infrastructure that allows daily activities we take for granted to happen.

Generally speaking, people recognise that because of the growth of the Internet infrastructure (particularly noticeable in East Asia, where roll-out of high speed connectivity has happened much more rapidly than in Europe or the USA) more things than ever before are "connected", but they don't necessarily understand how that ubiquitous connectivity works.

The Internet as a whole uses a common transmission protocol called TCP/IP, and has done so since it was originally used to connect military networks and government agencies. TCP/IP is open, available for anyone and any application to use; it's robust, resistant to failure, and flexible enough to be used across hugely diverse networks. It is, frankly, the best way we have of sending data from one location to another.

The protocol disassembles data into small packets for sending, and re-assembles them at the other end, providing a secure, scalable method of sending virtually any kind of information from one device to another.

But although we, as humans, know where those devices are in the world, they don't identify themselves geographically to one another – at least not at first. Instead, each device has a unique IP address, marking out its place in the global network. This same system is used to connect a web browser with a content server and, in my earlier example, an Uber driver with his fare.

This is all well and good today, but in a world where analysts estimate that between 8 and 75 billion objects (admittedly a fairly significant margin of error) will be connected to the Internet by 2020, are there enough unique addresses to go around?

The short answer is that there aren't, but it's being worked on.

South Korea is currently leading the charge with a figure of almost 38 IoT devices per 100 inhabitants (according to data released by the Organisation for Economic Co-operation and Development), but countries like Denmark, Switzerland and the USA are not far behind. As this pattern continues, the current version of the Internet Protocol (version 4, or IPv4) will run out of address space, leaving new nodes and devices with no way to identify themselves.

We can now see just how far the IoT is likely to change not just the world of fashion, or the world at large, but the Internet itself.

The appropriately named Internet Engineering Task Force is in the process (and has been since 1998) of collaborating with service providers to transition from IPv4, which has a hard limit of 4.3 billion unique addresses, to IPv6, which allows for 340 undecillion unique addresses. To save you a visit to Google, an undecillion has 36 zeroes.

But what, exactly, is the RFA industry going to be able to do with billions upon billions of addresses per person?

Although we have been careful not to neglect our core PLM coverage (turn to our end user survey, vendor profiles and market intelligence for our signature, world-class analysis) much of the rest of this publication is given over to answering that question. But I want to end this introduction with some hints at where I believe the IoT is taking our industry.

The key lies in understanding that it won't just be smartphones and wearables connecting (although the marketing potential of these for retail is vast), but potentially every single SKU and even the mirrors in our stores. From RFID chips to beacons to QR codes, connectivity has the potential to transform the way warehouses, retail stores, e-commerce platforms and entire design and development processes operate.

The phrase "digital transformation" is often used, but I firmly believe that it applies today. We have finally arrived at a point in time where sensors, smart devices, E-PLM apps, core PLM software and a multitude of hardware systems are ready to interconnect. And from that connectivity vendors and their customers will begin to achieve automation, and eventually transform the entire sourcing, supply chain, marketing, and retail paradigm.

As that paragraph suggests, the IoT is both the biggest topic WhichPLM has ever tackled, as well as being potentially the planet's biggest opportunity (and also one of its most confounding challenges) for decades.

To do it justice, our team began the year by collecting data and polling key brand and retail executives about their perceptions of the IoT, and in the process we discovered some genuinely mind-blowing applications that you'll find detailed in this publication's exclusive features. With the fiscal year over and our PLM analysis complete, we also asked key software vendors to provide their own opinions on the topic, and you can find these attached to each of their vendor profiles.

Whatever shape the end result takes – driverless cars and smart, utopian cities, or just smart fabrics and stores – I firmly believe the IoT is something none of our readers can afford to ignore.

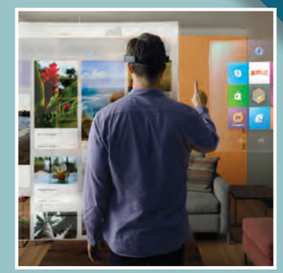
With that in mind, I invite you to turn the page, discover the rich contents of this, our sixth print publication, and then enjoy the best primer possible: a world exclusive interview with IoT inventor, entrepreneur and author, Kevin Ashton.

As always, I'm immensely proud to be a part of the fashion technology market, and this year I can confidently say I'm beyond excited to see how it will change.

MARK HARROP
Founder & CEO

CEO PICKS

THESE PERSONAL HIGHLIGHTS ARE JUST A SMALL SELECTION OF THE EXCLUSIVE, EXPERT CONTENT CONTAINED THROUGHOUT THIS PUBLICATION.



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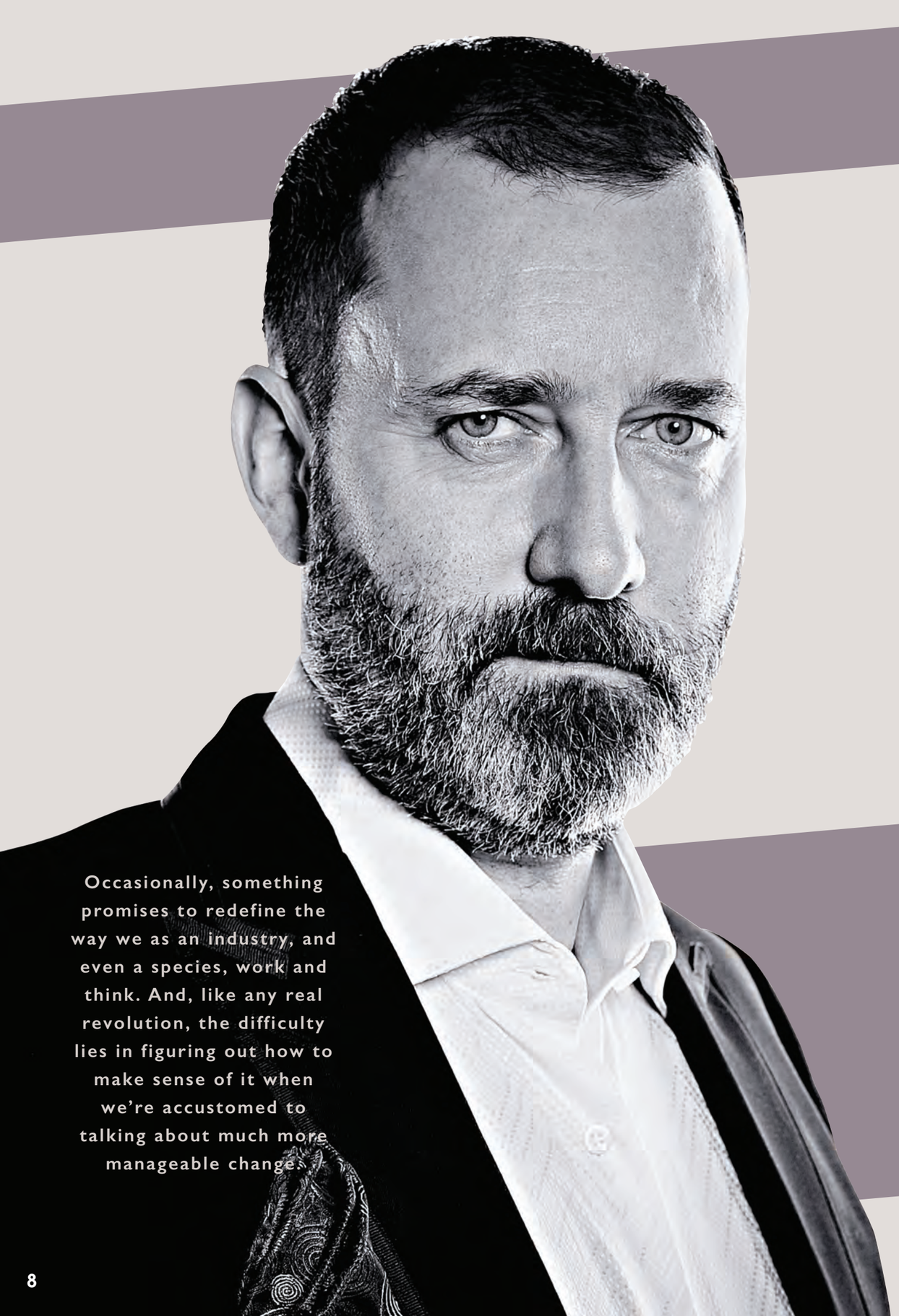


Occasionally, something promises to redefine the way we as an industry, and even a species, work and think. And, like any real revolution, the difficulty lies in figuring out how to make sense of it when we're accustomed to talking about much more manageable change.

YOU SAY YOU WANT A REVOLUTION

A CONVERSATION ABOUT CONNECTIVITY AND CREATIVITY IN THE 21ST CENTURY WITH IOT INVENTOR KEVIN ASHTON.

AS A SPECTATOR, YOU MIGHT BE FORGIVEN FOR ASSUMING THAT INNOVATION IN ENTERPRISE TECHNOLOGY HAPPENS PRETTY QUICKLY.

An individual or a startup formulates an idea; it undergoes a process of commercialisation and the rough edges are smoothed away, and the results are eventually deemed successful in their own right, or assimilated into one of the giants' product portfolios. The marketing and sales juggernauts then roll in, tout its benefits for a couple of years before we all move onto the next hot topic.

Writing about technology, it's easy to fall into that same mode of thinking. Something new comes to the industry's attention and we pick it apart - scrutinise it with different lenses, depending on the sector we cover. Maybe we revisit it a few years down the line to weigh up the ROI and chat to the people who made it work. Perhaps, as with PLM, it becomes sticky enough to start its own cycle. But broadly speaking, we tackle a topic when it reaches that tipping point of awareness, and we move on.

This can be a problem.

A problem for commentators, because the cycle breeds disillusionment and threatens to bury the magical among the mundane. A problem for technology vendors, who must walk a careful path somewhere between increments and innovation. And a problem for customers, who become disenfranchised by the idea – not always unjustified - that the industry prioritises newness over long-term value.

Occasionally, though, something crests the horizon that up-ends expectations, and promises to redefine the way we as an industry, and even a species, work and think. And, like any real revolution, the difficulty lies in figuring out how to make sense of it when we're accustomed to talking about much more manageable change.

Beginning with 2015's examination of the transformative potential of three-dimensional working, WhichPLM's reports have been designed to spark productive dialogues about precisely these kinds of developments: the kind that change the world, but that defy easy explanation.

While the value of a 3D asset was clear for design, prototyping and sampling purposes, last year's report (back issues remain available through the WhichPLM website) delved deeper, uncovering broader applications scattered throughout the product lifecycle, from costing to marketing.

This year's subject, the fabled "Internet of Things", faces a similar struggle. Its utility in the maintenance and monitoring of connected machinery is obvious, but its long-term implications for manufacturers, brands, retailers, and consumers are effectively limitless, making the concept as a whole difficult to define.

As Mark Harrop outlined in his introduction, this open-endedness has not prevented some extremely prescient people from building inspiring IoT products and services, but neither has it stopped less scrupulous salespeople from sticking the IoT label to almost wholly-unrelated things.

So while the marketing machine has begun to build a head of steam behind the IoT, beyond that starting point of smart machinery on the factory floor there is little or no consensus about what the term actually means for fashion today – let alone in the future. This, however, is not an unfamiliar situation; even today, more than a decade after the acronym came into circulation in retail, footwear and apparel, our definition of PLM is often tested, contested, and occasionally redefined as the technology and the processes that are built on it mature.

But just like PLM, attempts to define and delimit the IoT are often agenda-driven, and many brands' and retailers' primary exposure to its potential will come from people with something to sell, whether they openly acknowledge it or not.

The purpose of this publication – like its 2015 equivalent – is therefore to collect opinions and insights from some of the best minds in the industry about a topic that, WhichPLM believes, will have a profound and irreversible effect on our future. One that everyone from the entrepreneur to the end user should have a firm grasp of before being exposed to a sales pitch.

The features that make up the following pages are the result of extensive interviews and conversations that took place in early 2016, when WhichPLM tasked technology vendors, consultants, academics and its own analysts with explaining precisely how the retail, footwear and apparel industry and the IoT are going to interact in the short and longer term.

As you read on, you will notice that we received a wide range of different, often fascinating, answers, but one thread remained consistent throughout. The most significant and consistent challenge remains impressing upon brands, retailers and manufacturers (and their customers) that the IoT is an inevitability rather than just one potential future, and that its impact will therefore be felt even by those who choose not to engage with it directly today.

IoT education, then, requires a keen understanding of not just current and future applications, but a far broader blend of historical and contemporary context: IPv6, RFID, GPS, APIs, M2M communication, supply chain automation, systems integration, and all the commonplace apps and services that are already leveraging these to deliver experiences that many do not realise fall under the IoT umbrella.

And while Mark Harrop's introduction sets out the commonly-accepted story of how the IoT concept originated and evolved, WhichPLM recognises that there is no substitute for actually being there.

So we set out to speak to the man who was.

Born in Birmingham, England, Kevin Ashton coined the term "Internet of Things" during his tenure at the Massachusetts Institute of Technology, where, in 1999, he led the research consortium responsible for creating an open, standardised, global system for radio frequency identification (RFID) and other physical sensors.

Today, Ashton lives in Austin, Texas, and has drawn on his experience as a technology pioneer to become a successful investor, entrepreneur, author, and social scientist. He remains actively involved in shaping technologies that bridge the digital and physical worlds.

These following pages recount a conversation between Ashton and WhichPLM that took place in early 2016. Our subjects were the ways that technology is assimilated into the public consciousness, how connectivity at the physical and application layer is shaping the future of business, how business software must evolve to respond, and the real nature of invention. The result is an essential primer for everything that follows in this publication: the truth about the Internet of Things from the man who saw it coming.

Editor's note: while we have softened some of his coarser language, Ashton's particular brand of intelligent, infectious futurism is so compelling that we have otherwise presented our exchanges verbatim.

Computers in the twentieth century were entirely dependent on human beings to give them data, and this was placing huge limitations on what was actually possible with information technology.

WhichPLM: As you're no doubt aware, "the Internet of Things" is being used to refer to a lot of different, sometimes mutually exclusive things. In the interests of absolute clarity, what did it mean to you when you originally conceived it, and has your perspective on the IoT changed in the intervening years?

Kevin Ashton: The Internet of Things actually started because of a problem that is, in many ways, comparable to one that's extremely common in the fashion industry.

In the mid 1990s, I was working as an assistant brand manager at Procter & Gamble, tasked with introducing a new range of colour cosmetics. There are a lot of similarities between cosmetics and clothing, as it happens, including a rather fundamental one: colour and choice are extremely important for both.

Even though we were launching a relatively small range, we still had thirty-nine different shades of lipstick, certain ones of which proved more popular than others. Without e-commerce to fall back on, if the customer couldn't find the colour she wanted in-store, she couldn't make a purchase. And at any given time, our most popular colour was out of stock in four out of ten stores - something that really bothered me, as it would any brand manager in the same situation. I wanted to figure out what was causing that, and how we could fix it.

It's important to point out that the problem wasn't one of stock shortage. We manufactured enough of the lipsticks in even the most popular shades, and had sufficient stock in our distribution centres. The trouble was, the popular colours would only remain on store shelves for a very brief window, and then were not replenished for a long time.

The insight that struck me was that, although everyone at the time thought we were living in an information age, there was actually no way to gather information as detailed (and as necessary) as what colour of lipstick is on what shelf in which store. The only way to obtain that level of insight would have been manually: a member of staff would have needed to look at the shelf and count its contents.

This would have proven expensive, impractical, and highly inaccurate, since people tend to get bored very quickly with monotonous tasks. So my principle insight was this: computers cannot gather their own information. Computers in the twentieth century were entirely dependent on human beings to give them data, and this was placing huge limitations on what was actually possible with information technology.

The goal of the Internet of Things program - which was the label I gave the resulting strategy at Procter & Gamble, and that we later researched at MIT and broadened to cover essentially everything in the world – then became to create a ubiquitous sensor system for computing.

WhichPLM: Which makes perfect sense, if you'll forgive the pun, but sensor data is obviously only part of the picture.

Kevin Ashton: The absolutely crucial thing to understand about the Internet of Things, is the "Internet" part. Sensors are only really useful when they form part of a network.

The easiest analogue is our own human senses. Our fingertips, eyes, ears, noses, mouths, the ways we sense temperature – everything is connected via our central nervous system, to our brain. We turn our heads when we hear sound, or if that sound occurs at the same time we see something, we intuit that something was probably what caused the sound.

Having a synchronised, networked, distributed sensor system allows us to sense multiple things in multiple ways, and then to make sense of them in one centralised place. That's how sensor systems have to work in order to be useful.

So the Internet was an essential prerequisite for developing a system that allowed computers to gather their own information.

WhichPLM: That, for us, is the crux of this conversation. A lot of people appear to have this backwards: they believe that the Internet of Things is a grand, orchestrated strategy to add connectivity to objects so we can hook them up to an already-extant centralised processing system and make them better. In fact, what's happening is that the sensor system is emerging organically (through incredibly cheap embedded systems and the evolution of infrastructure), and the challenge of the IoT in business is actually to architect ways of making the resulting data meaningful.

Simply connecting new things is not an intrinsically valuable activity; we have to build methods of making them understood.

Kevin Ashton: Absolutely. And that's really the second major part of understanding the IoT.

The other thing to remember about twentieth century computing was the prevalence of human-entered data. And I'd like to add that although the fashion industry tends to think of barcodes as being outside that definition, they are really only a quicker method of manual data entry – someone still has to point the reader at the tag.

This created what I refer to as the "twentieth century data paradigm", which was characterised by spreadsheets, and which I believe we still feel the hangover from today. People gathered data from barcodes or warehouse inventory systems or point of sale systems, and that data was entered into some kind of business-to-business computer tool – like PLM or ERP – that allowed them to produce reports.

What Uber really did was take simple sensor data from smartphones, and create a really powerful application out of very familiar technology. And that scares people who are entrenched in a certain way of thinking.

Fashion deals with a lot more SKUs than other industries, and this volume and diversity is precisely where good, real-world data will come into its own. If you're multiplying styles by colours, sizes, dimensions, and so on, you have an incredibly complex supply chain – more so than most other sectors.

But as you've hinted at, somebody actually had to look at those reports to figure out what was going on. All these concepts like dashboarding, report generation, spreadsheets are the other side of the human-entered data coin: which is that human-entered data tends to then have to become human-readable data.

The classic business data paradigm is this: I have a system, it's gathering information somehow, those data elements go into a web-based database from which somebody – often fairly junior – generates a report. That report is distilled down into some kind of visual representation, and then more senior people get together, have a meeting, and they look at that visual to try and make some kind of decision based on it.

For all the labels we give it, that isn't real-time data processing. It's what I call Outlook-time data processing: it's limited by the least-available person on the shared Outlook calendar who has to be at the meeting.

In the twenty-first century, however, if we suddenly have all this granular sensor data streaming in real-time (most of which is actually trivial, most of the time) that spreadsheet paradigm simply isn't going to work.

So the second fundamental pillar of the Internet of Things is systems that use algorithms to look at data, spot exceptions, make sensible decisions automatically, and flag things for human action when automation fails. And this is the part of the twenty-first century data paradigm that people tend to overlook when they say that connectivity is the end rather than the means.

I use the word paradigm in the technical sense here: it's a philosophy of science term from the 1960s that means "way of seeing". And the hard thing about paradigms is that living under an old one can make it exceptionally difficult to, for want of a better phrase, turn your brain inside out and look at things differently.

WhichPLM: What's interesting there, though, is that the smaller steps towards the Internet of Things – actually embedding systems and connecting things – are readily understandable. While we don't mean to downplay the decades of research and implementation that went into creating the Global Positioning System, for example, it's actually quite straightforward to add a chip to a phone or a car that says "here I am in the world". We don't need to break out of our traditional mode of thinking to imagine that, because it's already commonplace.

It's the ramifications of those small advances that can be mind-blowing.

A Silicon Valley entrepreneur was recently quoted as saying that $100 million businesses are already being built off the back of private hire service Uber's open APIs [application protocol interfaces – Editor's note]. And that's a strong example, because, as Uber itself puts it, "reinventing transportation and logistics" is something that can conceivably be done with just a personal mobile device, a vehicle, or a package that each know where the other is, and good software to make that information useful.

Business software in general has a problem of trust. A lot of developers (and that includes hardware manufacturers) don't play well with others; their model is to win bidding wars and become embedded for a long time - not to cooperate.

Kevin Ashton: It's funny you mention Uber, because people are often shocked when I cite it as a great Internet of Things application. And it's doubly interesting because of where that negative impression comes from. Because the traditional regulated taxi industry is operating in an old paradigm, they've spread this impression that Uber is an ungoverned wasteland of criminals careening about in their own cars to earn a quick buck. This hostility is their only way of defending what, a lot of people will agree, has become a badly-managed monopoly.

What Uber really did was take simple sensor data from smartphones, and create a really powerful application out of very familiar technology. And that scares people who are entrenched in a certain way of thinking.

This is something I believe brands and retailers in particular need to consider when we talk about the Internet of Things. It isn't the devices themselves that are exciting. The media has become obsessed with finding the next iPhone, or the next sexy piece of IoT technology, but unless you're deeply geeky [WhichPLM is guilty as charged – Editor's note] sensors and digital signal processing are not and never will be sexy.

What is thrilling to you, in the fashion and retail industry, is the ability to run a more efficient business that delivers a better customer experience. And fashion is perhaps better poised than a lot of other industries to make the most of the IoT to do this.

As your readers know, fashion deals with a lot more SKUs than other industries, and this volume and diversity is precisely where good, real-world data will come into its own. If you're multiplying styles by colours, sizes, dimensions, and so on, you have an incredibly complex supply chain – more so than most other sectors.

And this isn't just at the retail end, although problems tend to manifest themselves there; as brands and retailers you're also managing thread, parts, finished goods, labelling requirements and everything else that happens behind the scenes.

None of this is a particularly compelling area for the consumer in and of itself, but it can make the difference between a major success and a major failure in the fashion industry.

WhichPLM: A big part of what we're talking about here, we think, is integration. The reams of data that emerge from connected things - and that need to be made sense of in a centralised location - must be in a common language for their full potential to be realised. These things and the systems that control and interpret them need to talk to one another.

An understandable fear would be that the sheer value of the IoT across the product lifecycle is going to be hampered by the decades-old spectre of integration, and the prohibitive expense of conducting bespoke interfaces each time a new opportunity is identified.

Kevin Ashton: Business software in general has a problem of trust. A lot of developers (and that includes hardware manufacturers) don't play well with others; their model is to win bidding wars and become embedded for a long time - not to cooperate.

This is also part of the reason for the current sprawl of different solutions [a number WhichPLM pegs at between 50 and 100 depending on business size, pre-PLM – Editor's note] as vendors of one successful platform recognised an opportunity to move into the next part of the value chain and so on.

But the important aspect is that there's generally no way to share data from one module from one company and another module from another. So if your supplier overseas isn't using the same system you're using, you then need to hire somebody to glue them together somehow, and that's how the expensive, bespoke integration you're talking about became common.

In the world of web applications – like the aforementioned Uber – APIs have become incredibly powerful, and in a lot of ways they are the antithesis of that outdated mindset. Google's Maps application was cool and exciting at launch, but it was only with the release of its well-documented developer tools that people were able to build things on top of it and realise what most of us now recognise as its full value.

Even though this wasn't particularly long ago, at the time Google released its APIs, big companies simply didn't engage in that kind of openness. Since then a lot of huge companies – generally in the web application space – have opened up their APIs, provided developer support, and allowed people to build modules the original developers never envisioned but that, critically, all play well together.

This is entirely unlike the twentieth-century paradigm, since it eschews that sense of protectiveness and acknowledges that third party developers can actually add value to your product. And it recognises that when someone does that, your product becomes more valuable.

That change in mindset is a transition that I believe is long overdue in the fashion PLM space, and it's about to become even more time-critical. When we begin to consider the possible impact of the IoT, there's going to be far too much complexity for any one company to handle well, and there's likely to be more than enough work to go around.

And while most vendors will have a list of reasons why that's a bad idea for them, those vendors are, frankly, wrong. Their customers do not benefit from being locked down today, because they need their legacy systems to talk to their new ones. They don't benefit from being locked down in the longer term, either, because they're going to need to do things that you, as a vendor, cannot anticipate – things they haven't even thought of yet themselves.

Having well-developed and clearly documented APIs does two things: firstly, it makes it easier for your internal developers to add value to your own product as circumstances change; secondly it makes the process of acquisition far simpler, should a third party developer create a module that your customers really like.

Making this shift doesn't just give technology vendors the chance to become better, more considerate partners for their customers; it also affords them the flexibility to survive and thrive in the Internet of Things age, when things are unquestionably going to be a lot more complicated and a lot less predictable than they are today.

WhichPLM: As we said before, there has been a long, slow push in the direction of integration, but the appetite for establishing and agreeing standards (something some developers say is essential) has simply never been there. WhichPLM itself has asked vendors and customers every twelve months for the past five years whether they would support a move to build a common markup language to allow for simpler integration between solutions, and the response has always been tepid at best.

How and why is that likely to change? Or are we asking the wrong question entirely?

Kevin Ashton: In a way, I'm afraid you're asking a twentieth century question in a twenty-first century world.

When you're talking about the application layer and software in the IoT age, standards are irrelevant. What will count is having good, open APIs and algorithms that can make sense of data from disparate sources. This isn't true of the physical layer, of course - where a radio will always need to talk to another radio in a common language - but certainly higher up the stack.

Unfortunately, there is still that holdover from the spreadsheet paradigm where executives fantasise about creating the next Microsoft Windows, and having it all because they're the de facto choice and they can govern the standards. The reality is that Windows happened once, and it happened in the late 1980s. We just don't live in that world any more.

WhichPLM: We want to come back to the topic of value, because it's critical to understanding what the Internet of Things is likely to mean in more practical, results-oriented terms. The current concept of "big data" is only the tip of the iceberg when we consider a world where potentially everything can talk to everything else – how, in that world, can retailers, brands and manufacturers identify the worthwhile information and separate the signal from the noise?

Kevin Ashton: I believe it's an algorithmic challenge on one level, but a business one on another.

As a business, it's a matter of asking yourself what data is already coming in, what more can be captured automatically and easily, and how you can make it all accessible to the same system. From there, you identify and prioritise the questions that will help your business grow.

Speaking on a technical level, we're getting into the field of machine learning, and the innovators in that area have already shown us that we can obtain fascinating results from data that you might not expect.

One of the pillars of this is understanding that all sensor data is proxy data. As an architect working on an IoT application, you aren't actually sensing the thing you care about, but rather something that correlates to the thing you care about and can be useful for making decisions. An easy example of this is the common thermostat, which does not actually sense changes in ambient temperature. Instead, it measures the expansion of a volume of mercury that correlates to how hot or cold the room is - but that data is sufficient to run a heating system.

If we look at fashion beyond the consumer, there are things you, as a brand, could measure that are not directly consequential to the end product: velocity through your distribution centre, or weight of fabric in storage by colour. The trick is then figuring out ways to correlate this information with something you care about. Getting this right will be less a matter of considering what kind of data you want to gather, and more a question of gathering as much as you can cost-effectively, and then using algorithms to find out what insights you can glean based on that data.

Or to put it more simply, you might surprise yourself at what you can figure out from indirect data.

WhichPLM: This has some pretty strong historical parallels. Factory managers have always been tasked with keeping tabs on what kinds of fabrics they have in stock, but also more contextual tasks like batching colour shades, measuring average widths for cutting and spreading and so on. This is information the industry is already accustomed to gathering, but that could have much wider utility if its collection and processing could be automated.

Kevin Ashton: That's a great example, because it helps us to see why the internet is so useful. A lot of textile and fashion manufacturing is already fairly automated, and those systems have sensor and data capture that is often not networked, but could easily be.

WhichPLM: Absolutely. Whether it's design in 2D or 3D, pattern development, lay planning, spreading or cutting, or even sewing, the machinery involved is likely already collecting valuable data, but its currently only used for a single purpose.

Kevin Ashton: Let me illustrate that potential a little further. Let's say we have a system doing grading for patterns, and a separate sewing system which is measuring how long it takes to sample a garment. If we can connect those two pieces of information, when we make an adjustment to the pattern and notice later how that change impacted sewing efficiency, we might then be able to optimise our pattern for sewing efficiency in a way that we just can't do right now.

There are all kinds of unexpected benefits and things you start to notice when you connect information from different parts of your supply chain. And while the twentieth century executive would tell you his processes are already as lean and efficient as they can be without that automated data capture, I know from experience

There are all kinds of unexpected benefits and things you start to notice when you connect information from different parts of your supply chain.

The reality of creative behaviour is nowhere more evident than it is in fashion, where we have thousands and thousands of people each making highly valuable creative contributions in well-established communities.

that putting it in place invariably leads to significant, unexpected value – often within the space of days.

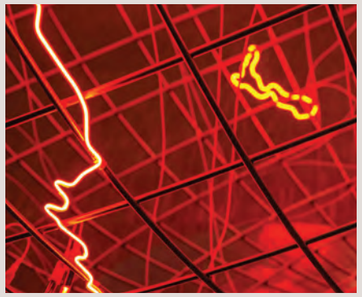
WhichPLM: Despite all this talk of efficiencies and automation, fashion remains an intensely creative industry. Originality is the lifeblood of our readers' businesses. Given the topic of your new book, we wanted to talk about how the perception of where creativity in retail, footwear and apparel lies might change in the IoT age. Today, for instance, designers are venerated above almost everyone else in that respect, but you might argue that the architects of the connected platforms and systems that will add value to the business of fashion tomorrow are important artists in their own right.

Kevin Ashton: Fashion really is a perfect example of the myth and the reality of human creative behaviour.

A lot of the time, what the customer buys has a single designer's name on it: Calvin Klein, for example, or Ralph Lauren. And although your readers know better, that customer may be under the impression that Calvin or Ralph personally drew their jacket, cut it, put it on the tailor's dummy and then instructed the people working under him to go and make it.

That's not at all what happens. True, it took creativity to put a vision for the brand together years or decades ago, but implementing that vision today requires the creative input and action of thousands of people operating in a large community. These people invent; they borrow from one another, consciously and unconsciously; they share with each other; and their creative behaviours can manifest in the product directly, as well as indirectly, in how it looks or how efficiently it's made. All of which amounts to the fact that that one person, with their name on the masthead, is usually barely – if at all – involved with the creation of the company's products.

The reality of creative behaviour is nowhere more evident than it is in fashion, where we have thousands and thousands of people each making highly valuable creative contributions in well-established communities. And when we talk about the Internet of Things, remember that communication is what powers communities. We're a communicative species precisely because we're a creative species, so the more methods of communication we have, and the more people and sources of information we are able to include in our communications, the more creative our organisations will become.



Kevin Ashton's book, How to Fly a Horse: the Secret History of Creation, Invention and Discovery is available to buy in print and digitally, and further examines the unglamorous, iterative acts that led to some of humanity's most astounding breakthroughs.

WORKING SMART:
A PRIMER FOR THE INTERNET OF THINGS

BY BEN HANSON

From a privileged position, it's easy to romanticise a life without the Internet. Living in a stable, relatively prosperous pocket of the world, I occasionally find myself daydreaming that all the noise – the deluge of emails, notifications, social media grandstanding – might just one day up and disappear. For many of us, vacations are that dream brought to life: an opportunity to disconnect, and to bathe in the sea of tranquillity we associate with "getting off the grid" for a few days.

But while it's tempting to indulge in those ideas, for most of us they're short-lived fantasies that crumble when we re-evaluate just how much the Internet really does for us. Deep down, we recognise that without VOIP communication we perhaps couldn't live where we do; recent Gallup polls suggest that almost 40% of American workers telecommute on a frequent basis. Without the Internet, we wonder whether we might never have met our partners or spouses; according to Pew Research Centre, more than a quarter of all 18-24 year olds have used online dating applications, and only slightly fewer 25-34 year olds have done the same. And while occasional (or constant) nagging from hyper-connected teammates can be a little grating, there is a good chance that your job simply would not exist without the Internet. I know mine wouldn't.

Even for those of us who do indulge and "pull the plug" for any length of time – a holiday or something more permanent – that little act of rebellion comes with a huge safety net. We know that, in an emergency, we can turn our phones back on, snatch a GPRS, 3G, or 4G signal, and be saved. As the dominant model of remote human interaction, the Internet would allow rescuers to zero in on where we were, put us in touch with family or friends a continent away, or allow us to scroll through the sum total of the world's academic, medical, and geographical knowledge to save ourselves.

Or perhaps nothing bad happens. No emergency. Just the slow, inexorable pull of convenience. And before we know it we're back, ordering restaurant food to be biked to our houses, plugging a route to tomorrow's meeting into Google Maps, checking the status of our Amazon Prime parcels, and pinging an Uber to get our friends home at the end of the night.

In short, we enjoy safety, convenience, and prosperity the likes of which our ancestors could never have conceived. And we have the Internet to thank.

But while some of these scenarios rely on nothing more than a pure Internet model – the sending of data from one place to another via standardised packet transmission protocols – others are actually real-world applications of what's become known as the Internet of Things, or IoT.

A new phase in the evolution of connectivity – and potentially the evolution of our species as a whole – the IoT is a vision for the future of the world that extends far beyond smartphones and laptops, and envisions a plausible, achievable state where everything – from the soil we grow in, to the cities we live in, to the ships we eventually send to the stars – will be connected wirelessly, using common protocols, and will be capable of communicating both with other things and with centralised or cloud-based interpretation and analysis systems, to take independent, automated actions.

"WITH A TRILLION SENSORS EMBEDDED IN THE ENVIRONMENT, ALL CONNECTED BY COMPUTING SYSTEMS, SOFTWARE, AND SERVICES, IT WILL BE POSSIBLE TO HEAR THE HEARTBEAT OF THE EARTH."

Peter Hartwell, Senior Researcher, HP Labs

Image provided by Microsoft

WE ENJOY SAFETY, CONVENIENCE, AND PROSPERITY THE LIKES OF WHICH OUR ANCESTORS COULD NEVER HAVE CONCEIVED. AND WE HAVE THE INTERNET TO THANK.

As Co-founder and Chief Marketing Officer of IoT company EVRYTHNG, and a partner in the first international Internet agency in the mid-1990s, Andy Hobsbawm has a very clear perspective on how connectivity has evolved, and how that constant development has led us towards the IoT:

"The first age of the web was managing information: websites, URLs, DNS and so on. In practice, this was all about managing trustability, identity, communications and transactions between information objects. The next stage was managing the identity of individuals: social networks, for example, or cloud CRM systems that promote the idea of the individual as a unique data record. The third age is going to be about doing the same with physical objects: managing the digital identities of things, and writing applications that can generate value from this for consumers, supply chain partners, and businesses."

This spring, EVRYTHNG signed a deal with packaging and labelling giant Avery Dennison to create unique digital identities for more than 10 billion pieces of apparel between now and 2019. EVRYTHNG's Janela solution (what Hobsbawm and his team call a "Smart Products Platform") will allow these garments, footwear, and accessories to be "born digital," which essentially means that connectivity will be present in each of them from the point of manufacture, and that their journeys from factory floor to point of sale and onwards will form a digital narrative of each product's life.

Your first exposure to the commercial reality of the IoT may actually have come from this news story, since it is something of watershed moment. EVRYTHNG's CEO, Niall Murphy, called it "probably the biggest deal the IoT industry has ever had", which is significant when we consider that technology giants like Cisco and Samsung have already invested in no small way in Murphy's company.

It's equally probable, though, that the impact this story – and others like it – will have on the retail, footwear, and apparel industry was not your major takeaway. You might instead have asked yourself, or an equally bewildered colleague, what a product being born digital really means. You may have pondered how, exactly, we go about connecting a handbag or few pieces of fabric on a hanger to the Internet. More fundamentally, you're likely to have wondered why we want to do these things, and whether you're the only person who doesn't really know what the IoT is or why you should care.

All of these – particularly the latter – would be reasonable reactions, because while technology vendors and analysts have talked a lot about the IoT, their various marketing pitches often ran at cross purposes, and sometimes betrayed a lack of understanding beyond the buzzword level. Real-world applications are only now being discussed. And while this might have been acceptable a few years ago, while even IoT proponents attempted to discern its eventual direction, our industry is now at a tipping point - much as it was on the cusp of e-commerce – after which those who saw the shift coming will thrive in a fundamentally changed market, while those who didn't will be left behind.

Not an ideal circumstance for muddled messaging, I'm sure you'll agree.

Luckily for those of us – and I counted myself among you this time last year – who are not sure what the IoT means for the retail, footwear and apparel industry, a raft of exceptionally smart inventors, executives, and commentators committed themselves to clarifying things in more than thirty exclusive interviews I (on behalf of WhichPLM) conducted throughout 2016. This feature and the three that follow it (consumer applications, enterprise applications, and value) are designed to dispel common misconceptions, provide impartial education, and explain why the industry is suddenly so keen to talk about a technology that very few of us really seem to understand.

For those readers who feel they know the IoT inside and out, I would encourage you to read on: you may just find your preconceptions being challenged.

"There is probably no other expression right now that means so many different things to so many different people," said Helmuth Ludwig, who is EVP of Digital Enterprise Realisation at Siemens, during our conversation. "But truly understanding the IoT requires us to look at things from two different angles: the device or product view; and the combination of the cloud and intelligent analytics that together bridge the digital and physical worlds."

If bridging the digital and the physical worlds sounds like a lofty goal: it is. But it's vital that we remember the foundations for this have already been laid. I'm 34 years old, so I was not a part of the emergence of the Internet except as a user, but I do know that it fulfilled – within my relatively short lifespan – what must have originally seemed a ridiculous promise: connecting everyone, everywhere, and transforming virtually every industry on the planet.

Image provided by IBM

Talking about the IoT today is akin to how it must have felt like to discuss the potential of the Internet itself in the early 1990s. The future is at once completely uncertain, entirely unavoidable, and absolutely intoxicating. And although there is no guarantee that things will play out now as they did then, the examples of those who bet large on the uptake of the world wide web and those who dismissed it as a passing fad are both worth taking into account.

Unlike the rise of the Internet, however, we already have proven models for how the IoT might redefine entire industries, and they exist right under our noses.

"The future is already here – it's just not very evenly distributed."

– William Gibson, novelist.

The temptation is strong to dismiss the IoT as science fiction. Fabrics that speak directly to our CRM systems? Smart dusts of micro sensors being sprayed over the countryside? Artificial intelligence predicting next season's trends? As viable as all of these applications are – as we'll see as the narrative laid out in these features progresses – the common response is to write them off as being either impractical, or impossible to realise within any meaningful timeframe for the purposes of business planning.

But despite the grand vocabulary and this huge reservoir of untapped potential, a lot of the Internet of Things' immediate applications are ones we are already familiar with. And a lot of its longer-term ones seem more like logical extensions of existing functionality by the day.

"Fifteen years ago, if you wanted to see a movie and get dinner, you would have to check the paper phonebook, call the theatre, listen to the times of the showings, get your map out, call the taxi, and arrange a pickup time hours in advance," said Susan Olivier, VP of Consumer Goods & Retail Industry Solutions for Dassault Systèmes. "Think about how different that entire process is now: you Google the movie you want, book it, use your voice to search for a nearby restaurant, book that, and ping for an Uber to come and pick you up in the next five minutes. And we take those things for granted. To me, this is precisely what the Internet of Things is intended to provide: it should be seamless; it should be an experience; and it should not be an effort on my part to take advantage of it."

For most of us, as Olivier rightly pointed out, Internet-driven applications have become both extremely pervasive and all but invisible. And while some of these scenarios are unique to the Western world, as infrastructure roll-outs and business expansions target new regions, more cities and lives will be transformed. We are accustomed to calling these "emerging markets" from a PLM point of view, but as this year's market analysis demonstrates, many of them have already outgrown that designation – fuelled by advances in connectivity, computing power and affordability.

Indeed, the Organisation for Economic Cooperation and Development recently named South Korea the world's foremost adopter of IoT technologies, with just shy of 38 connected devices per 100 inhabitants, compared to 25 in the United States. This statistic should come as no surprise, given that South Korea also leads the world in the deployment of high-speed connectivity, and is home to some of the most successful multi-industry technology

THE EXAMPLES OF THOSE WHO BET LARGE ON THE UPTAKE OF THE WORLD WIDE WEB AND THOSE WHO DISMISSED IT AS A PASSING FAD ARE BOTH WORTH TAKING INTO ACCOUNT.

Image provided by Coin/Fitbit

companies on the planet – one of which owns a billion-dollar fashion business.

But wherever you or your customers are, the IoT has probably already pervaded society far more than the average person realises.

"Although most people would not consider loyalty apps to be the "IoT" in the strictest sense, because they have been around for longer than the acronym has been popular, I think they are actually a great example," said Quach Hai, Product Management Director for multi-industry PLM vendor and IoT pioneer PTC. "These are strong instances of connectivity between people, devices, systems and locations. The customer can use a mobile app to understand what's being sold, what offers are currently on, where the marked-down products are in the store, and so on. And the retailer or brand can gain critical insights from those interactions."

Speaking to Hai, he hit upon two important distinctions: the extent that IoT applications have already changed the retail industry, and the simultaneous value that customers and retailers (or brand owners) are able to derive from a single IoT use case.

Crucially, though, not all of that value is necessarily visible to the other party, as Andy Hobsbawm explained:

"There is a set of IoT applications that you, as a consumer, may not realise are going on behind the scenes, but that directly affect your experience. As a simple example: if you walk into a shop to buy something, or order it online and choose to click and collect, that fact that the product is in-store, available to be bought or collected, may very well be because there are IoT applications in the background, looking at inventory management and optimising supply chains to make sure that the right things are in the right place at the right time."

This is a view shared by Britta Riedl, Director of Marketing for German fashion technology vendor Koppermann:

"For many years now the Internet of Things has increasingly found its way into our everyday lives, networking our activities despite the fact that the terminology cannot be considered as commonly used throughout society. Take, for instance, the ever-growing offer of online retailers who provide their customers with virtually real-time information on shipping progress and stock levels, or the extensive range of interactive assistance systems that make it easy for us to navigate to the places, goods or services of our choice."

IS THE ADDITION OF CONNECTIVITY TO A A HUGE VOLUME OF NEW OBJECTS AND DEVICES AN EXAMPLE OF THE OLD ADAGE: BECOMING SO OBSESSED WITH THE FACT THAT WE COULD DO SOMETHING, WE FORGOT TO QUESTION WHETHER WE SHOULD?

Riedl was also keen to emphasise that existing applications of the IoT are not limited to consumer-facing applications, citing early adoption of Radio Frequency Identification (RFID) and the Global Positioning System (GPS) in logistics and goods management as "a major cornerstone of the Internet of Things as we know it today".

I was also encouraged to recognise the long-existing applications of IoT technologies in enterprise environments by Rob Tiffany, author of Mobile Strategies for Business, one of the longest-serving IoT veterans I had the opportunity to interview, and currently Global Technology Lead on the IoT for Microsoft:

"The forerunner of the IoT was machine to machine, or M2M, where people have been using the same principles and even the same kinds of technologies for decades to monitor the health of machinery through telemetry information and back end systems. And that could just as easily be an industrial robot in an automotive factory as it could an NC cutting machinery in apparel. The difference between M2M then and the IoT today is, I think, a kind of perfect storm: embedded sensors have become so inexpensive and power efficient, and wireless data transfer has become so pervasive that it puts the same level of power into the hands of people and organisations that previously couldn't afford it. I don't like to use the word "democratises", but in this case it really is applicable."

And although very few retailers would currently acknowledge that they use IoT technologies or have an IoT strategy, Charlotte Kula-Przezwanski, Partner and Director of EMEA at Columbus Consulting, explained that while they may not recognise the acronym, they are more than familiar with the outcomes:

"While I don't necessarily hear the IoT buzzword as often as I do equivalents like omni-channel, the principles of retailers wanting to get closer to their data and closer to their consumers are very relevant. Retailers may not describe it as the Internet of Things, but the same desires are there."

Whichever side of retail we fall on – and most of WhichPLM's readers are both consumers and creators – it's clear that the world has changed substantially because of the Internet, even though some of those changes are less visible than others. And short of a major apocalyptic event, things are not changing back. In fact, the Internet of Things will only accelerate the transformation that its parent technology started. But how?

"We have yet to grasp fully the speed and breadth of this new revolution. Consider the unlimited possibilities of having billions of people connected by mobile devices."

– Klaus Schwab, Founder and Executive Chairman, World Economic Forum

Having mused over the subject myself for the best part of a year, I believe the simplest way to understand how we arrived at the Internet of Things is to think of it as both a logical extension of the Internet, and as the culmination of a steady march of technological development and innovation that began with the printed circuit.

As a society, we built a vast, world-spanning communications and information-sharing network, and soon we devised ways to access it without wires. Over time, the devices we used to access that network got smaller, more portable, and more powerful until each of us carried the equivalent of a 1990s supercomputer in our pockets. And by the time each of these devices had its own unique address on the global network, we had developed tiny microprocessors and even tinier sensors, and we chose to embed them into things that we could conceive a better use for if they could push (and in some cases pull) information to other devices and to centralised computing systems via that worldwide network.

All of this seems obvious in hindsight, but in the heat of the moment it would have been difficult for anyone involved to say with any confidence that they were working towards the exact future we live in today. The convenience, safety, and completely redefined commerce we now enjoy were not visible goals for these various developments – they emerged organically as the foundations they are built on took shape.

The current outcomes of all this ambition are twofold: first, we, as an industry, are about to begin generating more information than even the most prominent "big data" advocates have imagined; secondly, the Internet we have is about to run out of space to accommodate all the things we now want to connect to it.

Based on the prediction that the latter would eventually happen, the non-profit Internet Society began several years ago preparing for a new iteration – the sixth – of the Internet Protocol, switching 32-bit address space allocation for a 128-bit equivalent. In practice, this means that a theoretical 340 trillion, trillion, trillion (that's 36 zeroes) devices will eventually be able to connect to the same standardised network - a strong indication that those in the know certainly do not expect the pace of technology to slow down.

But what is the purpose of all that connectivity? Unlike the Internet itself, is it being deployed with a conscious end goal in mind or, as the old saying goes, is this a matter of becoming so obsessed with the fact that we could do something, we forgot to question whether we should? Do those theoretical trillions of connected devices and objects have real, measurable implications for the future of the retail, footwear and apparel industry, and for business in general?

Image provided by Ashley Chloe (model wears Helix Cuff)

Image provided by Nest

Asking these questions of leading IoT industry figures (and several PLM vendors who have devoted time and effort to mapping out their thoughts on the matter) seemed to me the best way we have of zeroing in on genuine answers, divorced from marketing. So, in the process of interrogating each of them about the concrete applications of the IoT, I also asked each of my interviewees to define what the concept means to them.

I won't presume to insert my own definition into this list, but readers will have to trust me that it changed a great many times during the interviews that gave rise to the following definitions.

"We don't talk about the IoT as a technology," I was told by Brion Carroll, VP of Global Business Development for PTC's Retail Business Unit. "It's something more: an enabler of a new kind of omniscient, omnipresent visibility of what's going on in the market, what's happening in the extended supply chain, and how those things can have direct impact and direct relevance for creative design, development, sourcing, and overall operational agility."

This is a theme that recurred in several interviews – the idea that the IoT has been marketed as a single technology or solution stack, when, as Warren Tucker (a Partner, leading the Digital Group at PwC) told me, it's anything but:

"The IoT gets coined as a single technology, when in fact it's a whole amalgamation of many heterogeneous technologies that are potentially very different depending on which industry we're looking at. To summarise it, though, as communications technologies become cheaper and network connectivity becomes all-pervasive, the combination allows us to deploy connected devices across a range of different applications, collecting data from otherwise inaccessible locations and objects. Making these devices part of your business processes can potentially allow you to manage those processes more efficiently, make different business decisions, or find and pursue new opportunities."

A common thread between Tucker's definition and others was the inaccessibility of data held by inanimate objects – a line of thought that begins to verge on the philosophical, but that actually articulates a key pillar for understanding the role of IoT technologies. Simply connecting a physical object to the Internet – a garment or a shoe, in our case – does not empower that object to become something else or to take different actions, it just allows other devices and systems to access key attributes that were always part of the object, albeit only in a physical sense.

"The IoT is fundamentally about data," Andy Hobsbawm said, "and connecting something to the web means unlocking a flow of data from within it that couldn't previously be accessed". Hobsbawm went on to explain what this might mean in an RFA context: "On some level, although not in the sense of true intelligence, that garment always knew what materials it was comprised of, where it was made, and where it had been shipped from and to. The difference was that, although these characteristics and events were part of the garment's physical existence, they were not captured in any digital form. By adding sensors, embedded chips, controllers, tags and so on to the garment, we are effectively turning it into an interface to the web – one that now captures and communicates digital data."

Some indication of what a retailer or brand owner might do with that data was provided by Michele Casucci, Founder and CEO of IoT apparel authentication platform Certilogo, and a speaker and thinker on the so-called "singularity," or the point at which advances in various technological disciplines will transform human civilisation beyond recognition:

"As part of the Internet of Things, a lot of information can be drawn out of a product, or added to it. It can be, of course, what the product is made of and where it is in the world, but it can also include: the identities of the manufacturers who had a hand in its creation; timestamps of when it left the warehouse; to which retailer or wholesaler it was sold; and the identity of the consumer who then purchased it. From the retailer's point of view, we can then know how old that consumer is, where they live, what else he or she buys – and this is tied to all the other valuable supply chain data. We can then combine those two sets of information and turn them into analytics in three key areas: fraud protection, market distribution, and supply chain security, creating marketing profiling and consumer engagement opportunities in the process."

These analytics – critical elements of the real-time business intelligence that it appears will be the cornerstone of successful IoT initiatives – may also prove as valuable to the consumer generating them as they do the brand or retailer using them to inform future design and development processes. Guy Alroy, VP of Product for 3D fashion software vendors (and PLM partners) Optitex believes in "the co-existence of billions of products we, as consumers, use on a daily basis, and which wirelessly communicate with each other and with the web, driving insights and bringing value to the individual consumer as well as the organisation".

Putting this theory into practice, Susan Olivier explained to me how a mutually beneficial cycle of intelligence – design to consumer and back around again – can be created from these kinds of intimate insights:

"The IoT lives in a world of experiences, and that's a continuum; from the time the customer wakes up in the morning to the time they go to sleep at the end of the day, they're interacting with products. We want to be able to make better use of information collected in an increasingly wide range of nonintrusive means to then create better products, streamline supply chain responsiveness, improve the shopping experience – physical and online – and connect with customers who then help reinforce the loop of designing better products."

THE TRUE REACH OF THE IOT EXTENDS FAR BEYOND SMARTPHONES, WEARABLES, AND HOME AUTOMATION.

As complex and all-encompassing as these definitions initially sound, Guy Courtin, who acts as VP for Industry & Solution Strategy in Retail and Fashion at digital supply chain management company GT Nexus, believes that looking at the IoT in this way can actually help with understanding both its potential and its limitations:

"The IoT is, at its core, a new form of data. It creates the ability for companies to put sensors and readers and communication technologies into a host of different inanimate objects in a way that wasn't possible or economical before. I think that, as long as people think about it in those terms, it can clear up a lot of confusion over what, exactly, the IoT is."

Mark Burstein, President of Sales, Marketing and R&D at PLM, SCM and ERP vendor NGC Software, also believes that tracking the information generated by this host of newly-connected nodes in the global network is the essence of the IoT, saying that "the Internet of Things, in a nutshell, is the ability to know, in real-time, the characteristics, conditions, attributes, and location of any product, in any place, at any time."

An even snappier take on the same summary came from Ravi Anand, General Manager and Practice Head for RFA and IoT at ITC Infotech (an IT consultancy profiled later in this publication), who captured the essence of the IoT as being "device, data, delivered", which is perhaps the closest we will ever get to fitting a world-altering idea onto a Post-It note.

Taking a much broader view – adding retail premises and other public spaces to the inaccessible data equation – was Scott Amyx, CEO at IoT strategy and innovation lab Amyx+, and one of the boldest thinkers I spoke with during my research:

"The most complete definition of the IoT is taking inanimate objects – which is 99% of the things around us, even down to the topsoil – and adding sensory capabilities to them, allowing them to understand the objects themselves, as well as the environments they are in". And, as Amyx explained to me, what we then choose to do with those connected objects is where the greatest potential for IoT technologies lies. "What's exciting is that when things become awakened – whether it's a retail building or an entire city – they start to gain senses. Eyes through camera networks and facial recognition, ears through voice analysis and natural language processes, and the ability to speak, like we're familiar with from Siri, Viv, or IBM Watson. With these senses switched on, these objects can then contribute to a neural or sensory network and start to give us information we can use."

While Amyx's long-term vision is compelling for the futurist in me, it is important to remember that the IoT umbrella has grown to encompass many real-world applications that have been current in the RFA industry for years – not least of which is connectivity in factory hardware. Philippe Ribera (Director of Marketing for Software at French apparel technology company Lectra) reminded me that intelligent, connected machinery has already delivered significant value for manufacturers and the brands they serve:

"The way I define the IoT is from a B2B perspective, and that's very different from the many B2C IoT applications that undoubtedly exist. From my point of view, the IoT gives us the ability to connect machines, and allows for predictive actions to be taken based on the information we receive from them. In manufacturing, this level of connectivity

Image provided by Fitbit

EVEN THOUGH I FULLY UNDERSTAND WHY COMMENTATORS AND CONSUMERS ALIKE HAVE LATCHED ONTO SMART IOT PRODUCTS, THEY NEVERTHELESS REPRESENT ONLY PART OF THE PICTURE, AND TO IGNORE THE REMAINDER IS TO SELL THE FUTURE SHORT.

has been present in cutters for nearly ten years, with performance analytics sent to support centres to enable predictive maintenance. But with more than a hundred sensors in a modern connected cutter, the same technology that powers better service and support can also help to improve quality and time to market. A cutter could alert the operator or the production manager that the cut parameters were not adjusted when the material was changed from lace to denim, for example."

Another vendor that shares a similar perspective on connectivity between hardware and software is Gerber Technology, whose VP of Software Development for Digital Solutions, Amit Kumar, believes in a systemic approach to enterprise connectivity – something that has also been a factor in the results many brand and retailers have been able to obtain from PLM and extended-PLM over the last decade:

"To me, the IoT is all about connected ecosystems. First, enterprise technology was about disconnected systems, then it advanced to ecosystems, and now we're connecting those to one another and to a range of different devices – all enabled by the cloud. These ecosystems have existed for some time, but they either were not connected to the consumer at one end of the spectrum, or to the production facility at the other. So while the apparel industry has had connected manufacturing hardware [for] years, the IoT is allowing us to create a complete circle – seamless integration between consumers, partners, departments, vendors, agents and production locations. The goal is to drive efficiency, improve customer satisfaction, improve revenues and reduce waste."

As you might imagine from Kumar's definition, any change that has the potential to drag in the entire spectrum of a given product's lifecycle – from the raw material level to how it performs when it's worn on the street – will have an array of different disciplines and devices to contend with. And it's here that the biggest gap between the common understanding of the IoT and its real potential exists.

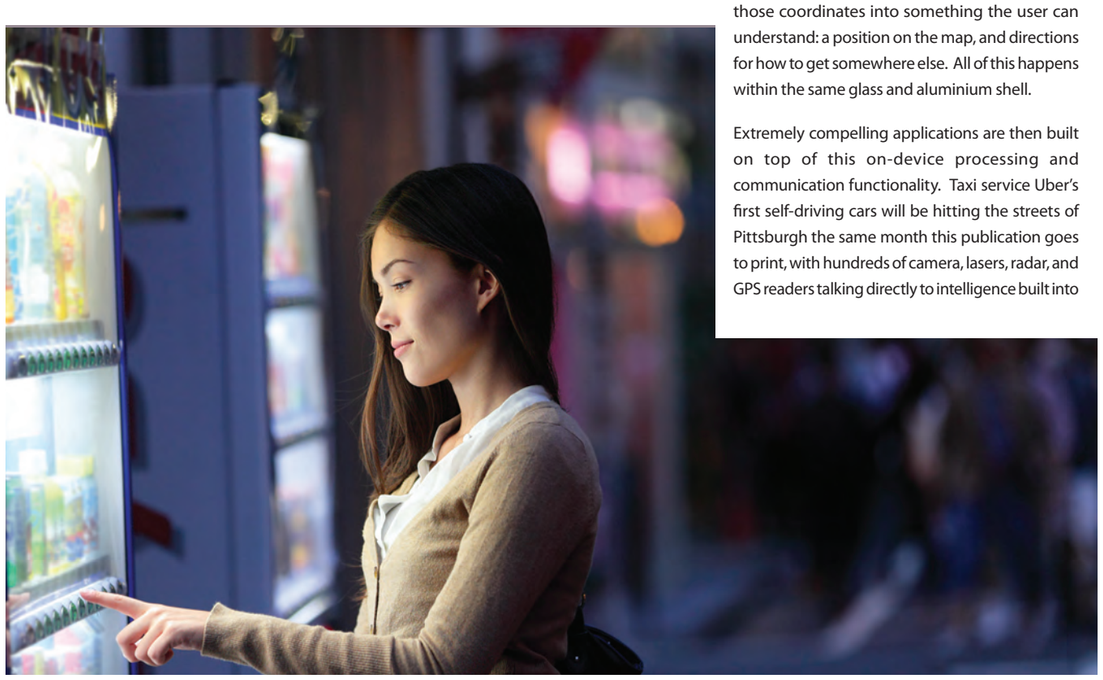
"If a lion could talk, we would not understand him."

– Ludwig Wittengenstein, philosopher.

As some of these definitions reveal, the true reach of the IoT extends far beyond smartphones, wearables, and home automation – and even beyond connectivity of hardware in the supply chain. The crucial difference is that each of these are what's commonly referred to as "smart" devices, in the sense that they have a level of processing power that allows them to both collect data and act upon it (or at the very least interpret it in such a way that allows a human being to act upon it), while the vast majority of "things" that will eventually be connected to the IoT will have much more limited capabilities.

A smartphone, for example, knows where it is in the world, but it is also powerful enough to provide immediate access to the information at an application or service level. We can run a route planning app on that phone, and it will translate those coordinates into something the user can understand: a position on the map, and directions for how to get somewhere else. All of this happens within the same glass and aluminium shell.

Extremely compelling applications are then built on top of this on-device processing and communication functionality. Taxi service Uber's first self-driving cars will be hitting the streets of Pittsburgh the same month this publication goes to print, with hundreds of camera, lasers, radar, and GPS readers talking directly to intelligence built into



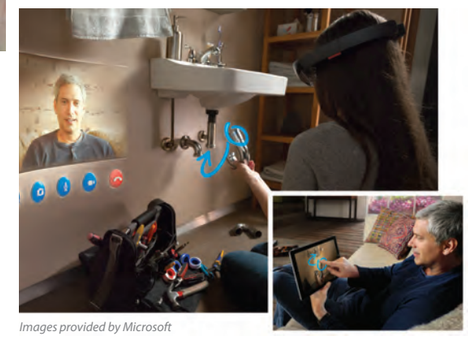
the chassis of a fleet of Volvo XC90s, and also to the smartphones of customers, via Uber's centralised systems.

And Uber is by no means alone on this playing field: IBM's Watson artificial intelligence has already hit the road in self-driving, 3D-printed vehicles called "Olli" which use a similar array of sensors and onboard processing to achieve their level of automation.

Similarly, the intelligent thermostat Nest (now part of the Google family) functions at the basic level like an old mercury thermometer, measuring the ambient temperature and displaying a Celsius or Fahrenheit value. But unlike a passive thermometer, the Nest has the ability to translate this information into action: it will switch on the boiler or climate control if it knows someone is typically home at this time of day and likes their living room to remain at 19 degrees. (That's Celsius; American readers would almost certainly not set a sub-zero temperature for their homes.)

All of these smart devices, as heterogeneous as they are, are IoT microcosms: potted examples of how unintelligent information can be turned into valuable, automated action when that information is properly interpreted in-device.

The same cannot be said, however, for RFID chips or Near Field Communication (NFC) tags. These, effectively, are the sensor elements of a smart device taken out of the shell and proliferated throughout the supply chain; they are capable of broadcasting their identity and location, but in a processing sense they lack the ability to translate those data points into meaning for an end user. For these "dumb" applications of the IoT, an external reading and interpreting system is needed – one that aggregates and analyses the information from one or ten thousand of these sensors and allows something, either manual or automated, to be done with the data.



Images provided by Microsoft

Chris Colyer, Worldwide VP for Consumer Goods & Retail at Dassault Systèmes, echoed my thoughts on the necessity of looking beyond the surface level to find the true value of the IoT:

"The Internet of Things is about taking sensor-level data and aggregating and analysing it in a way that helps drive and accelerate efficiencies in business decisions. The nuance, that I think sometimes gets overlooked, is that this sensor-level data is not just coming from smartphones and wearable technology: it can originate from everything from passive RFID tags to social media, and it can influence the customer experience all the way through ideation, design and production."

I actually think Colyer is being charitable in saying that the difference between smart and passive devices "sometimes" goes unacknowledged; a huge proportion of the technology industry's market and coverage of the IoT is given over exclusively to smart applications. Seek out IoT editorials outside of trade publications, and you will inevitably find

THERE WAS – AND REMAINS – AN IMPORTANT DISTINCTION TO BE MADE BETWEEN BEING CONNECTED AND BEING UNDERSTOOD.

news about the aforementioned Nest and Uber, and Phillips Hue (the connected lightbulb ecosystem that has become one of the most noticeable public faces of the connected home), and very little else.

From those relatable applications, as Chad Markle (Partner, leading Digital Innovation for consultancy firm Kalypso) explained, it is a huge leap for us to then begin thinking about connecting essentially everything from carpets to point of sale systems - and the benefits of doing so become very hard to envision:

"People readily understand the smartphone, which has apps and sensors in one place, but it's a little harder to make the leap to understanding where we can actually get value from combining the digital and physical worlds. A lot of emerging services and data aren't just new to that person or their particular industry; they're new to the world. Brands and retailers are accustomed to innovating around materials and technology, but they haven't really innovated around business models, or evaluated the new processes and customer experiences that might now be possible."

Indeed, many of the brands and retailers I spoke to this year were, to put it mildly, turned off by this gap between the consumer-facing side of the IoT and what occasionally comes across as an "all or nothing" take on its role in the enterprise.

But even though I fully understand why commentators and consumers alike have latched onto smart IoT products, they nevertheless represent only part of the picture, and to ignore the remainder is to sell the future short. Rob Tiffany agreed, telling me how history can teach us a lot about how non-smart devices can provide value in more manageable steps, and how the smaller, more direct applications of the IoT are in many ways easier to grasp than the big, showy ones – because the template for getting them right was established decades ago:

"One of the earliest use cases of the IoT was in vending machines, and it's still a poster child people use today, because it captures the essence of what's involved – from automation to inventory, and from merchandising to supply and demand. What's interesting is that people are now kind of reinventing the same principles, and we're seeing the same patterns repeat themselves. I think people are overthinking things and coming away intimidated by the IoT, thinking of it as a giant mountain they have to climb in one go. So I find myself reminding people that we've done this before: it's just a little sensor, a software agent monitoring the output of that sensor, and we're sending the resulting data somewhere to be used. The major difference is that, historically, I might have run SQL queries on the database I built up over time, whereas today I'm running advanced analytics in real time."

Tiffany's example is, for me, the crux of the IoT discussion. For all its mind-bending complexity, the real work lies in very manageable chunks: figuring out how human beings – executives, designers, salespeople, and everyone in between – can interpret and act on information coming from devices that cannot always understand and act on that information themselves.

And while old hands like Tiffany are tired of hearing about it, the vending machine story he mentioned was a crucial piece of the IoT puzzle for me – even if it is the oldest example in the book.

"Necessity is the mother of invention."

– Plato, philosopher.

The first internet-connected "thing" (i.e. something not considered a fully-fledged computer, and certainly not "smart" by modern standards) is widely agreed to have been a soft drink vending machine at Carnegie Mellon University, where small sensors on the racks of plastic bottles and a serial interface were repurposed to allow caffeine-starved programming students to remotely determine the machine's inventory.

The critical part of the example, though, came when the vending machine's sensory data was transmitted over what was at the time ARPANET (a precursor to the modern TCP/IP internet). On their own, the packets of data sent by the machine meant nothing. In order for them to be considered useful, a server-side script had to be written to interpret the binary on / off signals from the bottle sensors, returning a yes / no (or soda / empty) value to the user.

And it's here that the example becomes enduringly relevant: the vending machine was not originally designed to make any determinations beyond dispensing a drink from a chosen slot when the right coins were inserted, and this limited feature set did not change at the machine level when these sensors were allowed to communicate with the outside world. But, equipped with digital access to that limited instruction set, programmers were able to apply a layer of reasoning and interpretation to it, using the soda / empty flag to track how long a bottle had been inside the machine, and consequently whether it had been refrigerated long enough to be considered cold.

In the case of this vending machine, simply being hooked up to the Internet wasn't enough to deliver value, because there was – and remains – an important distinction to be made between being connected and being understood.

The method of gaining value from ubiquitous connectivity in any industry, particularly one as focused on newness and invention as fashion, then, will be to build that layer of understanding on top of the devices we choose to connect. And this strategy will be shaped by human needs, business objectives and a host of other variables that will determine how a connected solution or product feeds into a wider intelligence ecosystem.

More bluntly, the money to be made in the IoT – whether it's creating a new business model entirely or supercharging an existing one – will come from architecting services that sit on top of interactions and data flows between passive sensors, smart systems, and people. This is how we will change the world.

"With the technology at our disposal, the possibilities are unbounded. All we need to do is make sure we keep talking."

– Stephen Hawking, scientist.

Had I set out my stall at the start of this primer and told you, the reader, that I thought the IoT was likely to be the principle engine of human progress in mine and my daughter's lifetimes, you might justifiably have turned the page. My hope, though is that by strolling through more manageable, more immediate use cases for the technology, its more futuristic applications will seem less outlandish.

Fortunately, I'm not alone in believing that the IoT will soon change not just our industry, but the entire concept of industry. Amit Kumar, of Gerber Technology, believes that the IoT is a new form of industrial revolution, like none we have ever encountered before. "The definition of what a "thing", connected to the Internet of Things, can be is limited only by our imagination," Kumar told me. "I think human beings will eventually become nodes in that vast network, and I believe that will change the way our entire society and economy works."

Scott Amyx is equally enthusiastic about the potential for the IoT to change the commercial experience:

"In fashion, one of the best recent examples of the IoT in action was the acquisition of Coin by Fitbit. Coin externalises the RFID chip and onboard security of credit and debit cards, and allows multiple sets of payment details to be integrated into a single device or, eventually, piece of clothing. This means that our financial information could soon be sewn into our sleeves, allowing us to make contactless payments without touching our phones or wallets. And I believe we will see many more use cases where it becomes practical and desirable to integrate the functionality of multipurpose tools, like smartphones, into clothing."

And although some might balk at these ideas as being too far distant, concrete investment in extremely futuristic IoT applications is already being made by some of the industry's biggest players. Eric Symon, VP and General Manager for PTC's Global Retail Business Unit was clear about his and his company's belief in the long-term transformative potential of the IoT:

"We firmly believe the IoT is the next big wave. In fact we're betting the company on it. It's catching on already, of course, but it's going to completely change the way we plan, create, source, and sell in the near future. The IoT is much more than just an I.T. transformation – it will alter the way everybody does things on a day to day basis, just as the Internet itself did."

As part of its IoT strategy, PTC has invested heavily in augmented reality – something I personally believe will become one of the most visible manifestations of the IoT in our homes and workplaces in the very near future. Imagine a world where fit sessions can be conducted remotely, with virtual garments draped over real models; or picture furniture shopping from home, and being able to overlay a realistic 3D model of a particular piece on a live camera feed of your living room.

But while these future applications are incredibly exciting, they will not come to fruition overnight, and retailers and brands who invest in intermediate steps – making the most of what the IoT has to offer today – will be well-prepared to obtain value in the future, as Charles Benoualid, VP of R&D for Visual 2000 explained:

"I don't believe that to have any type of IoT functionality at all you have to wait for standards to be established. Right now we have a return to the early days of the video cassette format wars, in a way – a time when nobody quite knew how things would develop but some businesses went ahead anyway. And while I think over time one or more standardised protocols for communication will be established, the important thing is that infrastructures are already in place to enable base IoT capabilities: things like WiFi, RFID, NFC, and even platforms like Microsoft Azure. As long as there's a single common thread that works across different technologies, different devices, and even different industries, we already have the raw materials to make a start on IoT applications and develop real-world use cases."

The following features examine the specific shape those use cases are taking now, and how new opportunities – and entirely new business models – might emerge in the future. Turn the page to begin with consumer-facing applications, followed by a separate feature covering those more focused on design, development and production. Finally, we look at the security implications of the IoT, and then the potential returns on investment that brands and retailers can hope to obtain by planning ahead in a changing world.

Image provided by Nest

Image provided by Rebecca Minkoff

CONNECTED CONSUMERS

IOT IN RETAIL

BY
BEN
HANSON

Very few people would argue that the Internet has irreversibly changed retail. E-commerce is listed by the Centre for Retail Research as the fastest-growing retail market in Europe and North America, and where traditionally brick-and-mortar retailers competed with one another, today they are united in fear of online giants like ASOS and Amazon.

Consider, though, how rapidly that landscape has changed. Just twenty years ago, Amazon sold an extremely limited range of items from a garage in Bellevue, Washington; today it dominates the retail conversation, and has made significant strides with its own private label apparel brands, building an enviable pool of talent and infrastructure that, perhaps rightly, has traditional fashion companies well and truly spooked.

But although Amazon has all but destroyed the physical book store and reshaped the landscape of delivery across hundreds of markets, it is by no means the only online-exclusive success story. British e-commerce-only retailer ASOS passed a turnover threshold of £1 billion ($1.3 billion) in 2014, and is targeting sales of £2.5 billion ($3.3 billion) to UK, European, and Asian markets in the near future – all without a single physical retail location.

It is no stretch of the imagination to say that, wherever I am in the world, I can have whatever I want – within reason – delivered to my front door as quickly as tomorrow morning.

Understandably, physical retail has struggled to differentiate itself from its online counterpart. Why, after all, should shoppers brave the weather and the crowds to browse an artificially limited selection when rapid delivery, complete ranges, and hassle-free returns are available from the comfort of the couch? So while so-called "showrooming" remains a force to be reckoned with – shoppers entering bricks and mortar stores to try on clothes, only to buy them cheaper online – retail executives have experimented with various technologies to carve out new, unique selling points for the physical store.

Many of these already fall under the rubric of the Internet of Things: solutions such as smart, connected mirrors, loyalty applications, and even the now-essential click-and-collect service all make some use of the connectivity and consumer engagement that typifies the IoT. But nevertheless these are likely to represent just the tip of the iceberg for the potential of the IoT to further transform the retail experience – online and off.

"The IoT is the next big thing in a continuum of more than fifteen years of technology-driven transformation in the retail space," as Chad Markle of Kalypso put it. And he and the other industry figures interviewed for this publication were unanimous in predicting that IoT technologies will be key to improving our understanding of consumer demand, revitalising the shopping experience across channels, and reclaiming a level of customer service and engagement that many feared was permanently lost.

THE MODERN MERCHANT

"I come from a retail background, so I know from first-hand experience how disengaged the industry has become from its customers," Amit Kumar from Gerber Technology admitted. "There was a personal connection that existed before the industrialisation of apparel – when we were all mom and pop stores and everyone knew everyone – but that was lost as part of the growing pains associated with the industrialisation and internationalisation processes. The IoT is the next revolution; it can allow us to re-establish the human touch, engage with customers, and – taking account of security and privacy – take back and reinterpret the role of the traditional retailer."

I have written about the changing place in society that retail is expected to fill before; it figured as a major theme in several National Retail Federation events, and evidence suggests that despite the incredible level of convenience and selection offered by online stores, the knowledge and intimacy of a more traditional model – underpinned by the cutting edge in technology - might be due for a return.

As the rise of Amazon shows us, retail very rapidly became about getting as many products as possible into people's hands in the shortest span of time. The e-commerce rush took us from absolute zero in the early 1990s to today, where, according to renowned advertising agency DDB Worldwide, 40% of all men aged 18 to 34 would prefer to buy everything online. Not just clothing. Everything.

In that race to redefine convenience, though, millennia's worth of tradition was thrown out of the window. By targeting more customers than ever before, and turning the transactional experience with them around more rapidly,

retailers all but abandoned customer relationships in the traditional sense. And while analytics-driven recommendations fulfil a similar purpose on e-commerce websites, they are no replacement for the humble shopkeeper: knowledgeable, personable, available, expert, and local. He or she once knew why you came in today, and if they didn't, they certainly knew enough about their collections and your desires to help you find what you were looking for. In short, they were connected to their customers in a way it's incredibly difficult to be when they're potentially on the other side of the world.

"Connection can mean different things to different consumers at different times," said Petah Marian, Senior Editor of Retail Intelligence at trend forecasting agency WGSN, when I asked her to try and define how the relationship between retailers and shoppers has shifted. "It can mean communicating with them in the way that they want to be spoken to, or offering them products that suit their lifestyles with a level of speed or service they like – it really depends on the consumer need at the time, and the sort of consumer the retailer is servicing. The one constant is that consumers' expectations are higher than ever, and they continue to rise. In a world where cars and food can be ordered seamlessly and with very little wait, customers are becoming increasingly impatient with retailers that can't service them in that way."

One of the simplest models for competing with the instant gratification of the hospitality industry, or the automatically-generated recommendations that make cross-selling online so effective is, of course, to copy them. But for physical retailers, this requires a much wider – and more costly – set of tools than a bicycle courier or IP address recognition and cookies.

"One of the unique selling points of Amazon has been their "customers also bought" suggestions, and this is something IoT technologies can help us achieve, and even improve upon, in physical retail space," Warren Tucker of PwC told me. "As a shopper walks into the dressing room, the clothing they have brought in could be identified through RFID tags, and cross-selling and upselling items could be displayed on a screen next to the hangers. By downloading a basic app to their smartphone, a customer in the dressing room could then request one or more of those recommendations, or a replacement size or colourway, and a salesperson – similarly equipped - would bring it straight to them. Now you, the retailer, have a much higher conversion rate in your stores, and you have weighted staff time towards sales activities rather than store presentation, which is a much more valuable activity."

Today's modern merchant, then, may rely on Big Data and demographic analytics to get the job done, but his or her role finds its closest analogue in the old-fashioned, local shopkeeper. Both seek to gain the most detailed knowledge of their products and the people they are intended for, and both play a vital role in delivering the essential retail experience.

But while most of this personalised interaction can be replicated online, there are other IoT-driven methods of getting people into stores (and improving the time they spend there) that are specifically designed to revitalise physical retail as either a complement or an alternative to e-commerce.

THE CUSTOMER CYCLE

Some of these applications, Petah Marian of WGSN explained, fall specifically into the category of convenience – optimising the way high street and mall-based retail operates to offer a similarly streamlined service to shopping online:

"Loyalty and discount codes that can be distributed to customers based on location are the obvious incentives, but some shopping centre [mall] operators are taking location-tracking services further, helping customers to find a car parking space, or offering a searchable inventory across all their retailers, so out of stock products can be found elsewhere on the same site".

Another approach that also relies on IoT technologies is for retailers to embrace online, mobile, and even catalogue shopping as viable routes to create new, exciting experiences that encourage customers to visit physical stores, and foster loyalty across channels.

"We already see a lot of interest in augmented reality for enhancing the consumer buying experience by overlaying data onto physical objects," said Quach Hai of PTC. "Home goods retailers like Lowe's and Ikea have developed apps that leverage some degree of augmented reality to provide additional information and context to the consumer as they're interacting with product marketing materials. These companies have coupled traditional print catalogues with mobile applications, allowing the customer to hover their device over the catalogue, see the products displayed in 3D, and interact with them. That's compelling because I don't need to drive to my local Lowe's to get some initial insight into a product, but the more information I do get from their materials, the more likely I am to end up there to make the purchase eventually."

While some of these applications are delivered through the burgeoning consumer AR and VR (virtual reality) headset market, including high end devices like the Oculus Rift and HoloLens, and lower-end alternatives like Samsung's Gear VR, these tend to be experiences best had at home. So, as Hai went on to tell me, the best in-store AR strategies make use of the screens and devices that are already in shoppers' hands. "American Apparel has a good in-store application: the shopper can hover their mobile device over a rack of shoes or clothing and get overlaid information about the available colours and sizes, as well as seeing product reviews from other consumers."

This approach benefits retailers both directly and indirectly: their engagement with the customer can extend to wherever their smartphone goes, and the retailer avoids the need to refresh in-store technology at the same pace as the near-constant cycle of replacement in the smartphone market.

"The rise of the Internet and mobile devices means that physical stores need to do more to engage customers and get them in," said Petah Marian of WGSN. "But I recently spoke to the store design director of a major UK retailer who had decided not to invest in in-store screens, because they would never be able to keep up with the capabilities of the technology that is in the customer's hand."

This question of long-term viability may cloud much of what happens in consumer-facing IoT in uncertainty – at least until formal standards for certain types of connectivity are codified. The way we, as shoppers, for example, interact with the brands and retailers we love is changing incredibly quickly. Snapchat barely registered as a channel in 2012, but four years later, according to the company's own statistics, it is installed on more than 60% of all 13-34 year-olds' devices in America. And eMarketer surveys also revealed that 22% of advertising executives intend to use Snapchat to reach that profitable demographic, despite the fact that it offers only indirect promotional opportunities; there is no way of directly linking a Snapchat or Instagram story to a product page.

For me personally, born at a bit of a transitional time, a big portion of the social media phenomenon passed me by. But while I'm not young enough to be "snapping" my favourite brands (I'm going to assume that's the verb form) neither am I old enough not to have a perspective on what that entails. Not only are the younger generation fickler than any previous one about the avenues they will use to communicate; they also purchase their technology heavily subsidised by mobile network carriers, meaning that the underlying platforms for that connectivity are prone to changing equally rapidly.

What happens, then, if NFC – currently a fixture of a lot of contactless payment systems – or Apple's iBeacons are superseded by better alternatives? Smartphone manufacturers are agile enough to move with the times, and the purchasing model for new technologies means that any changes to baseline capabilities will be reflected in the broader market incredibly quickly. In that hypothetical situation, the retailer who invested heavily in rolling out iBeacons or RFID – which several people I interviewed suggested was ripe for improvement or replacement – is now staring down the barrel of an expensive re-tooling of their core consumer engagement systems.

But while the churning cycle of technology may well make some of the technologies we consider essential to the IoT today obsolete in the long term, Andrey Golub (Founder and CEO of "virtual retail and cloud manufacturing" startup ELSE Corp) was keen to remind me just how close the solutions we currently use have come to matching the vision of science fiction.

"If you remember the movie Minority Report [which is set in 2054], Tom Cruise's character is welcomed by a retail store with personalised advertising based on biometric recognition. This seemed so futuristic when the film released [in 2002] but a lot of it is achievable today. What I see as the real future is that stores conduct this kind of personalised advertising, but no longer hold stock of product at all. Body scanners, 3D simulations, augmented and virtual reality, and potentially just-in-time manufacturing will instead allow shoppers to customise products suggested just for them, and then have them made right in the store."

WHEREVER I AM IN THE WORLD, I CAN HAVE WHATEVER I WANT – WITHIN REASON – DELIVERED TO MY FRONT DOOR AS QUICKLY AS TOMORROW MORNING.

Images provided by Fitbit

Whether you find this vision to be dystopian or utopian will rather depend on your perspective on personal privacy – covered in greater detail shortly – but what is inarguable is that the data that could power this level of personalisation is already being traded between brands, retailers, and consumers. From the way we behave in-store to the way we use our products after purchase, we either willingly or involuntarily provide companies with extremely valuable insights in exchange for better experiences. And one of the most obvious and interesting ways this relationship manifests itself is in the popularity of wearable technology.

WE ARE WHAT WE WEAR

Many examples of consumer-facing IoT rely on either the unknowing exchange of information, or a grudging sort of acceptance; the idea of getting better customer service in exchange for providing some simple demographic data being an example of the latter. One of the most talked-about faces of the IoT, however, is one that consumers voluntarily immerse themselves in: wearable technology for the purpose of health and fitness tracking.

Everyone knows someone who is completely immersed in their Fitbit, Jawbone, Nike+ or similar ecosystem. While it was extremely unusual to see a human being wearing technology on their body a decade ago, it is now commonplace, and is, I think, indicative of how the IoT will slowly but surely infiltrate different strata of society – by providing a level of utility that the wearer feels is a worthwhile trade-off in exchange for becoming a node in the global network.

Kay Rathschlag, founder of the German company developing the Antelope electro muscle stimulation (EMS) smartsuit, has a strong opinion on where that kind of utility should come from, and how platform holders should look to use it:

"Wearable technology is a really interesting field, and one that's going to grow really quickly in the next few years. All the big players in consumer technology are already entering the market with smart watches and fitness trackers, but I believe the second generation of these products will be much smarter. Eventually, of course, there will be no need to wear an activity tracker because the same technology can be integrated into your clothes. In the case of Antelope, combinations between the muscle activating power of the suit and IoT technologies are going to help us, as platform owners, become more like personal trainers than brand owners. We want to be able to prompt people when they haven't worked out in a while, and we want sensor data to tell us whether they are doing their exercises correctly or not. Done right, IoT-enabled fitness garments can do much more than traditional wearables to bring brands and their customers closer together."

Antelope is an interesting case study in wearable technology for several reasons: first, it goes beyond surface-level tracking to become an active device whose connectivity to the user's smartphone is truly bi-directional. Secondly, it showcases one potential direction for integrating complex, active electrical systems into performance materials, creating aesthetically pleasing sportswear with cutting-edge technological functionality.

While Rathschlag's goal could be summed up as creating wearable science, another interviewee believes that for technology embedded in garments to truly advance, the industry will need to address the gulf between what is considered wearable, and what is considered fashionable.

WHILE IT WAS EXTREMELY UNUSUAL TO SEE A HUMAN BEING WEARING TECHNOLOGY ON THEIR BODY A DECADE AGO, IT IS NOW COMMONPLACE.

"I think that for wearable technology to achieve broad adoption, design will be vital," said Angela Pan, founder of Ashley Chloe, which develops "digital wearables designed expressly for the modern lifestyle". While the company's initial wearable, the Helix Cuff Bluetooth headphone, is not an IoT product in the strictest sense (it connects to a smartphone, but not the wider web), it is potentially one product in a new vanguard of wearable technology that seeks to blend functionality more evenly with form – something Pan believes many wearable manufacturers currently ignore:

"The consumer electronics industry has been trying to enter the fashion space for a while, but a lot of the gadgets and technologies lack that truly desirable element. Look at the Apple Watch: functionally it is not all that different from other smart watches and wearables, and a lot of people mainly use it for notifications and basic fitness tracking. But it succeeded on the basis of two things that are very familiar to the fashion industry: simplicity and brand recognition. It is going to take time for customers, fashion companies, and technology companies to find the right balance, but I know that making technology fashionable will be the only way wearables will truly succeed in the market."

Both traditional and more advanced (or more stylish) wearables will, however, share a common currency that brings to the fore concerns that some privacy groups – and some users – have about the ownership of personal data. The information streams that wearables generate once we have them on our wrists belong simultaneously to us and to the companies who own and maintain the backend systems that house and make use of them.

The way this information is treated – and the implications of collecting it in the first place – is distinct from data security, which is covered in an opinion piece later in this publication, and asks a much broader question: what will it mean to buy connected apparel that can communicate, in real-time, where we are and what we're doing?

PRIVATE LIVES; PUBLIC PLACES

Amazon achieves its aforementioned automated product suggestions by tracking our browser histories – something that, until recently, it was not required to tell us it was doing. European Union legislation recently changed that dynamic, however, and shoppers are becoming increasingly aware that their browsing is being data mined. And retailers hoping to mirror that strategy of cross-selling may find themselves walking into a similar minefield.

Consumers, as we have established, buy wearable technology in order to get measurable insights into their health and fitness, and those metrics are communicated to the brand owner with express consent; but when we walk into a store and find ourselves being tracked, are we making a similar statement of intent?

Data privacy is an incredibly complex legal topic and one we do not have the space to cover here, but at the highest level I believe the jury is still out on what constitutes explicit versus implicit consent in advertising and profiling. We are, after all, tracked through the streets of our cities via CCTV, and retail stores have used footfall counters and other methods of demographic analysis for decades.

What is unclear, though, is how much this ambiguity actually matters to the new generation of shoppers. By coincidence or by design, the IoT is entering retail at a time when customers are more willing than ever before to be advertised to, and to participate in promotions and other activities that previous generations might have found intrusive. In 2016, brands and retailers are targeting a consumer who is willing to be engaged, provided they can build an experience or a level of convenience that captures them in the moment.

The differences in generational attitudes to privacy are, for me, quite neatly encapsulated in the iris scanners that began to be added to smartphones this summer. These are certainly secure – more so than fingerprints, given that eyes are not easily cloned – but when a technology becomes sufficiently affordable and capable that it is embedded into common consumer devices, it is not difficult to envision less-than-honest uses for it in government or private enterprise hands. Also, what was wrong with just putting in a passcode?

As you may have guessed, I, personally, would find the idea of being iris-scanned when I entered a shop, and then being presented with discounts as I walk past the things I like, uncomfortable. Some, on the other hand, would find it incredibly useful, and its privacy implications may simply never enter their minds. So perhaps I'm just getting old.

To try and confirm those suspicions one way or the other, I asked interviewees whether attitudes

WHEN WE WALK INTO A STORE AND FIND OURSELVES BEING TRACKED, ARE WE MAKING AN UNCONSCIOUS STATEMENT OF INTENT?

towards privacy are generational, cultural, or a combination of both. And while the answers I received were enlightening, they also confirmed something I suspect I may always have secretly known about myself: that my own level of discomfort with intrusive technology becomes something of a secondary concern when there is a discount at the other end of the tunnel.

"I think people are quite prepared to give away their data if there's an economic advantage for them," said Warren Tucker of PwC. "If someone chooses to download an app on their phone that allows a retailer to know their preference and location, that retailer can then start to do some pretty interesting, real-time things that benefit both parties. When that customer walks into a shopping mall and past a certain store, basic technologies like iBeacons can push a relevant offer to them, based on their historical buying habits. A lot of digital native companies are doing this already; they're just not yet blending it with the physical side of retail."

I ACTUALLY CONSIDER MYSELF QUITE PROTECTIVE OF MY DIGITAL IDENTITY, BUT EVEN I HAVE TO ADMIT THAT THERE ARE QUITE A FEW THINGS THAT A 20% DISCOUNT MIGHT GET ME TO COMPROMISE MY PRINCIPLES FOR.

The form these benefits for the consumer take will vary depending on the applications, but Britta Riedl from Koppermann envisions clear opportunities for loyal shoppers to help shape the next season of products from their favourite brands:

"The relationship between manufacturers and brands to customers is often based first and foremost on the mutual transfer of information. In this scenario the brand provides the latest information on current and planned products, and the customer evaluates the portfolio and communicates personal preferences for future collections. Targeted use of the Internet of Things in this regard can support the bidirectional flow of data between both partners, thereby gaining a deeper customer understanding whilst sustainably encouraging brand awareness and customer loyalty."

While these kinds of interactive opportunities may prove compelling, perhaps the most enduring way that consumers will stand to benefit from the exchange of personal information is our innate desire to feel as though we're getting a bargain, as Charlotte Kula-Przezwanski of Columbus Consulting explained:

"For luxury brands, I think loyalty can be created by communicating with dedicated customers and asking them to preview and provide feedback on future ranges. But throughout the UK and Europe we have become coupon junkies, and if we are going to give away our personal information – whether that's where we are, where we shop, or more detailed buying habits – to the mass market, we want something in return. This is the new loyalty equation for the bulk of the retail industry. The same principles of communication and understanding apply to both markets, but the approach differs."

A common belief among the various industry figures I spoke to – many of whom have a vested interest in creating a sustainable future of information exchange between retailers and their customers – is that when the customer feels valued as part of this relationship, their level of engagement is likely to be of a higher value than in cases where data is relinquished involuntarily.

"When parting with information is voluntary, the quality of the contact for other consumer engagement purposes is extremely high," said Michele Casucci of Certilogo. "If the product is

Image provided by Antelope

also physically in the customer's hand at the point of interaction, an even deeper level of connection can be created."

This is an opinion shared by Guy Alroy of Optitex, who anchored the theory in a long-running, practical application of the IoT in other areas of our personal lives:

"Look at the Waze satellite navigation system [now owned by Google]. I used it for years before the acquisition, and it's a fascinating case study for how the contributor of data – the driver in this case – should feel as though they are getting something useful in return. If an application is only designed to collect data, people are far less likely to cooperate than if there is some clear value for them – in this case receiving live traffic updates and allowing them to make better decisions. Making this example more relevant to apparel, once wearable technology actually becomes part of the garment, we will be able to deliver a better customer experience at the same time as creating real value for merchandising, planning, and fit teams."

This is also, I should add, hardly the first time that automation and raw data interchange has replaced human interaction in situations that are linked closely to our personal identities, and Susan Olivier of Dassault Systèmes argues that what seems unusual now will soon become the norm as attitudes and applications evolve over time:

"I remember when ATM machines were first introduced, and how strange it felt to be able to go and get cash without interacting with a real bank teller. You'd compare the notes to your receipt afterwards, and in the unlikely event something went wrong, there was nobody to talk to. We don't even think about that any more – it just doesn't register with us as being unusual. So I think for brands and retailers, this new level of consumer intelligence is going to be a trade-off between privacy and convenience that develops over time. It's likely to be push and pull for a while, but it's an irreversible tide that's coming. You may not want a particular coupon pushed to you walking by, but a mother shopping for childrenswear might be thrilled to get it. Or a heavy coffee drinker might be happy to know

there's a Starbucks two blocks over, and here's a coupon for their favourite latte. Once those personas are fine-tuned, it will be the norm to give brands permission to interact with us in ways that we find useful."

As a case in point, I do not remember a time before ATMs, so I have absolutely no compunctions about handling a transaction from my cherished current (checking) account or my life savings with a machine. So as these new concepts propagate into the mainstream and new generations of consumers enter target demographics, we may find the last pockets of resistance disappearing in a similar way. And if not, the right offer may be all it takes to tip the scales, as Mike Anderson, CTO and Chief Scientist for engineering and real-time computing services company PTR Group predicts:

"When I have spoken to security professionals, they've told me they'd never allow a smart fridge to act on their behalf and automatically reorder milk, which is a common example of the IoT in action. It's too intrusive, they say, and they find it uncomfortable. But what if the grocery store gave them a five percent discount for handling your ordering and fulfilment that way? They said no. Ten percent? No. Fifteen percent? Probably not. Twenty percent? Well, for twenty percent, yes. So we've just established that even security professionals have a price – and that getting the insight you want into an individual or group really is just a matter of negotiation."

I actually consider myself quite protective of my digital identity, but even I have to admit that there are quite a few things that a 20% discount might get me to compromise my principles for. I don't like to second-guess, but I imagine you can, too.

While some of these examples sound pessimistic, it's important to remember that transparent, IoT-enabled interactions and information sharing can also be used to involve the customer more deeply in the product design, development and production processes. And the results can be better quality, greater trend-accuracy, and improved fit across apparel, footwear and accessories.

DESIGNED WITH YOU IN MIND

As I mentioned earlier, retailers seek above all else to better understand and better serve their customers. While the volume and variety of data they are now capable of collecting has potential implications for privacy, it is also a fundamental component of a much more positive application of IoT technologies: inviting the customer to collaborate on the creation of better products.

One example of this philosophy put into practice is the use of in-store intelligence, paired with usage data from connected products, and communicated to retailers and brand owners with the goal of improving fit and quality, as Brion Carroll from PTC explained:

"The more people buy products that generate usage information – wearables today, but more general apparel and footwear in the future – the more that information can be used to develop better products. And in a similar sense, when a retailer has detailed information about shoppers' activities in-store, that can be shared with the owners of the brands they sell, helping them to achieve a greater level of sell-through or conversion to cash. That equation has value for all parties: my interactive fitting room might reveal that 25% of customers trying on a particular pair of jeans are then asking for a different size, even though they picked their usual waist and leg measurements off the shelf. That's information the brand owner can use to improve fit and quality, and it's data the retailer can use to redefine the shopping experience and pursue greater customer satisfaction."

Another name for customer satisfaction, of course, is loyalty, and Andrey Golub of ELSE Corp paints a vivid picture of how improved products and

Images on these pages provided by Samsung and Rebecca Minkoff

better relationships might underpin the creation of personalised replenishment schedules and other applications:

"We believe in the rebirth of CRM and brand loyalty. Consider the famous "long tail" of Internet purchases, which has already changed the way we think of business models. In future, this may become the main method of ongoing relationships between retailers and customers, with shoppers able to re-order past purchases and request new iterations on items they already have in their wardrobes with a single click. Imagine a scenario where I can say "Siri, get me a shirt just like the one I bought last month, only in dark blue rather than black"."

Lorna Ward, a Partner at PwC Consulting Services, responsible for retail technology, picks up on these ideas and adds another IoT device to the mix: the wardrobe itself. As Amazon's dash buttons (small IoT devices subsidised by brands that allow for single-press re-ordering of regularly purchased items like detergent) have attempted to do for household goods, a connected wardrobe or home mirror could quite easily allow customers to re-order basics once they have exceeded their durability threshold, or request new styles that complement the articles and accessories they already have at home, without going near a retail store:

"We hear a lot about the connected refrigerator as a compelling IoT application, but is there any reason it couldn't be a connected wardrobe? By adding RFID tags to clothing we, as retailers, can then start to gather information and take actions based on what people are actually wearing, rather than just what they're buying."

The undercurrent of both these examples is a level of individuation in market data that brands and retailers in every industry have thus far struggled to achieve without IoT technologies. For customers who are satisfied with providing detailed insight to businesses, stepping out from under the veil of anonymity, their digital identity can then be used to tailor a range of different services and products targeted specifically at their niche – something Brion Carroll from PTC believes will be a key differentiator for companies who develop a clear IoT strategy.

"I think the key value driver for the IoT in RFA is enabling the retailer or brand owner to understand their customers' buying habits," Carroll told me. "This is different to the traditional approach, where a designer creates from his or her own inspiration and asks whether people want to buy the resulting products. Today, brands and retailers are serving very well-defined markets, and we believe vehemently that the IoT can enable them to build incredibly detailed personas from heightened levels of consumer intelligence, then use that insight to develop specifically for their actual market, rather than an imagined one. This isn't just connectivity for connectivity's sake; it's all in service of allowing designers and developers to ask themselves, before creating products, what a forty-year-old soccer mom, with a salary of $42,000 per year, for example, wants today, and what she might want next month. We're talking about being able to analyse how weather affects buying patterns, or how the complex world of macro and microeconomics govern consumer behaviour. There are so many variables in the minds of shoppers, and we know that if we can get retailers and brand owners information access to those, they will develop products that better fit what the market wants now, and as it evolves."

The ability for brands and retailers to execute that development is the subject of the next feature in this publication, which examines how businesses can align their processes to respond to new levels of insight into consumer demand, and highlights other ways in which the Internet of Things can potentially transform design, development, supply chain, and manufacturing processes.

Practical Examples of the IoT in Action

While very few retail, footwear and apparel companies have yet settled on a concrete IoT strategy – hence the high-level content of these features – a growing number are watching other industries' experimentations with the technologies extremely closely.

The purpose of this section is to highlight three such use cases from outside the fashion industry, and to draw parallels between the way these businesses leveraged smart or passive products to better engage their customers, better understand their supply chains, and better prepare for a connected future, and how fashion might achieve similar results.

Diageo – bottling the essence of the IoT

Although the apparel sector and its food and beverage counterpart are very different industries, they share similar challenges and opportunities. Shoppers are almost as likely to impulse buy clothing as they are food and drink, and the need for brands to differentiate themselves from one another in both their products and their customer engagement strategies is common to both sectors.

In this sense, premium spirit group Diageo assembled a persuasive IoT strategy, connecting its physical products to the digital world to both influence buying decisions and to retain a link to consumers that transcends the transactional.

The group – owner of brands like Johnnie Walker, Smirnoff, and Captain Morgan – sought to capitalise on the fact that more than 80% of consumers (across sectors) have a smartphone in-hand when shopping, and added connectivity to its physical goods, as well as a range of other materials, to deliver what it calls "information and experiences" to consumers at a critical point in their engagement with the brand.

The group used this connectivity to create gifting and loyalty campaigns, allowing consumers to attach a personalised film tribute to a bottle of whisky gifted to a relative, for example. For the consumer, this represented added value: both giver and recipient could share their personalised content via social media. For Diageo, the product engagement data generated past the point of sale allowed the group to trace individual consumer journeys through brand activity for the first time. APIs linked this information to the group's global ERP and CRM systems, and fuelled future development and social media activities.

As well as physical products serving as digital media assets and consumer engagement tools, the same traceability also allows Diageo to track its bottles throughout the supply chain, with a consistent digital identity that accompanies its physical products from manufacture to consumption.

These are all potent possibilities for fashion, where consumers are even more eager to engage with the brands they love, and where inventory and asset tracking, and supply chain transparency are coming to define the future of agility and accountability.

iHome – a new family of smart products

Some of the most obvious consumer-facing manifestations of the IoT are the closest to home - literally. If ubiquitous connectivity's primary value for us, as individuals, is adding greater utility and usability to things we interact with every day, then it makes sense that the cornerstones of the places we live – light, heat, food, security, and entertainment – were among the first and most-visible proving grounds for IoT technologies.

Today it's taken as read that we can control the temperature of our houses from our smartphones, and dedicated, connected devices like Nest thermostats (now part of Google parent Alphabet's group) and Philips Hue light bulbs have proven extremely popular among early adopters.

iHome's Smart Plug is a more egalitarian prospect. Each small unit sits between the home's electrical supply and any household appliance plugged into it - from slow cookers to air conditioners – allowing the outlet to be controlled remotely and securely by touch or voice on iOS and Android.

As one of only five partners chosen to support the launch of Apple's HomeKit platform, iHome represents a more granular approach to home automation, and a more democratic outlook for the IoT – placing the decision of what, exactly, the consumer wants to connect back in his or her hands.

iHome's target market is residential users, but it isn't difficult to see how the principles behind its success could be mapped to retail use. Rather than expensively re-tooling in store electrical systems, user-friendly connectivity can instead be added at the point of power.

The company also prioritised a clean, clear user experience in its consumer apps – a necessity for any retailer or brand looking to build its own mobile applications to capture and engage consumers.

iHome also serves as a model for the value of real-time consumer data, and an indication of how a new generation of leading brands might address post-sale consumer support and ongoing relationships. With the Smart Plug now functioning across the full suite of smart home ecosystems - Apple's HomeKit, Google Nest, and Samsung SmartThings - iHome can rely on extensive, accurate, platform-agnostic, up-to-the-minute usage data to help drive improvements to its future products and applications.

Most importantly for our industry, where the cost of an IoT strategy is often uncertain, the Smart Plug demonstrates how easily and cost-effectively individual pieces can become part of a connected whole.

Coca-Cola – ubiquitous products; ubiquitous connectivity

As one of the most recognisable and widely-sold brands on the planet, Coca-Cola has little trouble getting its goods into customers' hands. But with a primary product that's bought, consumed, and often forgotten equally quickly, the company has to rely on a huge array of other avenues to maintain its engagement with customers.

When shaping its IoT strategy, the company therefore aimed to use the products themselves as the most accessible point from which the consumer could embark on the path to the wider brand. Without significantly redesigning their iconic packaging, Coca-Cola set out to deliver personalised, digital content to consumers; and in return it collected detailed analytics to support both wide and targeted marketing and consumer engagement strategies in the future.

"Our ultimate goal is to make the physical product part of every campaign, across all countries, so that anyone buying a coke product will digitally interact via their smartphone just as naturally as they navigate the rest of the digital world on the Internet," says Michael Schwarz, Head of Digital Acceleration for Coca-Cola in Western Europe.

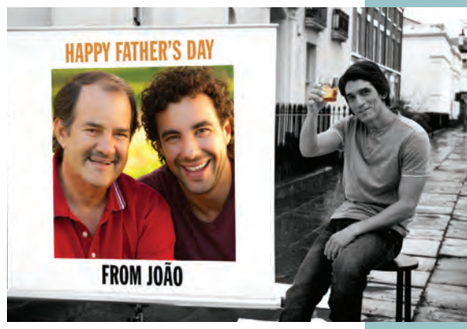
Built around the German football (soccer, for American readers) league, Coca-Cola packed the market with specially-design Coke Zero cans, each imprinted with a club logo that consumers could scan – without needing a dedicated app – and be directed to a landing page providing personalised, contextual information, and a way of winning prizes tied to the Bundesliga division.

At the point of connection, the scanned cans accessed SKU data, time, date, user preferences and history, and real-time geographical information, providing Coca-Cola with detailed insights into consumer behaviour and a level of personalised, in-the-moment engagement that outperformed many of its other digital advertising methods. All of this was information that the company directly captured into its CRM solution, creating a seamless bridge between the digital and physical identities of products and people.

While the choice of a garment is slightly more considered than the choice of a can of soda, of course, the concept of unified product and digital engagement strategies centred on a particular lifestyle passion or occasion will resonate with any brand that operates a runway calendar – particularly those who have staked their claim to the emerging "see now, buy now" model of shoppable shows.

Likewise, Coca-Cola's goal of turning products into smart, wholly-owned media delivery mechanisms is one that fashion brands and retailers might look to model their own initial approaches to the IoT. Smart swing tickets, for example, could open up a rich vein of ongoing connectivity with value for shoppers and brand owners alike: personalised lifestyle content served to loyal customers; unparalleled intelligence provided to teams in both product design and development, and retail strategy and marketing.

iHome can rely on extensive, accurate, platform-agnostic, up-to-the-minute usage data to help drive improvements to its future products and applications.



Material for these case studies was provided by EVRYTHNG, whose scalable Smart Products Platform powered each. Visit https://evrythng.com/customers/ for more information, or read on to hear from Co-Founder Andy Hobsbawm and other industry figures about the real-world applications of the IoT in production.

REDEFINING THE PRODUCT LIFECYCLE:

Applications of the IoT in Production

BY
BEN HANSON

"So much of what goes on in a product's lifecycle is hidden – particularly when we compare fashion to other industries."

In fashion, we like to think we know our products, their production cycles and their supply chains inside out. They are the embodiment of our brand principles, after all, and marketing is conducted on the basis that everything we, as brands and retailers, sell is a reflection of care, consideration, and attention at every stage of a product's lifecycle – from sketch to retail floor, and every supply-chain process in-between.

The less-glamorous reality of modern fashion – even high fashion – is that many of these products barely make it to market on time, and more still straddle a fine line between being profitable enough to warrant replenishment or iteration, and being retired. The average brand owner wrestles with quality issues, fit problems, roadblocks in their workflows and other crises up to the moment the final goods land in stores – and often beyond.

Without wishing to simplify things too much, the proximate cause of most of these unforeseen difficulties is a chronic lack of supply chain visibility. So much of what goes on in a product's lifecycle is hidden – particularly when we compare fashion to other industries like food and beverage, where every individual item is tracked, checked, and checked again from the point its constituent ingredients are pulled out of the soil to the point of sale and beyond.

For many brands and retailers, sourcing is something of a black box: they pick a contractor, put a purchase order in and get a product out. And while they do receive prototypes and samples during the pre-production phase, broadly speaking the average retailer or brand cannot accurately manage the process operation-by-operation, or count precisely how many quality-checked garments make their way into a shipping container. Neither can they track that container's contents outside of limited logistics information, and they are constrained in their abilities to track who the garments are then sold to and how they are subsequently used.

A confluence of different factors may be about to change this picture: transparency and sustainability have become two of the industry's watchwords, and advances in IoT technologies have allowed for accurate, actionable streams of information to emerge from both the production process flow and retail ends of the product lifecycle, and every stage in between.

Real transparency, as we now mean it, involves managing and interpreting tremendous volumes of extremely granular data, running the gamut from retail intelligence to thread production, and from robotic manufacturing facilities to returns information. The goal of the IoT in production is to provide access to those streams of previously inaccessible data, and then to analyse it, making it accessible via PLM at any stage of the product lifecycle, and using it to inform future design, development, distribution and retail strategies.

Over the course of these interviews, six particularly compelling use cases of IoT technologies in production emerged:

- Seizing trend opportunities.
- Tracking products at the individual item level throughout the lifecycles.
- Monitoring products with field testing and real world usage data.
- Using augmented reality to streamline the design and manufacturing processes.
- Employing industrial automation to disrupt the manufacturing status quo.
- Using consumer insights to shape production.

This feature will now analyse these in order to provide some insight into the way the IoT has been applied in RFA production to date, and how it is likely to present new opportunities and challenge fundamental assumptions in the near future.

Hitting the trend target

The perennial problem of fashion intelligence is thus: retailers know what we buy, but are frustrated by an inability to know what we didn't, and why. Often, though, the answer is relatively simple: the product was not on-trend. Today, fit problems can be guessed at by charting which items entered dressing rooms frequently but were seldom purchased, while trend acuity can be measured by those items not leaving the shelves particularly often in the first place.

This kind of data, by definition, has to be judged after the fact. Once an IoT roll-out has happened in stores, it will be relatively simple to check RFID logs and see that, with the benefit of hindsight, a particular style fell wide of the mark. It's considerably harder to recognise this before those styles reach the racks, but given the pace of consumer demand, this level of predictive demand planning will soon become a necessity, as Petah Marian from WGSN explained:

"Being on-trend is such a broad concept today. It's really about understanding your customer base and knowing what they want before they do. Ideally that means having short supply chains and lead times so that brands can react quickly to changes in the market."

As trends move and morph more quickly than ever before, and as growing numbers of brands and retailers turn to internationalisation across diverse markets, a blanket approach to trend is no longer viable. Here, the importance of more localised, even individualised, data sets, collected through IoT sensors and properly analysed, will count for a great deal, according to Julia Fowler, Co-Founder of trend intelligence and real-time retail data agency EDITED:

"The one thing that's consistent about fashion trends, no matter where they come from, is that to capitalise on them brands and retailers need products. And products still require lead times. So that means that for most trends it boils down to advanced vision and awareness. Monitoring the right channels compulsively and looking for the tell-tale signs that something is on the horizon. If you're able to do that, you can spot trends early and get orders in fast so that you're in a perfect position to get to market first. If you're in a position where you're reacting to product a competitor already has in stores, you've missed the first and most profitable wave. Part of that requires a streamlined manufacturing process, but the bigger part is insight into the market."

The other key to pouncing on trend opportunities is recognising that only a few select companies are able to actually create them. Unlike even a decade ago, when a single designer's catwalk show, or the pen of a sole magazine editor could dictate the uptake of a particular fabric or silhouette or theme, and everyone else would fall in line, today's fashion shows and media are moving to be instantly shoppable, reducing the ability for others to draw inspiration from them and still get products to market within a reasonable timeframe.

Today, the concept of trend has been almost entirely democratised, with hundreds of thousands of street style feeds and enthusiast "hype" websites dedicated to discovering and documenting the rise and fall of micro-trends like "normcore," which I think briefly made me cool a year or so ago.

This shift has placed brands, merchandisers, buyers, and designers into a very different mode: listening rather than talking. "Retail is a very fast environment, and retailers have to be agile rather than resting on their laurels," said Charlotte Kula-Przezwanski of Columbus Consulting. "Twenty years ago we had a 'push' mentality, making products and pushing them out into the market. Apart from historical sales information, retailers didn't know too much about the customers' shopping habits, so they had to rely on educated guesswork to create things they hoped would be well-received. Today, we have transitioned to much more of a 'pull' relationship: the consumer dictates to us what they want, where and when they want it, and what kind of fulfilment they need – store pick-up, same day delivery, a drop box or locker [at a local participating business] and so on."

Another vital aspect of the fulfilment Kula-Przezwanski talks about is the ability to actually turn products from sketches into finished goods in time to respond to the pull of the market. Lead times are significant, but so too is the commitment to making products available when and where the customer wants them – something that experience tells us is easier said than done. This standard of experience is something that Uwe Hennig is targeting with his company Detego, which focuses on "real-time analytics and article transparency" for fashion:

"Consumers now have the expectation that once something has been on the catwalk, it should be available in the stores right away. That's one side of consumer demand – the rapidly increasing pace. The other is the volume of new material. One fast fashion retailer, for example, now has 26 collections per year, which means new products are coming into the stores every two weeks. In that fast fashion segment, marketing may be doing a terrific job of getting people into stores, but with new products arriving in more than 3,000 locations every fortnight, it is no wonder that sales teams are sometimes too busy or too preoccupied to get it all onto shelves in time to satisfy the consumer. Real-time visibility at the item level can avoid this situation, taking information from marketing and tracking the associated products from distribution centres to store shelves, with notifications along the way."

"Lead times are significant, but so too is the commitment to making products available when and where the customer wants them – something that experience tells us is easier said than done."

The previous articles in this publication devoted attention to the considerable changes that e-commerce has already wrought upon the high street fashion and retail industry, but the IoT – particularly as it applies to garments tagged and monitored at the individual level – also has a rather important role to play in blending those channels and delivering on the promise of omni-channel. I spoke with Peter Charness, Senior VP for the Americas and Global CMO at PLM and planning vendor TXT Retail, about how item-level tracking can eliminate the costly margin of error in what we might call "blind" channel-blending:

"Two things are happening in the market today: brands and retailers have to release new products more quickly than ever before, and the customers want those products to be available whenever and wherever they want to shop. The IoT creates a level of precision that allows us to quantify, qualify, and fulfil that demand. It enables us to know who that customer is, and to meet their expectations. Traditionally, retailers have accepted a very high degree of error from their ERP systems, because inventory visibility was not as crucial as it is now. Accuracy in the order of 90%, though, is no longer acceptable. When you have promised a product to a customer who ordered it online and who is making a special trip to the store to get it, you need 100% precision to know it's available. Through facilities like RFID, with products communicating where they are, the IoT allows retailers to guarantee that kind of promise."

It can be tempting to talk about trend and demand as though it were a single, unchanging thing. As the experts know, though, its definition is forever evolving, with the only single constant being that, over time, brands and retailers will need to continue developing better-organised processes across the entire supply-chain in order to keep pace.

"With more channels to monitor, the task of catching all trends can seem overwhelming, but only if you're using traditional methods," Julia Fowler of EDITED told me. "Data analytics can amalgamate insight from any number of channels – be it retail activity, street style or social, and distil the crucial information instantly. There's so much information out there that collecting it has really become a computer-necessary job; human analysis just can't handle the sheer volume. So really, more than anything, it's a matter of having the right tools to deal with the realities of today's markets."

Unsurprisingly, I agree with Fowler and many of the other interviewees, that those tools must be a carefully curated collection of different technologies – as capable of handling real-time trend feeds as they are of managing virtual samples, or digital media stored in a centralised database and made available to digital catalogues, smart mirrors and dressing rooms.

In short, to manage entire product lifecycles in the IoT age, we need to treat those products as unique, individual, digital assets whose journeys we can chart from cradle to grave.

Total transparency

Practically speaking, a brand or retailer can tag essentially anything with RFID, NFC, or some other type of sensor with equivalent functionality. While the readers and systems required to make use of that kind of roll-out are costly, the tags themselves are becoming cheaper with each passing week. Everything from rolls of materials to individual components can be assigned an identity without any significant expenditure. But how desirable would that holistic level of tracking actually be? Ravi Anand of ITC Infotech believes the use cases at virtually every stage of the product lifecycle speak for themselves:

"There are, in fact, numerous use cases for tracking individual items right from the factory floor. Packing accuracy, with RFID enabled scanning devices, stock loading, shipping, tracking, store allocation, shelf space management, automated replenishment and restocking – all are uses for the same thread of information. Getting value from the IoT in this way is about creating operational efficiency and gaining some level of predictive intelligence from greater visibility into how your merchandise is moving through the supply chain."

"Performance wear companies and high fashion companies in particular make a lot of prototypes during their exploration and innovation processes. These can be anywhere from three to eight times the factory price of the final garment, depending on complexity, and even without malicious intent, a lot of them go missing during photo shoots, testing, and celebrity endorsements. We're investigating how these brands can keep tabs on their prototypes through what we call asset tracking – allowing the garments themselves to report on their location and status over cellular networks, in places and at a level of frequency that RFID scanners can't match."

The difference between passive sensors and more advanced, active equivalents is evident here: RFID's major shortcoming is the need for manual scanning or reading every time a product changes hands. Those pairs of hands might be very few in retail applications – likely just sales staff and customers – but during creation, fitting, sampling and other early-stage processes, one product may cover a lot of ground, as Mark Burstein of NGC explained:

"When a brand or retailer requests a sample from a vendor, a QR code can be printed at the time of manufacture, attached to the garment, and then scanned at key stages of its journey. We can then know when it left the factory, where it went en route to the show room, whether it came back from a retailer it was loaned to for a runway show. And at the end of the sample's useful life, we can scan it at the time it's archived, so if we ever need it again, we know exactly where to find it."

At the time of writing, however, products are typically not tagged at the point of manufacture, leaving a gap in their digital journeys, and potentially undermining applications further down the value chain that rely on total transparency. The majority of garments and footwear that are given a digital identity (through RFID or an equivalent) only become trackable at the individual level when they reach their destination market. And while adding tags at distribution centres still adds value from an inventory management and usage data perspective, at this point the planning, design, development and sourcing processes have already been undertaken in the traditional blind way.

As Ron Watson, Senior VP for Global Sales at Centric Software (a key PLM vendor that has emphasised the use of mobile devices during design, development and collection planning) explained, even where tags are applied early in the product lifecycle, the manual work involved in reading them at every critical juncture means milestones often go undocumented:

This same degree of insight into how products make their way from design to finished goods is also the cornerstone of a growing market for counterfeit protection, which relies on each garment having its own unique digital identity that remains consistent throughout its useful life.

"High end fashion brands care deeply about brand protection, but they have not, until now, had a very comprehensive solution available to manage it," said Sybille Korrodi, Head of Marketing and Business Development for TexTrace. "Beyond identifying the product as genuine or fake, real counterfeit protection is about tracking those authentic products through channels, and from the factory floor to the consumer. Our aim is to deliver complete transparency as to where a product has been, but also a legal, reliable means to fight counterfeiting."

TexTrace aims to incorporate RFID technology into woven brand labels in a way that is visually nonintrusive, giving customers like Louis Vuitton, Lululemon, and Vivienne Westwood (which is on record as saying it "wouldn't sacrifice [its] brand for technology") a way to track their products through both approved and grey market channels.

As an additional benefit, complete visibility into a product's journey through the supply chain can allow brands and retailers to turn the same knowledge they use to fight counterfeiting into benefits for regulatory compliance and public relations, as Michele Casucci of Certilogo explains:

"Being able to say where a product came from is also an opportunity to give the consumer access to its provenance and supply chain. Making it obvious and evident to the consumer how the company is manufacturing products, and in line with what standards of sustainability and compliance. From the perspective of the brand owner, they can identify whether there are any suspicious patterns in his supply chain. Using machine learning to identify anomalies of this kind means that we can detect whether codes have been cloned, so we can actually find out which contractor or subcontractor is making off-label versions."

Going a step further, Charles Benoualid of Visual 2000 believes that opening some of this information – governed by business logic, of course – to the end consumer may represent the future of apparel design and production, as critical stages of the product lifecycle move into customers' hands:

"We are working with a company that allows customers to make and measure their own shoes, and then track their production to a fairly detailed level. This, I think, is where the IoT is going to add real value: by breaking down these layers between manufacturing, distributing, retailing, buying, wholesaling and so on, and making the consumer part of the process. Because while it may not be you and I, a generation or two from now it will be common for customers to have that level of instant gratification – to have sensors in the production line tell them that their made to measure suit has had the last button sewn on and is now in packaging."

I was cautioned, though, by Guy Courtin of GT Nexus, who explained that visibility alone – whether it is communicated to the customer or not – is no guarantee that we will like what we see:

"Look at the food and beverage supply chain, where traceability matters an incredible amount for regulatory and marketing purposes. The same need to know who was involved with a product's lifecycle, and where, is emerging in a lot of other retail supply chains, including fashion, but the IoT is not a magic wand: connecting things will not resolve all of your supply chain problems overnight."

Eventually, of course, products exit the supply chain and arrive in retail stores, where their digital identities can be used to enable many of the exciting consumer-facing applications seen in the previous feature in this publication. From a retailer's perspective, though, the clearest benefit at this time comes from combining the individual product's identity with other systems, enabling store associates to make split-second decisions based on this morning's intelligence, not last week's.

"A single passive sensor, embedded in an item of clothing, can broadcast where it is, but if we pair those with smarter systems, arrays, and networks, we can then translate that location data and track where a product has moved from and to within a single store," said Chris Jones of TXT Retail. "Has it been taken into the fitting room a lot but never purchased? If so, it's not fitting right. Are people coming in off the street, picking it up right away, and carrying it around while they browse? If so, it's obviously a desirable item that could pull people in if we repositioned it closer to the front of the store. Adding that level of precision to the retail equation is very possible, but only if we have precise data in a form that we can quickly use."

As interesting as Jones's scenario is, the same pairing of individual products with more extensive monitoring systems can also provide critical information when products leave retail stores without passing the point of sale. Some of these are damaged in the process of trying on, but many more are lost through either carelessness in inventory management, or criminal activity. And although an RFID tag is not, strictly speaking, an anti-theft device, it does allow retailers to systematically analyse instances of shrinkage in their physical stores, and to potentially identify and quickly manage issues that might otherwise have taken no small amount of time and manpower to resolve.

"Retailers don't necessarily realise that there is a difference between what they feel is their physical inventory, versus what actually exists in stock," said Mark Burstein of NGC. "This may be a 1% difference or a 10% difference, but the only way they currently have of finding out is to do a visible inventory. IoT technologies have the potential to change this, and to address very real issues as a result. A customer of ours recently noticed that one group of its stores was experiencing significantly higher shrinkage than others, for example, and had to bring in extra security to discover that it was the employees who were stealing. With the right kind of embedded sensors and monitoring systems, this kind of insight can be gleaned with far less work."

All of these compartmentalised applications of full lifecycle tracking – from the technical drawing to the transaction – are effective and, depending on the business, may represent compelling use cases in their own right. When they are combined, however, they have the potential to underpin a level of agility, efficiency, and customer satisfaction that will help to distinguish companies in a competitive market. And, conversely, where one or more gaps exist in an otherwise transparent product journey, the chances of the brand or retailer falling short of consumer expectations increase, as Uwe Hennig of Detego told me:

"Today, fashion retailers are quite blind when it comes to inventory visibility. They place orders with suppliers somewhere in Asia, and garments are shipped, arrive in distribution centres and leave, but nothing is ever accurate to the individual item level. Sadly, in today's market, the opportunities to disappoint customers are quite large, and a lack of visibility at the right level can have a serious effect on the customer experience. Let's say you, as a shopper, visit a web store and find a t-shirt you like. You then realise you'll be passing one of the retailer's locations tomorrow, so you investigate the online store to try and find out whether the t-shirt is available in your size to try on in-store. In nine out of ten cases today, you can't do that. And if you do go into the store and ask the sales associate for guidance, they only have access to the same information you do. Nobody is willing to wait ten minutes while a staff member checks stock in the back room, so the retailer needs to know that inventory levels are absolutely correct online and in-store if they hope to retain that customer."

"The majority of garments and footwear that are given a digital identity (through RFID or an equivalent) only become trackable at the individual level when they reach their destination market."

Real world; real-time

Although wearable technology is the most active avenue for development when it comes to collecting real world usage data, as more garments, footwear, and performance wear become sensor-enabled and connected, a wider variety of opportunities to measure durability, quality, fit, and other key metrics will emerge.

"The number one thing our customers want is a better picture of how their products are being used, and whether or not the user is satisfied," said Humberto Roa, VP of Innovation at Centric Software. "The potential of the IoT is that the products themselves can share

Images on these pages provided by Levi's/Google ATAP Labs

performance information, durability, and a range of other usage data with brands, allowing them to make better products. For performance wear companies in particular, being able to validate technical performance in the months after launch can enable them to pursue exceptional levels of quality."

While some of these indicators are tracked by brands today, they are measured by hand, and involve using second hand information to inform critical decisions. "In field testing, for example, the objective data coming from sensors is extremely important; a tester might tell us that a performance jacket wasn't breathable enough while they hiked a mountain, but that's a subjective assessment based on an individual's level of comfort," Roa went on to say. "With IoT technologies embedded in prototypes, we can conduct more scientific assessments, and conduct comparative A/B testing to see for ourselves what differences a change in materials, zippers, or venting systems actually make to the product's performance – positively or negatively."

Drawing on the same pool of information – and assuming different companies adopt some level of commonality in the way they connect their products - brands focused more on loyalty and

"Just as superimposing key points of measure over samples can help fit teams to better visualise the impact of their decisions, similar data can be overlaid at the factory of the supplier making the next round of samples for approval."

aesthetics can begin to analyse which of their other products, or which competitors' products, a given style is most often paired with, and make decisions on future design and development accordingly.

"A lot of what's being done with the IoT today – particularly with RFID – is related to managing inventory and tracking user behaviour in stores," said Guy Alroy of Optitex. "But if we look further forward, I think there is a lot of potential for the IoT to teach us about fit, usage trends, and other metrics once the sensors are part of a garment that has been purchased. As a designer, technical designer, or patternmaker, I can then use this data to make better strategic decisions about the types of lines and styles I create, or to improve fit for my target demographics."

As a bridge between the two extremes, the middle market may soon be able to measure, through small pressure sensors or other measurement tools, how quality and fit are maintained after multiple cycles of wash and wear. It's important to remember, though, that the more complex electrical systems required to access this level of intelligence are themselves subject to degradation over time, and Mike Anderson of the PTR Group believes that technical hurdles remain between these visions and our current methods of data gathering:

"The thing about embedding sensors and other electronics into fabrics is that fabrics tend to get used and washed a lot. Are all the connections going to be watertight? What will happen if we get detergent into the system? These are questions for materials scientists and engineers to answer."

Transforming sampling and transferring skills

Taking this level of sensory information and using it to improve fit and quality is not as straightforward as it sounds. While a large enough pool of IoT-collected usage data will provide a basis for better decision making in the abstract, providing designers and technical teams with more in the way of real-world demographic data to rely upon, there remains a disconnect between that raw data and the samples that represent the iterative steps towards measurable improvements and, after several rounds, final approval.

"We think augmented reality can improve the way designers and developers experience product creation, and quality management is one particularly strong use case for the superimposition of data over physical objects," said Quach Hai of PTC. "All apparel and footwear brand owners and retailers undertake physical sampling processes – part of which is evaluating a prototype or first sample against criteria [like fit] that were imagined visually in CAD and PLM. The current process is very segmented in the sense that looking at the physical prototype, then at a laptop or tablet, and jotting down notes that bridge the two, is a fundamentally disconnected experience. Augmented reality can bring both of things together into one fluid experience, projecting critical measurements onto the shoe or garment itself, and allowing designers and developers to interact with samples in a way they never have before."

The applications of augmented reality in sampling and production do not end there; just as superimposing key points of measure over samples can help fit teams to better visualise the impact of their decisions, similar data can be overlaid at the factory of the supplier making the next round of samples for approval.

Despite government efforts in multiple countries to bring manufacturing back on-shore, and even with the burgeoning 'artisan economy', at a systemic level manufacturing is not seen as a particularly viable career path in the United States or Europe. And as China and other traditional manufacturing strongholds continue to grow their own domestic consumption markets, the same skills – whether they are for machine usage or completely manual processes – that all but disappeared from the western world will soon be in short supply at a global level. Rob Tiffany of Microsoft, however, believes that augmented reality devices like HoloLens can potentially circumvent this issue:

"Manufacturing in general has a problem with its experienced workforce ageing – and that's true across aerospace and apparel alike. The next generation of aeroplane builders and sewing machine technicians just isn't out there. Augmented reality is one of the most compelling ways to pass on those skills to a new generation: using HoloLens, experienced professionals can bring on board apprentices by digitally overlaying their insights onto the real world. Whether it's making denim or a Dreamliner, AR can provide essential information in the moment, with a heads-up display showing someone how to work with or repair particular equipment, or perform a new manual task. And you can apply this to any scenario where we need to train somebody to do something as clearly and cost-effectively as possible. AR stands to become one of the most vital tools for leveraging the data coming out of the IoT."

This skill sharing does not have to be limited to internal departments, of course. Imagine a fit session where a technical team at a western HQ provides augmented reality guidelines for where to adjust a seam or pocket placement, and in return a supplier or liaison office shares its own AR perspective on how a particular material is compromising fit or stylistic accuracy in other areas. I believe this level of data-driven interaction is emblematic of how the IoT will redefine relationships between links in the supply chain – a change that Sonia Parekh, Senior Manager for Kalypso's Retail Practice believes will be necessary for companies to thrive in the future:

"I think the IoT has the potential to change the relationship between brands and their suppliers from the current arrangement, where one gives orders to the other, into a relationship that's much more highly collaborative. That will also change the dynamics of the supply chain as a whole, and the demands that brands and retailers make from the people building their products. It won't just be a matter of cost; the best relationships will be forged by companies that share a common attitude to transparency and value."

Look into the mid-term future, however, and human relationships may have a greatly reduced influence on manufacturing, as more brands sidestep the issue of rising labour and logistics costs and embrace automation.

Automate to innovate

Fashion is relatively late to the automation game. Our cars have been made predominantly by robots for decades, and automated manufacturing has permeated most other industries that create products - with the exception of apparel, footwear and accessories.

Indeed, automated manufacturing is one of the major pillars of what various industries and government refer to as "Industry 4.0". Following on from the eras of mechanisation, mass production, and more isolated automation, Industry 4.0 is a term used to collect various technological advances – connectivity, simulation, virtualisation, and the interfacing of digital and physical systems - under a snappy heading. Depending on where you live in the world, it may or may not be a term you are familiar with. It

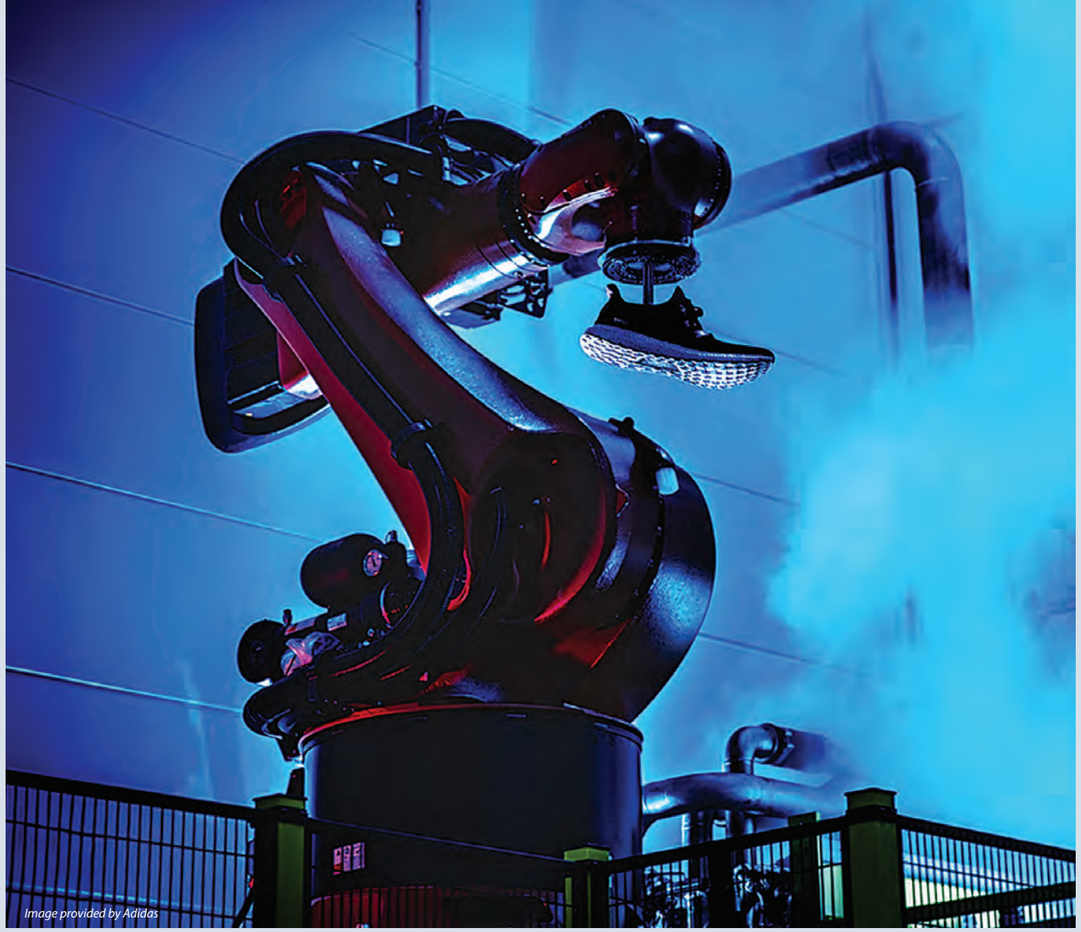


Image provided by Adidas

originated in Germany, which is a world leader in automotive design and manufacturing, and while similar advances in so-called smart factories have also taken place elsewhere in Europe, Asia, and the USA, they are not always referred to by that name.

Although some people would tell you otherwise, Industry 4.0 is not synonymous with the IoT, even though they share the essential characteristics of smart and passive devices connected to localised control and monitoring systems, and then to the Internet.

There are several reasons for the slow adoption of industrial automation in the RFA industry. First, there will be a significant upfront cost and some unavoidable downtime for any company looking to migrate from manual processes. Secondly, the variety and volume of garments, footwear and accessories that make up a typical collection – most in different sizes and colourways – do not lend themselves terribly well to robotic construction as it has existed until recently. The assembly line currently works best when robots are pre-programmed to produce large quantities of a single thing for months at a time, rather than hundreds of slightly different things in the space of a few weeks. And working with rigid materials (such as fibreglass and metal for cars) is an entirely different prospect to managing flexible fabrics.

But nevertheless, as labour costs become prohibitive, or pools of skilled resources begin to dry up entirely, the smart factory may represent the RFA industry's best option for maintaining margins – with the corollary benefit of enabling new levels of responsiveness to market demands.

Brion Carroll of PTC believes though, that while lessons can be taken from other sectors, apparel companies will have to make their own decisions about how, when, and where to move away from their long-held but ultimately unsustainable manual model:

"One of the key questions for the RFA industry is how the manufacturing transformation journey that hard goods and aerospace companies, for example, have gone through might be mirrored in transformations to the flow of production for soft goods and apparel. How useful might the same principles of robotic automation be when applied to transmitting marker data? As much as the IoT is going to transform design, development, and retail in the next three, five, and ten years, there's an equal level of potential for it to connect what's happening on the factory floor with what's happening in the market. This is an immature area for the apparel industry right now, but the space is wide open for companies to take small steps into that world, feeding manufacturing from the information held in PLM the way a lot of other industries already do."

Carroll's view is also shared by Britta Riedl of Koppermann, who is keen to point out that large elements of apparel manufacturing already qualify as being automated:

"Many production steps are already largely autonomous thanks to intelligent individual components that communicate interactively with one another. In turn, this can lead to shorter production cycles and the ability to offer a wider range of product variants combined with tighter delivery cycles. This is a significant competitive advantage in particular in the RFA industry, where collection cycles are consistently becoming ever shorter. Intelligent technology and varied data availability can therefore model anticipatory planning that, in turn, offers potential for perfecting capacities with regard to material and machines, thus making it possible to produce larger quantities in less time and make the collections available to the end consumer at a faster rate."

One well-publicised example of experimentation with a new kind of manufacturing is Adidas, which recently set up what it calls a "SPEEDFACTORY" in its native Germany, using robotics to build high-performing sporting goods faster than ever before, with little in the way of manual intervention. The sportswear giant has also taken steps to address the relative inflexibility of automated manufacture seen in other industries, employing what it calls a "decentralised, flexible manufacturing process".

While the SPEEDFACTORY is certainly considered a small pilot in the grand scheme of Adidas's globe-spanning supply chain, its effects are anticipated to be more profound than just publicity. Adidas claims it can create shoes more quickly than ever before, whilst also eliminating the environmental and cost impacts of international logistics by building similar factories wherever space and market conditions allow.

And as Chad Markle of Kalypso told me, this is likely to be just the first step on a long-term transformation for the industry as a whole:

"Smart factories and the IoT can give consumers the ability to configure or customise their products, and then to monitor them all the way through automated production. That's an immensely powerful thing, and we know of a major footwear brand that aims for 40% of its products to be handled through direct-to-consumer manufacturing by 2020. Using sensors and connectivity to bridge the gap between factory floors (in South East Asia or closer to home) and customers is critical here, and the same flow of data will also help to power industrial automation, with an incredible level of visibility into production bottlenecks."

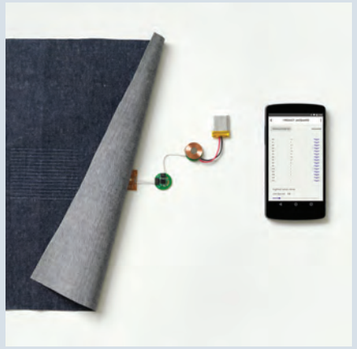
Even the SPEEDFACTORY, though, falls short of what is known in the industry as "lights out" manufacture, or the construction of factories with absolutely no human component. Suzanne Kopcha, Vice President of Consumer Products and Retail Strategy for Siemens PLM Software, believes that brands and retailers can both target this long-term strategy as well as addressing more immediate challenges in their manufacturing processes:

"Most of the manufacturing in apparel, footwear and accessories is still manual. We still don't have machinery that can thread laces or do complex stitching in an automated way at the scale that is needed to fully automate the industry. I would encourage brands and their partners to focus on what we call production engineering: the set-up for manufacturing, including the cutting process. We don't currently see a lot of businesses focusing on that step, but in fact many of the problems with quality and fabric waste we see arise during that cutting and prep process. Investments in these kinds of manufacturing infrastructure and processes also tend to last for decades, so our industry has a unique opportunity to design the manufacturing of the future in a very smart way."

Customers: your new creatives

More than perhaps any other industry, fashion relies on its proximity to its customers. Brands and retailers have strived for hundreds of years to understand their market better than the competition, and to anticipate people's desires. But while intelligence reports and consumer feedback have always been essential parts of that demand planning process, they have always come at one remove: a comment or survey conducted after the fact, from a small sample size of customers who cared enough one way or the other to participate.

The use of IoT technologies to track objective, up-to-the-minute insights from various media, and across all retail channels, has already transformed



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this process, as Charlotte Kula-Przezwanski of Columbus Consulting explained:

"Catalogue companies used to send out printed catalogues to the top 20% of their customer bases (they called these previews) three months before the season started. They would invite them to order at a 15% discount, and from the results they would get some idea of the best and worst sellers and start to conduct demand planning. Now that can all be done digitally, with online trials and validation, linked to a CRM solution."

While the most obvious difference between this historical example and the IoT-enabled future is the accuracy and accessibility of the information, equally important is the ability to ensure that the connection made with the consumer during this initial period of collaboration is maintained. Indeed, Warren Tucker of PwC believes that sustaining and extending that relationship will be the essence of the next generation of demand-driven production:

"The real power of the IoT is that it can give you access to data that was previously unknown without the customer themselves giving you that information. It's about having the ability to collect real-time and non-real-time information in a seamless way that doesn't require the consumer to do anything, but gives you, the retailer, the opportunity to have a relationship with that consumer that extends beyond the transaction. The value then lies in managing that ongoing relationship with consumption data and usage data – two new currencies in the interchange between retailers and customers that have the potential to create much stronger retention and loyalty."

More than perhaps any other industry, fashion relies on its proximity to its customers. Brands and retailers have strived for hundreds of years to understand their market better than the competition, and to anticipate people's desires.

This ongoing relationship between brands and their customers should also allow for much more reactive decision-making, since companies can, through aggregated feeds from social media and other channels, better understand how external influences unrelated to product fit or quality can affect market performance.

"Using the IoT to streamline production and gain a greater level of consumer insight allows us to make products to address specific market needs, rather than making them for stock, or to supply historical demand," said Chris Colyer of Dassault Systèmes. "As an example, imagine you're a sportswear brand making an official jersey for a football player, and that player is then traded to another team. Traditionally, you're now making goods that are not going to meet a market need. Using IoT technologies, and sensor-level data from social media, on the other hand, can help you to gauge the ongoing viability of that product. And you can translate that same principle into almost any other instance of trend or market-driven customer demand signals, using them to inform design and production on an ongoing basis."

Those demand signals, Mark Burstein from NGC argued, are perhaps the most valuable currency of the IoT, since they will allow more traditional businesses to not just match the responsiveness – if not always the lead times – of fast fashion, but also potentially to leapfrog it by using new sources of intelligence to align their production processes in anticipation of demand.

"In most cases today, designers have to wait until the end of the season to find out how well their designs did. Imagine instead that, on a daily basis, they received sales alerts from individual stores, with the data generated by IoT technologies. That would allow them to better understand the impact of their decisions, and it would allow the brand to position production capacity and raw materials so that new iterations in the same category could reach shelves in as little as three weeks. This is what the biggest fast fashion companies are doing, except that they're doing it manually, with conference calls, emails, and discussion threads. The IoT can systematise that entire process."

Pre-production demand is also only part of the picture; the previously-mentioned improvements to in-store data collection methods can also build a huge reserve of brass tacks retail intelligence, which allows retailers to use customer behaviour in select locations as a litmus test for how products or in-store experiences might be received by the wider market.

"As a product manager, designer, or developer, I can leverage that information to influence my designs according to what we call a consideration index," said Sonia Parekh of Kalypso. "How long did the customer spend looking at a pair of shoes? Did they eventually try them on? If so, what was the conversion rate to a sale? The goal is to take that information that was previously either unstructured or unavailable, and use it to make products and experiences that people genuinely want."

But perhaps nobody captured the potential of this symbiotic relationship between shoppers and shop owners better than Koppermann's Britta Riedl:

"Ultimately, we see the integration of the customer in the product lifecycle as the RFA industry's greatest potential. The product does not disappear from the manufacturer's view when it is sold, but rather continues to support the customer and actively integrate into his daily life. Never before has the Internet of Things opened up so many opportunities for retailers and brands, and there is ample room for new ideas enabling them to face the future with competitive ability, innovation and sustainability - and to model a new relationship between their products and the world they are used in."

For all its positive influences on the product design, development and production cycles, though, the IoT may also force brands and retailers to re-evaluate what it means, in a marketing, strategic, and ongoing support sense - to become a company making connected products. Which is something entirely different than being a fashion company whose products are connected, as Warren Tucker from PwC explained to me:

"There are always going to be use cases and applications for passive devices: Oyster cards [RFID enabled travel passes used throughout metropolitan London], and other dumb tagging applications will all continue to exist. The real opportunity, though, is that we will soon be able to deploy much smarter devices at a much lower price point. Five years ago, the iPhone 4S retailed for £500 [$660 at the current exchange rate], whereas now you have equivalent processing power for less than a tenth of that cost in a very short space of time, and in tiny form factors. Processing speeds will continue to grow, costs will continue to come down, and we will see a lot more smart devices in a variety of new places. The issue is that suddenly you need an entirely different technology environment and perhaps a completely different mindset to manage it all. What happens when something electronic breaks? Can you patch software remotely? Is your current repair and warranty process still valid for connected devices? How are you going to actually analyse that huge volume of data? Are you going to invest in AI? For physical retailers, these are questions that have never traditionally been in their remit."

A very visible example of this change from a brand creating clothes to creating technology is Levi's collaboration with Google's ATAP lab on Project Jacquard, which weaves capacitive, touch-sensing technology into fabrics, allowing the wearer to control their smartphone by swiping their sleeve. Until recently this was a theoretical exercise, but early this summer the technology was placed into the Levi's Commuter Jacket, the beta release of which is seen on these pages, and the commercial debut of which is set for 2017.

For now, the only technology woven into the jacket is human interface elements; in future, though, smartphone components themselves may be integrated into clothing – a vision that is designed to address what Google's Dr. Ivan Poupyrey calls the "inherent tension" between fashion and technology.

Consider, for a moment, that I just wrote about a jacket being released in beta. This is not the world of fashion as we know it.

But while this sounds like a noble goal, the ripple effect has the potential to turn the RFA business on its head: fashion companies, accustomed to fashion challenges and processes, may find themselves transformed into technology companies, with all the additional complications, liabilities, and market forces that entails.

Consider, for a moment, that I just wrote about a jacket being released in beta. This is not the world of fashion as we know it. It is not beyond the realm of possibility that one day – perhaps sooner than we think – I might need to contact the brand who made my coat because a firmware update has stopped it from interfacing with the climate control in my car.

And as thrilling a prospect as this is, it may – and, I feel, should – prompt brands and retailers to consider the flipside of IoT opportunity: its potential costs. The final article in this series now examines some of these risks, weighed against the ways in which businesses of all shapes and sizes can begin exploring and benefitting from the potential of the IoT.

Risk, Resilience & Reward:

CYBER SECURITY IN A CHANGED WORLD

BY
BEN HANSON

AS I'VE OUTLINED IN MY PREVIOUS FEATURES, THE INTERNET HAS UNEQUIVOCALLY CHANGED THE WORLD. OVER THE COURSE OF THE PAST TWO DECADES, IT HAS BEEN AT THE CENTRE OF MANY OF THE WORLD'S MOST EXCITING INSPIRATIONS AND INNOVATIONS, CHANGED ENTIRE INFRASTRUCTURES, REDEFINED THE WAY WE THINK ABOUT GEOGRAPHICAL AND PERSONAL BOUNDARIES, AND EVEN POWERED POLITICAL REVOLUTIONS.

But for all its power and ongoing potential, the excitement of the Internet has rather rubbed off in 2016. The Internet has suffused our lives to the extent that, for much of the world, it's considered a utility in the same sense as water, electricity, gas, and transportation. And nobody I know gets particularly excited about their electric supply.

From a security perspective, though, this is cause for concern. Now that the technical wizardry behind the Internet has faded into the background, we – as individuals and as representatives of businesses – place it on a unique, unacknowledged pedestal; the trust we have in the Internet far outweighs our acknowledgement and understanding of its risks.

To compare it with something similarly ubiquitous and convenient, we should no more consider the Internet "safe" than we do the road network of whatever country we live in. As luck would have it, I bought a new car while I was researching and writing these features, and, as a father, my choice of make and model was influenced fairly strongly by safety ratings. And although I don't mean to draw any kind of equivalence between a car crash and an incident of identity theft, the way I thought about that purchase compared to the priorities that govern my choice of smartphone or laptop or wearable is, I think, emblematic of the cursory glance we give to cyber security.

Generally speaking, we tend towards extreme complacency when it comes to entrusting our identities to technology. Which is why smartphone manufacturers, to use a common example, push cloud backups, GPS tracking, and biometric user identification – fingerprints – as the opt-out defaults for setting up a new device. These actions prompt some people to cry "nanny state," and to assume that companies like Apple and Samsung are intruding on our privacy and selling our data to the highest bidder. In reality, this is one of only a few occasions where I believe big corporations actually have our best interests at heart - ignoring the inconvenient fact that fingerprints are fundamentally less secure than proper passwords (your authentication key is now on every surface you touched today). We're so comfortable with the concept of smartphones – everyone has one, after all, and our favourite apps are right there if we can just dismiss this pesky request for two-factor authentication – that it takes serious urging to prompt us to look past the utility and at least recognise the unknowns.

It's important to note, though, that there is nothing inherently insecure about the Internet or, by extension, the Internet of Things. But what they both share is a degree of blind faith in the unknown that simply isn't mirrored in other areas of our lives where a comparable level of risk – abstract or definite – exists. Or to put it more harshly: both the Internet and the IoT are proof positive that the average user's comfort with technology is not commensurate with their understanding of how it works and how it might go wrong.

The purpose of this feature is therefore to encourage readers, in both their personal and professional interactions with technology, to consider addressing that kind of knowledge gap before blindly embracing anything new. And this requires us to look beyond value – which the next feature in this publication examines in depth – and to weigh up a longer list of variables than we might be expecting.

ANGLES OF ATTACK

I'm writing from something of a privileged position; I'm a technology commentator, speaking to an audience that, broadly speaking, is well-versed in technology. The average shopper, though, is going to make up the bulk of the consumer market for IoT-enabled products – and that goes for smart running shoes as much as it does for home automation. So, as product owners and potential platform holders, we owe it to our customers to consider the IoT from their point of view as well as ours.

That average shopper will soon walk into Best Buy (or your country's equivalent, which, frustratingly, the UK does not have) and purchase an Internet-connected doorbell. Equipped with a camera and microphone, the doorbell will feed, via standard TCP/IP, to an app on their smartphone, allowing them to see who's calling from anywhere in the house or, indeed, world. This kind of functionality has been achievable for a long time by privacy proponents and paranoiacs, but it is now penetrating the mainstream to become cool rather than borderline creepy.

The difference, of course, is that the DIY security expert of yesterday understood what he or she was doing and could limit their exposure accordingly. For today's mainstream audience, that IoT doorbell is a convenience and nothing more. For someone with malicious intent, it's what is called an attack vector, which is not coincidentally the same term we use to track the progression of particularly virulent physiological viruses.

What matters, for the purposes of this thought experiment, is not that the doorbell itself might be insecure (although a popular model was recently found to be storing WiFi access keys in unencrypted plaintext), but rather that it represents another attack vector towards its owner. And given predictions – documented earlier in this publication – about the volume of connected devices per person in the near future, this heightens the pitch of IoT security discussions because such attack vectors will soon surround people who have little, if any, idea that this is happening. People who are unlikely to take appropriate steps to guard against its potentially negative consequences.

Also contributing to the urgency of this discussion is the fact that connected devices will eventually become the only choice in certain categories. We may always be able to buy a "dumb" doorbell, for instance, but will our children ever have the option of buying a dumb car?

The latter category has already been stung by cybersecurity multiple times: last summer, Fiat Chrysler was forced to recall 1.4 million vehicles when it emerged that a hacker could remotely gain control of both non-essential systems (infotainment) and vital ones like brakes and steering[1]. Is it fair to assume that the average Fiat owner knew that this level of compromise was possible? Did they even consciously choose an IoT-enabled vehicle?

To borrow another – albeit extreme – example of how IoT security flies under our radar, you may be wearing a fitness tracker of some kind on your wrist as you read this feature. If you also wore it when you typed your laptop login details or online banking credentials earlier today, it would be possible for me to intercept the log of its gyroscopes and other sensors the next time they are transmitted to your phone, and from there to interpret your passwords from the motions of your hand.

This is not terribly likely for two reasons. One, it would require me to study and model your typing patterns over time in order to have a chance of interpreting the information I stole. Two, it would not be very efficient; I'd be better served just looking over your shoulder. But it does call forth the spectre of the "hacker," who we're conditioned to think of as a master criminal, but who is more than likely a young man or woman parked down the street with a little radio antenna and a $40 Raspberry Pi – which is all the Fiat exploit required, and possibly all it would take to interfere with an IoT application in a retail environment.

WORLD WIDE WEB

As our homes, cars, clothes, and computers become nodes in the same vast network, we expose each of those things to the Internet at large – a community that we know, whether we like to admit it or not, is not entirely benevolent.

Luckily, the expensive items on that list generally have a great deal of thought and R&D put into their security. And as we have seen, they get recalled when the reputation of their parent brand is at stake. As consumers, though, can we reasonably expect the same from an IoT doorbell, lightbulb, or smart training shoe? And as brand owners, can we promise the same from comparatively cheap, high volume goods? Or, in both instances, are we guilty of occasionally neglecting common sense when we're presented with uncommon opportunities?

PRODUCT LIFECYCLES

Which side of the IoT equation you fall on will depend on your reaction to the previous features in this publication. You may be satisfied to leave the innovation to others, or you may be fervently making notes for your own imminent IoT strategy. What you cannot be however, is apart from it entirely. Whether you're buying or selling, the IoT will inevitably transform the way you live and work, and the remainder of this feature will provide some initial guidelines and thinking points for making sure your role in the future of your identity and your products' identities is not a passive, intrusion-prone one.

As we have already established, individuals and industries tend to adopt technologies before they truly understand their impacts, concerned that they will be left behind otherwise. This has been true of many PLM implementations – particularly the earliest ones, where budgets and timescales overran dramatically, and project teams were airlifted out of their day jobs for years – and it will doubtless become true of an equal number of IoT strategies.

As any PLM project team member or manager will know, our attitudes are also extremely portable. We bring over our biases and bad habits from one generation of technology to another very easily, which is why the IoT Security Foundation recommends a clean sheet approach, with three principles that they feel (and I agree) should govern any IoT strategy or product:

- Security first – inbuilt from the start.
- Fit for purpose – security that is appropriate for the application.
- Resilience – security that lasts through the operating life of the product or application.

Interpretations of the second pillar will vary greatly depending on the individual application: an RFID authenticity programme, for instance, will be dramatically different in scope, scale, and cost than a multi-media marketing initiative or an industrial transformation through connected, automated machinery. But provided these and everything in between are built with appropriate security considerations in mind from the outset, they should be safe in a live environment – at least at the time they launch.

The third principle, however, raises some difficult questions because of the differences in disposability between garments and footwear themselves, and the IoT platforms they might interact with. Or, to put it another way, the consequences of a security breach at the product level and the platform level could be significantly different in terms of severity.

Once we, as an industry, roll out a technology like RFID or a new equivalent, it is likely to stay current for some time. The investment required in chips, readers, beacons and other infrastructure across retail stores, logistics hubs, warehouses and so on will not be recouped quickly. Which, by necessity, means that even if that technology is compromised, potential vulnerabilities may remain in the market for years or even decades if the identified holes cannot be cost-effectively plugged or patched.

In a market accustomed to short seasons and fast fashion, at the individual garment level the impact of these attack vectors is likely to be minimal. But in a structural sense, when entire retail intelligence, warehousing, inventory management, and authenticity systems are built on a common footing, a crack in that foundation could have devastating effects.

Take a further cautionary example from the automotive industry – one that became public knowledge just weeks before this publication went to press. Computer science researchers, who are luckily not hackers in the criminal sense, recently discovered that eavesdropping on the radio communication between a single Volkswagen vehicle and its owner's key fob allowed them to reverse-engineer the handshake the two perform and then clone the fob, enabling them to unlock the car remotely at any time. This does not sound particularly major, I realise, but that's because I haven't told you the same cryptographic key that secured the car – and that was stolen – was also used in an estimated 100 million different Volkswagen-owned vehicles. And that same key is stored in various internal components of the car, so it cannot be remotely patched by the manufacturer.

While older cars – some dating back to 1995 are affected by the hack – are not IoT devices in the traditional sense, the same underlying technology is employed in a huge number of connected devices that do meet the criteria. So we now have a single security hole that suddenly affects huge numbers of existing customers and may prompt tens of millions in lost revenues if a recall is required – all because of a $40 radio device[2].

This is also only the tip of the iceberg. The Volkswagen group sued, in 2012, to keep a similar vulnerability – this time in the RFID transponder chip used in immobilisers across some VW, Audi, Porsche, Bentley, Fiat, Honda, Volvo, and Maserati models – out of the media. That gag order expired in the summer of 2015, and it was subsequently shown that the hack allowed a criminal – a "bad actor" in hacker parlance – to override keyless ignition systems and start these models of car without the owner being present[3].

Newer models – produced since the discoveries – will not have these vulnerabilities, but the two combined nevertheless serve as a case study for the kind of perfect storm that might conceivably affect the fashion and retail industry. These were single platforms, rolled out across multiple group brands, deployed in huge numbers of products owned by loyal customers, that, when compromised, affected millions and could not easily be fixed.

And this is without addressing the far more frightening prospect of industrial espionage. This may sound far-fetched given that we're talking about fashion rather than foreign policy, but as cost-effective manual manufacturing disappears from countries like China, large brands have already begun to move to robotic assembly lines to make footwear. And, like any connected device, the Programmable Logic Controllers (PLCs) that power these robots have proved vulnerable to intrusion.

This kind of cyber security breach reached the news several years ago, when the Stuxnet virus – widely theorised to have been the work of a Western government – emerged in the PLCs of Iranian nuclear facilities, destroying at least a fifth of the centrifuge machinery involved. Stuxnet is notable for our purposes because it also went beyond its original target and spread uncontrollably to other automated facilities involved in manufacture of entirely unrelated products.

So while it isn't likely that your brand will be the target of state-sponsored subterfuge, it is conceivable that automated, IoT-enabled manufacturing facilities in less-than-stable regions may be compromised as collateral damage in non-traditional warfare.

MICROSOFT'S WINDOWS 10 IOT CORE IS NOW IN PUBLIC BETA, AND IN AUTUMN 2015 THE SOFTWARE GIANT ANNOUNCED THAT ITS SECURE BOOT AND BITLOCKER ENCRYPTION TECHNOLOGIES WERE BEING ADDED TO THE PLATFORM.

PUSH AND PULL

Security, of course, is never static. As the old adage goes, we build bigger walls; they build bigger ladders. As the IoT evolves and its value – examined in the next and final feature on the subject in this publication – becomes more apparent, the world's biggest platform holders will establish new safety paradigms for their customers, and penetration testers will attempt to break them, in an ongoing cycle.

Case in point: Microsoft's Windows 10 IoT Core is now in public beta, and in autumn 2015 the software giant announced that its Secure Boot and Bitlocker encryption technologies were being added to the platform to provide greater security from the kind of attacks seen in other IoT applications. Microsoft also began offering a DIY IoT starter pack for hobbyists – which is likely a precursor to wider, enterprise-grade applications in the near future.

As luck would have it, though, less than a month before this publication went to press, their master UEFI (Unified Extensible Firmware Interface) Secure Boot key was leaked, providing a convenient backdoor into essentially all commercially available Windows 10 devices – a list that, had the leak happened five years from now, might have included a lot more than laptops, tablets and smartphones[4].

And so it goes.

When it comes to understanding security in an IoT world, we must remember that for every smart person putting up safeguards, there is an equally smart person breaking them down. And like all genuinely world-changing technologies, the people and businesses looking to leverage the IoT in their personal and professional lives will do well to educate themselves a little before jumping in.

Because while the IoT will unquestionably be world-changing, industry-altering, and even life-saving - and while the businesses who take the right actions now stand to benefit perhaps as much as those who saw e-commerce coming decades ago - standing out from the crowd doesn't have to mean making yourself an easy target.

NB: This is an opinion piece, and these views are not necessarily shared by any of the interviewees, contributors, or advertisers featured anywhere in this publication.

SOURCES:

[1] www.bbc.co.uk/news/technology-33650491

[2] www.wired.com/2016/08/oh-good-new-hack-can-unlock-100-million-volkswagens/

[3] www.bloomberg.com/news/articles/2015-08-14/vw-has-spent-two-years-trying-to-hide-a-big-security-flaw

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START SMALL, THINK BIG

THE ROI ON THE IOT

BY BEN HANSON

A year ago, I dreaded having to write this feature.

As the second re-branded WhichPLM publication, the loose structure of these editorials was defined by our 5th Edition coverage of 3D working. Although the tale grew in the telling, we knew setting out that the task of these features was not just to introduce readers to the Internet of Things and explain its applications, but to analyse the return on investment potential of implementing an IoT strategy with the tools and technologies available in the market at the time of writing.

Twelve months ago, embarking on the research and interview process that provided the material for these features, I worried that, for all the potential I personally saw in the IoT, an unbiased assessment of it from an investment perspective might possibly reach one of three negative conclusions:

- The IoT might turn out to be an example of the emperor's new clothes – technology vendors and analysts borrowing a popular buzzword to sell existing products, or even worse, pipe dreams.
- The value might be evident, but might require such a significant upfront investment as to be out of reach of all but the biggest businesses, meaning we had tackled the topic too early.
- The applications of the IoT might prove to be relatively limited in retail, footwear, and apparel, or confined only to consumer applications.

On all counts, I needn't have worried. As the preceding features have demonstrated, the RFA-specific benefits of IoT technologies are clear, compelling, immediate and achievable – but only for those brands, retailers, and manufacturers who are prepared to educate themselves on the foundations of that value, and to recognise that although disruption is coming, it's coming by degrees.

Because, unlike 3D working (the subject of last year's editorial analysis) or even PLM itself, where the value equation is relatively simple, the ROI on the IoT is interpretive and subjective, and how and where value can be found is almost entirely unique for each business.

The easiest parallel to be drawn is between the IoT and the Internet itself. With the benefit of more than two decades' hindsight, it is easy to chart the contours of e-commerce and social media and point to the ways they have changed the landscape of fashion. Today we know that trend, retail, marketing, and even the extended supply chain have all been altered completely, but at the time HTTP was unveiled to the wider world, none of those revolutions was immediately obvious – or even that predictable. As large-scale

Images provided by Google ATAP Labs and Samsung

transformations often do, they emerged organically and in stages, from innovation piled on top of innovation, and from long-term investments made by companies who got in on the ground floor.

In a similar way, the value that retailers, brands, and manufacturers are able to get out of the IoT will be equal to what they put in soon, but it may only be realised in small portions over the course of many years – eventually culminating in the ability to seize much larger-scale opportunities in a world they prepared themselves to meet. So, even with the immediate use cases laid out in these features, investing in the IoT requires a balance of foresight and faith, because what the RFA industry will look like two decades from now is nigh-on impossible to predict. But ours is not the only industry facing this challenge, as futurist Danial Burrus wrote in Wired magazine in 2014:

"The key is not to think small. […] The Internet of Things is not merely about creating savings within current industry models. It's about upending old models entirely, creating new services and new products. There is no one sector where the IoT is making the biggest impact - it will disrupt every industry imaginable, including agriculture, energy, security, disaster management, and healthcare, just to name a few."

As Burrus hinted at two years ago, thinking of the IoT in isolationist terms – how it affects the RFA industry alone, in our case – is a limited viewpoint, and one that will artificially limit the value that we are able to extract from it. Sooner rather than later, we will live in a world suffused by data streams from passive sensors and smart things, just as today we are surrounded by analogue and digital radio frequencies. The technology to bring that vision to life already exists, and it is becoming cheaper and smaller by the year. The desire, too, is current; consumers in particular appear to want everything connected for the sake of convenience. So, once the first connected refrigerator – to use the popular example – becomes successful in the mass market, seizing on those data streams from properly-tagged products, what consumer is going to seek out a non-connected fridge? And more to the point, what manufacturer is going to make one?

The same principles have already applied to connected sportswear and performance wear; entire ecosystems are being built by the likes of Nike, Adidas and Under Armour around their connected, sensor-enabled footwear, and competitors are all but guaranteed to be following suit.

In a world that is already being changed by technology at a holistic level, then, the key to charting a path to value with the IoT in the RFA industry is to interpret that world for our purposes – something that Warren Tucker of PwC believes requires a keen understanding of the technology itself to achieve:

"We're seeing a big shift, across all industries, from a paradigm where business strategies were enabled or supported by technology, to one where technology is actually driving business opportunities. In every sector, the fastest growing, most innovative companies are typically led by technologists who have innovative ideas and work with others to realise them. If you understand what technology can do, you can identify entirely different applications for it than someone who doesn't, and I think that's one of the biggest issues that different businesses face when it comes to getting value out of the IoT."

> THIS LEVEL OF CHOICE CAN LEAD TO INACTION; THE TEMPTATION IS TO WAIT AND TO LET THE TIDE WASH OVER US.

At present, though, independent research suggests that this grounding in the fundamentals of the IoT is still lacking. Analyst firm Gartner recently surveyed a cross-section of businesses and discovered that while 40% of them expected the IoT to "transform their business or offer significant new revenue or cost savings opportunities in the short term," most had not established "clear business or technical leadership for their IoT efforts".

PARALYSED BY CHOICE

I want to be unambiguous about the following point, because it may be the most important one in this publication. While the IoT has virtually limitless potential, and while the new revenue streams and efficiency savings Gartner's respondents identified do exist, it is entirely possible to come out of investing in the IoT worse off than when you went in – unless you have the right viewpoint and the right executive vision. Investing blindly and hoping to come out ahead is not a valid strategy any more than building a website without a clear purpose would have been in the mid-1990s.

Amazon may be a tired example, but it is an apt one: it was founded to change the face of retail, and that combination of goal and initiative played a large part in its success. Jeff Bezos and his team did not wait for an independent body to tell them what the Internet could become, because no such body existed then, and it does not exist now for the IoT. There is no grand design; no firm hand on the tiller, steering the IoT in a direction that will be profitable for everyone. The opportunity is not to buy into an existing vision, but rather to shape the IoT for the RFA industry in our own image.

In a way this is liberating, because there is no fixed script, and, within reason, all avenues of exploration are equally valid. In another sense, this level of choice can easily lead to inaction; just as some businesses did during the earliest days of the Internet, the temptation now is to wait and see how things develop, and to let the tide wash over us, as Mike Anderson from the PTR Group explained:

"The trouble with the way the IoT is spoken about today is that speakers at conferences are still saying they believe there's a market for it. I don't blame the typical business owner or consumer looking at the way the whole subject is discussed and concluding that it doesn't have anything to do with them. To arrive at the stage where companies can actually make money from the IoT, we need to advance, accept that the market exists, and address the issue of how we actually do something to serve it."

Like any viable market, though, the key to making a sensible investment in the IoT is recognising that choice exists. In order to achieve the transformative applications of the Internet itself, small steps had to be taken - and during the initial stages of the dotcom revolution, these steps were each as unique as the businesses taking them. The same will be true as the IoT develops: no two customer bases are alike; no two supply chains are identical; no two roadmaps perfectly align. The IoT is so broad and so potentially far-reaching that it can be valuable to you in almost any way you can conceive of connecting one physical thing to another, or to an interpreting system, and obtaining results.

This open-ended potential, though, has a downside. Business cases are notoriously hard to assemble on the basis of promise alone, and technology for technology's sake does not enjoy a good reputation, as Sybille Korrodi of TexTrace told me:

"People in the fashion industry tend to be more fashion-orientated than business-orientated, and they don't necessarily like new technologies, which is a challenge for anyone proposing a technological solution to a problem. Building a business case for technologies like the IoT is difficult, then, because it involves changing people's minds."

A change in mindset, however, may be exactly what is required. While fashion and technology are certainly converging, and while the average brand or retailer today likely has more individual software solutions in place than ever before, neither pace matches the uptake of technology in other industries, or in consumer applications, as Julia Fowler from EDITED explained:

"So much innovation and progress has gone into consumer-side technology that it's created an asymmetry wherein some retailers are using less technology to track and analyse the trajectory of the market than the consumers who are driving that trajectory. In almost any other industry that would be unthinkable. And yet the apparel industry, this trillion-dollar market, has lagged in that respect."

Some of the blame for this comparatively slow adoption of technology can be laid at the feet of fast fashion, which has forced brands and retailers of all shapes and sizes to accelerate production cycles and concentrate on efficiency rather than innovation. Still more can be attributed to the fact that e-commerce has enabled an entirely new kind of explosive growth – one that Andy Hobsbawm from EVRYTHNG believes adds an additional layer of difficulty for businesses looking to get the most out of the IoT:

"The apparel industry is actually quite open to innovation, because fashion and retail has to be as close as possible to the speed of culture. The industry trades on knowing what people want as close as possible to the time they want it – or even anticipating and shaping that demand. But there are also a lot of very traditional ways of doing things that stem from cool street brands growing rapidly, and discovering that they lack the systems they need to compete globally. Suddenly, these businesses have billions of dollars in sales, but their technologies and data are not fit for purpose with their new scale. And this happens more than in other industries just because fashion moves so quickly."

Addressing these more pressing challenges (which are often the inspiration for companies turning to PLM) will in many cases offer a more immediate return than implementing a long-term strategy for the IoT – particularly when we consider the scale of investment and uncertainty that rolling out IoT technologies involves when compared with surer bets like PLM. I have, for example, written throughout these features as though RFID is a universally adopted standard, when that is not the case. In Europe, and particularly here in the UK, several large-scale pilot schemes failed to find traction, and Mark Burstein from NGC revealed that the same is true in the USA:

"Five years ago, RFID was hyped by retailers like Walmart, Macy's, and JC Penney, who tried to mandate it with their suppliers, but broadly speaking it has not been a big hit in the United States. It certainly hasn't become ubiquitous; almost all product shipped into the States is not RFID tagged at all, and when those tags are attached at a US distribution centre, they are only placed on key garments, and only after some of the most important stages of their journey have finished. The machinery to encode those chips and embroider them at the factory level is just too expensive, and the factory owners see little value for themselves, so RFID has not caught on the way we thought it would."

And even for retailers and brands who have taken that leap of faith, Burstein explained that current RFID capabilities fall short of what will be needed to fulfil the promise of the IoT:

"The biggest barrier to a lot of the exciting visions for the IoT is that they can't be realised without improved hardware. RFID readers currently only have a usable range of 3-10 feet, so taking an inventory of an entire store or warehouse is not as simple as clicking a button – it requires time and effort to walk the floor. Once we're able to put either a new version of RFID or a better equivalent in place, we will be able to track inventory in real-time with very little work, and that's going to go a long way."

In addition to the investment required in rolling out new and improved technologies themselves, Burstein's example is indicative of a broader problem with articulating the value of the IoT – namely that some of the most dramatic results are, for want of a better word, a little boring, as Guy Courtin from GT Nexus explained:

"The passive IoT is a lot less headline-grabbing than the active one. Things like smart fridges and connected homes are what I like to call the "unicorns" of IoT, because they're visible and desirable and sometimes a little quirky. There's a company that makes a connected chopping board, for example, that can recognise a properly tagged ingredient placed on it – salmon, maybe – and suggest recipes based on what else is in your connected fridge. That's an evolution of what's possible with RFID, the same way a retailer reducing shrinkage by 10% through tagged garments is, but the difference is that one attracts more attention than the other. There are real use cases out there, though, that go beyond the obvious ones like smart mirrors, but nevertheless have a real dollar value."

TUNING INTO VALUE IN A SEA OF INFORMATION IS A MATTER OF IDENTIFYING WHICH DATA STREAMS MATTER IN YOUR UNIQUE BUSINESS CASES

GETTING STARTED

For brands and retailers who do have the right technological baseline (i.e. there are no more pressing and potentially more lucrative investments in core enterprise technologies to be made) and executive buy-in, and who are willing to look beneath the surface gloss, obtaining value from the IoT can actually be more straightforward than initial impressions indicate. As Ravi Anand from ITC Infotech suggested, businesses should start with small building blocks that will help to pave the way for more complete transformations:

"Getting value from the IoT does not need to be complicated. Let's say you have a lack of real-time visibility into progress on a purchase order that was released to a certain supplier. This is a concrete activity that you can track or make more visible, giving you or your stakeholders the chance to make more effective decisions, or to intervene in a timely way, with accountability."

Indeed, this is how many of the IoT applications currently in place began life - from smart mirror tests in single city locations to inventory tracking across select stores. The perception may be that big businesses invest considerable amounts of money into wholesale transformations, but in reality even the most widespread distributions of the IoT started at a much smaller scale, as Eric Symon from PTC told me:

"The biggest question we face from retailers and brand owners is how they should get started. Case studies for IoT strategies are few and far between, so we tend to conduct workshops with customers to help them better understand the tools and capabilities available, and to frame their thinking. In a real sense, we're still talking to early adopters and innovators, and while the buzz is strong for the IoT, most of the retail applications are really at the pilot stage. This is why our Retail Transformation Journey is structured around the idea that anyone can take manageable steps today that will help prepare them for long-term value, but also deliver a return relatively soon."

But, as Symon says, starting small does not necessarily mean staying small. We have already established that today's boutique brand can easily become tomorrow's big business, and the same is true of IoT applications. Yesterday's experiment can become something so important the entire business is reoriented around it tomorrow, as Chris Jones from TXT Retail explained:

"The data you need to extract from the IoT is going to be very much related to your objectives at the time. Obviously these objectives also change over time, as relationships between retailers and consumers evolve. Often, they're going to become more complex in the process, and involve re-evaluation of what the key parameters and KPIs might be. So I would encourage businesses to take the same approach they do with enterprise systems: start simple, and you will discover that new use cases emerge organically."

OBTAINING VALUE FROM THE IOT CAN ACTUALLY BE MORE STRAIGHTFORWARD THAN INITIAL IMPRESSIONS INDICATE.

UNIQUE OPPORTUNITIES

The trick to establishing pilot programmes with a chance of success, Warren Tucker of PwC explained to me, is to structure these around business goals and to resist the temptation to rush towards tentative sources of revenue:

"I don't think there is one common decision to be made about what we, as an industry, want the IoT to be. There are use cases to be investigated, there are trials of different technology options that we need to consider, and from there it's a matter of identifying which technologies support your strategic objectives. The danger comes from thinking that you need to make a quick decision: I think it's perfectly reasonable for an apparel company to pick multiple different technologies for different use cases if that's appropriate, rather than sticking to the traditional approach of capturing all their requirements, analysing all the available solutions, and making one big bet on a single technology to deliver returns. This iterative process is essential. We can't confidently say today which use case will prove to be the best ROI investment; it will be a combination of different use cases based on market segmentation and individual requirements."

The importance of building an IoT strategy structured around individual strategic goals is something that every interviewee we spoke to endorsed. In a market where, once garments themselves become smart, everything can theoretically talk to everything else, tuning into value in a sea of information is a matter of identifying which data streams matter in your unique business cases, as Susan Olivier from Dassault Systèmes explained:

"What constitutes signal rather than noise really depends on what a brand or a retailer thinks of as their core competency. There will always be more information in the market than anyone can deal with at any one time, so the question will be what challenge or opportunity a particular business is trying to address. Because if your primary challenge is speed to market, then you're going to focus, perhaps, on collapsing the production cycles, and you might want to use that IoT-collected consumer information before you make your final cut decisions. On the other hand, it might be a question of operational efficiencies: how can I get that last few cents out of my supply chain? How do I really optimise deliveries and product flow-through?"

But while these unique use cases will form the bulk of most businesses' IoT strategies, common challenges and opportunities will emerge – just as they have with PLM and extended PLM – and best practices will become established that are, in a broad sense, useful to most businesses. Indeed, operational efficiencies applicable to essentially any business that sells stock were one of the major potential benefits of the IoT as outlined by Suzanne Kopcha of Siemens:

"Inventory visibility and traceability of the product from design through the production value chain can transform the retail industry – particularly for big box stores. Big box retail is losing to the off-price stores. For the first time in history, seven out of 10 of the top retailers are off-price. Big name brands are not doing a good job predicting consumer demand and taking account of the cycle times they have for new products. Powered by IoT and analytics tools, visibility and intelligence can change things completely: companies could limit the quantities they produce on the basis of intelligence, allowing them to hold prices in the retail environment longer. They could better analyse and predict demand signals, and take steps to secure the authenticity of the products that reach the market. Predicting and managing the right level of inventory and preventing counterfeiting and replication could return $1.5 -$2 trillion in revenue to the industry. These are big value items."

And value items like these are where Guy Courtin of GT Nexus suggests brands and retailers begin developing an IoT strategy, seeking out areas of their business where revenues or margins are being constrained, and where a business case already exists for the adoption of technology in some form:

"Businesses looking to get value out of the IoT need to do a hard assessment and detailed audit of the data they're already pulling in – things like inventory and point of sale, most likely – and evaluate what other information they need to enhance or improve business processes, then use that to inform their investments. Obtaining value is not about doing IoT for the sake of doing IoT; it's about identifying

SMALL OR SINGLE-PERSON BRANDS, SELLING ONLINE TODAY, MAY BECOME MULTINATIONAL FIXTURES OF THE IOT-INFUSED FUTURE.

business cases you already have and figuring out how the IoT can help with them."

This may sound mundane, but in the context of the misgivings I had when I first began researching the IoT, it is incredibly encouraging. For all its world-changing potential, the IoT came to life most immediately for me when it was spoken about in the same terms as other software solutions, solidifying its place in the pantheon of real, viable, investment opportunities with measurable end results.

PREPARING PEOPLE

Like any viable solution, though, identifying the potential value of the IoT does not make a brand, retailer or manufacturer automatically qualified to capitalise on it. Embarking on an IoT strategy is a unique prospect in that it absolutely demands expertise and experience that exceeds the remit of most traditional fashion industry teams – even those who have previously been conscripted into a multidisciplinary PLM project team.

As Humberto Roa of Centric Software explained to me, translating IoT potential into IoT value will require many businesses to rethink the makeup of their teams:

"One of the primary challenges is that, for the IoT to work, your business has to have a broad array of skills. You have to be able to incorporate the required hardware into your products. You have to build a secure way of transporting the information those sensors generate. You have to be able to then store and analyse the data in a way that's meaningful. Brands and retailers that have that kind of skill in-house are the early adopters of IoT technologies, because they have a clear understanding of the concepts of hardware, software, and analytics. An easy litmus test for preparedness is to look at your existing merchandising process: is it spreadsheet based, with surface level analytics and straightforward forecasting and planning? If so, this facet of the IoT may not be something your business is in a position to adopt just yet."

Equally important is that executives, the people to whom business cases are being put, have sufficient technical knowledge to understand current opportunities and visualise future ones, as Sybille Korrodi of TexTrace said:

"For retailers and brands to understand the value that the IoT can bring, they need to first understand the core concept of having a unique identity integrated into each product, and what that might mean. I don't believe that this is fully understood yet. Retailers and brands do not fully grasp the ramifications of the idea that there's a chip with a unique identifier, and that they have a database where they can link information to that number. There's a grounding in some fundamental technical concepts that will be required for people to see the results that are possible."

In addition to rethinking the composition of their internal communities, the IoT will also challenge brands and retailers to reconsider their central business models. Common to the "lean startup" mentality seen in other technology-led industries is the idea of failing fast, or experimenting with new technologies and approaches, and then trying again with experience gleaned from failure. But while the fashion industry is known for trying outlandish things with new trends and materials, the same cannot be said for its relationship with technology; ours is an industry mired in the traditional license and maintenance pricing model for software, and is only now slowly – but surely – moving towards cloud-based and subscription applications. That being the case, Lorna Ward of PwC believes that businesses will soon need to change the way they think about technology:

"Retailers have historically been very cautious about investing in systems, and I think the concept that they may need to make an investment today, but that something better could come along tomorrow is a difficult one for them to come to terms with. In fact, this is one of the biggest barriers for retailers and brands taking advantage of the IoT and other new technologies coming to the market."

And implicit in that redefinition of the industry's relationship with technology is a re-evaluation of what technology means for the central value proposition of brands and retailers who begin trading in IoT-enabled garments and footwear.

"The IoT is going to prompt brands and retailers to ask big questions of themselves," said Chad Markle of Kalypso. "Are we performance wear companies that leverage technology, or technology companies that make performance wear? This is a fairly common question, and one that has led several brands to make big investments in becoming technological leaders."

But provided specific businesses – and the industry as a whole – can weather these changes, the initial business cases we have identified throughout these features are just the tipping point.

FROM THE UNIQUE TO THE UNFORESEEN

Finally, we come full circle. With all the history, caveats and preparatory steps addressed, we are free to think in the much longer term, and to embrace the sheer, unbridled possibilities of the IoT.

WhichPLM, as a commentator and analyst firm, cannot predict what the world's brightest minds will be able to do with the power of the IoT in the next five or ten years, but one thing is certain: those minds will not come solely from traditional technological disciplines, as Mike Anderson from the PTR Group told me:

"The only real way to understand the full significance of the IoT is to look at its applications, but the Catch 22 is that you have to remember that a lot of those potential applications haven't even been investigated at this point. Right now it's more limited by human imagination than it is by anything else. I think we'll see the IoT make significant strides once we simplify the technology to where you don't have to be an engineer to understand it, and then other people will begin to be able to visualise use cases. When you add artists and creative people to the mix, then you really have an opportunity to get some interesting synergies out of something an engineer or another technical professional looks at and sees only problems."

And while Anderson talks about use cases, the value of the IoT is not limited to improving the lives of existing businesses. Indeed, as Chris Colyer from Dassault Systèmes explained to me, it has the potential to create entirely new kinds of businesses that, at the time of writing, we simply cannot predict:

"In the next five to ten years, you'll see businesses that emerge by leveraging IoT capabilities. Uber is a really interesting example of exactly that: they took IoT information – location of connected devices – and built out a business, interacting with their customers, building pricing models, paying their drivers and so on. And I think you're going to see new business models being developed across the consumer goods and retail space that rely on the IoT in the same way."

Not only am I equally confident that these new businesses will emerge, but I share an opinion with Warren Tucker of PwC, who believes that the IoT will soon become so ingrained in our industry that obtaining value from it will be as commonplace as using PLM or a digital point of sale system is today:

"I think the whole notion and even the terminology around the IoT will just disappear in the same way that e-commerce and e-business has disappeared. Today it's just business. We'll continue to see lower cost, more efficient devices being deployed in more and more areas of our personal and business lives, combined with machine learning and AI in a way that's largely invisible and seamless. And we'll see its applications stretch across everything from automotive to retail, and from healthcare into supply chain and industrial usage. The IoT will just become the normal way that businesses are supported and consumers are engaged, and what's occasionally difficult to grasp today will become business as usual."

Last, but by no means least, it is important to remember just how empowering the emergence of new technology can be for smaller businesses – those single-person brands selling online today, who may become permanent, multinational fixtures of the IoT-infused industry Tucker is talking about. With the cost of embedded systems and analytics tools decreasing rapidly, the real value of the IoT will come from architecting environments that make use of their data – and this is potentially one area in which new, lean businesses can not only match their larger competitors, but overtake them on the basis of their digital native experience.

Or, as Michele Casucci from Certilogo put it, the startups may be about to shake up the world:

"When it comes to the IoT, I don't believe we've seen anything yet compared to what we're going to see in the future. We are already doing things it was impossible to do before, and the fact that there are 2 billion people with a smartphone in their pocket - more powerful than a supercomputer was 20 years ago - means that you don't need to be a 2,000 person company to do incredible things."

For more on the future of the IoT, machine learning and big data, turn to the final pages of this publication. A short feature there analyses the biggest trends affecting the RFA industry in the near future, and contains a sneak peak at the topic of WhichPLM's 7th Edition publication.

Otherwise, turn the page to explore more exclusive features, our ongoing customer survey, vendor and consultant profiles, and market analysis – all with a core PLM focus.

A Recipe

FOR RELINKING

DESIGN and the SUPPLY CHAIN

Fashion runs on a timeless treadmill of translating paper to product, idea to item. As a reader of WhichPLM's 6th Edition Report, you're probably all too familiar with this never-ending apparel saga. And you're likely more than conversant with the continuing challenge of reconciling what goes into a tech pack with what eventually comes out.

Herein lies the conundrum: there's an unruly, unpredictable gap between design and development of a garment, and the physical end product. Whichever end you look at, there's a level of frustration surrounding the opaque wormhole – a place where specifications go in, activities (without much in the way of real transparency as to what they are, and who takes them) take place, and the boots, blouse, or brooch is physically constituted on the other side.

As much as we'd like this to be true, fashion – and particularly the part where we turn ideas into real items – is not an exact science. There's obvious art involved in the sketching, design, and technical adaptation of styles, but when it comes to their manufacture, a lot of educated guesswork and assumption goes into making fashion come to life – and we all know the old adage about what "assume" does to "u" and "me".

The purpose of this article, then, is to explore how the industry might use technology to rise above these kinds of assumptions, achieve greater transparency into the traditionally-invisible hole where things are made, and streamline the flow of data in a way that makes sense for the modern product lifecycle. And as we all know, retail, technology, and consumer appetites are evolving so rapidly that what's considered "modern" today might look wildly different tomorrow, so I'd like to look at the situation through a couple of different lenses.

Before we dive in and examine things from a traditional "mass production" industry perspective, let's step back for a moment, because at the time this feature goes to print – autumn 2016 - we're at an interesting intersection. We live in a time where there is great interest from consumers in customising their products. And for years, footwear brands like Nike and New Balance have done so before manufacturing. These models allow consumers to pull from known in-stock materials used in a pre-designed product, and mix and match them to create their own mash-up. In the case of shoes, this is adding embellishment onto an already manufactured product. I'll circle back to this later with some comments from a manufacturing perspective, but for our immediate purposes we can see the alignment of typical 'supply chain' elements here, such as: inventory management, a production sewing line, and logistics sitting behind a customer driven user interface for 'design'.

Brands such as Gucci and Opening Ceremony are also allowing customisation in-store via add-ons – things like snap-on trim items and embroidery that can be added to ready-to-wear goods.

by
Kilara Le

To truly transform the way we design, develop, make, market and sell, we need modern day information architects.

Equally immediately, a recent startup, YR Store, lets consumers customise a 'design' via a user-friendly interface, which is dye-sublimated onto a garment in-store while they wait.

Consider how this begins to alter the way the supply chain looks. In the case of embroidery and a custom digital print, the means of manufacture – the printing machines - are sitting in the store, instead of on another continent. The consumables are, respectively, thread, a dye-sublimation printer and a small heat transfer press. There is still an aspect of inventory here, but it's digitally driven and not as complicated as the cutting and sewing of different materials in multiple colours to produce a shoe.

Taking things to a new level and further meshing the digital with traditional, Under Armour has just opened Lighthouse, a new "factory of the future" which will begin prototyping locally and, eventually, producing (either in short runs or en masse) much closer to the point of sale. In theory, Lighthouse will use business intelligence (BI) to create products more in sync with the final consumer, and to deliver them faster. From Under Armour's point of view this also equates to greater confidence – again in theory – that their predictive intelligence will lead to sales. However, once we move beyond the idea of a BI-driven, real-time trend analysis, we realise that enabling this type of rapid, reactionary factory production will require a much a deeper connection between product data and the extended supply chain – an abandonment of the assumptions that typically occupy that space between the digital and the physical.

Like the apparel market at large, even in the Lighthouse lab, we hear of traditional solutions being put in place despite the industry's broad push towards new technologies. But when it comes to bridging these with the pillars of big enterprises and boutique brands alike – PLM and ERP - we're not hearing much about the digital connectivity of these solutions.

In simple terms, manufacturing locally (or even on site) certainly cuts down logistics and lead times, but there remains a fundamental disconnect between the advanced, digital identities of products and the way they're realised. To truly transform the way we design, develop, make, market and sell, we need modern day information architects – professionals who can look at the data flow of product lifecycles and develop methods of integration and interoperability that will underpin the next wave of technical innovation.

The Spaces in Between

By my own admission, I'm no information architect, so to get a better understanding of where we really are in extending PLM data through the supply chain, I wanted to gather some different viewpoints. Historically, although the functionality is a selling point of virtually every PLM system on the market – indeed, it's one of the major things that distinguishes modern PLM from legacy PDM - the perception among commentators and analysts is that there has been a low rate of adoption of supply chain use of PLM. Whether it's through external licenses or a slightly outdated "supplier portal", collaboration between suppliers and their brand or retail clients is the essence of effective, modern use of PLM, and the data it holds, during design and development.

I asked Philippe Ribera, Marketing Director for Software at Lectra, about why this gap between the potential of PLM and the reality of its use might exist. "My personal point of view is that many brands and retailers still have issues with collaborating internally," he said, hitting on a point that many companies struggle with. Due to this lack of internal alignment, Ribera says, "they are not ready to really move on to co-development with suppliers, " which means they aren't ready – or don't feel ready - to include them in their PLM systems and processes. For Philippe, co-development means just that – something deeper than the traditional supplier to customer relationships, and something he calls a "partnership". As Philippe says, "most brands are competing on cost, margin and delivery, while suppliers compete to have some medium term capacity for their most profitable clients," and this delicate balance has the potential to create friction on a number of levels in a more mutual arrangement.

Still speaking about process alignment between retail and brand customers and their suppliers, Charles Benoualid, VP of R&D at Visual 2000, had a slightly different take. "That perception is not in line with our experience," he remarked. "Our customers have recently been able to onboard their suppliers at a much higher rate than previously," he continued, citing continued advancements in the collaborative potential of PLM. With regards to why PLM collaboration doesn't occur more frequently, Charles added that, "even though the capability to do so is there, we believe that companies elect not to onboard suppliers since they lack the clout or the processes to clearly define the tasks expected to be performed in PLM by the suppliers". However, "A flexible PLM designed for collaborating is a key factor to a successful adoption," says Charles.

This is an interesting point: collaboration (or the lack thereof) may not be driven just by

Many brands and retailers still have issues with collaborating internally.

technological capabilities, but rather by a combination of the right software and the establishment of clear expectations of how PLM will be used not just internally, but with suppliers as well. Speaking about the importance of security credentials when it comes to managing the information that suppliers might be able to see in PLM, Charles added that features such as being able to auto-hide fields and other information depending on tiers of supplier access are helpful and that, "automated reminders, as annoying as they are, have actually brought suppliers in line and greatly improved their performance."

President & CEO of Simparel, Inc., Roberto Mangual, echoes the view that true supply chain integration is about more than technology. He says that, "supplier collaboration and adoption is very viable when brands and retailers are actively involved in making it happen." He further clarified that this especially applies to the power wielded by some of the world's larger brands and retailers, because, when they issue a mandate for this kind of collaboration, "suppliers simply have only one way to obtain information, and that is through their customers' portals; even the most difficult PLM portals have very high supplier adoption rates when failure to adopt a customer's portal means losing that customer's business!" Roberto also added that, of course, "proper on-boarding cannot be neglected," because, let's face it, even with a 'my way or the highway ('motorway' for you Brits)' PLM approach, brands and retailers do need to at least provide a map.

I asked Frank Henderson, CEO of Henderson Sewing Machine Co. - a company with 350 years' collective sewing experience, and one that sells, services and collaborates to create both traditional and automated sewing solutions - about his thoughts on the disconnect between modern information-centric systems and the traditional business of manufacture. He believes that, while the data contained in PLM is useful to a huge range of job functions, it's still divorced from an understanding of what is actually needed to drive production on the factory floor.

Frank also intimated that the knowledge gap between how something is designed to be manufactured, and how it's actually manufactured, is widening.

This is an especially interesting angle. Frank (and others like him, with long apparel industry service) has observed that, over the time he's worked in apparel manufacture, designers are having less and less frequent interaction with factories – either communicating directly and verbally with them, or actually working with them onsite.

Blame offshoring or budget cuts, or even a new generation of creatives, but today there are many designers and technical designers who have not ever visited a sewing factory. And while they understand the essentials of manufacturing in the abstract, they lack a real understanding of how information should best be transferred in that environment, how operations should be sequenced, or even how machinery is actually set up once the tech pack is transferred – whether that's via email or PLM.

So, in essence, while PLM vendors have worked hard to make common fields mutually intelligible in English, simplified Chinese, and a host of other languages, one of the largest gaps in our ability to communicate with the global supply chain is an inability to communicate what we want to build in the universal engineering language of an apparel factory.

And this is a problem that won't go away on its own. The next generation of fashion creatives are likely to be "born digital," completely divorced from the realities of manufacture. While maverick single designers may be experimenting with 3D printing, and more hands-on methods of production, the average designer of tomorrow is likely to be simultaneously more creative than ever before, but also perhaps less capable than ever of understanding how to bring that creativity to life at any kind of scale.

There is a lot of interest, right now, in creating prototyping and creative spaces for apparel designers - from Under Armour's aforementioned Lighthouse facility, to Manufacture New York's new collaborative space. In theory these will allow for the creation of some interesting products in innovative ways, and doubtless some real invention in materials, all while allowing designers to use on-site facilities and consumables to actually participate in prototype creation. But a prototype is one thing; a mass-market viable product is another. I believe the industry should be looking to balance this kind of experimentation with a keener appreciation of what it takes to scale a production environment in a cost effective way.

The average designer of tomorrow is likely to be simultaneously more creative than ever before, but also perhaps less capable than ever of understanding how to bring that creativity to life at any kind of scale.

Room for Opportunity

Luckily, when we talk about supply chain collaboration, we aren't discussing a one-way street. With better connectivity and a stronger mutual understanding between design and manufacture, the opportunity arises for each to learn from the other, and technologies like PLM are likely to play a vital role in connecting not just data, but experiences.

It's here that the core capabilities of PLM really come into play. Alignment and optimisation of business processes, combined with one-time entry of product data to connected enterprise systems, is an obvious place to start the kind of partnership Philippe Ribera mentioned.

In the past, however, due to many factors, enterprise system implementation has prioritised data capture over ease of use - something that makes on-boarding suppliers (firmly rooted in the logical world of manufacture) something of an uphill struggle. I'm willing to bet that many of you reading this have worked with or for companies where imperfect business systems resulted in a lot of data wrangling and re-entry of information outside of these systems due to lack of flexibility and needed functionality. I'm equally ready to wager that many of you know at least one company – customer or supplier – that has refused to work with an enterprise system because using it felt more like an imposition than anything empowering.

If you cringed reading that last paragraph, you know all too well that aligning processes and systems across both internal departments and external suppliers is not without its challenges, both major and minor. That being said, though, modern PLM solutions have largely shed their legacy "ugly duckling" skin, and many vendors have emphasised design and usability as significant components of their adoption strategies. And, as interviewees have mentioned, although internal processes are obviously first in line for revamping, the technical barriers to supply chain adoption of the same shared platform have all but disappeared.

Roberto of Simparel has some good recommendations in this area: "Start by looking at the user interface," he says, referring to the on-screen environment that your supplier will use to access your PLM. Elements such as ease of logging in, extracting or inputting information should all be examined and, Roberto suggests, the following questions should be asked: "Does it take [a supplier] twelve steps to do something simple like download product specs?" If so, given that the old-fashioned alternative (a PDF tech pack in an email) is likely to be much quicker, you may want to re-evaluate things. As Roberto puts it, "you want to make it painless for your supplier to contribute to your PLM database, and to help you streamline processes and increase efficiency for both of you." He adds that doing this "can create a win-win scenario," where both customer and supplier are maximising their creative time and minimising data entry.

One company looking to bridge this gap is Shop Floor Control, which sells a solution and platform that Justin Hershoran, Member Manager, calls "the missing component". He explains that the system "creates a real-time link for anything that is a process [involving] an employee and a machine." The data from these interactions "is sent to a platform and allows for real-time, direct links into whatever the customer wants." So, for example, static specs or even PLM database library entries (such as construction details, sketches, or photos) can, in theory, be accessed via a tablet alongside a sewing machine. At the same time, the interface can also be capturing piece rate and work in process for any specific operation. Since the solution runs on a tablet, the user can also take pictures of an item at any given time – either for quality control purposes, or to instantly show a development partner an issue the user might be having in the sample room with one of their products.

In summary, if the promise of Shop Floor Control is fulfilled, the sewing floor should be able to communicate back and forth with the design team visually – sending off a photo with callouts and comments, and receiving an answer almost instantly.

Charles Benoualid has some additional thoughts on how this kind of continuous thread between digital information and physical manufacturing

Bringing 3D CAD into the mix and having 2D patterns, there is the capability to create markers from CAD software and product development team members could know immediately if a garment fits within the cut-able width of the fabric.

(and other processes) might make positive changes to traditional ways of working: "As more data is shared between PLM and the different departments within a given business, designers will gain greater access to information regarding the performance of their work. This will make way for higher-performing, iterative designs. Using key performance data, driven by digital tags and enhanced analytics, designers will be given more relevant data from other sources, allowing them to easily align their creative direction with business objectives."

While business intelligence from sales and social avenues immediately comes to mind when we think about "data from other sources", on the supply chain side the data feeding back to designers could also include cost-influencing information such as fabric utilisation, sewing times, and defect rates – all valuable intelligence for the people responsible for making designs that sell.

As another example: bringing 3D CAD into the mix and having 2D patterns (yet another regression for many apparel companies), there is the capability to create markers from CAD software (albeit estimated ones) and product development team members could know immediately if a garment fits within the cut-able width of the fabric its slated to be produced in, or if a change in the design could move fabric utilisation from 40% to 80% and drastically reduce the cost.

Now that we're thinking about integrating the digital environment with the factory floor, let's go back to our customised shoe example – an application where the product is already designed and specified, and settled into its own production process prior to customisation. For the consumer, picking colours and design details is intuitive because the user interface is easy and modern and they can "see" exactly what their shoes are going to look like – as well as understanding the various factors, within reason, that contribute to its cost. The back end of construction and material sourcing doesn't even cross their minds as they anticipate the joy of getting their custom, perfectly finished product in a couple of weeks.

In a way, this begins to approach the dream environment for a product designer, but with more flexibility on manipulation of shapes and sizes, and a more granular level of insight into costing.

So, what gives? How come the final consumer can do this kind of intuitive customisation, but paid designers cannot? Well, 3D, CAD, and PLM providers? Is the industry's push towards automated manufacturing likely to be the key to unlocking a smoother link between the designer and the shop floor?

Frank, with his 41 years' experience in the industry (he claims he started visiting factories when he was 8 with his grandfather) pointed out something very practical: that creating an automated sewing line, with robots and sewing machines that create an entire assembly in one go, is currently quite dependent on repeatability of shapes. While robots can now sew around curves and hold pieces with their "arms" just like humans (and solutions from SoftWear Automation can count threads while stitching to drive very precise sewing operations) they still need to be programmed and the sequence of operations still must be defined. Furthermore, there are some things that robots still cannot do that human hands can do quite easily. Not to mention, most of us can make a decision quickly, if the need should arise while sewing.

This makes automated manufacture of prototypes and new, unique styles a little harder to visualise, since programming robotic manufacturing lines to carry these operations out would be time-consuming, bespoke work started afresh for each and every new style.

One way that Frank, of Henderson Sewing suggests the industry might better utilise automation is mass customisation: the ability for both paid designers, amateurs and consumers to build products from pre-configured, manufacture-ready libraries of standardised product components: soles, uppers, back pocket shapes, collars, and so on.

Now we're getting somewhere more reachable. When pieces suited for automatic assembly are put into a PLM library, connected to 3D CAD, we should be able to both speed up the design-to-manufacture process and gain a much more detailed level of insight into what has traditionally been an invisible, ill-understood process. There remain questions in my mind about creative freedom and limiting possibilities for design, but there is a real opportunity to create more iterations, and more "custom" products (within pre-set parameters) when we think in this way.

And moving toward 2020...

Product designers and developers in every industry want to make useful, attractive, and effective products that make their customers lives better. But their role is also a commercial one: they need the information they consume and generate to flow effectively through the supply chain, and the designs they create – informed by bills of material, labour, quality, and other influencing factors – must also make a profit for the company.

To properly balance both sides of this equation in the modern market, creative teams need to be given the tools, taught the skills, and provided with the data – through intelligent integration - to do this from initial concept to the final consumer.

The important part: I think this is all eminently possible with today's technology, and as readers have seen in this publication's coverage of the Internet of Things, software, smart hardware, and passive sensors have already begun to converge in a way that will likely transform things even further.

Continuing on that train of thought, we can imagine that 3D CAD integrated directly with smart manufacturing facilities – aided by passively-identified materials, bundles, components, and SKUs - could enable not just faster design decisions, but a straight-to-production model, passing through PLM for other essential product data, of course. Or perhaps, 3D CAD will become more integrated with PLM and become yet another extension of its reach throughout the product lifecycle. We, as an industry, have a lot of work to do before that dream is realised, but if enough of us dream it, maybe it will become a reality.

3D CAD will become more integrated with PLM and become yet another extension of its reach throughout the product lifecycle.

Thinking about what the future holds, Philippe Ribera of Lectra muses that, "more and better software integration will serve to make labour-intensive processes leaner – particularly when it's paired with as much integration of automatic services as possible." Charles Benoualid of Visual 2000 sees how the IoT can, "further bridge the gap between physical processes and intellectual processes," as well as allowing us to better understand what happens to products post-manufacturing – both of which could, "allow designers the ability to develop products better suited for their target consumer".

However things shake out, we need to remember one key piece; for anything IoT related, the need for a platform to connect the "things" together and let them talk to one another and distil their collective data for us in a meaningful way. We struggle as an industry to do this today with sharing product data, yet it will be a key to unlocking the power of the IoT. How do we as an industry drive more open collaboration and data exchange from design down into supply chain and beyond? Could PLM play this role?

As you think about where the supply chain is headed, with both traditional production models and newer ones, and how we extend PLM product data through it, I challenge you, especially after you read the great perspectives on the IoT throughout this publication, to think about how your people and processes – digitally linked - are going to drive the next revolution in apparel manufacturing and consumption around the globe.

PLM Stories: SRG Apparel

The first in a series examining the relationships that different brands, manufacturers and retailers have with technology, this exclusive feature charts the history of SRG Apparel, a family-owned British company that adopted PLM at a critical juncture in the evolution of its business model.

Like any long-running business in the cutthroat world of clothing, SRG Apparel has lived several lives.

Once famous for making knitwear in the textile heartland of the UK, the company is now classified as an international design house and private label brand owner, working with high quality, semi-exclusive supply chain partners around the world. SRG's own brands include Tokyo Laundry, Le Shark, Dissident, Kensington Eastside, and Volcano. The company counts big name UK retailers like Next, River Island, and Asda (part of the Walmart family) among its customers.

Between these stages, SRG was also a wholesale manufacturer supplying inventory, and a European importer with a large distribution hub – now closed – close to the seaport of Rotterdam.

Rather than coming about through any lack of focus, SRG's multifaceted history is an example of how fashion business models evolve out of necessity. Just as they do today, industry forces have conspired against long-term stability (or some would say stagnation) since at least the 1970s, when SRG was founded by the Passi family – who started with manufacturing firmly in mind.

The company's founder and Chairman, Rajesh Passi, was brought up in what was then called "the rag trade," and his own children have followed suit. Rajesh's father owned a knitwear factory in the industrial powerhouse of Manchester, UK. And Gaurav, Rohit, and Sachin Passi now oversee product development and own brand activities for SRG.

SRG relocated in early 2014, although it did not move far. The company's Northern heritage is as evident in its new, 40,000 square foot, Whitefield headquarters as it was in nearby Prestwich, where SRG had maintained its base of operations for more than a quarter century.

But for all its success – the company is targeting sales of £100 million in 2017 – SRG's Managing Director, Mahesh Patel, recognises that fashion has always lived on a knife edge.

"If you don't evolve, you stand still," Patel says. "And if you stand still, you die."

While not all of his proclamations are this stark, Patel is more business-minded than his own relaxed fashion sense and giddy enthusiasm for the revived, mod-style Le Shark brand might suggest. A chartered accountant, Patel joined SRG as a financial controller in 1992, and his tenure with the company has overlapped with some of the biggest changes in its business model, culminating in its adoption of an integrated, end-to-end technology environment centred around PLM and ERP – the latter of which went live just months before our visit in the summer of 2016.

Lacking a fashion industry background, Patel faced a learning curve in some respects, but brought a valuable new perspective to a slowing business in others. By the time he joined SRG, the UK apparel manufacturing industry had been in decline for a decade. And while the company was still successfully fulfilling orders, its machinery was steadily becoming obsolete, and fully 60% of its turnover came from an agreement with a single retailer in what Patel recognised was an unsustainable arrangement. Technologically speaking, SRG was then using the Pegasus ERP system to handle stock control and the allocation of sales orders.

Around the same time, the spectre of offshoring began to loom large over the continued viability of domestic manufacturing throughout Europe. Wages were high; machinery costs just as high. So although SRG kept a hand in direct manufacturing until as late as 1995, its focus shifted almost entirely to imports two years before that. And in hindsight, this reorientation was vital. As part of a general downturn in high street shopping and the explosion of e-commerce, many of the retailers SRG manufactured inventory for in the early 1990s no longer trade, and adopting a diverse balance of wholesale and retail clients eventually allowed SRG to experiment with growing its own label business.

In the immediate term, though, SRG's technology requirements were governed by its primarily inventory-based import business model, and the company soon acquired a new ERP solution with the aim of transitioning to more sophisticated models of sales order management, inventory management, and procurement.

Further evolution of the import / export strategy in 1996 saw SRG establish its distribution centre in Amsterdam, shipping out of the nearby Rotterdam harbour, and build a springboard for globalisation. At this stage, the company's technology requirements became more comparable to those of a traditional brand or private label owner. SRG's need had evolved from basic procurement functionality to encompass colourways, style creation, and the then-new concept of product data management and Technical Specifications (or "Tech Packs").

Shortly before the turn of the millennium, SRG implemented a mid-generation PDM solution that, over time, morphed into a platform branded with the short-lived "collaborative product management" (CPM) badge.

> *"We put the initial investment in, but I don't think we used PDM (or later CPM) to its fullest - we simply focused on developing Tech Packs. We were still very much stuck in our stock mentality."*

In a publication that sees a significant shift in the way low-cost PLM is sold and deployed to the largest sector of the market – more in our exclusive Market Analysis – the investment SRG then made in its technology makes for sobering reading. To manage the volume the company was handling, its initial hardware costs alone – for an IBM AS/400 mainframe that ran its ERP solution – were £250,000, or $325,000 without adjusting for inflation. This excluded software licensing, implementation services, and ongoing maintenance. And while SRG's PDM infrastructure investments were much lower, the value the company was able to realise from them did not meet expectations.

But Patel acknowledges that PDM itself was not entirely to blame for its relatively short shelf life and limited material impact at SRG; the company's financial outlay was not matched by commitment from senior management or complete buy-in from end users. "As executives, I think we underestimated just how fast retail was changing back then," he says. "We put the initial investment in, but I don't think we used PDM (or later CPM) to its fullest - we simply focused on developing Tech Packs. We were still very much stuck in our stock mentality. At the time, we didn't quite recognise that private label was going to become as big as inventory for us, and in some ways we sold ourselves short, technologically-speaking."

Speaking pragmatically, Patel describes PDM in general as adequate for SRG's immediate needs, but restrictive as its business model evolved: "our original PDM solution was very much a database system, so things like critical path and dashboards that are essential today, just weren't there. But if nothing else, PDM gave us experience of working with IT platforms and helped us to build a mindset for the future. And luckily we have loyal staff, so the 30-40% of them who have evolved with us since those PDM days share our base of experience."

Like many other PDM users – and there were many, particularly in North America and Europe – the global shift from web-enabled to web-based software led SRG to recognise a need to extend the accessibility and the reach of its primary technology solutions. Its move to PLM was therefore driven on the one hand by an executive vision for global collaboration, and on the other by the more pressing need to stay agile and afloat in what was becoming an increasingly hostile marketplace.

"The industry is twenty times as complex and challenging today as it was twenty years ago, and for the same amount of effort we see perhaps a twentieth of the return."

"The main focus of our business, then and now, is improving time to market and reducing costs," Patel says. "The industry is twenty times as complex and challenging today as it was twenty years ago, and for the same amount of effort we see perhaps a twentieth of the return. And we recognised that it was only going to get harder; retailers want a better price every year, and with material prices, oil prices, and labour costs rising, we knew we had to embrace change in order to find our margin. We had to find a system that could integrate people, processes, and product data."

But the system itself, Patel and his fellow executives realised, was only part of the picture. Prior to choosing and implementing a PLM solution, SRG worked with a Manchester-based independent advisory service for several months to re-evaluate their business from the ground up, and to challenge assumptions the way it had when it moved away from direct manufacture.

The major result of this introspection and self-knowledge, Patel says, was confidence in approaching the market:

"I didn't want our business processes to have to change, just so we could fit with what a huge software vendor told us we should be doing. We know ourselves, and we understand the fundamentals of our business. We were happy to look at as many different PLM systems as time would allow, but we weren't willing to make radical changes to the way we work just to align with other people's priorities."

After an extensive selection process, SRG chose a solution from a North American vendor that was, in their opinion, relatively unproven in the UK market. But, as Patel explains, they were willing to serve as regional guinea pigs in order to get the kind of flexibility, simplicity, and usability they needed. "I didn't want to overcomplicate things," he says. "I wanted something the users could embrace, and while we had some trials and tribulations along the way, I'm happy with the choice we made."

To offset some of these unknown elements, SRG asked the same local advisory practice, who were experienced in the UK and global markets, to handle implementation (which began in 2011), configuration, and on-site support. The same practice was also responsible for managing integration, using SRG's new PLM platform as a pillar for bridging other elements of its extended IT ecosystem.

"At the time we put PLM in place, we had our second ERP solution (which we've now replaced), a CAD solution, and scatterings of Excel spreadsheets with no real standardisation," Patel told WhichPLM. "Our offices in Bangladesh and China used different systems, so we were re-inputting data on a consistent basis, and our design tools were not integrated with our data management systems at all. At one point we even employed someone whose sole job it was to extract purchase orders from one system and put them into another."

This may sound extreme, but it is a familiar situation for many brands and retailers whose growth or evolution outpaced their technology. SRG chased an "end to end" goal to both overcome these roadblocks to internal communication, and to exert greater control over sourcing, compliance, and other critical channels of collaboration that existed between its UK headquarters and overseas liaison offices.

Today, SRG's supply chain partners have secure, role-based access to PLM, and Patel believes that this extension of the solution to external users was essential for realising value from the solution:

"Buying PLM and implementing PDM was not an option for us. Our liaison offices are critical for bridging the gaps between us and our retail customers. So having everyone use the same system helps us to avoid duplication, yes, but its real value lies in helping us to monitor lead times and manage expectations. It's difficult to say exactly how much our lead times have reduced, since environmental and infrastructural factors are still out of our control, but as a conservative estimate we've been able to cut them from 90 days to 80."

"Before we implemented PLM, we weren't dealing with the likes of Walmart, Next, and River Island. Whereas today, I know that our integrated platform gives us the ability to support customers of that kind of size and scale."

Prospective PLM customers should, however, use the timeline of SRG's success as a yardstick for managing their own expectations. It took a full five years – and the implementation of a new ERP solution, the company's third - from the day SRG chose its PLM partner to the day its complete, end-to-end integration project was considered functionally finished. And Patel believes that work remains to be done rolling PLM licenses and potentially further systems integrations out to logistics partners and other critical players in the supply chain that will add further value.

This is an important distinction that's often lost in post-implementation presentations and case studies: neither the work nor the value associated with PLM should have a measurable end point. All too often, as was the case with SRG's original PDM implementation, businesses buy software and think of it in transactional terms – as a one-off purchase with an immediate impact. In practice, as Patel explained during our visit, truly gauging the potential of PLM requires brands, retailers and manufacturers to restructure their traditional definitions of time and value.

Take air freight, for example. It is preferential for businesses to ship products from their point of manufacture to retail markets by sea, because it costs less – often considerably less – and because boats can carry a lot more than planes. Often, though, long lead times and unforeseen delays make this impossible, and logistics must be switched to air in order for retail dates to be kept.

"Five years ago, we might have been spending half a million pounds [roughly $650,000] on air freight, whereas today it's less than £100,000 [or $130,000] and that's solely down to better planning and better process organisation," Patel says.

This kind of whole-business attitude to the results obtainable from PLM is perhaps the most crucial lesson that prospective customers should take away from SRG's story. Not only do results often take longer to see than we might expect, but they may also be less visible or harder to quantify than marketing materials lead us to believe.

"Before we implemented PLM, we weren't dealing with the likes of Walmart, Next, and River Island," Patel says. "Whereas today, I know that our integrated platform gives us the ability to support customers of that kind of size and scale. PLM isn't the only part of that equation, certainly, but it's a vital part. Those are relationships we have been able to build because of confidence in our own capabilities, and genuine visibility into the capacity of our supply chain partners. And they're relationships that are all going exceptionally well; we've shown that we can produce private labels for big names, on time, and at competitive prices. I don't believe that these positive results are a coincidence – it's a snowball effect that starts from having good systems that people actually use."

Keep watch on the WhichPLM website and our future publications for further instalments in the PLM Stories series.

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Strategy | Consulting | Digital | Technology | Operations

WINNING AT THE SPEED OF FASHION

WHAT ARE FASHION BRANDS DOING TO WIN IN A FASTER, DIGITAL, OMNICHANNEL MARKETPLACE?

Being RIGHT
Bringing on-trend products to target customers

Being FAST
Delivering the product when it's needed, faster than peers

Being EFFICIENT
Creating lean, cost efficient, end-to-end operations

HOW ARE BRANDS RESPONDING TO MARKET PRESSURES?

INNOVATION	MERCHANDISING	DEVELOPMENT	SOURCING
empower brands to take the right risks with new products	balance the "art" of fashion, with the "science" of data driven decision making	develop products faster and at the optimal cost through PLM	keep vendors accountable to performance and sustainability targets

PLANNING
implement a calendar that enables planning lines around the consumer, closer to market

DESIGN
invest in design capabilities as innovative as your products

COMMERCIALIZE
manage how you sample and test products to scale production quickly

WHY ARE BRANDS MAKING THESE INVESTMENTS?

REVENUE
through trend-right, customer-centric assortments and innovations

COSTS
through smarter product component sourcing and reuse

SPEED
to market through smarter calendar and streamlined processes

LOYALTY
of lifetime customers achieved by being right and being fast

QUESTIONS? CONTACT OUR TEAM OF FASHION INDUSTRY EXPERTS


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PC CHANDRA
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2016 PLM Customer Survey

WE HAVE NOW SURVEYED THE GLOBAL FASHION PLM CUSTOMER BASE FIVE TIMES. FIRST, IN 2010, AS A STANDALONE INITIATIVE, THEN IN THREE CONSECUTIVE ANNUAL REVIEWS (2012, 2013 AND 2014) AND MOST RECENTLY IN A MORE STREAMLINED FORMAT IN OUR REDESIGNED, REFOCUSED 5TH EDITION.

The degree to which retailers, brands and manufacturers around the world have committed to these surveys has remained humbling throughout that time – and in fact this year's results are built from our widest pool of participants to date. As always, the data we were provided in the financial year 2015/16 has allowed us to do something we believe is unequalled anywhere else in the industry: assemble and present a truly unbiased picture of PLM for retail, footwear and apparel, built on the opinions and experiences of project teams and real end users.

In our 5th Edition, we took the opportunity to bring the questions we asked of the market up to date, streamlining some areas of inquiry that had returned consistent results for the previous four years, and soliciting new information to provide better content and greater context for readers looking to make their own informed investments in PLM.

This year we've pursued that goal slightly further. Our questions have been further focused to glean the most important insights from the global PLM customer base, and we have encouraged participants to address their answers and additional information directly to a hypothetical brand, retailer, or manufacturer embarking on their own PLM journey.

Readers will find the results of this refined approach scattered throughout this section, but most prominently adjacent to this introduction and executive summary, where, for the first time, we invited respondents to distil their experience into short, sharp recommendations addressed to the next generation of PLM customers.

EXECUTIVE SUMMARY

The results of this year's survey are remarkable not only because they represent a wider and therefore more accurate cross-section of the industry than ever before, but because they also demonstrate the steady progress the RFA PLM industry has made towards total customer satisfaction.

We have now watched dissatisfaction with either PLM software or the vendors responsible for selling and implementing it fall from a high of 30% in 2011/12 (a sobering statistic in an industry built on brand perception and loyalty) to a zero figure in 2015/16. While this only holds true for the slice of the market that participated in our survey, WhichPLM believes that this incremental progression is likely to be reflected in the industry at large, supporting our 2013/14 conclusion that PLM has finally "crossed the chasm" and achieved not only mass market adoption, but mass market approval.

Aligned closely to this incremental sense of improvement is respondents' satisfaction with their implementations. Whether they were first or third party professionals, customers in 2015/16 were happy with the experience, expertise and attitude of the people responsible for putting their solutions in place, and supporting them afterwards. Similarly, although customisation is still required in a considerable majority of implementations – something more configurable solutions will help to minimise but not necessarily eliminate – this bespoke work is being completed quickly and efficiently in 70% of cases.

All of which suggests that RFA PLM is a market running well: customers are happy and, in the majority of cases, are looking to remain with their current solution or commit to their chosen vendor's upgrade path. It must be said that, less than a decade ago, this was not something we could have said with confidence about our industry; implementations ran over schedule and over budget more frequently, or were handed off to previously-undisclosed third parties.

On balance, then, this year's survey results reveal a market whose on-the-ground health matches its financial and geographical growth, and one whose continued expansion is secured by longer-term, more productive partnerships between the vendors and customers who are driving its future.

Nevertheless, we encourage any brand, retailer or manufacturer reading these results to remember that adopting PLM is not a matter of buying the most competitively-priced variant of a one-size-fits-all product. Examining your business and then using the results of that introspection to shortlist and select a vendor is about more than choosing software: it is a search for a long-term strategic business partner whose software, professional services teams and roadmap will all play pivotal roles in your future.

Readers are encouraged to visit our website (www.whichplm.com) and read our most recent Supplier Evaluations, which are designed to assess vendors on precisely this kind of multi-year stability and vision.

CUSTOMER GUIDANCE

For this publication, we asked as many participants as possible to provide the guidance they wish they had had when embarking on their PLM project. For more detailed insight into the path those projects charted, please turn the page for our complete survey results, but we encourage every ready to take in these words of advice from real brands, retailers, and manufacturers who now have the benefit of hindsight.

" Know who will be using the solution and at what level. Will you use the software in its entirety, or only several pieces of it? Make sure you understand your factory structures, and make sure that they are willing to use PLM on their side, and that they understand the hardware requirements."

"[You must] really consider the future of your business and evaluate its long-term needs. PLM is not just about solving the immediate business issues, and it's important to really consider the impact of the change you are about to make."

"Industry experience matters! There are subtle and distinct differences between apparel and footwear, for instance, and those two categories are significantly different from CPG [Consumer Packaged Goods] or Aerospace."

"It was invaluable for us to have an unbiased industry expert to guide us through the vendor selection and recommendation process."

"PLM implementations are complex. Do not underestimate the time it takes to understand the PLM solution and how that solution works with your business processes, as well as the change management that will be required to support the implementation."

"Ensure your business team is engaged in the project."

"Do not forget integration of PLM with your existing IT landscape – solutions such as ERP, data warehouse, and planning systems. A good integration [structure] is as important as the PLM tool itself. Avoid redundant tasks across the different systems."

"Commit to fully exploring the infrastructure of your business model and its future."

"Ensure that you backfill appropriately, and make sure expectations and deliverables are properly managed."

"Make sure that you are open to adjusting your processes to get the most out of the solution, otherwise you risk unnecessary expenditures and delays for unproven changes to the software."

"Find the ROI [return on investment], determine the greatest benefits, and align your deliverables to reflect this and to constantly deliver value back to the business – particularly where the project directly impacts users."

"In addition to an ROI analysis, a risk assessment is mandatory."

"The most difficult issue for us was importing data from the legacy system and manual spreadsheets. It is imperative that you find out where all the data resides [in your business] and plan accordingly."

"Make changes only if they are needed to support the business, not just because the users want [the new PLM platform] to match their existing system."

"The implementation will require more detail of current practices and requirements, take more time, and therefore cost more than you anticipate. But it will be worth it if you hang on in there."

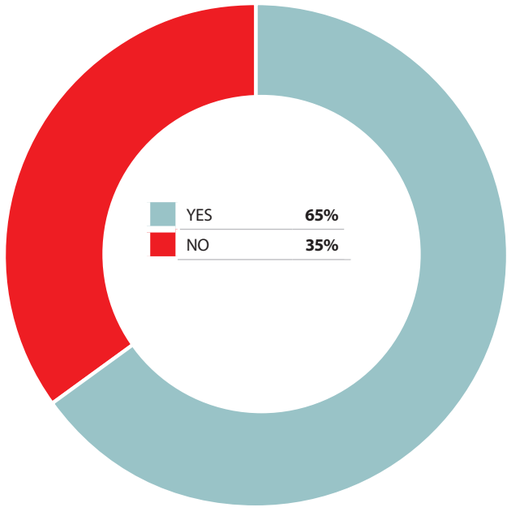
"It's important during implementation to focus initially on the key benefits for the business and the major user groups. Do not attempt to do everything that a PLM solution might do long term in one go, or right away. Start slowly."

"It's horses for courses. Your choice of vendor will depend on your priorities, which must be clear at the outset. Once the wider business, especially management, see the things that PLM can do, the tendency is to want it all. But take things one (or two) steps at a time!"

"Don't underestimate the amount of business change management and communication that will be required to get buy-in. It's not just about the software itself, however easy [it is] to use."

SECTION 1 | PROJECT RESEARCH AND PREPARATION, AND PRE-IMPLEMENTATION

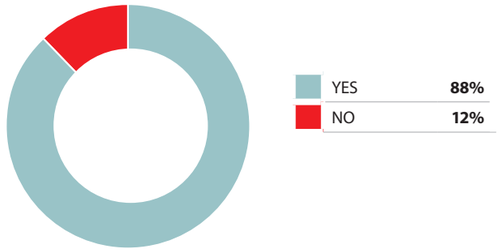
1A IN RECOGNITION OF THE COMPLEXITY OF MODERN PLM PROJECTS, DO YOU FEEL YOUR TEAM WAS EQUIPPED WITH THE NECESSARY KNOWLEDGE OF THE TRUE NATURE AND SCOPE OF A PLM PROJECT PRIOR TO BEGINNING SHORTLISTING AND SELECTION?



ANALYSIS: While it remains encouraging to see that the majority of brands, retailers and manufacturers adopting PLM are doing so with a firm understanding of the size, business-wide scope, and complexity of a modern implementation, this year's results paint a slightly darker picture than those seen in our 5th Edition - a reduction of 5% in positive responses. As the real customer quote accompanying this analysis shows, more than a third of all projects are still being embarked upon by project teams who are either unfamiliar with PLM software, unprepared for the project's significant impact on day-to-day operations, or not sufficiently experienced and prepared to make an informed choice of vendor and implementation strategy. While later responses in this survey demonstrate the value of independent expertise, equally vital is recognising that a modern a PLM project is equal in importance to an ERP implementation or any other large-scale enterprise transformation.

> "Our company chose an internal project leader without any PLM experience. Do not make the same mistake. PLM from your PLM software partner."

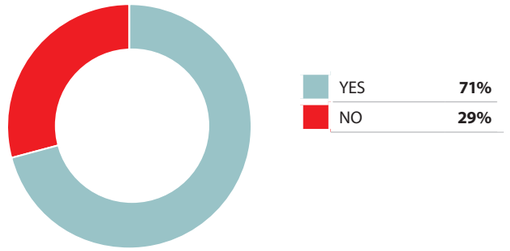
1B DID YOU CONDUCT AN IN-DEPTH ANALYSIS OF YOUR CURRENT BUSINESS PROCESSES AND ASSOCIATED CHALLENGES PRIOR TO IMPLEMENTING A PLM SOLUTION?



ANALYSIS: Extremely similar to the results we saw in last year's survey, these positive figures underscore the importance of any PLM customer's truly understanding their business - from infrastructure to process - in finite details prior to preparing for, choosing, and implementing PLM. Rather than being a simple process of software installation, a truly modern PLM project is better thought of as a digital business transformation initiative - one that requires considerable introspection, radical process re-engineering, and technological change in order to be successful.

> "It is necessary to understand your process and priorities."

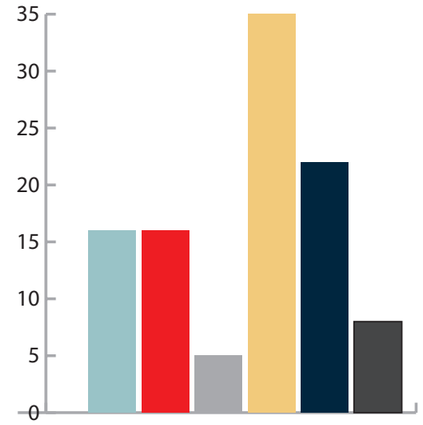
1C DID YOUR BUSINESS TAILOR ITS REQUEST FOR INFORMATION (RFI/RFP) QUESTIONNAIRES ACCORDING TO THE UNIQUE CHALLENGES AND PROCESSES YOUR PROJECT TEAM HAD IDENTIFIED?



ANALYSIS: Our 5th Edition revealed a downturn on the previous year (2013/14) in the number of PLM customers taking the necessary step of preparing their own vendor shortlisting and selection questionnaires informed by their unique business challenges and opportunities. Instead, 36% were effectively choosing a PLM partner on the assumption that "one size fits all" - something we believe may have constrained the long-term potential of their projects. This year's data are more positive; less than 30% of respondents neglected this important step, mirroring similar improvements in preparation and process analysis seen elsewhere.

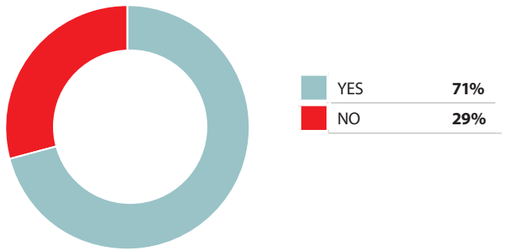
1D WHICHPLM BELIEVES THAT IT REMAINS IMPORTANT FOR PROSPECTIVE PLM CUSTOMERS TO CONDUCT REFERENCE SITE VISITS BEFORE MAKING A FINAL PLM PURCHASING DECISION. DID YOU CONDUCT ANY OF THE FOLLOWING BEFORE YOU MADE YOUR DECISION?

ANALYSIS: Customer reference interactions (where a prospective customer is invited to attend the premises of an existing customer, or speak to them via telephone without mediation from the vendor) present the best opportunity for new customers to ascertain how the functionality and user experience they have seen in pre-sales demonstrations transfer to a comparable production environment to their own, and to gauge the realised value of ongoing service relationships in real-world scenarios. While telephone - or VOIP in today's world - references remain the primary means by which new customers glean insights from existing ones, we now believe that cloud deployments and improved configuration are already beginning to change the nature of these references, shifting the emphasis away from service satisfaction towards the capabilities of the PLM products themselves.



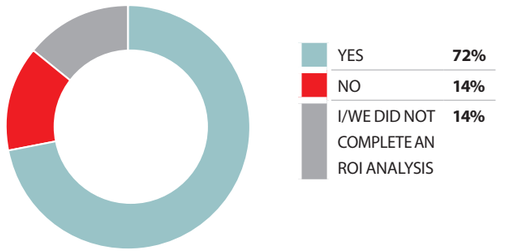
PLM CUSTOMER SITE VISIT ORGANISED BY A VENDOR	16%
SITE VISIT ACCOMPANIED BY A VENDOR	14%
DIRECTLY ORGANISED PLM CUSTOMER SITE VISIT, UNACCOMPANIED	5%
TELEPHONE REFERENCE CALLS	35%
COMMISSIONING A CONSULTING SERVICE TO PROVIDE QUALITATIVE, UNBIASED INSIGHTS INTO THE VENDOR'S CUSTOMERS	22%
NONE OF THE ABOVE	8%

1E DID YOU COMPLETE A THOROUGH, SCIENTIFIC RETURN ON INVESTMENT (ROI) ANALYSIS IN ADVANCE OF YOUR IMPLEMENTATION?



ANALYSIS: Tied to initial budgeting, an ROI analysis is an essential tool for both understanding the cost to benefit ratio of a PLM project, and for directing the project itself to deliver the most potent benefits in the desired timeframe. Proceeding without this information can severely limit not only the potential for later analysis of the project, but also its ability to meet expectations in the first place. Our two prior surveys - covering the periods 2013/14 and 2014/15 - revealed that only around 40% of PLM customers undertook this kind of analysis each year, whereas this year's results (an additional 30% of survey participants responded in the affirmative) are far more encouraging. WhichPLM has long advocated the value of robust ROI analysis, and we are pleased to see that the industry has responded in such a significant way this year.

1F DID YOU USE THAT ROI ANALYSIS TO DEFINE YOUR IMPLEMENTATION STRATEGY?

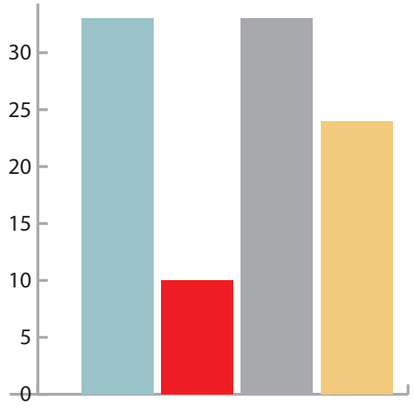


ANALYSIS: This is another area in which changes to the average maturity of PLM products, and improvements to the way solutions are marketed, sold, and implemented has de-emphasised the importance of something WhichPLM has long regarded as critical. While it is still a positive thing to see that the vast majority of respondents used their ROI analysis to both prioritise immediate benefits (the proverbial "low hanging fruit") and provide an informed framework for longer term benefits, we now believe that clean, clear data structures, more configurable solutions, an openness to less measurable kinds of value, and the rise of agile approaches to implementation are allowing a less rigid, more adaptable kind of PLM project to flourish. This is not to say that implementation strategies can be ignored, but rather that they can begin (and end) in a much wider range of places than ever before.

> "[Customers should discover the] tangible benefits through a cab or ROI analysis, but also try to add in some intangible benefits, and try to develop suitable metrics for measuring these, too. [This creates] a more balanced, scorecard-based approach."

1G DID YOU CONDUCT THIS ANALYSIS IN-HOUSE, DID YOU USE A THIRD-PARTY ROI TOOL (SUCH AS AN ROI CALCULATOR), OR DID YOU EMPLOY THE SERVICES OF A CONSULTANT OR ADVISOR?

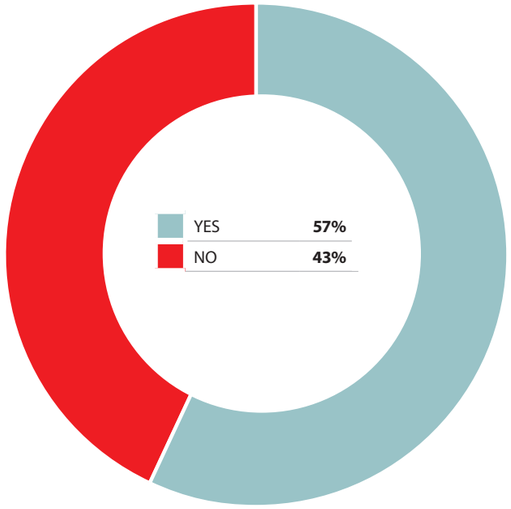
ANALYSIS: In one of the most dramatic shifts in this year's results compared to those of previous years, only a third of respondents conducted their ROI analysis in-house - a full 50% fewer than in our 5th Edition survey. This significant change was likely driven by a recognition of the strategic impact of PLM; as the capabilities of solutions have improved, the onus is no longer on project teams to quantify the value of buying a PLM product, but is rather on their ability to evaluate and understand its long-term strategic and architectural potential. And while internal teams certainly understand their own section of the business - often referred to as a "silo" - it can prove difficult for them take the requisite whole-business view. This is why a growing number are choosing to work with subject matter experts, armed with hundreds (if not thousands) of questions designed to drive the most detailed analysis possible of the value a business can obtain from core PLM, extended PLM, and the wealth of opportunities that a complete digital transformation presents.



INTERNALLY	**33%**
THIRD PARTY TOOL	**10%**
CONSULTANT/ADVISER	**33%**
I/WE DID NOT COMPLETE AN ROI ANALYSIS	**24%**

1H DID YOU USE ANY THIRD-PARTY CONSULTANTS OR ADVISORS TO HELP YOU PLAN YOUR IMPLEMENTATION BEYOND THE ROI LEVEL?

ANALYSIS: Although these figures represent a slight swing (an additional 7% of respondents employed the services of a third party advisor this year versus the results of our 5th Edition survey) it appears as though the proportion of PLM customers who feel they require the assistance of an independent consultant has remained fairly static in 2015/16. In WhichPLM's experience, larger, more complex organisations continue to seek out the services of experienced subject matter experts, while small businesses are often more content to rely on modern, configurable, solutions and their vendors to structure their PLM projects. As has been the case with our previous publications, the WhichPLM advisory team has worked with several brands and retailers in this capacity this year, and quotes received from survey respondents underscore the value that the right independent advisor can bring to an in-depth implementation.



YES	**57%**
NO	**43%**

"[We know of implementations that were] successful because the project team worked with consulting companies that had PLM experience as well as ERP experience. We also know of others that continue to struggle, because they engaged an advisor who did NOT have PLM experience and did not understand the full depth of the challenges ahead. "

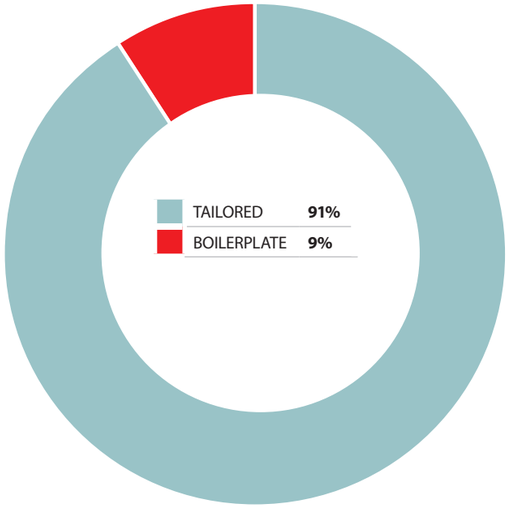
"We would not have progressed so far without third-party expertise, but it should be used to inform your plans not dictate them. Remember who knows your business best."

"[It's] beneficial to have outside opinions prior to making decisions, [rather than] basing [them] solely on internal information."

SECTION 2 | IMPLEMENTATION – WORKSHOPS, CUSTOMISATION & QUALITY

2A WAS YOUR IMPLEMENTATION DRAWN FROM A BOILERPLATE TEMPLATE, OR DID YOUR SUPPLIER TAILOR ITS METHOD AND MILESTONES TO ADDRESS AND PRIORITISE THOSE PROCESSES THAT OFFERED THE GREATER ROI POTENTIAL IN YOUR PARTICULAR CASE?

ANALYSIS: WhichPLM has previously been skeptical of so-called boilerplate implementations - i.e. those that force all PLM projects, irrespective of size, to conform to a set strategy in order to save time and cost on the vendor's part. In previous years we drew a clear line between these and more tailored approaches - those where the vendor evaluates each customer's unique challenges and opportunities, and structures their implementation accordingly. While it remains encouraging to see that a large majority of this year's respondents ensured that their implementation was aligned with their priorities and greatest sources of potential ROI, this is not to say that all of the remaining 9% were necessarily ill-served. Configurable software and agile implementation methods have together made more generalised, "off-plan" projects viable for less complex businesses.



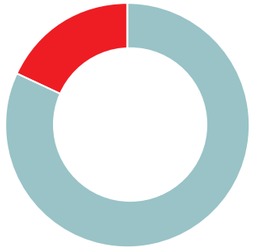
TAILORED	**91%**
BOILERPLATE	**9%**

"There is a huge amount of restructuring of processes and practices involved and this should be mapped and understood ahead of PLM implementation in order to benefit the project."

"The project plan was a template and the schedule was set around that implementation template. It allowed little flexibility to customize or adapt to customer needs."

"We started with the standardised approach, but had to move to a configured and tailored solution as we realised the limitations of the standardised implementation."

2B TODAY, THE MAJORITY OF PLM VENDORS ADVERTISE OUT-OF-THE-BOX, READY-TO-DEPLOY SOLUTIONS, WITH THE NEED FOR LITTLE OR NO CUSTOMISATION. WHATEVER SOLUTION YOU CHOSE, WAS CUSTOMISATION REQUIRED?

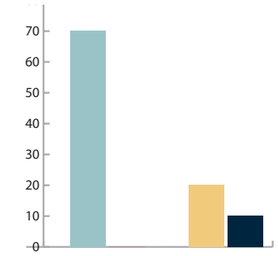


YES	**82%**
NO	**18%**

ANALYSIS: WhichPLM has always remained skeptical of the term "out of the box", which is a label applied to PLM products that vendors state can be implemented in a short time frame, and that can be considered fully operational with minimal or no customisation. Hewing closely to the results we saw in previous surveys, this year's data suggest that despite improvements to the configurability of cloud-based solutions, this promise remains unrealistic. While we endorse several key vendors' desire to reduce customisation (and therefore reduce the duration and complexity of the implementation process, and secure the viability of a multi-year upgrade path), the reality remains that most customers consider customisation essential in order to adapt their chosen solution to fit their unique ways of working.

"The product we purchased would not [have been] usable out of the box. While we did not implement any customisations we did implement with a lot of configurations that allowed us to tailor the solution to our needs and our business requirements."

2C WAS ANY CUSTOMISATION YOU REQUIRED CONDUCTED ON TIME AND TO BUDGET?



ON TIME AND TO BUDGET	**70%**
ON TIME BUT NOT TO BUDGET	**0%**
NOT ON TIME BUT TO BUDGET	**0%**
NEITHER ON TIME NOR TO BUDGET	**20%**
I DON'T KNOW	**10%**

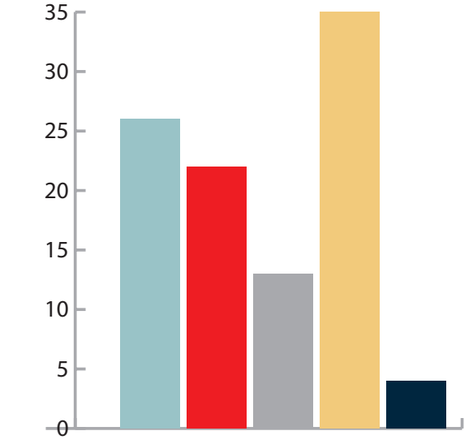
ANALYSIS: Where - as in more than 80% of cases covered by this year's survey - software customisation is required, it is important for prospective PLM customers to realise that what is essentially bespoke work comes with its own additional expense and delay that must be factored into the budget and time allowed for the project as a whole. Unlike previous surveys, this year respondents revealed that in most instances these customisations were completed on schedule and within budget, but nevertheless it's important to note that almost a quarter of all customisation work still overruns the time or cost allotted to it. Praise must be given, though, to vendors, who have collectively improved satisfactory delivery of customisation by 30% since 2014/15.

2D WERE THE IMPLEMENTATION TEAM (WHETHER INTERNAL OR THIRD PARTY) DEPLOYED TO SERVE YOUR PROJECT FULLY QUALIFIED AND EXPERIENCED IN BOTH FASHION AND THE TECHNICAL AND FUNCTIONAL ASPECTS OF PLM?

ANALYSIS: The rapid growth of the RFA PLM market - as evidenced in our year-on-year market analysis - continues to place a great deal of strain on a limited, but steadily growing, pool of highly-skilled apparel PLM experts. This is particularly true in emerging markets, where manufacturing expertise is widespread, but the right balance of retail / brand and enterprise technology skills is in short supply. In WhichPLM's experience, industry-specific training and up-skilling of vendor staff in the USA and Europe has begun to address this concern, and while 13% of projects undertaken in the period 2014/15 were handled by teams who lacked the skill set to ensure their success, that figure has dropped to just 4% in 2015/16. This is evidently a good thing for the industry as a whole, and is a statistic that PLM vendors and implementers should be proud of.

"[Our] Project Manager was highly skilled in PLM for Fashion, allowing the rest of the team to upskill in PLM over the life of the project."

"You really cannot grasp how significant this is. You think everyone knows how the industry works and understands its jargon. This is simply not the case. Very few "experts" have been in a sewing factory, worked with designers, understand fabric etc. I would say this is a critical success factor."



THE TEAM WAS EXPERIENCED IN THE RFA INDUSTRY	**26%**
THE TEAM HAD EXPERIENCE OF TECHNICAL IMPLEMENTATIONS	**22%**
THE TEAM HAD EXPERIENCE OF RFA-SPECIFIC IMPLEMENTATIONS	**13%**
ALL OF THE ABOVE	**35%**
THE TEAM LACKED EXPERIENCE	**4%**

2E WAS YOUR IMPLEMENTATION HANDLED IN-HOUSE BY YOUR CHOSEN SUPPLIER'S TEAM, OR GIVEN TO A THIRD PARTY IMPLEMENTER? IF THE LATTER IS TRUE, WAS THE ENTIRE IMPLEMENTATION HANDLED BY THEM, OR AS A JOINT INITIATIVE?

SUPPLIER	**27%**
THIRD PARTY	**36%**
JOINT IMPLEMENTATION	**36%**

ANALYSIS: While more configurable software and more agile, adaptable methods have begun to redefine the way that vendors and customers think about their PLM projects, this year's responses demonstrate that more brands and retailers than ever before still worked with a third party in some capacity during their implementations. Despite commendable efforts by vendors to employ and grow a new generation of subject matter experts, many choose to contract all or part of their implementations to a third party partner to compensate for a shortage of in-house resources created by continued RFA PLM market growth around the world. This year, 72% of PLM projects were therefore handled either wholly or partially by a third party implementer - an increase of almost 20% on the figures we saw in 2014/15.

"It's important that third party suppliers work well with each other, in the likely scenario (in a large retailer) that more than one connected implementations are going on at the same time. There also needs to be strong and well informed project management - overall and for both business and IT aspects of the implementation."

2F IF YOUR SUPPLIER DID CONTRACT YOUR IMPLEMENTATION OUT TO A THIRD PARTY, DO YOU BELIEVE THEY WERE SUITABLY QUALIFIED FOR THIS TASK – WELL VERSED NOT ONLY IN THE TECHNOLOGY ITSELF, BUT IN THE PARTICULARS OF FASHION-SPECIFIC PROCESSES?

THE THIRD PARTY HAD FASHION EXPERIENCE AND QUALIFICATIONS	**33%**
THE THIRD PARTY HAD TECHNICAL EXPERIENCE AND QUALIFICATIONS	**28%**
THE THIRD PARTY HAD DIRECT RFA PLM EXPERIENCE	**39%**
THE THIRD PARTY LACKED EXPERIENCE	**0%**

ANALYSIS: Historically, it was not uncommon for a PLM customer to discover that their implementation was being handed off to a previously-undisclosed third party only after the initial contracts had been signed. This practice has, thankfully, fallen by the wayside, and this year's results reveal that 100% of respondents who needed to work with a third party implementer were able to select a consultant or advisor that met their criteria. As a result, the majority of brands and retailers we surveyed were satisfied that their chosen partner had direct experience of RFA PLM implementations, with the remainder stating that they selected a partner who demonstrated either considerable technical expertise or fashion industry knowledge. These are positive statistics, but WhichPLM encourages customers to continue to assess the qualifications and experience of all implementation professionals.

"We asked the vendor to allow us to hire a third party consultant of our choice, and [they] had experience with [our chosen] solution."

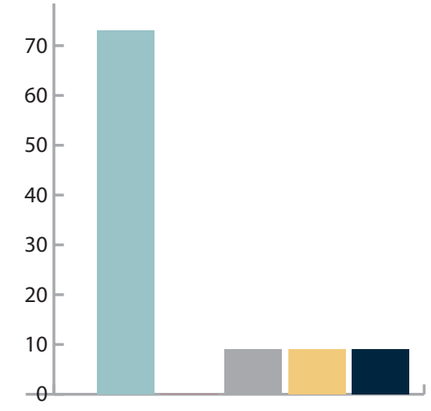
2G DID YOUR SUPPLIER AND/OR THEIR THIRD PARTY IMPLEMENTATION PARTNER COMPLETE YOUR OVERALL IMPLEMENTATION PROJECT ON TIME AND TO BUDGET?

ANALYSIS: The results of our 5th Edition survey showed only slight positive progress in what had otherwise been a consistent downward slide in the number of PLM projects completed on time and without exceeding their budget. As a result, we were hesitant to describe last year's results as evidence that the trend had reversed - but this year's data certainly appear to support that conclusion. While 45% of implementations either lagged behind schedule, cost too much, or were both overdue and over-expensive in 2014/15, this year that figure fell to just 27%, meaning that the proportion of projects that met their budgetary goals and deadlines rose from 55% to 73% in 2015/16. We credit this significant change to a more educated consumer base (undertaking more detailed planning and more diligent selection processes), more widespread use of third party consultants, and improvements to both PLM software and implementation methods on the part of vendors.

"Our vendor was reluctant to suggest timeline changes until one month before go-live. [Your] preference should be to suggest changes early."

"Weekly project meetings helped to keep the timeline intact."

"If [your chosen] third party has the necessary experience, they can definitely enable an on-time and on budget implementation."



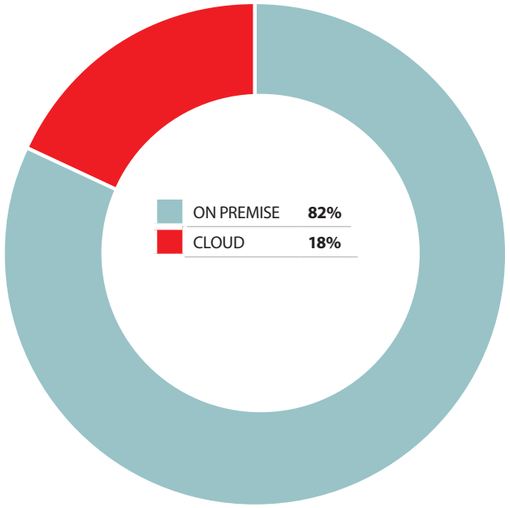
ON TIME AND TO BUDGET	**73%**
ON TIME BUT NOT TO BUDGET	**0%**
NOT ON TIME BUT TO BUDGET	**9%**
NEITHER ON TIME NOR TO BUDGET	**9%**
I DON'T KNOW	**9%**

2H HOW WAS YOUR PLM SOLUTION DEPLOYED? ON-PREMISE (USING YOUR OWN SERVERS) OR VIA THE CLOUD?

ANALYSIS: The RFA PLM market's attitude towards cloud deployments remains in flux. Judged year on year, the proportion of implementations conducted off-premise (an umbrella under which we now collect cloud, Software As a Service, and managed services deployments) has risen and fallen with seemingly little pattern.

Our 5th Edition survey showed an increase of 11% (to a total of 24%) in the number of projects that fell under the cloud umbrella, but this year's figures see a reduction of 6%, perhaps postponing the idea that the industry is ready to embrace the same model for PLM that it does for Microsoft Office and Adobe's Creative Suite. We should note, though, that even 18% of deployments being off-site is a significant improvement to the zero figure we saw in our 2012 Annual Review: a large shift in just a four-year span of time. And while those vendors who do offer cloud-based solutions also maintain a traditional license / service model alongside them, WhichPLM believes that off-premise models will become the norm in the medium-term future.

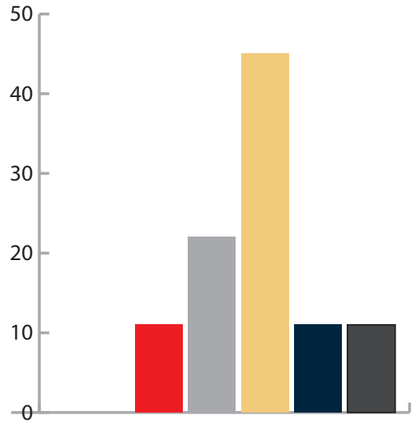
Tied to this slow move towards off-premise deployments is the subject of the traditional PLM licensing model. As Question 3A (overleaf) shows, the cost of implementation services, relative to the licensing of the software itself, has fallen considerably in the last decade. We believe this trend will help pave the way for increased cloud deployments as customers become more comfortable with the concept of hands-off software licensing and installation, and in turn begin to embrace the subscription model that is becoming more common in other enterprise applications.



ON PREMISE	**82%**
CLOUD	**18%**

SECTION 3 | AFTER IMPLEMENTATION – SATISFACTION

3A IN WHICHPLM'S EXPERIENCE, TYPICAL PROJECT COSTS ARE BECOMING FAR MORE EVENLY BALANCED BETWEEN LICENSING AND SERVICES. WHAT WAS THE RATIO OF SOFTWARE LICENCING TO SERVICE COSTS FOR YOUR PROJECT?



1:8	0%
1:6	11%
1:4	22%
1:2	45%
1:1	11%
Other	11%

ANALYSIS: When PLM first entered the RFA industry, the vast majority of a typical project cost came from what we refer to as services (the vendor providing training, implementation services, customisation, configuration, and ongoing support) rather than from the expense of purchasing the software licenses themselves. This is referred to as the software to services ratio - something that around the turn of the millennium would have been expected at around 1:10, or ten units of service cost for every unit of software cost. In the last sixteen years, that ratio has become much more balanced: in our 5th Edition, a ratio of 1:4 was the most common, and this year 1:2 emerges as the most popular costing model. We should note, though, that this method of judging overall implementation cost will be upended when subscription-based deployments reach critical mass and the traditional license and services model eventually disappears. This change will reframe the way that vendors and customers think about value, and WhichPLM will alter its metrics accordingly when that time comes.

3B FOLLOWING ON FROM YOUR INITIAL INTROSPECTION, ROI ANALYSIS AND IMPLEMENTATION, HAVE YOU BEEN ABLE TO QUANTIFY ON A PROCESS-BY-PROCESS BASIS THE VALUE THAT PLM HAS DELIVERED TO YOUR BUSINESS?

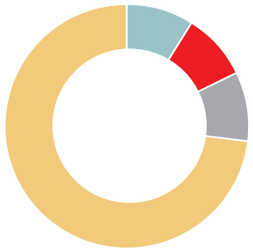
YES	27%
NO	18%
DON'T KNOW	9%
TOO EARLY TO DRAW CONCLUSIONS	46%

ANALYSIS: One of the most disappointing sets of results from our 5th Edition survey, close to 70% of customers in 2014/15 could not say with any certainty whether their PLM implementation had delivered the expected return on investment from process improvements. While that same metric appears on the surface to remain discouraging this year - only 27% of respondents reporting that their project had succeeded in this regard - it's important to realise that almost half of the customers we surveyed in 2015/16 reported that it was too early in their implementation to draw conclusions, and that this admittedly low number still represents an increase of 8% in the last twelve months. This should serve as a reminder to prospective PLM customers of both the importance of establishing baselines against which project success can be measured, and of the long-term commitment that a modern PLM project represents.

"Maturity modelling - understand it, do it!"

"It's important to make sure these measures are clearly made before the implementation starts - otherwise there is nothing to measure against. This is often overlooked in the rush to gather requirements and then "try it out""

3C HAS YOUR PLM SOLUTION ENABLED YOU TO ACHIEVE INCREASED SALES AND REVENUE BY ALLOWING YOU TO POSITION YOUR PRODUCT LAUNCHES MORE EFFECTIVELY AND CUT PRODUCT LIFECYCLE TIMES?



YES	9%
NO	9%
DON'T KNOW	9%
TOO EARLY TO DRAW CONCLUSIONS	73%

ANALYSIS: As with the previous question, this year's responses are clouded by the fact that more than 70% of survey participants believed that their PLM project was in too early a stage for this kind of return on investment to be measured. This does not represent any kind of shortfall in the capabilities of PLM itself, but does reinforce the importance of any brand or retailer taking a realistic, multi-year view on their transformation project - regardless of how quickly the implementation itself is completed. Well-positioned product launches, on-trend delivery, and reduced lead times are all certainly important metrics by which success can be judged, but we must remember that those judgments require retail and production intelligence spread across multiple seasons in order for comparisons to be effective.

"[Our] business is going through significant change, and that is making an ROI review, process by process, difficult."

"Communicate successes - the journey is a long one, celebrate success."

"Projects need to be realistic about how long it takes to deliver benefit."

3D PLEASE RATE THE PLM SOLUTION YOU CHOSE ON ITS EASE OF USE, AND THE QUALITY OF THE USER EXPERIENCE AVERAGED ACROSS ALL MODULES. ARE YOUR USERS SATISFIED WITH THEIR DAY-TO-DAY WORKING ENVIRONMENT?

VERY	20%
NOT AT ALL	10%
QUITE	70%

ANALYSIS: For every year that we have tracked it as an indicator of satisfaction, the market as a whole has responded well to the experience of working with PLM. This was the case in 2014/15 and remains the case today, with a considerable majority being quite or very satisfied with their chosen solution's interface and overall user experience (UX). WhichPLM's market research and freely-available Supplier Evaluations, however, tell us that this level of satisfaction is by no means guaranteed; as the quotes accompanying this analysis demonstrate, a new generation of apparel industry professionals will soon expect user interface and user experience design that is as considered, intuitive, and attractive as the operating systems and applications they are accustomed to using in their personal lives. UI and UX may historically have been minor concerns, but they will, if left unaddressed, become significant barriers to adoption in the near future.

"The UI was surprisingly dated. Our team are very young and this is important to them. An ugly, difficult interface and poor experience is a real barrier to PLM success and really needs addressing urgently."

"Interface and menus are perceived as overly complex, but this is being improved with ongoing support."

3E PLEASE PRIORITISE THE FOLLOWING FUNCTIONAL AREAS (1 BEING THE MOST IMPORTANT; 5 THE LEAST) ACCORDING TO WHERE YOU WOULD LIKE YOUR VENDOR TO FOCUS THEIR DEVELOPMENT EFFORTS IN THE NEAR-TERM FUTURE.

1	Management Functionality (Calendar Management, Critical Path, Change Approvals/ Disapprovals, Automation & Workflow, Business Intelligence, Dashboards, Reporting) Technical Development (Technical Specification, Sizing & Measurements, 2D Pattern & Design, 3D Virtual Design & Sampling, Sample Management)
2	Sourcing & RFQ (Costing Bill of Labour, Quotation Management, Supply Chain Tracking, Visibility & Control, Supplier & Relationship Management)
3	Corporate Social Responsibility (Quality Assurance, Audit Management, Legal Requirements, Sustainability & Compliance, Green Design) Marketing and Customer Engagement (e-Commerce Content & Maintenance, Magazine Creation, Photography & Editing, Social Media, Partner Collaboration, Translation Services, Competitive Analysis) Creative Design (Trend Analysis, Storyboard, 2D Design, 3D Avatar & Engineering Design, 3D Printing, CAD, Knits, Weaves etc.)
4	Materials Development (Material, Component, Trim, Packaging, Labelling) Colour Development (Trends, Seasonality, Testing, Digital Approvals, Palette Development)
5	Consumer Experience (Voice of the Customer, Product Testing, Surveys, Specialty User Testing)

3F PLEASE RATE THE PLM SOLUTION YOU CHOSE ON THE BASIS OF ITS SPEED, WHICH MIGHT INCLUDE REFRESH RATES AND THE NUMBER OF CLICKS REQUIRED TO NAVIGATE TO COMMONLY-USED FUNCTIONALITY.

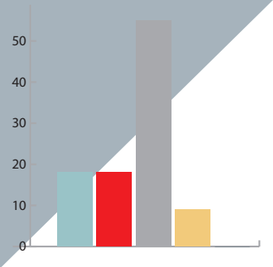
SLOW	10%
ACCEPTABLE	45%
FAST	45%

ANALYSIS: Distinct from user interface (and only a small component of UX), the speed of PLM modules can be extremely variable, governed by infrastructure, organisation, optimisation and - in the case of off-premise hosting models - connection speed. Compared to the results we saw in our 5th Edition, this year's data paints a far more encouraging picture: an additional 36% of customers rated their solution as "fast", while 26% fewer rated it as "slow". In line with the user experience expectations set by consumer technology, click rates and refresh speeds have now become a priority for vendor research and development teams, although it remains to be seen what impact - if any - the eventual rise of cloud deployments will have on how well the next generation of software measures up in terms of speed.

"[With the benefit of hindsight] I would have asked to see a demo in another workplace; the vendor demo will always look slick, [because] they are driving something very familiar to them and know how to make it look great. Amateurs don't!."

"Some areas have many clicks, but [the solution] can be configured or customised to remove some of them."

3G THE UNFORTUNATE REALITY IS THAT, FOR A VARIETY OF REASONS, NOT ALL PLM PROJECTS REACH COMPLETION ACCORDING TO THEIR ORIGINAL VISION. WAS THE INITIAL VISION FOR YOUR PROJECT REALISED, OR WAS THAT GOAL TEMPERED IN SOME WAY?



REACHED COMPLETION	18%
SCALED BACK	18%
STILL IN IMPLEMENTATION	55%
ON HOLD	9%
CANCELLED	0%

ANALYSIS: While we are yet to hear from a respondent whose PLM project was cancelled in its entirety - something that first-hand experience tells us does happen, albeit not frequently - both this year's results and those seen in our 5th Edition demonstrate that implementations are as likely to be scaled back from their original vision as they are to fulfil it. In last year's case, these figures were 31% and 38% respectively, while this year the significant number of projects still in implementation reduced them to 18% each. It's important for prospective customers to bear these relatively similar figures in mind; statistically speaking, their implementation is far from guaranteed to run completely to plan, and without adequate preparation and process analysis, some degree of compromise on the original vision may be required. In several instances this year, for example, a PLM project was frozen completely while other software projects or extensive re-scoping were given priority.

"This project was put on hold waiting on the company's ERP implementation that was extremely behind schedule."

"One [implementation I worked on] was over ambitious, and poorly planned. The other was just bigger and more complex than anticipated."

3I ARE YOU CONSIDERING REPLACING OR UPGRADING YOUR PRESENT SOLUTION – EVEN IF IT'S WITH A NEW VERSION FROM THE SAME VENDOR?

ANALYSIS: As is to be expected given the total satisfaction revealed in the previous question, none of this year's respondents have considered replacing their current PLM solution. This is further evidence that PLM software as a whole has reached a level of maturity that meets most essential needs, and that vendors' implementation and services teams - first and third party - are able to support its potential in projects of varying shapes and sizes. In our 5th Edition, a full third of respondents admitted that they were considering replacing their solution, so this year's results represent another milestone in customer satisfaction. Perhaps less obvious in its impact is the desire that 30% of respondents have to upgrade their solution: historically this was not always possible due to extensive customisation, whereas today's push for more configurable, cloud-based solutions is likely to open the upgrade path for more customers than ever before.

"[We are] upgrading to a cloud deployment."

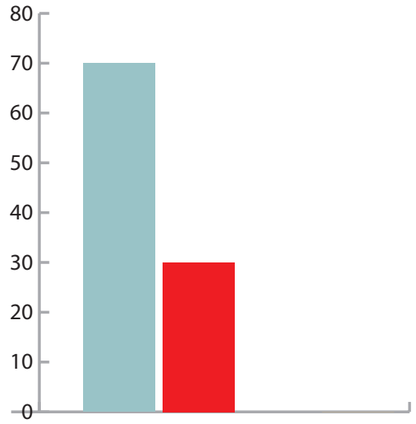
"As we upgraded, we didn't analyse the competitors as much as a normal RFI/RFP process. [I highly] recommend that even upgrades are treated with a high level of due diligence to keep your vendor honest."

3H OVERALL, HOW SATISFIED ARE YOU WITH THE PLM SOLUTION AND VENDOR YOU CHOSE?

NOT AT ALL	0%
QUITE	40%
VERY	60%

ANALYSIS: These results represent a significant milestone. The year 2015/16 is the first in which every survey respondent reported being either "quite" or "very" satisfied with their selected PLM solution and vendor. In the year 2011/12, dissatisfaction with either software or services sat at 30%; that figure fell to 26% in 2012/13, then 20% in 2013/14, before reaching just 16% in 2014/15. With the benefit of several years' worth of data, we can see that, on balance, PLM customer satisfaction has risen steadily in every period WhichPLM has assessed, before reaching total satisfaction this year. As the most succinct indicator of the viability of the RFA PLM market, we consider 100% customer satisfaction to be one of this industry's proudest achievements, and one we hope to see sustained in 2016/17.

Although we should note that this level of satisfaction only applies to the cross-section of the RFA PLM customer base that took part in this year's survey, WhichPLM believes that satisfaction rates in the wider industry will have seen similar rises over the last few years. Both anecdotal and first-hand evidence tell us that this market maturity is being driven by a combination of a better-educated, better-prepared customer base (and hence more appropriate choices of vendor partner) and intelligent investments in resources, research and targeted development by vendors who have a firm idea of their customers' needs.



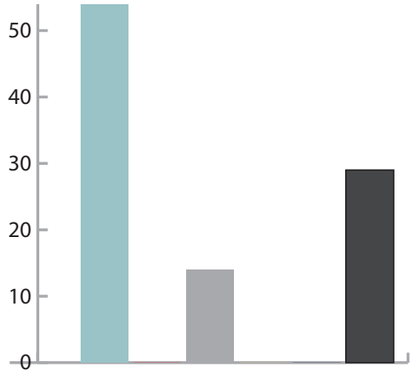
I AM HAPPY WITH THE SOLUTION I HAVE	70%
I AM CONSIDERING UPGRADING	30%
I AM CONSIDERING REPLACING MY CURRENT SOLUTION	0%
I AM NOT SURE HOW I FEEL	0%

"Choose carefully - it is a big deal to change mid-project, and unlikely to be feasible."

SECTION 4 | CUSTOMER RELATIONS & PARTNERSHIPS

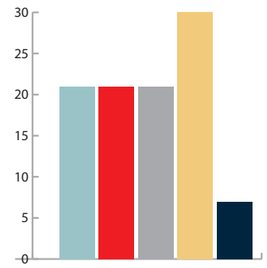
4A DOES YOUR SUPPLIER OFFER A SUPPORT SERVICE THAT COVERS ALL TIME ZONES WITHIN YOUR SUPPLY CHAIN, ON A 24/7 BASIS?

ANALYSIS: It is important to note that almost a third of this year's respondents indicated that they did not know the availability of their chosen supplier's support services. We construe this as a positive response, since it suggests that these customers have not yet had cause to contact their designated support representatives. For the remainder, these figures are encouraging: in 100% of cases where a retailer, brand, or manufacturer had requested support, these services were available when and where they were needed - in the majority of cases even on weekends. And while our 5th Edition survey revealed that 18% of respondents in 2014/15 had discovered gaps in their vendor's provision of support, that figure has fallen to zero this year.



COVERS ALL TIME ZONES 7 DAYS A WEEK	57%
COVERS ALL TIME ZONES 6 DAYS A WEEK	0%
COVERS ALL TIME ZONES 5 DAYS A WEEK	14%
DOES NOT COVER ALL TIME ZONES	0%
PROVIDES SUPPORT ONLY TO MY HEAD OFFICE LOCATION	0%
I DON'T KNOW	29%

4B HAS YOUR SUPPLIER OFFERED SUPPORT THAT TAKES ACCOUNT OF YOUR CONFIGURATIONS AND CUSTOMISATIONS SINCE THE POINT OF GO-LIVE?



SUPPORT FULLY UNDERSTANDS THE RFA INDUSTRY	21%
SUPPORT UNDERSTANDS MY CONFIGURED SOLUTION	21%
SUPPORT UNDERSTANDS MY CUSTOMISED SOLUTION	21%
SUPPORT HAS BEEN IN PLACE SINCE THE POINT OF GO-LIVE	30%
SUPPORT HAS BEEN LACKING	17%

ANALYSIS: As was the case in previous years, the responses we received to this question are a strong indicator that global support for PLM implementations, as well as being broadly available when and where it is required, is of a good standard. In an industry where the majority of products are customised in some way, it is encouraging to see that only 7% of support experiences fell short of expectations, and that an additional 10% of respondents (up from 11% in 2014/15) felt that their vendor's support team fully understood their unique, customised environment. It's likely that stronger links between vendor sales and support departments, and better internal documentation, are driving these improvements.

"Support encouraging and consistent throughout process of installation and post go-live."

"Support is highly effective, but is not always speedy or transparent."

4C IF YOUR IMPLEMENTATION WAS HANDLED VIA A THIRD PARTY, WHO NOW MANAGES YOUR ONGOING SUPPORT?

SUPPLIER	50%
THIRD PARTY WHO IMPLEMENTED	33%
A MIXTURE OF BOTH	17%

ANALYSIS: Taken together, the results of our 5th Edition and the responses we received to this year's survey show that the majority of ongoing support is provided by vendors' in-house teams. This is to be expected, given that these are typically dedicated pools of knowledgable professionals, generally separated from more resource-constrained areas of the business like sales and implementation. Unlike previous years, though, these results tell us that a significantly larger proportion (an additional 22%) of support is now entrusted to the same third parties that handled the customers' implementations. This is significant because, while many people recognise the long-term partnership potential of a PLM project, this is often thought of as being exclusively between customers and vendors. Instead, these figures demonstrate that trusted advisors are now increasingly likely to be involved in securing the success of their projects for months and years after the point of go-live.

4D HOW SATISFIED HAVE YOU BEEN WITH THE TECHNICAL SUPPORT PROVIDED BY YOUR PLM SUPPLIER AND/OR THIRD PARTY IMPLEMENTER OVER THE LAST TWELVE MONTHS?

NOT AT ALL	0%
QUITE	20%
VERY	80%

ANALYSIS: In line with the results of previous questions, all of this year's respondents reported being satisfied with the technical knowledge of their vendor's support team. While this was also the case in 2014/15, this year sees a much larger percentage of brands, retailers, and manufacturers categorising themselves as "very" satisfied - an additional 52%. Given the fact that a larger than usual percentage of the PLM projects covered by this year's survey are still incomplete in some way, we should note that this level of satisfaction may change as they are extended, with supply chain partners sharing role-based access to the solution. At this stage, these results may change depending on vendors' ability to support the customers' manufacturing base as well as its production offices.

4E DOES YOUR PLM SUPPLIER HAVE A CLEAR DOCUMENTED PROCESS AND POLICY IN PLACE TO ENABLE YOU AND OTHER FELLOW CUSTOMERS TO SUGGEST NPI (NEW PROCESS INTRODUCTIONS) AND ENHANCEMENTS TO THE SOLUTION?

YES	50%
NO	17%
I DON'T KNOW	33%

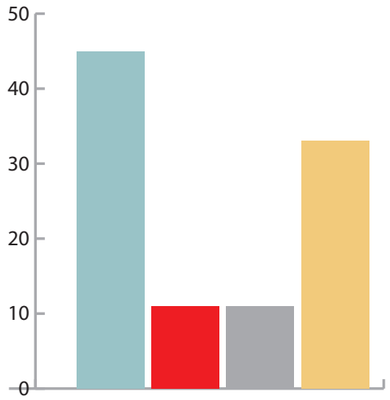
ANALYSIS: After working with the solution for some time, customers might privately request specific enhancements or changes. The supplier will then need to factor these requests and those received from other customers into their ongoing development - a process that often sees requests from more lucrative or prestigious customers taking priority. As with other elements of the relationship between customer and vendor, though, this paradigm is changing, with forward-thinking vendors targeting a more democratic approach and encouraging customers to put their ideas forward in public forums. Considering that an additional 18% of survey respondents this year did not realise that their vendor had any formal process in place to allow these suggestions to be made, WhichPLM believes that any move towards greater transparency in change and enhancement requests is a positive step for the industry.

> "This is a great idea, I have loads [of ideas] but this never occurred to me."

> "[We were] not involved in the process of prioritising enhancements and new features."

4F WHAT MECHANISM(S) DOES YOUR SUPPLIER HAVE IN PLACE FOR TAKING ON BOARD THESE KINDS OF REQUESTS AND RECOMMENDATIONS?

ANALYSIS: To manage these change requests and recommendations, the majority of suppliers still appear to operate a "new requirements document" process, whereby a designated supplier contact submits a formal request that may or may not then be factored into development. Where this year's results differ from those we have seen in previous years is in who bears the bulk of the cost of customisation: in 2014/15 this was borne in full by the customer as often as it was discounted to take account of loyalty, whereas this year we see the discounted model used far more often. We see this as an important precursor to a more democratic model, since bespoke customisation is being reduced, while enhancements with common value are becoming far more likely to find their way into the core application and become available to all users.



> "The vendor developed a couple of features into the solution, at our cost, and then made these available to the general user community."

NEW REQUIREMENTS DOCUMENT, SUBMITTED BY THE CUSTOMER TO A DESIGNATED PERSON/ TEAM WITHIN YOUR SUPPLIER	45%
CUSTOMER NPI VOTING SYSTEM	11%
OFFER FROM THE SUPPLIER TO CUSTOMISE THE SOLUTION AT A FULL COST TO THE CUSTOMERS	11%
OFFER FROM THE SUPPLIER TO CUSTOMISE THE SOLUTION AT A HEAVILY DISCOUNTED RATE, WITH NEW OR IMPROVED PROCESSES THAT WILL IN TIME MAKE THEIR WAY INTO THE CORE APPLICATION	33%

SECTION 5 | THE SHORT-TERM FUTURE OF PLM & THE INTERNET OF THINGS

5A DOES YOUR CURRENT PLM SOLUTION OFFER ANY OF THE FOLLOWING SUPPLY CHAIN MANAGEMENT CAPABILITIES? IF SO, HOW WOULD YOU RATE THEIR IMPORTANCE TO YOUR BUSINESS ON A SCALE OF 1 TO 5, WHERE 1 IS THE HIGHEST AND 5 THE LOWEST?:

ANALYSIS: Only a small percentage of the brands, retailers and manufacturers we surveyed this year had implemented PLM solutions that incorporated some level of Corporate Social Responsibility (CSR) functionality. In WhichPLM's experience, this mirrors the state of the industry at large: sustainability and compliance modules have only recently been identified by vendors as priorities for development, and as a result very few live implementations include these capabilities. Among those respondents whose solutions did offer CSR tools (usually as part of their supplier management and sourcing functionality), quality assurance and quality control emerged as by far the most important to their businesses, while they placed equal weight on green design, technical, ethical, and environmental compliance.

> "These important aspects are overlooked. [Corporate Social Responsibility] is not a "selling-point", but it should be."

> "Waste valorisation [the cost of disposing of consumer product wastage] will shortly be the trending topic, as landfill becomes an increasing issue. Coupled with this, 'cradle to cradle' will be seen as ticking a number of boxes including resource use, waste reduction, and consumer preference."

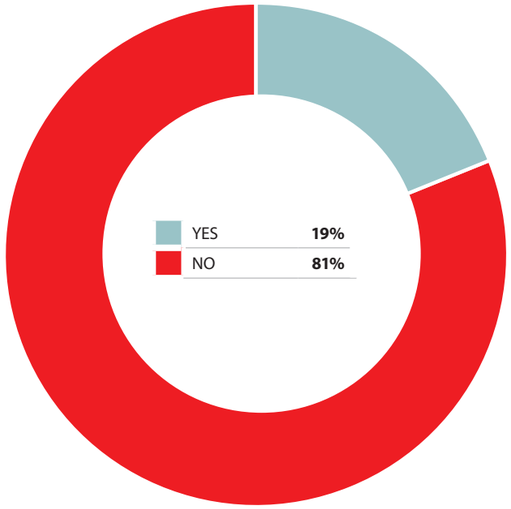
1	Quality Assurance & Control
2	Sustainable Manufacturing Technical Compliance (KPIs linked to the technical capabilities and competence of a supplier) Ethical Compliance (freely available auditing information on your supplier and their ethical practices) Environmental Compliance (freely available auditing information on your supplier and their affect on the environment e.g. pollution)
3	Green Design

5B IS THERE A MARKETING MODULE WITHIN YOUR SUPPLIER'S CURRENT PLM SOLUTION OFFERING, AND IF SO WHICH OF THE FOLLOWING FUNCTIONALITY DOES IT INCORPORATE?

DIGITAL ASSET MANAGEMENT (MULTIPLE FILE FORMATS MADE AVAILABLE FOR DIFFERENT CHANNELS: PRINT, E-COMMERCE, REPORTS, EXTENDED-PLM SOLUTIONS ETC.)	21%
DEFINED MARKETING DATA CAPTURE (A FORMAL PROCESS FOR CAPTURING MARKETING DATA E.G. SHORT AND LONG DESCRIPTIONS, HOW A PRODUCT IS TO BE USED ETC.)	33%
AUTOMATIC OUTPUT OF IMAGES AND TEXT TO CREATE ONLINE CATALOGUES AND COLLECTION BOOKS	29%
ABILITY TO WORK WITHIN INDESIGN AND/OR PHOTOSHOP (INDESIGN FOR MARKETING PUBLICATIONS; PHOTOSHOP FOR IMAGE EDITING AND THE CREATION OF NEW MARKETING MATERIALS)	17%

5C DOES YOUR CURRENT PLM PLATFORM FEATURE AN INTEGRATED APPAREL 3D MODULE, EITHER FIRST OR THIRD PARTY?

ANALYSIS: The special focus of last year's WhichPLM Report: 5th Edition, 3D remains an exciting growth area for retail, footwear and apparel, but one that is yet to reach the tipping point for widespread adoption. As these results attest, the vast majority of brands, retailers, and manufacturers implementing PLM today are not yet complementing it with 3D beyond simple browser-based viewers. Related to this, very few PLM vendors offer a home-grown 3D solution as part of their portfolio (i.e. one with truly native integration between their own 2D CAD and patternmaking products) while a small number of others have built close relationships with third parties, offering integration to design, virtual sampling, store planning and other 3D products proven elsewhere in the market. Readers interested in the state of 3D adoption are invited to read the adjacent update, and are encouraged to seek out our 5th Edition publication for more detailed insights.



"Yes, currently using 2D data, 3D will be introduced as users' confidence develops."

"3D files can be imported and also viewed from within system."

"3D printed accessories, planning for next year."

5D WHICHPLM BELIEVES THAT IOT IS ONE OF THE MOST DISRUPTIVE TECHNOLOGIES TO ENTER OUR INDUSTRY IN RECENT YEARS, AND WHILE IT'S UNLIKELY THAT MANY BRANDS AND RETAILERS HAVE YET DEVELOPED A FIRM IOT STRATEGY, WE NEVERTHELESS WOULD LIKE TO KNOW HOW YOU RATE THE FOLLOWING IN TERMS OF THEIR POTENTIAL VALUE TO YOUR BUSINESS (1 BEING OF THE HIGHEST POTENTIAL, AND 5 THE LOWEST).

ANALYSIS: The editorial features section of this publication goes into considerable detail regarding the Internet of Things and its likely impact on the near and longer-term future of fashion, but WhichPLM also took the opportunity with this question to ask real PLM customers which immediate term applications for IoT technologies they considered to be the most compelling. Needless to say, productive integration between enterprise systems emerged in front of less obvious applications like augmented reality and virtual reality fit sessions. While our editorial features also explain the crossover between the IoT and more traditional IT integration and data openness, it's important to note that here we refer to data sharing in the context of the huge volumes of data that will potentially emerge from the roll-out of RFID, smart fabrics, connected stores and other IoT scenarios.

1	The ability for your ERP system (capturing sales data) to share data with your merchandise planning system in real-time
2	Information to trigger from PLM to the marketing teams in an automatic way (i.e. once a native image is approved, upon saving, the system converts the image into multiple formats which can be used for e-commerce, marketing collateral, supply chain partners etc.)
3	Technical specification data and images to flow into the front-end retailer/brand to support augmented reality, by overlaying data on products and/or virtual mirrors within the fitting room.
4	The ability to utilise data from PLM or 3D during a fit session so the data can be overlaid (augmented) on the fit model, to present 'how to measure guides' or provide more details on material & trims etc.

5E WHETHER YOU ARE A RETAILER, BRAND, OR SUPPLY CHAIN PARTNER, HOW WOULD YOU RATE THE FOLLOWING IN TERMS OF IMPORTANCE (1 BEING OF HIGH IMPORTANCE AND 5 BEING OF LOW):

ANALYSIS: Although these are not all direct IoT applications, each of them leverages the huge volumes of data, automated interpretation, and next-generation connectivity between hardware and software that WhichPLM believes will underpin the future of fashion technology. The "Future of PLM" feature at the end of this publication considers the roles of big data and machine learning in greater detail, but in line with many of the industry figures interviewed for this year's publications, PLM customers appear to share the view that the most valuable application is in improved tracking of the complete product lifecycle from manufacture to consumer use.

The comparatively low weight given to data integration and interoperability between software and manufacturing hardware is likely the result of two different factors. First, the responses that WhichPLM received to this year's survey questions were predominantly from brands and retailers, rather than manufacturers. Secondly, the industry as a whole tends to regard the manufacturing process - and the additional efficiency and transparency that can be driven from it through IoT technologies - as something that effectively takes care of itself, placing the onus for optimisation on supply chain partners. Over time, IoT strategies are likely to change this perception, and brands and retailers may become more invested in supply chain visibility at a granular level.

To discover more about this and other uses for IoT technologies, please refer to the editorial features towards the beginning of this publication.

1	The ability of PLM to track products from concept to consumer.
2	As above the ability for 2D CAD pattern systems that on completion of an approved 2D pattern, would automatically update PLM on its current lifecycle status and would then use a push command to drive the next process (e.g. automatically instructing the marker maker, to proceed with marker making / lay planning). The ability for the PLM system to support automatic (push & pull) triggered notifications and commands coming from creative design systems - including 2D, knitting, weaving, packages - that supply data on approved products directly back into PLM with their current lifecycle status.
3	The ability of PLM to support human resource and capacity planning in both retail stores and across the extended supply-chain e.g. manufacturing.
4	A material inspection machine that could automatically record quality defects in the roll and share these with the spreaders, cutting teams and quality control teams. The ability for material information (width, length, utilisation etc.) to be fed to a spreading machine upon approval/completion of the marker/layplan. Automatic notification of material types, cut plans, cutting parameters and production data feeds to be shared with the cutting machine when the material spread is ready for cutting. Cutting machines (on completion of style and quantity) to also share (actual cut data) details back to PLM to monitor tracking/visibility of a given product's stage/status in the production process.

3D IN FASHION - AN UPDATE

Three-dimensional working is not a new concept in fashion. As our 5th Edition explains in considerable detail, the idea of visualising garments, accessories, footwear, and the retail spaces they occupy in 3D has been circulating for years or even decades. It's only extremely recently, though, that the underlying technology has caught up to the vision, and that compelling use cases have emerged , delivering real returns on investment for brands and retailers around the world. So while adoption does not appear to have increased in the past twelve months (both our 2014/15 data and those from this year demonstrate that around 80% of customers do not have integration between their PLM solution and either a first or third party 3D module), research tells us that where 3D is in place, it potential is being realised in multi-million dollar savings in virtual sampling alone.

Of the small number of survey participants who went on to provide us with further insights, 2D store planograms and 3D store visualisation functionality were being used in very few cases, while output to 3D printers was available in more instances, but used only in a single case for developing prototype buttons, belt buckles, and other similar rigid components.

The full spectrum of market forces helping to drive more widespread adoption of 3D are studied in detail in our 5th Edition publication, and WhichPLM will continue to track developments in this area in future publications.

ADVISORY SERVICES FROM whichPLM

Considering a PLM, 3D, or digital transformation project of your own?

The WhichPLM Advisory Services team undertakes process analysis, extended-PLM system architecture mapping, master data consolidation and scientific shortlisting and selection projects for major brands in Europe, the United States and Asia. We also support enterprise-wide digital transformations, and have helped to manage investments in 3D and other cutting-edge technologies.

Each of our associates has direct experience of multiple and varied technology implementations, and our services remain unbiased and expertly informed.

Our proven methods - born from a marriage of best practices and hands-on experience - have helped to shape the strategies of retailers and brands around the world. Customer references are available upon request.

PLM Customer Services
- Business case & ROI analysis
- Best-practice process maturity redesign
- PLM education for all levels

PLM Vendor Services
- Solution and roadmap evaluation
- Process maturity scoring
- Education of in-house or partner resources

3D Customer Services
- 3D enterprise process evaluation
- 3D selection & evaluation
- 3D education services
- 3D integration services

Digital Transformation
- Education services
- Extended PLM solution mapping
- Extended solution inputs & outputs
- Integration services

Educational Establishments
- Guest lectures on PLM, E-PLM & 3D
- PLM process landscape analysis
- Predictions for PLM & E-PLM futures
- Individual lectures available online
- Complete, accredited online courses

... and more available on request.

whichPLM

Contact **advisory@whichplm.com** to arrange an introductory conversation

www.whichplm.com

PLM Vendor Profiles

BEGINNING WITH THE VERY FIRST CUSTOMER SURVEY IN 2010, OUR PUBLICATIONS HAVE BEEN CONSIDERED ESSENTIAL READING FOR ANY BRAND, RETAILER OR MANUFACTURER PREPARING FOR A PLM PROJECT.

Informed by feedback from those readers, each year we have taken progressive steps to make sure that the information we publish serves their needs. We know from speaking to brands and retailers on every continent that a large part of the value they realised from each "PLM bible" stemmed from our vendor listings – annual snapshots of the PLM landscape designed to allow readers to make informed decisions.

In 2014, at the market's request, we added to these listings with counterparts for PLM consultants – those professional services organisations, large and small, who are proving instrumental to growing numbers of implementations. Those profiles appear later in this publication.

The following PLM vendor profiles, though, collect statistics, insights, and opinions exclusive to WhichPLM readers, and are designed to collectively serve as an introductory step for any fashion organisation looking to shortlist and select the right PLM partner for their unique requirements.

To make this shortlisting exercise simpler, in our 5th Edition (covering the financial period 2014/15) we applied even more stringent inclusion criteria to ensure that the vendors who appear in these listings played a demonstrable regional or global role in the RFA PLM market. The same criteria have been applied to this year's listings.

On the surface it may appear as though this kind of first-stage filtering of the global pool of vendors serves to artificially reduce choice, but it's important to remember that of the forty or more software vendors that claim to sell PLM for fashion, only a fraction actually offer what WhichPLM and other analysts consider to be a modern PLM product, and only these merit inclusion in a WhichPLM publication.

(Our definition of what constitutes modern RFA PLM is set out in full in the glossary at the back of this publication.)

Some vendors, for example, continue to sell outdated PDM software with a PLM sales pitch, while others who advertise PLM functionality actually better qualify as providers of extended PLM – particularly those in the area of supply chain management and planning.

Other vendors whose software does meet the criteria we set out instead fell short of our minimum RFA sector turnover requirements, voluntarily excused themselves from listing, or were revealed during WhichPLM advisory engagements to lack the apparel industry expertise or experience to merit inclusion on prospective customers' selection lists.

Although any PLM vendor is welcome to submit its product and services to a WhichPLM Supplier Evaluation – with more information, and a growing number of published Evaluations available on our website – this section is restricted only to those vendors who we know to be making continued research, development and investment efforts, and who are invested in the apparel industry either entirely, or as a strong element of a broader industry portfolio.

For those vendors that do cater to two or more different industries, the figures that appear in the following pages are confined to the sale, development and support of core PLM for the retail, footwear and apparel industry only. Similarly, where a vendor markets a range of products to the apparel industry - as is the case with vendors of CAD/CAM, pattern making software, three-dimensional design, and other components of the extended product development environment - we have disregarded income, resourcing and investment that falls outside the scope of this section's PLM focus.

In recognition of this year's focus topic, each vendor was also given the opportunity this year to write about the Internet of Things from their own perspective. So while the profiles and adjacent advertisements over the following pages follow the same guidelines as in previous WhichPLM publication, readers will also find a double-page spread after almost every vendor's profile, where a key figure from the organisation gives their take on one of the biggest challenges (and potentially greatest opportunities) facing the RFA industry today.

Readers of previous Annual Reviews will notice that this year's publication continues the more detailed format pioneered in our 2014 Annual Review and carried through to 2015's 5th Edition. We present overall customer figures, resource allocation by region, and the ratio of internal to external users as supplemental to the core customer data that has always been the backbone of our vendor listings.

Where "N/A" appears, it denotes that the vendor in question was unable or unwilling to provide the relevant information. In the majority of cases, the division between public and private companies' disclosure policies was the cause, but in some instances information was withheld for other reasons. For this reason, "N/A" should be read as "not publically disclosed", since this information – whether financial or otherwise - may be divulged to private parties.

Elsewhere, our vendor profiles continue the tradition of asking each listed supplier to provide their own insight into what they feel has differentiated them from their core PLM competitors this year, and to explain what they see as the prominent emerging trends for the near future. These insights are always exclusive to WhichPLM readers, and provide a unique perspective on the roadmaps, ethos and future direction of the market's biggest players.

Where actual sales to new customers are concerned – our primary metric for the Market Analysis section of this publication - we remind readers that despite our best efforts towards verification and completeness, these lists are not exhaustive. Many of the suppliers listed here have made sales that have not been disclosed to the public, either through reasons of brand secrecy, or because those implementations have not yet reached agreed milestones at which they can be discussed in public forums. We have afforded suppliers the opportunity to number but not name these customers, provided their identities have been disclosed to the WhichPLM team under the terms of a non-disclosure agreement. This allows us to adhere to our goal of providing the most complete market intelligence without compromising customers' rights to secrecy.

The final accuracy of these customer lists, too, remains the responsibility of each individual vendor. Just as we have in previous years, the WhichPLM team rebuffed attempts by suppliers to pass off non-PLM customers, non-apparel customers, and customers whose contracts were signed far outside the 2015/16 period as valid inclusions for these pages. We are happy to report that this practice occurs less and less frequently with each passing year, though, and in most of these cases the vendors in question retracted their baseless claims.

Where vendors chose instead to stand by their initial submissions, WhichPLM holds written confirmation from each of these suppliers that the customer lists displayed in their vendor profile are accurate, despite our own misgivings.

Although we do thank the overwhelming majority of vendors for their honesty, nothing in the vendor profiles, advertisements, or IoT advertorials that follow should be considered as an endorsement of any particular PLM vendor. Indeed, we would caution all prospective customers to pay particular attention to the suitability of any vendor who, for example, refused to divulge the size of their R&D team or the composition of their global apparel resource pool.

All prospective customers of PLM should be seeking a viable and sustainable long-term partner, conducting their shortlisting and selection on the basis of financial stability, expertise, experience, and demonstrable investment in their PLM product. A vendor who is able to share these details and be candid about their performance and roadmap – rather than focusing on today's deals and remaining guarded about the future – is clear about their willingness to engage in the kind of frank, open partnership that a truly successful PLM project demands.

Readers are invited, after finishing this section, to turn to our consultancy listings to continue building their picture of the apparel technology landscape, or to visit the WhichPLM website to see whether their newly shortlisted supplier(s) has submitted their solution for an impartial WhichPLM Supplier Evaluation.

> Of the forty or more software vendors that claim to sell PLM for fashion, only a fraction actually offer what WhichPLM and other analysts consider to be a modern PLM product.

> Our vendor profiles continue the tradition of asking each listed supplier to provide their own insight into what they feel has differentiated them from their core PLM competitors

NB: Adjacent to the vendor profiles that make up the remaining pages of this section are full-page advertisements provided by the vendors; following these are double-page advertorials also provided by the vendors. WhichPLM does not control and is not responsible for the content of these advertisements or advertorials. Where advertorials adopt an interview format, the interviewer is not a member or representative of the WhichPLM team, and the interviewee's opinions are his or her own, or the opinions of their employer, not of WhichPLM.

CentricSoftware™

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FINANCIAL YEAR 2015/16

40

NEW CUSTOMERS OF RFA PLM, INCLUDING:

3 color | Aimer | Amer | Aokang | arena | Armed Angels | ASICS | Bagir | Bench | Boden | Cofel | Coldwater Creek | Eden Park | EIN | Helsport | K Bird | Kate Spade | Lancaster | Luthai | Musto | OJG | Orchestra | Paul & Shark | Philipp Plein | Quest | Sunday Afternoons | Superfeet | TAO | tentree | Tom Tailor | Tristate | Triumph | Truworths | Under Armour | Uniqlo | Varner | Wilson | Wolf Lingerie

147

OVERALL NUMBER OF ACTIVE CUSTOMERS

of PLM within the RFA industry, excluding customers cited as new in 2015/16

40,526

TOTAL NUMBER OF INTERNAL USERS WORLDWIDE

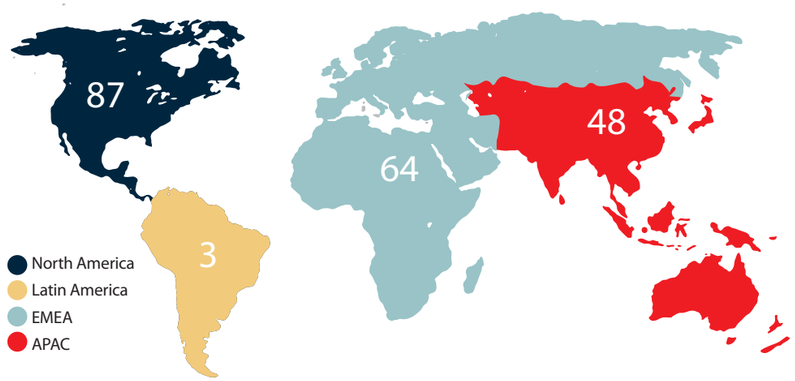
N/A

TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE

60

NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:

N/A

Implementation & services revenue:

N/A

All maintenance revenue:

N/A

R&D investment:

$6-10 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

Last year, Centric hit several key milestones to help its customers face rapid changes, boost growth and cope with the relentlessness need to develop innovative products at an ever-faster pace.

Pushing the boundaries of PLM, Centric launched Centric SMB, a cloud-based, SaaS solution specifically tailored for emerging brands to increase productivity, visibility and collaboration with end-to-end product lifecycle management. With ultra-fast implementation, affordable costs and minimal barriers to adoption, Centric SMB gives smaller companies the same PLM benefits and best practices as larger companies. Centric SMB can be scaled up as a company grows.

Centric also increased its leadership in mobile apps for PLM by adding new mobile apps to its portfolio (Factory Audit, Retail operations, Sample Management and Fit Evaluations) and expanded the footprint of its best-in-class, web-based PLM product suite, with the development of the Merchandising Planning module for Centric 8.

Lastly, Centric enhanced mass data management to streamline tasks, further accelerate time to market and increase agility. Enhanced BOM and costing scenarios for soft and hardlines, refined supplier management and a tight Adobe Creative Cloud integration are also part of Centric's new product offering.

All major Centric innovations are market driven through close partnerships with our customers.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

In an industry shaken up by the "See Now, Buy Now" approach which is disrupting the fashion calendar and product delivery schedules, PLM is more and more recognized as a must have tool. The expected benefits and uses of PLM are changing as adoption matures. Thought once to be primarily an operational tool bringing efficiencies such as reduced time to market, waste and costs, PLM is now evolving into a strategic approach bringing agility and flexibility to an organization. Companies are now using PLM to support new business initiatives such as incorporating consumer feedback into collection development and production or bringing experimental or short-run products to market such as limited-edition products or pop-up stores, for example.

Large companies are looking at innovative ways to streamline operations further and to make the most business-savvy decisions possible. AFA companies are focusing more on well designed, well sourced products to compete with emerging brands that are starting to gain traction worldwide. Emerging brands are really making their mark, and more and more young brands are finding success through innovative products and business models.

Both are placing the product at the core of their strategy to ensure the success of the business.

AN ADVERTORIAL BY

CentricSoftware™

Internet of Things

comes to life behind the scenes

The Internet of Things (IoT) has brought unprecedented ways for companies to use connected devices to interact with consumers, understand their purchasing decisions and predict future behavior. However, the potential of the iot is also coming to life away from the limelight, enhancing the backstage processes that make your business tick.

Discussions about IoT often focus on the consumer-facing side: what can athletic performance stats from wearable fitness devices tell us about consumer use? Can RFID tags on clothing reveal which garments are taken off the rails and tried on most often? Understandably, much of the IoT conversation is about understanding the end consumer's behavior and preferences in order to refine and enhance products and marketing.

However, the IoT also has applications at much earlier stages in the product lifecycle, long before products get into the hands of consumers. Connected devices are changing the way people look at asset tracking, collecting data during performance testing, supply chains, and decision-making during research and development.

TRACKING VALUABLE ASSETS

As Humberto Roa, VP of Innovation at Centric Software explains, the IoT has exciting implications for keeping track of assets such as prototypes, particularly in industries where prototype production is an expensive process:

"What we're seeing with performance wear companies, and even high fashion companies, is that in the exploration and innovation process, they make a lot of prototypes – and we are always shocked by how expensive these prototypes are. They can be between three and eight times the factory price, depending on the complexity of the product and amount of handwork required."

Roa explains that these prototypes often get sent away for photoshoots or celebrity appearances, and get mislaid. "Customers are losing these expensive assets, these early prototypes...nobody's being malicious, but they might get sent to a magazine and never get returned. A big pull from our customer base is: how do we know where everything is?"

> in the exploration and innovation process, they make a lot of prototypes – and we are always shocked by how expensive these prototypes are.

Centric and others are investigating connected chips or devices that can report the position of prototypes over cellular networks and help companies to keep track of where their prototypes have ended up.

"RFID has certainly been explored and applied in retail, but less so in sample tracking," explains Ron Watson, VP Product Development at Centric. "Assets move a lot, going to places that can't be typically tracked by RFID scanners. It's important to have something that reports back home."

With the ability to capture data points and keep the timeline of the data, it's possible to know where assets have been and connect an asset to a prototype record in the PLM system. "When you look at a prototype record, you can see who has it, where has it been and what interesting feedback has come back," says Roa.

MAKING SENSE OF PERFORMANCE DATA

Prototype records can also be used to store and make sense of data on a product's performance during real-world tests. "If you're going to epoxy something to a pair of skis to measure vibration, or put a device on a jacket to measure humidity, or put a pedometer on someone who is doing shoe tests to know the number of steps they travelled, you get a lot of unconnected data streaming back," says Roa.

"We're putting tools in place to connect that all back to a prototype record, and then be able to do A/B testing. To evaluate whether the changes you're making actually improve performance, durability and comfort at a measurable level."

This data can also be combined with field test results such as form-based data and feedback submitted by product testers during the testing process in order to form a well-rounded, objective view of the product's performance.

Roa explains, for instance, that a person testing a jacket while mountain climbing might, when wearing the jacket, feel like the humidity level is high and that the jacket is not breathing properly, but this is a subjective judgment based on a personal comfort level and a specific set of circumstances. Combining these impressions with real-time data from connected humidity sensors can provide a more accurate picture. This can help to discover whether alterations, such as a different material, venting system, or type of zipper, can make a measurable difference.

RAPID ADAPTATION

Instant access to this kind of data is crucial in the early stages of research and development, particularly in the apparel and footwear industries. IoT devices that stream data back to the PLM system can help companies to adapt as they go and make informed decisions about issues such as materials selection.

"Early R & D has got a lot going on. They're making Frankenstein jackets with one sleeve a different material to the other sleeve, and experimenting a lot. Customers we work with put so much money into development and materials selection: making sure vendors can meet capacity, materials can meet performance, and products can meet the right price all comes down to these material decisions," says Roa.

Companies select materials based on tester and laboratory feedback, but as Watson notes, downselecting from ten fabrics to two is a difficult decision that requires as much information as possible.

Performance data collected using IoT devices during testing can be instantly fed back into the system, giving a broader picture and making it easier to choose the right fit and fabric – the qualities most people look for when buying. There's a lot of pressure to get this right the first time, particularly in performance and athletics wear.

"For performance wear, especially if you have a warranty, you will have customers with very high expectations," continues Roa. "If they don't feel comfortable using the product they won't buy it again and will let a lot of people know not to buy that product – it's a very demanding industry in terms of product design."

THE MISSING PIECE

The IoT is still in its infancy, and its potential to produce floods of data on everything from the movement of a shirt across the world to the heart rate of the person who eventually wears it begs important questions: how do you even begin to manage and understand all that data? And where do PLM providers fit in?

"There's going to be an explosion of data, many orders of magnitude bigger than it is now," declares Roa. "Someone will be mountain climbing and there will be ten to twenty streams of data to let us know every minute what's going on with the product – temperature and humidity inside and outside the garment, a pedometer for tracking steps and distance, GPS – how do you synthesize all that together?"

Data science is "the missing piece," says Roa. The ability of companies to apply sophisticated analytics to the data they collect will be critical to whether or not they truly adapt to the IoT. To do this, of course, they need appropriate hardware to collect the data as well as robust IT systems that can process it and use it effectively.

PLM software providers are the link between these data streams and effective product management and development. The PLM industry can learn a lot from industries that have been deeply involved in the IoT from the beginning, notes Watson.

"We feel that there's a lot of technology we're trying to cross over from semiconductors. They've already invested in building huge datasets, real-time acquiring of data and the workflows to make decisions based on it."

"There's an opportunity to learn from an industry that's heavily invested in the IoT. It's not a problem that hasn't been solved yet, but it hasn't got a context that people can get their minds around yet in apparel and footwear," concludes Roa.

UNPREDICTABLE

The IoT is an evolving and unpredictable environment. PLM providers have to be flexible in order to react effectively to changes, and companies who are making tentative steps into the world of connected devices must be prepared to adapt quickly.

"We see our role as responding to changes – we can't predict exactly what's going to happen with the Internet of Things, but we're watching it," says Watson.

"We're going to track what the trends are and what makes them appealing. We trust that our software is flexible enough to adapt to changes we see designers coming up with – new designs, fabrics, and wearable technology they incorporate – and that we can help companies using the software to get the most information out of it."

Ultimately, says Roa, companies that are comfortable with technology, have a broad array of skills and are early adopters of innovations are best-placed to take advantage of the behind-the-scenes capabilities of the IoT. Beyond headline-grabbers like Google Glass and Fitbit, the IoT is quietly fueling a product lifecycle management revolution.

> There's an opportunity to learn from an industry that's heavily invested in the IoT. It's not a problem that hasn't been solved yet, but it hasn't got a context that people can get their minds around yet in apparel and footwear

DASSAULT SYSTEMES

www.3ds.com

FINANCIAL YEAR 2015/16

11 **NEW CUSTOMERS OF RFA PLM, INCLUDING:**
Gurmen Group
Nowy Styl Group
Rockport

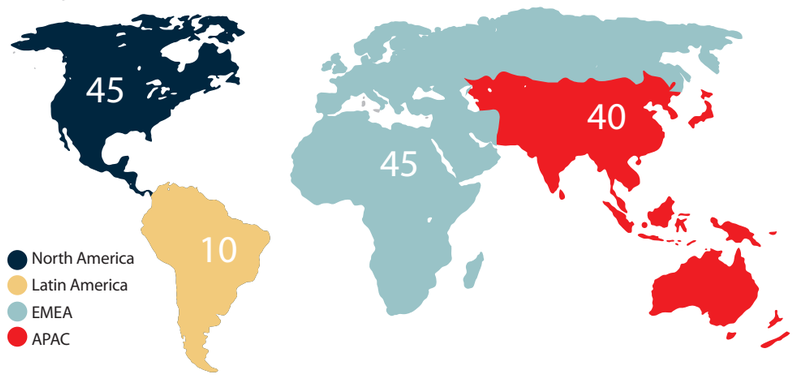
51 **OVERALL NUMBER OF ACTIVE CUSTOMERS**
of PLM within the RFA industry, excluding customers cited as new in 2015/16

33,500 **TOTAL NUMBER OF INTERNAL USERS WORLDWIDE**

10,500 **TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE**

N/A **NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D**

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
$5-7 million

Implementation & services revenue:
$5-7 million

All maintenance revenue:
$8-10 million

R&D investment:
N/A

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

Dassault Systèmes' continues to enhance its industry leading 2-way integration between core PLM (My Collection) and Adobe Illustrator for extended digital continuity. New features for product briefs and product families make it easy for Designers to work in their preferred environment, while remaining synchronized to PLM.

New 'Configurable Costing' provides predefined Costing Templates OOTB while also offering highly configurable formulas and layouts so companies can tailor their approach by brand, product category, and more. New offline quote capabilities make it easier for vendors to provide timely responses regardless of local bandwidth challenges.

Also new within PLM release R2016x, the Digital Asset Hub manages images and information between extended teams who don't need full PLM capabilities. Designers, Product and Brand Managers, and Marketing teams can share 2D and 3D images, videos, marketing materials, and more through role-based, enterprise-wide libraries with parametric search and comparison, asset usage rights and tracking, collaboration, workflow and approvals,

We've enhanced the connections directly from My Collection PLM into My Store for intuitive 3D Visual Merchandising of store layouts and collection options with robust metrics and scenario capabilities.

There are also continuous improvements to UI, navigation and flexibility with excellent feedback on the latest release.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

Leading fashion brands and retailers are continuing to focus on the consumer experience as a way to differentiate themselves.

We've seen continued interest in accelerating the development and consumer engagement cycle through innovative use of 3D technologies to design, develop, validate, merchandise and even sell product. And configurable products have moved from novelty to mainstream, providing consumers compelling options to define a personal and unique product. The acceleration of additive manufacturing in footwear and accessories provides even more flexibility as substrates continue to broaden.

Using the growing wealth of consumer data, brand managers can assess not just sales data but product purchase patterns (try versus try and buy), and direct consumer feedback coupled with product performance information from smart devices and smarter products to evolve their product offerings and create new collections.

At Dassault Systemes we believe this convergence of rich information and 3D digital strategy is part of the new product lifecycle management our customers expect. And it's something we provide through the 3Dexperience Platform; with digital continuity from product innovation to consumer experience.

AN ADVERTORIAL BY

DASSAULT SYSTEMES

An integrated vision for the IoT

Progress has always been about how to make life easier and more convenient, how to make the everyday enjoyable—and modern technologies are doing just that by making the devices around us 'smart'; with the ability to collect data about their use and send it somewhere for analysis. Analysing this data allows the world around us to be customized to our preferences and needs.

Smart devices and experiences are starting to become common for consumer electronics. But more traditional industries like fashion are struggling to understand how to put these new technologies into action. After all, fashion has always been about things that are largely intangible such as colour, hand-feel, taste, and fit. How can we gather empirical information about fashion from digital devices, analyse the data, and have it inform the products we make?

To help better understand how this might be possible, let's use a story of creating a new line of footwear and see how using IoT to gather data to understand consumer preferences, inform design and enhance retail planning might transform the creation process and revolutionize the consumer experience.

Sarah is a runner living in Sydney, Australia, constantly looking to get more fit and improve her running times.

She recently purchased some running shoes from one of her favourite brands that incorporate sensors in the outsole. She also started using a fitness bracelet that can capture information such as heartrate, steps per minute, exercise habits, and location. Further, she has linked the various devices through her favourite exercise app and monitors the information in the evenings before she goes to bed. The information coming from all these devices, apps, and websites has allowed Sarah to build a complete picture of her day, including the best time for her to workout, the exact amount of sleep she needs, and chart her fitness improvement over time. And, although she doesn't yet realise it, it also lets her favourite brand build her the perfect shoe.

> Transform the creation process and revolutionise the consumer experience.

Gabriel is the footwear designer working for Sarah's favourite brand. He designed her current running shoe and is looking for ways to improve it for next season. Gabriel works for a technology-forward brand that uses a PLM tool (such as My Collection, from Dassault Systèmes) throughout the development process. This creates a seamless, end-to-end flow of images and data allowing the company to create better products, in less time, and generate more consumer excitement.

Gabriel begins by collecting all the information and inspiration in a collaboration tool like 3DSwYm (part of the Dassault Systèmes' 3DEXPERIENCE Platform). This allows him to organise in one location: visual inspiration from his recent trip to Australia's Great Barrier Reef, consumer data from the brand's running app, sales data from the corporate website and stores, as well as commentary from social networks. He's able to share this information with his team members and gather their feedback. Analysing all of this, Gabriel comes to several conclusions:

- The current shoe is very popular, but especially in coastal locations because it performs well in packed sand.
- Consumers are unhappy with amount of cushioning.
- Consumers are looking for more colour options.
- Stitching in the upper usually fails before the outsole.
- Shoes assorted next to apparel tend to sell better
- Certain shoes (including the shoe being redesigned by Gabriel) are being tried on, but not purchased, more than average compared to other shoes.
- Darker colourways do better in colder climates, while brighter colourways do better in coastal climates.

Given these conclusions, Gabriel decides to make the following changes to the shoe for the upcoming season:

- Use a colour palette inspired by beach locations
- Allow the consumer to customise the cushioning in the outsole using the brand's proprietary new 3D printing process.
- Allow colour customisation
- Replace the stitching in the upper with a new high-pressure bonding method.

To come up with the look for the new shoe's bonded upper, Gabriel sketches a few ideas in a 3D sketching application (such as SolidWorks Industrial Designer). This allows him to take his 2D sketching skills and apply them in the world of 3D. He can sketch over a "last," the brand's footwear shape form, to make sure that proportions are correct and that design lines flow from one side of the shoe to the other. Gabriel posts his designs to his collaborative environment and, while waiting for feedback from his team, starts work on the outsole.

Gabriel hands his sketches to one of his technical designers who models the outsole in a CAD solution (such as Dassault Systèmes CATIA) and preps it for the cushioning customisation process. Using a simulation environment like Dassault Systèmes SIMULIA, Gabriel is able to see simulations of various levels of cushioning applied to different parts of the outsole based on consumer preferences. Using consumer data from the sensors in the current shoe, Gabriel and his technical designer develop three levels of "off the shelf" cushioning for traditional manufacturing as well as a scheme for creating "point of sale" 3D-printed outsoles with custom cushioning that can easily be bonded to the new upper.

Gabriel now turns his attention back to the upper. Feedback from his team is strongest for one particular design. He looks through the materials database for the best options to meet his target price and performance objectives. Gabriel builds all the component of the upper and generates a tech pack that can be shared on-line or emailed to the factory. In the meantime, Gabriel takes the upper design, merges it with the outsole, and creates a 3D print for the team to evaluate.

Gabriel also shares his data with the appropriate members of the team for approval. The feedback from his team, and the company CEO, is overwhelmingly positive and the shoe moves into the commercialisation process.

In the meantime, Suzanne, the merchandiser working on the line, begins the assortment planning process with the retail team. Shopping habits coming from RFID tags, as well as sales data on last season's shoes, are showing a number of different things:

Given this information, Suzanne decides to try some different approaches with merchandising the line and equipping the store. She uses the company's visual assortment planning tool (such as My Store from Dassault Systèmes) to create a 3D visualisation of the store. She places smaller shoe walls next to coordinating apparel. She also creates one assortment for colder climates and modifies it with different colourways and product for warmer climates. She's able to analyse profitability and take virtual walkthroughs of the stores in order to validate the consumer experience.

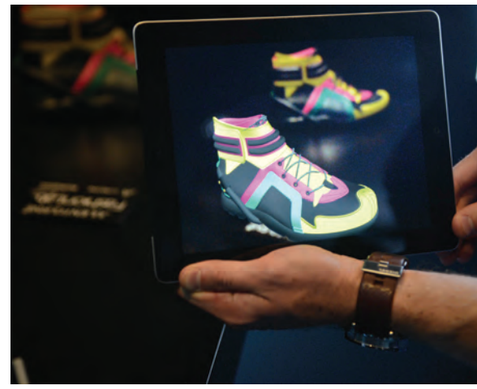
Months later, Sarah's fitness bracelet alerts her to the fact that there is a new version of her favourite shoe launching next month and that she is part of a select number of customers invited to join a pre-release customisation program due to her loyalty to the brand.

A week before the official launch, Sarah is able to visit the brand's Sydney flagship store and try the new shoe. When she enters the store, her fitness bracelet informs the store that she has arrived. Video monitors welcome her while a sales associate is sent to escort her to the customization experience. She is asked if she would like to use the data from her current shoe's sensors, as well as her workout habits, to better inform the customisation process. She excitedly agrees! She then has her foot scanned and analysed while choosing colours for her specific shoe.

She uses a user-friendly application (such as My Retail Theatre from Dassault Systèmes) to customise her 3D shoe, picking colours and fabrics from a digital library, as the shoe is being built onscreen in 3D. Sarah decides to customise her shoe for more support and less cushioning since she tends to run on soft surfaces like hard packed beach sand and the sensors from her existing shoe support this decision. When Sarah's session is finished, her design goes to a local robotic factory for 3D printing and colour application and she tweets out a 3D model of the finished shoe to her followers.

In a few days, Sarah receives her new shoes along with an invitation to attend a 5K beach run on the day of the product launch. The launch day arrives and Sarah is again greeted personally on the in-store screens—along with a 3D model of her custom shoe. Before the event, she's able to meet Gabriel, the shoe designer himself, and the two are able to share their love of the beach and the effectiveness of her shoe customisation. The experience brings an entirely new realisation to both Sarah, the consumer, and Gabriel, the designer; that, over vast distances, they have been able to create a connection that brought Sarah exactly the product she was looking for while Gabriel was given deep consumer insights that he never thought was previously possible.

Sarah is thrilled with her new shoes and has one of her best 5K runs of her life. She has a deeper brand loyalty than ever before and is excited to be one of an exclusive group of consumers involved in the company's product planning group.



FastReact

www.fastreact.com

FINANCIAL YEAR 2015/16

4

NEW CUSTOMERS OF RFA PLM, INCLUDING:

Cleversocks
Denimatrix
Portfolio 2008
Sortz

35

OVERALL NUMBER OF ACTIVE CUSTOMERS

of PLM within the RFA industry, excluding customers cited as new in 2015/16

2,720

TOTAL NUMBER OF INTERNAL USERS WORLDWIDE

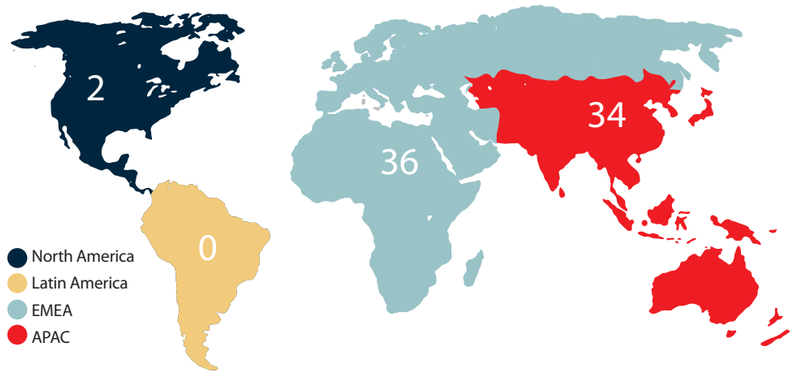
480

TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE

10

NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
$1-2 million

Implementation & services revenue:
$1-2 million

All maintenance revenue:
$1-2 million

R&D investment:
$0-2 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

Our browser based PLM, Vision^{ng}, is a reflection of our unparalleled reach through the fashion supply chain and features further enhancements to critical path management and supplier collaboration at its core. From materials, to garments and POs, critical path is handled in a highly visual, integrated, intuitive manner, with prioritised tasks, colour coded early alerts of issues, and fast drill down for detail and rapid updating. The addition of smart workflows avoids the need for unnecessary updating and screen navigation, improving the user experience, data integrity and efficiency. Supplier collaboration now includes drag and drop functionality and 'what if' planning for high level management of demand and supplier capacity, with tracking of PO status through to delivery. In core PLM functionality, our latest bi-directional Ai plugin maximises designers creative focus and minimises administration, while leveraging the power of PLM, and Range Planning now includes mood boards, and auto-generated bookmarks for focused range development around materials, colour palates, options and price points. A new sample management module allows the creation, management and tracking of sample POs and stock. There have also been further improvements in the UI, with global search functionality and navigational short cuts, driving improved UX and rapid adoption.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

Innovation, speed to market and cost price efficiency, continue to be the major drivers shaping the industry as retailers and brands focus on 'playing closer to the market' to maximise full price sales, whilst minimising inventory and write downs. This has been on the agenda for some time, and an increasing number of businesses are embracing technology to support the streamlining and control of their processes, from design and product development to sourcing, garment and fabric production. Perhaps the biggest opportunities for improvement lie in tools which support a more collaborative, agile and efficient supply chain, with buyers and vendors sharing information and working more closely together to internationally recognised standards (a common language) and to common goals. Adoption of 3D technology is having profound effects in sampling and fits, while cloud computing allows mobile, universal access to shared data and 'one source of the truth'. Manufacturers interest in PLM is growing as they seek to add further value to their proposition to buyers, or launch their own brands, and further investment is taking place in technology which supports time-cost benchmarking and manufacturing planning to improve speed and operational efficiency, but also underpin social and ethical compliance.

GERBER TECHNOLOGY

www.gerbertechnology.com

FINANCIAL YEAR 2015/16

25 **NEW CUSTOMERS OF RFA PLM, INCLUDING:**
Carrefour | General Sportwear | Helly Hansen | Italidea SRL
Mulliez-Flory

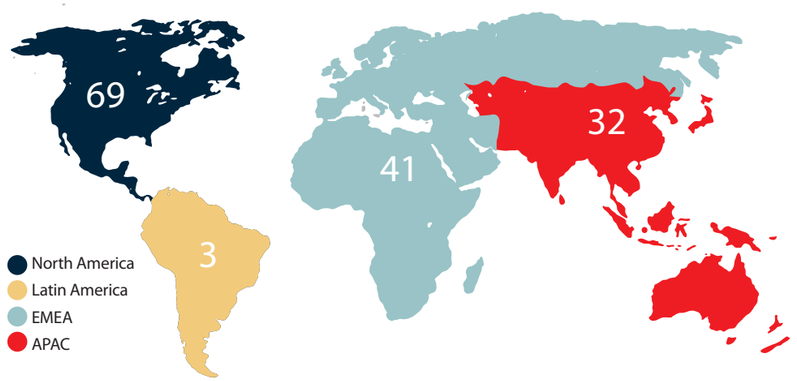
179 **OVERALL NUMBER OF ACTIVE CUSTOMERS**
of PLM within the RFA industry, excluding customers cited as new in 2015/16

23,278 **TOTAL NUMBER OF INTERNAL USERS WORLDWIDE**

13,139 **TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE**

49 **NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D**

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
N/A

Implementation & services revenue:
N/A

All maintenance revenue:
N/A

R&D investment:
$6-10 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

Gerber Technology recently launched YuniquePLM® In The Cloud and a subscription based program, making the benefits of a world-class PLM affordable and attainable for businesses of any size. YuniquePLM In The Cloud provides a flexible and scalable solution without having to invest in costly infrastructure.

In the Spring, Gerber also launched YuniquePLM V7 with compelling new features which improve usability and collaborations. Features like user defined interactive notifications and a configurable user interface allow an admin to easily add, remove, or rearrange fields across the application with a few simple clicks. YuniquePLM V7 also integrates seamlessly with Gerber Technology's AccuMark® CAD system eliminating errors and time associated with manually re-entering data.

Gerber Technology is leveraging the Internet of Things (IoT) with a complete digital solutions offering, connecting PLM, CAD, and smart machine in production environments to help businesses drive efficiency, shorten lifecycle times, enhance workflow, automate critical processes and improve collaboration while adopting cloud technology to help drive this process.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

IoT, Cloud and 3D technologies are clearly becoming the fastest growing trends in the industry and Gerber Technology is striving to simplify the process for our clients to not only access a single point of truth from anywhere that they operate, but how they communicate and interact through their entire supply chain.

Utilizing these technologies, Gerber allows our clients to respond quickly to ever-changing consumer preferences giving them the ability to scale quickly, easily and affordably.

Finally, Gerber believes that it's important for our applications to integrate easily with other workflows and products. APIs are a critical element we are continually refining, thus allowing for extended utilization of PLM and an increased offering of capabilities and tools through Gerber's technological partnerships.

AN ADVERTORIAL BY

GERBER TECHNOLOGY

For Fashion and Apparel, the Internet of Things (IoT) Delivers Efficiencies through Data Sharing and Collaboration

Bringing the Vast Internet of Things Into Focus

As the latest advancement in the ongoing evolution of connected technology, the Internet of Things (IoT) holds expansive potential: it promises seemingly limitless possibilities for communication and information exchange among sensor-enabled products and smart devices outfitted with applications to receive and analyse the data these products share.

The term is perhaps best understood by consulting the man generally credited with coining it, innovator and product tracking expert Kevin Ashton[1]. One of the major premises of the IoT concept is that while computers have been informed and equipped by humans to process ideas, in the real world things matter more than ideas. Therefore, the thrust of IoT is to employ information technology to its full potential by applying it to products, machines, and other physical objects of all kinds in the real world[2].

At the consumer level, many of these products are garments, and the IoT already has forged inroads in the fashion industry with several high-profile innovations. Leading the way was inventory tracking of apparel products throughout the supply chain via embedded radio frequency identification (RFID) sensors that carry a digital identity (a technology pioneered in large part by Ashton's contributions).

Embedded Sensors Enabling Apparel With Smart Functionality

The focus has now shifted to creating fabrics and garments embedded with chip technology that provides a function to the wearer, with many such garments already available for the health and wellness market. Fitness wear of different types and styles is embedded with miniature, washable sensors (or larger, removable ones) that track physiological data, such as heart rate and respiration, that provides meaningful feedback to the wearer via a smartphone app. An abbreviated list of recently introduced smart apparel products include garments that can gather solar energy, charge a cell phone, monitor an infant, pay for a retail transaction and provide safety lighting for airline workers[3].

Joint Venture Hints at Developments for IoT in Apparel Industry

Some equally sophisticated developments are in the works that will have a far-reaching effect on the apparel industry. EVRYTHNG IoT Smart Products Platform, a recently announced joint venture aims over the next three years to embed more than 10 billion apparel and footwear items from major fashion and performance brands with a digital label accessible to the consumer via a smartphone app. After purchasing the items, consumers will be able to find out the product history, brand, care and reorder information, as well as unlock personalised digital content, among other functions.

The agreement, between packaging materials and labelling giant Avery Dennison Retail Branding and Information Solutions and IoT smart products platform pioneer EVRYTHNG, offers just a glimpse of future prospects for IoT in the apparel industry[4].

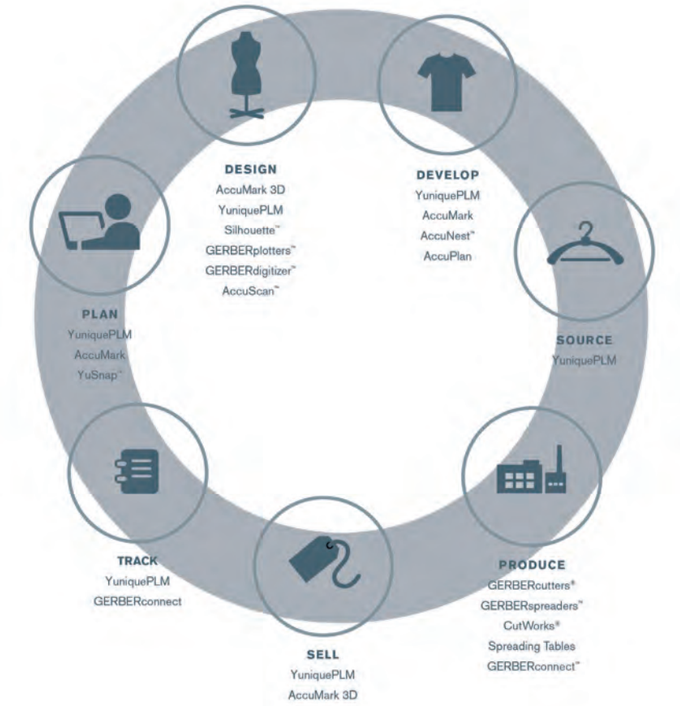
Manufacturers Eyeing IoT investments Sooner Rather Than Later

It's safe to say that manufacturers worldwide are expressing interest and confidence in IoT technology. According to a 2015 survey by the supply-chain-management learning community SCM World, about 40 percent of respondents said they believe the time is right to invest in smart manufacturing, along with its foundational technology – the Internet of Things[5].

Two recent studies by Cisco Consulting Services support this hunch, estimating that the Internet of Everything (equivalent to the IoT) will create $14.4 trillion of value for the global private sector in the next decade. That dollar value translates into the opportunity to increase global corporate profits by 21 percent. Firms that lag in adopting these technologies may risk loss of profit, market share and potential long-term viability[6].

Existing "IoT-Ready" Technology Now in Place With Product Lifecycle Management Systems

Technology already in place in some apparel manufacturers can be considered "IoT-ready." for example, smart sensors installed in spreaders, cutters, and all types of production equipment can readily capture key performance metrics in real time, sharing this information both with other machines, and with design and production teams to provide actionable insights.



Beyond the shop floor, product-related data—from planning, design, and costing to project management and distribution channels—stored and accessed from cloud-based services, is now visible and accessible across the enterprise, and by global partners. These product lifecycle management (PLM) systems are made possible by storing the specifications and data associated with each garment in a common file language accessible to contributors in real time.

PLM software eliminates the creation of separate spreadsheets by different teams within the company by generating a single, accurate garment "snapshot" represented in a common file language that is accessible in real time, for a seamless transfer of data from one module to the next.

> Manufacturers worldwide are expressing interest and confidence in IoT - about 40 percent of respondents said they believe the time is right to invest in smart manufacturing

These modules combine to create a transparent system that connects and integrates a company's creative process with its supply chain and production process, resulting in substantial benefits: faster time to market, optimised material use, minimised errors, reduced labor costs and improved inventory controls. Manufacturers that have implemented this technology have realised improved efficiencies and a marketplace advantage in the extremely competitive fashion industry.

Unique Competitive Environment Challenges Apparel Manufacturers

Apparel manufacturers, who serve discerning customers and operate under tight production timelines and stringent cost parameters, are positioned to realisze the multiple benefits of IoT manufacturing. Whether they produce volume apparel for mass markets or small, custom lots, apparel manufacturers need access to management tools that collect, share and analysze data within the shop floor and across the organisation.

"Regardless if of whether you're producing 10,000 shirts a day or personaliszing jerseys for a sports team, the key to success is a digitiszed network that allows you to move information throughout your supply chain down to the equipment level and back," said Mike Elia, CEO of Gerber Technology, maker of YuniquePLM software. "Integrating the flow of data and leveraging IoT technology provides companies with the valuable insight they need to remain agile and optimisze their supply chain."

Integrating the Consumer: The Personalised Trend in Apparel

To date, such data-sharing technology has proven effective in the mass production environment. While many segments of the garment industry operate only under this mass automation approach, Gerber also sees continued growth in personalised apparel. The company enables digital sharing technology as applicable for mass customisation, enabling manufacturers to meet made-to-measure specifications while optimising inventory levels.

Smart Technologies Can Help Deliver: Right Product, Right Time, Right Price

Implementing technologies based on network sharing of product development, production and distribution data will enable apparel makers to get their garments to market faster and more cheaply, maximisze revenues, and capitalisze on fashion trends. And importantly, the accessibility of these technologies to smaller apparel manufacturers will empower many to become competitive on a regional and even global scale

The Internet of Things is transforming from an abstract vision into a set of tangible tools that can help the apparel industry efficiently and cost effectively meet its primary aim: to deliver the right products at the right time and at the right price. And systems in back-end design, production, and management are gearing up to make this vision a reality.

SOURCES:

[1] www.smithsonianmag.com/innovation/kevin-ashton-describes-the-internet-of-things-180953749/?no-ist

[2] www.rfidjournal.com/articles/view?4986

[3] www.techinsider.io/innovative-smart-clothes-2015-12

[4] news.averydennison.com/press-release/corporate/avery-dennison-and-evrythng-switch-apparel-industry-10-billion-products-worl

[5] www.industryweek.com/manufacturing-smarter

[6] www.cisco.com/c/dam/en_us/services/portfolio/consulting-services/documents/consulting-services-capturing-ioe-value-aag.pdf

HUMAN SOLUTIONS ASSYST AVM

www.human-solutions.com

FINANCIAL YEAR 2015/16

4 **NEW CUSTOMERS OF RFA PLM, INCLUDING:**
Brax
s-gard
Haltex
Karstadt

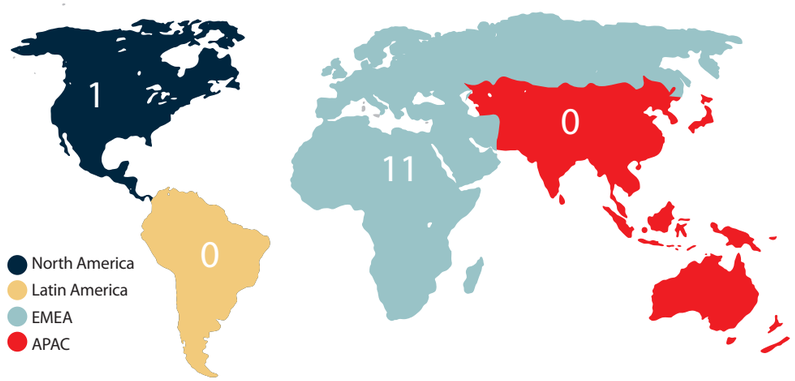
65 **OVERALL NUMBER OF ACTIVE CUSTOMERS**
of PLM within the RFA industry, excluding customers cited as new in 2015/16

2,300 **TOTAL NUMBER OF INTERNAL USERS WORLDWIDE**

N/A **TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE**

24 **NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D**

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
$1-2 million

Implementation & services revenue:
$1-2 million

All maintenance revenue:
$1-2 million

R&D investment:
$0-2 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

We have made PLM GoLive faster, redesigned BOM and integrated a Reporting Tool and a SCM Solution. Above all, we have improved our fashion apps "Dashboard", "Product catalogue" and "Snapshot" and developed a new App.

PLM GoLive has a consistent and proven reference process for apparel development. A company only has to change what's really important for the individual process.

As a standard system, PLM GoLive exploits technical innovations with every release - the system is always future-proof and combines many Human Solutions Group technologies, so there are no extra outlays. These include Cad.Assyst, ERP BOS, Vidya and iSize.

And we offer global flexibility: PLM GoLive is available as a local, a remote and a web client. This makes it available anywhere and anytime – and the user decides who accesses what. Program and data can be hosted in the Human Solutions Cloud, in your private Cloud or by network.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

The whole fashion industry is moving faster and faster - companies have to deliver their goods in shorter intervals. Apps, the Integration of technologies, collaboration of people working together in one project from different parts of the world, quality assurance and creative design become more and more important.

We see PLM systems as a process and data guarantee. And the better this system manages and distributes your product data, the more economically a company can work. That's why PLM GoLive combines all process elements, integrates central tools like CAD, 3D with Vidya and ERP, helps to optimally organize daily operations and gets all the data and files to where they're needed. It's also a valuable tool for translating strategy into practice. PLM GoLive is a control center if you want to be faster to market, increase product quality and reduce costs.

How does the future look? PLM is the backbone of the development process and instantly provides a seamless process (also in the Cloud upon request), from the first draft to the store – a process which every company can freely customize. Employees, locations and partners are all flexibly linked.

Pure Fashion PLM.
PLM GoLive – from collection framework planning to production

This is how PLM should be – right at the heart of your collection development with a full reference process and with amazing potential for your business in terms of costs, time and quality.

Manage your data
Variants, files, lists
Men, women, children
Outward processing/full purchase

Accelerate your processes
Wide functionality
Workflow automation
Integration – from CAD to ERP

Collaborate worldwide
Desktop, Web, Cloud
Multi-brand, multi-lingual
Integration of teams, sites, partners

NEW: Fashion Apps
Dashboard, Product Catalog, Snapshot

More information on www.human-solutions.com or contact@human-solutions.com

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Textile and fashion industry production in transition

THE DIGITIZATION OF EVERYDAY LIFE IS PROGRESSING CONTINUOUSLY, AND SMART PHONES AND CO. HAVE BECOME INDISPENSABLE IN THE EVERYDAY LIVES OF MANY OF US. THE "INTERNET OF THINGS" IS ALSO FORGING AHEAD – BUT WHAT DOES THIS MEAN FOR THE TEXTILE AND FASHION INDUSTRY? IN THIS INTERVIEW, DR. ANDREAS SEIDL, CEO OF HUMAN SOLUTIONS GMBH GIVES US HIS INSIGHT INTO AN INDUSTRY IN TRANSITION AND PRESENTS DIGITAL SOLUTIONS FOR THE ENTIRE PRODUCTION CHAIN IN THE APPAREL INDUSTRY.

In Germany the term "Industry 4.0" is dominating public debates even more than the "Internet of Things". How are these two concepts interrelated?

The "Internet of Things" is becoming the focus of attention for us as consumers and we could be totally surrounded by numerous, interconnected everyday objects in the near future – indeed, this is even happening now to a somewhat lesser extent. In Germany the current debates are all about another term called "Industry 4.0". This focuses on the perspective of the companies that produce these goods. It concerns the production itself, but it also takes in the big picture, the labour market and the economy.

The Internet is the driving force behind this development; our real world is merging with a virtual world to form the "Internet of Things". This is changing the way goods are produced, for in future production will be increasingly characterised by intensive customisation of the products, which will often be created using highly flexibilised, large-scale production methods. Customers will be fully or partially involved in business or value-added processes. This will change many processes within companies.

The textile and fashion industry can look back on many years of tradition in Germany. To what extent is the industry involved in Industry 4.0?

In recent years, the textile, clothing, leather and footwear industries have had to outsource their production to low-wage countries to withstand the pressure of global competition. In spite of that, the textile and leather-processing industries in Germany are very successful. There are around 1,200 textile-processing companies in Germany and their 400,000 employees develop, produce and market products at home and abroad. The cost of production in low-wage countries has increased considerably in recent years, so Industry 4.0 offers a realistic chance to become competitive for companies that relocate close to their sales markets again.

Does that apply to the entire industry?

I believe that the market for technical textiles should be separately dealt with here. Many technical textiles play a key role in the "Internet of Things", because products and materials are included that have a large number of special technical functions and capabilities, setting them apart from the traditional textile fabric. Technical textiles are used in a variety of industries. Examples here are the airbag in the automotive industry, the mattress with antibacterial properties and the glove used for operating a smartphone. Industry 4.0 creates a solid foundation to enable the research and development of the necessary technologies, machines and processes, making them useful for the specific requirements of the apparel, shoe and leather industries and for the processing of technical textiles.

To what extent do the technologies like those sold by the Human Solutions Group support this process?

We are watching the discussions about the "Internet of Things" and "Industry 4.0" very closely. Our aim is to offer technologies that make development and production more efficient, while providing the centralised sizing & fitting data of different target groups at the same time – the human being is at the hub of all our considerations. We have this in common with many products that are typical of the Internet of Things. We seek to build solutions for the entire production process in the fashion industry, from the first sketch to the sale of the finished product. We see a key to success in the digitization of worksteps, one which streamlines the production process, but only at the points where it can be done – because there are still many steps that must be performed manually during the production of footwear and apparel.

What role do PLM systems play in the concept of industrial 4.0?

A very central role! PLM is the heart of development and a stimulus from the first draft to product delivery. Industry 4.0 enables the cross-system and cross-company networking and integration of entire value creation networks. It's based on industry-specific standardisation, in which the mechanisms for exchanging information are set to neutral for hardware and software. This should not be done at the control level, but in intelligent manufacturing control systems like PLM or ERP systems that can manage the entire production process technologically. We can already link all process elements today with PLM products like GoLive – they can integrate with central tools such as CAD, 3D simulation software like our Vidya solution, and ERP. This helps to optimally organise daily operations and implement strategies in practice. PLM can become a useful tool in terms of time, costs and quality.

Human Solutions offers a data portal for body dimensions with iSize. Can you see any associative links here to the "Internet of Things" concept?

Absolutely, because for us the production process in the apparel industry starts with the definition of the right target group. Users can find comprehensive data from many international serial measurement surveys in our portal or, for some elements, elsewhere, and the market shares of different clothing sizes can be derived from that data. The goal is not to just measure test persons; we should also be acquiring socio-demographic data that can contain valuable information, especially for the "smart wearables." This data pool is being continuously expanded. We are currently making preparations for the first representative serial measurement in the US and Canada – performed with 3D body scanners.

If many worksteps in apparel production are still being performed manually, where do you visualise the starting points for digitisation?

Clearly in the creative process of designing, because three-dimensional digital designs can replace prototypes that were previously sewn and shipped halfway around the world. Digital prototypes also facilitate communication among partners – coordination is sped up, since colour and pattern variations are available to partners immediately. We even believe that 3D software like Vidya can do a lot more than a realistic design, because it simulates people using real body measurement, body volume and movement behaviour data. A simulated 3D garment can consist of the sewn CAD pattern pieces, just like in real life.

Are there any important products that already influence the digitisation of the production process in the textile and fashion industry?

Yes, there are: our company Assyst developed a product for digital textile production in cooperation with other companies. In addition to digital design and pattern piece development, we built a process called "Simulate, Print and Go!" that also achieves the placement of the design in virtual 3D space and the automatic generation of colour-consistent printing files. These prints can be produced in different qualities and in any batch sizes. The process opens up new avenues in the creation and production of printed products for the apparel industry.

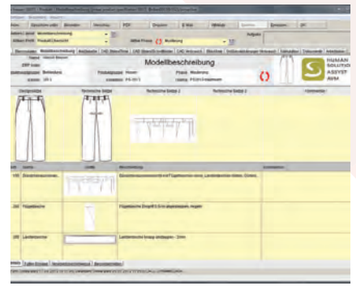
Which technological steps will now be necessary to make the apparel industry fit for Industry 4.0?

There's still a long road to travel and it must be researched and developed at many locations. A meta-layer, for example must be developed and standardised to enable machines to communicate with one another. They have to incorporate control systems and cater to industry-specific requirements and fields of activity. Production today is still very much oriented on mass manufacture. However, the demands for more flexible and more configurable systems presuppose that each machine can adapt to the product that has to be manufactured. New business models must also be developed that offer customized apparel for the price of mass-produced garments – and all the processes will of course still be planned and monitored by human beings. This will enable the creation of completely new occupations within the industry; but the requirements for existing tasks will also change.

About Dr. Andreas Seidl

Andreas Seidl has been CEO of the Human Solutions Group since 2002. His concept to place the human being at the center of product development and manufacturing is new and globally unique.

Dr. Engr. Andreas Seidl graduated in communications engineering and electronics, then studied electrical engineering and cybernetics at the universities in Graz and Munich. Between 1990 and 1994, he completed his doctorate studies at the Technical University Munich and the Catholic University in Eichstätt. He was awarded his doctorate with honours in 1994 in Munich. Within the context of his scientific and professional activities, Dr. Seidl has published more than 60 articles on ergonomics, human modelling, body measurement, body scanning and mass customization.



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FINANCIAL YEAR 2015/16

11

NEW CUSTOMERS OF RFA PLM, INCLUDING:
Not for public disclosure.

77

OVERALL NUMBER OF ACTIVE CUSTOMERS
of PLM within the RFA industry, excluding customers cited as new in 2015/16

1,500

TOTAL NUMBER OF INTERNAL USERS WORLDWIDE

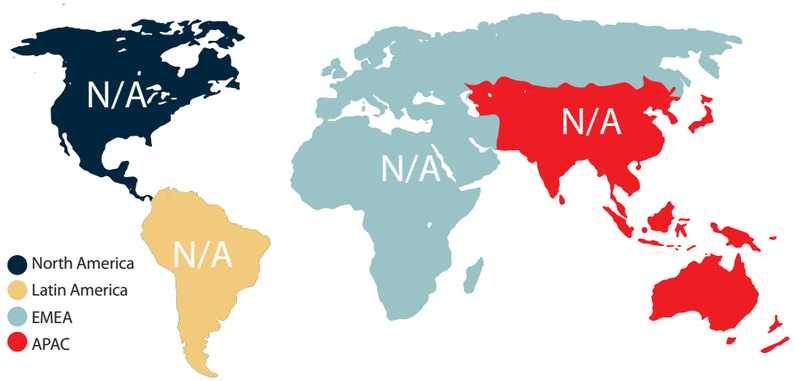
300

TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE

N/A

NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
$1-2 million

Implementation & services revenue:
$1-2 million

All maintenance revenue:
$1-2 million

R&D investment:
$0-2 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

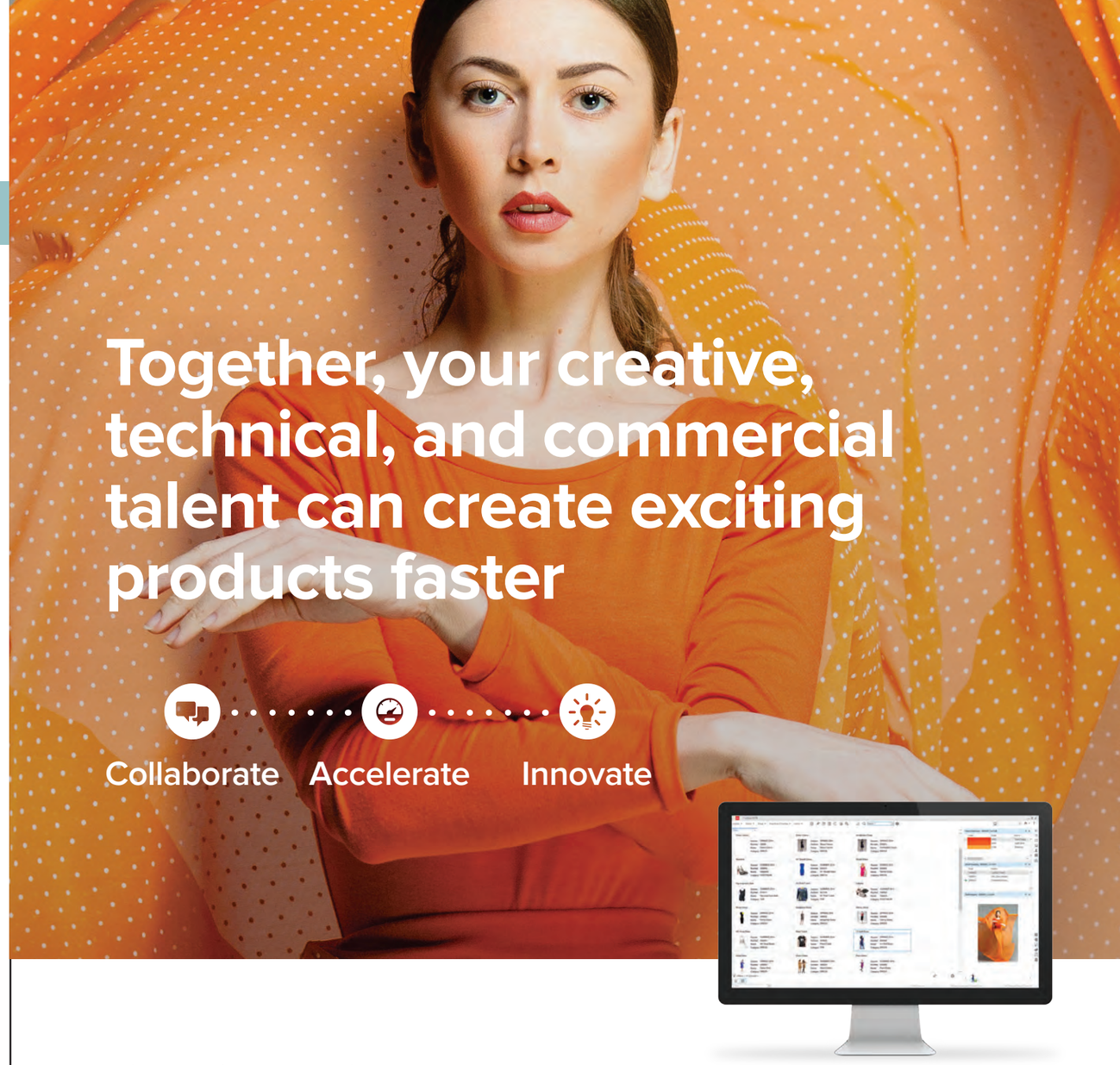
Infor Fashion PLM 15.1.7.0 is the latest delivery of Infor's PLM product, which is specifically for apparel, footwear, textiles, and fashion accessories companies. Infor Fashion PLM helps create the foundations for faster work, greater flexibility and a superior user experience. This latest version is designed to help improve speed and collaboration from merchandise planning to partner collaboration and includes:

- **Bi-directional Adobe plug-ins**
- **Industry-leading user experience**
- **Intuitive planning & development**
- **Time-saving "mass" functionality**
- **Easy sample order generation**
- **Get to market faster with 24/7 vendor collaboration**
- **Graphical drilldown and critical path tracking**
- **Built-in analytics & reporting**
- **Training time slashed**
- **Integration that accelerates business**

The software was designed with the help of Hook & Loop, Infor's in-house design agency, to empower creative, technical and commercial teams to collaborate and unlock the full potential of the business. The software includes a configurable user home page and driven processes for a new level in user experience and greater speed in daily activities. Infor Fashion PLM is designed to be intuitive to use, which can speed up user adoption and reduce training requirements.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

The fashion industry thrives on innovation, speed, and sales (omni) channels. New products are critical to business success, but only half of them achieve the profit objectives set before launch. To improve the ratio of hits to disappointments, it's essential to listen to the consumer and collaborate with the supply chain. Allowing marketing to collaborate more closely with consumers can be a game changer for fashion value chains, with new strategies, opportunities and a fashion-forward influence for consumers to believe in. The consumer sets the bar for value and the supply chain determines whether you meet or miss it. The next decade will call for significant materials and process innovations at both the micro (product) and the macro (enterprise, supply chain, and industry) level. At strategic planning levels, the industry must figure out how to convert to more sustainable ways of doing business, starting with raw materials and R&D, expanding PLM practices to include recycling and multiple sales channels for consumers. Innovations arise at every stage, when all the partners can see the value chain as a whole.



Infor Fashion PLM software

It covers the entire product lifecycle, from sales budgeting and merchandise planning; through style design, development, and costing; to sample and critical path management. Plus, sourcing compliance and vendor collaboration capabilities help protect your brand integrity, ensuring ethical conformity and product quality.

infor.com/fashion-plm

Download information about the new Infor Fashion PLM

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It's Time To Get Ready For A Brave New World

A Human's Guide to the Internet of Things

Imagine a world where you could communicate with physical objects—and they could communicate with you. Where everything from shoes to delivery trucks to cycle paths were equipped to capture and distribute meaningful data in real time. And this information could be used to automate manual tasks and enrich almost every aspect of our lives.

Sounds like something out of a sci-fi novel, but the reality is these capabilities are closer than most people realize—and some are already happening.

Think about today's smart phone apps that let you control your air conditioner remotely, or watches that calculate how far you've run and how many calories you've burned, then post your progress on Facebook.

These are all part of the Internet of Things (IoT) and it's the fastest growing area of technology today. Not only in terms of providing consumers with more intelligent objects, but also in the area of manufacturing where companies stand to increase efficiencies across virtually every aspect of their operations.

As part of a trend towards analyzing all kinds of information within Big Data, IoT's potential is limited only by what you want to capture.

This is such an important development that, according to LNS research, up to 35% of manufacturers are already working on an IoT project [1] while Bloomberg reports that by 2030, the projected global economic value from connected devices could reach $19 trillion [2].

DATA WITHOUT BORDERS

Despite a growing focus on IoT there is still discussion around exactly what it is and where its full potential lies.

Broadly speaking, the concept can be explained as 'a system of connected devices that have the ability to share information with one another'. This connectivity is achieved by embedding electronics, sensors and transmitters into everyday objects or 'things'.

It includes things that are connected to other things, or even to people or animals carrying things. A pet with a biochip transporter, machinery with built in sensors, humans with a heart monitor ... In fact, anything that has a unique identifier and can automatically transfer data over a network could be part of a new connected world.

Regarding its application for the manufacturing industry, the technologies are often referred to as The Industrial Internet of Things (IIOT). Like the broader IoT, this involves a combination of several abilities unified into one cohesive plan.

INBUILT INTELLIGENCE—BUT NOT AS WE KNOW IT

While (IoT) is widely regarded as the next technical revolution, it should be noted that devices have been collecting information since the first days of microprocessors and networks.

Early iterations of Radio Frequency Identification (RFID) technology, for example, first emerged the 1970s. With decades of commercial adoption, the applications include everything from tracking parts along a manufacturing line right through to identifying pets and livestock.

The widespread use of RFID however has been restricted by the cost of the tags, the time needed to fit them, and the investment required to install fixed and mobile readers.

A more important limitation lies in the fact that information captured is usually not in a format that can be easily shared across systems and departments—confining it to a company's intranet.

This is not to say RFID has no role in a digitally connected world, rather many experts believe it will develop into a valuable supporting technology for broader IoT implementation.

Highlighting the need for data integration is a Gartner Report that points out "Many manufacturers already have the foundational aspects of the IoT in place; however, deployments are siloed, and pockets of insufficiently digitalized processes and data flows in the product supply network are now exposed. This hinders manufacturing's ability to get the right data and act on it at the same pace as market events". [3]

THE RISE OF THE MACHINES

What distinguishes today's IoT developments is the ability to capture, analyze and distribute data on a common platform, over the whole of the Internet. This is a result of advancements across four key areas:

1. CONNECTIVITY

Smaller and more affordable sensors and transmitters, together with wireless technology, allow real time communications anywhere and everywhere.

2. CLOUD

Due to the large volume of data that must be stored, and accessed from any point, cloud deployment is at the heart of any IoT strategy.

3. BIG DATA

The ability to process enormous volumes of information, put it in context and present accurate and meaningful results.

4. INFRASTRUCTURE

The development of fully integrated IT environments that allow data to be shared across departments, with customers and with partners throughout the value chain.

An environment where data is received from multiple sources then analyzed and distributed to relevant areas to facilitate actions and enhance decisions.

SUPPORTING A CUSTOMER-CENTRIC FASHION MODEL

When it comes to the nuances of the fashion industry, IoT can add value at every stage of the process—from initial concept, right through to delivery and ongoing relationships.

So immense is the potential that a recent Forbes article notes that even in these early stages, over 10 billion products in the apparel, accessories and footwear markets are already being digitally connected. And the number keeps growing by the day. [4]

A customer-centric approach to fashion

Linking customers to your brand through a digital thread will allow collaboration on everything—from product design and quality control through to logistics, such as delivery times. With technology embedded in their individual purchases, they'll be able to interact with products in an innovative range of ways. Locating lost shoes, reading about garment care, finding style tips, examining how and where something was made ...

And when you align specific product identifiers with CRM data, the options for enhanced customer interactions become almost limitless.

SMART MACHINERY FOR EFFICIENT FACTORIES

With sensors in shop floor equipment, managers can monitor the health of machinery and receive warnings that trigger early intervention.

Over time, the data captured could also be used to develop optimization maintenance strategies that balance asset life, costs and risks.

One study conducted by the US Department of Energy reports that a 30% reduction in maintenance costs can be achieved from a predictive program. It could also reduce downtime by 45%, and eliminate breakdowns by as much as 75%. [5]

TIGHTER CONTROL OF SCM LOGISTICS

With products being transferred between manufacturers, suppliers, distributors, retailer and customers, keeping track of inventory can be a challenge in itself.

This is even more pronounced with the rise of global omnichannel markets, where sales points may be scattered around the world.

By having rich data gathered from products wherever they are, companies have a clear idea of available stock as well as an ability to automate production and replenishment schedules.

Shipping plans could also incorporate information such as weather conditions and traffic for more accurate delivery estimates, better utilization of transportation fleets and reduced fuel costs.

IT'S TIME TO MEET THE FUTURE

Although many IoT opportunities are still in the early stages of development, a study by Industry Week found that about 40% of respondents believe it's the right time to invest in this technology. [6]

Not necessarily in the areas of strategy implementation or data gathering, but rather with regard to overall IT readiness.

Quite simply, to gain competitive advantage through new IoT developments as they happen, you first need an environment that's capable of transforming vast amounts of information into meaningful and actionable insights.

This is where the right software partner plays a vital role.

As a central part of your technical transformation your vendor should demonstrate proven experience in open standards technology, social collaboration tools, cloud technology, enhanced security and scalable networks.

With these capabilities in place you'll have far more than a highly connected and streamlined infrastructure.

You'll be fully prepared for your journey into this brave new world of opportunity.

SOURCES:

[1] LNS Research "Leveraging the Internet of Things to Make the Customer the Center of Everything" LNS Research Infographic

[2] Olga Kharif "Cisco CEO pegs Internet of Things as $19 Trillion Market" Bloomberg, January 8, 2014.

[3] Simon Jacobson "Four Best Practices to Manage the Strategic Vision for the Internet of Things in Manufacturing" Gartner, November 5, 2014.

[4] Rachel Arthur "10 Billion Items Of connected Clothing: The Internet Of Things Just Became A Lot More Fashionable" Forbes, April 21, 2016.

[5] Infor "Estimating the potential benefits of Industrial IoT" Infor, July 25, 2015.

[6] Kevin O'Marah "The Internet Of Things Will Make Manufacturing Smarter" Industry Week, August14, 2015.

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FINANCIAL YEAR 2015/16

6 **NEW CUSTOMERS OF RFA PLM, INCLUDING:**
HOM
Gina Laura

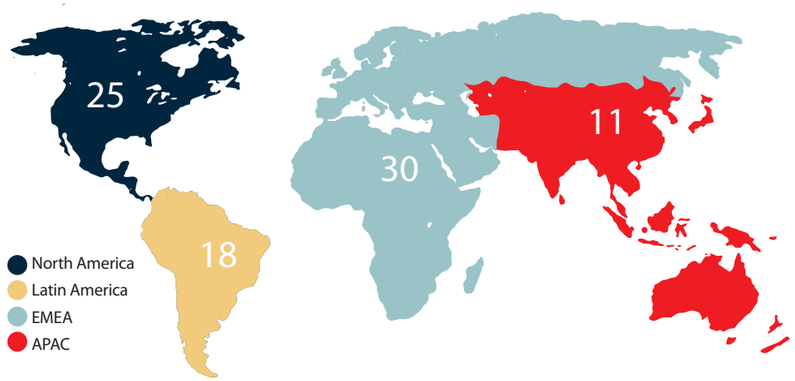
101 **OVERALL NUMBER OF ACTIVE CUSTOMERS**
of PLM within the RFA industry, excluding customers cited as new in 2015/16

5,430 **TOTAL NUMBER OF INTERNAL USERS WORLDWIDE**

2,315 **TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE**

21 **NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D**

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
$1-2 million

Implementation & services revenue:
$3-4 million

All maintenance revenue:
$1-2 million

R&D investment:
$0-2 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

In addition to continuously improving user experience, our focus last year was placed firmly on extending our module portfolio in connection with further developments to our PLM solution. This allows us not only to continuously adapt the user interface to meet user requirements, but also to add important functions to our solution to provide our customers with even more targeted support for specific process steps. The modules make it possible to simplify departmental work processes and thus accommodate the chronological shortening of processing rhythms. In times of increasing collection cycles and higher raw material costs a design-controlled basic collection plan with links to the shop floor reduces the risk of misguided model development or too many costly patterns.

Additionally, creating structured workflows helps companies in the RFA industry to manage deadlines and events across departments for all models and therefore contributes towards sustainable quality assurance and increasing the efficiency of the value-adding process thanks to standardised milestone definitions.

Last but not least, the integration of creative data from Adobe Illustrator in the Koppermann PLM solution has been perfected to increase user convenience and to ensure a rapid and uncomplicated adoption of creative drafts.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

Customer expectations with regard to the global value-adding chain are rising continuously with a particular public focus remaining on the subjects of ecological sustainability and social responsibility.

This is where we see the increasing integration of interactive technologies as one of the biggest trends as it offers a seamless connection between everyone involved in the creative process – from the artistic product developer to the end customer on the shop floor – as well virtually unlimited options for generating active customer feedback.

Positive effects are generated in connection with reductions in the cost of transport and fuel, as well as with efficient warehouse management that enable a significant competitive advantage in times of ever increasing collection cycles.

We can also observe a significant increase sensitisation within the RFA industry with regard to vertical corporate alignment. For us this trend means a growing demand for tailor-made solutions enabling seamless system integration as well as the symbiosis of creative development potential and active shop floor management. The 3D Vertical Planning Module from Koppermann – currently the only one of its kind on the market – turns this trend into reality and is suitable for global use thanks to its technologically unique web-based application.

www.lectra.com

FINANCIAL YEAR 2015/16

6 **NEW CUSTOMERS OF RFA PLM, INCLUDING:**
Galeries Lafayette | Kaltex | Revman | Kyly | Zamasport

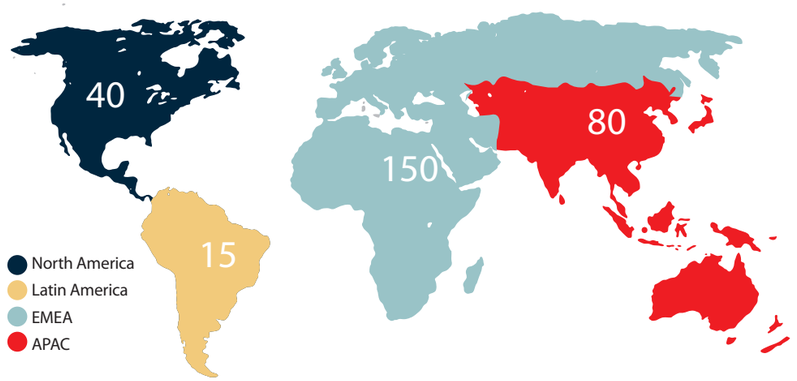
180 **OVERALL NUMBER OF ACTIVE CUSTOMERS**
of PLM within the RFA industry, excluding customers cited as new in 2015/16

5,000 **TOTAL NUMBER OF INTERNAL USERS WORLDWIDE**

N/A **TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE**

150 **NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D**

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
$1-2 million

Implementation & services revenue:
$3-4 million

All maintenance revenue:
$3-4 million

R&D investment:
$11-20 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

Lectra Fashion PLM, based on over 40 years of experience in the industry, is deep-rooted in our three pillars of value – expertise, approach and technologies. Serving our customers with our in-depth expertise, gradual approach and advanced technologies ensures that they adapt to market trends with ease by creating better products faster.

We are going a step further for our customers. Our PLM solution will accompany them from stages as early as conception and pre-production all the way up to manufacturing to improve efficiency right from the start. That way, fashion companies react fast to trends and speed up production without compromising on quality.

Adopting Lectra Fashion PLM brings about a new way of working and thinking. By providing greater visibility of the entire design-to-production process that is paired with a step-by-step project management methodology, customers get to adjust their value chains according to the requirements of today's competitive market.

Lectra Fashion PLM's strength stems from its long history of working in the fashion industry and solid research and development experience. Having produced other successful solutions for design, pattern- and marker marking, Lectra is confident that its PLM solution will expand technological horizons for its customers.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

The digital age has prompted consumers to lead the production line as they become active participants in the making of their products. Fashion companies now need to become more customer-oriented and move towards a more integrated supply chain.

Nowadays, retailers and brands have to produce goods that are more personalized to satisfy the specific needs of their target consumers. This means that they have to be more adept in collection planning and product development in order to deliver more capsule collections, mass-customized and made-to-measure items. Meanwhile, more data-driven collections are being developed, where production is planned according to point-of-sale data from stores via CRM platforms.

On the supply side, manufacturers are playing a more active role in the design and product development processes of their customers' products by becoming service providers. The supply chain has become more integrated as a result, as both manufacturers and retailers have to share information on pricing and profit margins in order to offer the best value proposition to consumers.

As a result of more knowledgeable and demanding consumers, retailers will not only use 3D technology to improve fit during the product development process, but will also be used during the entire design-to-production process as well.

CREATE BETTER PRODUCTS FASTER

LECTRA FASHION PLM

// EXPERTISE //

// TECHNOLOGY //

// APPROACH //

The growing complexity of the fashion industry has prompted companies to adjust their traditional business models in order to remain innovative and competitive. Lectra Fashion PLM helps companies adapt to market trends with ease by enabling them to continuously develop products that appeal to consumers. By improving design-to-production teamwork, fashion companies can create better products faster while boosting overall business performance.

lectrafashionplm.lectra.com

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Garment manufacturing
in the age of the Industrial Internet

The commoditisation of sensor technology and the spread of embedded systems are opening a brave new world of consumer engagement. From smart clothing to life accessories, fitness trackers and smart jewelry, wearable tech is already a reality. In the future, clothing and accessories will connect to people, places and spaces and communicate on the wearer's behalf, interacting with the physical and virtual worlds in a redefined time-space called the Internet of Things (IoT). The quality of real-time information captured by these connected objects will forever transform the delivery of goods and services. At retail level, multitudes of sensors will relay information on in-store stock levels, the comings and goings of shoppers and their evolving buying patterns. Beyond bricks-and-mortar stores, data registered by e-commerce sites, mobile applications, smart watches and other 'wearables' will also provide deep insight into consumer shopping habits. In the future, sensors embedded in smart clothing will even interface directly with the human body to track wellness metrics.

More importantly, these transformational changes will create opportunities to enhance brand sentiment through new forms of interaction between brands and consumers. The extension of connectivity beyond dedicated computing devices into everyday objects is driving change outside the realm of the business-to-consumer retail environment and fueling the creation of smart, connected clothing and accessories with significant consumer appeal. The increasing prevalence of remote technologies is impacting the way companies manufacture products, too. The 'Industrial Internet of Things', or IIoT, is already shaping the way ready-to-wear clothing and accessories are manufactured. The ongoing integration of complex physical machinery with networked sensors and software is revolutionising capacity planning and decision-making, removing the guesswork from many critical processes and streamlining the flow of information to the point where stocks will become entirely unnecessary.

> All garment manufacturers aim to derive more value and returns from their industrial assets.

WHEN BIG IRON MEETS BIG DATA

All garment manufacturers aim to derive more value and returns from their industrial assets. Today, experimental new applications of software and analytics are producing novel approaches to the improvement of industrial asset operations. The integration of cloud-based analytics ("Big Data") with industrial machinery ("Big Iron") offers a tremendous opportunity for productivity gains. Technologies can be leveraged to drill down into data for insight into asset performance and all related processes, enabling substantial increases in productivity and efficiency.

IIoT is essentially an extension of the automation and connectivity enabled by machine-to-machine (M2M) communication in the plant environment. To realise significant industrial efficiency savings, it only takes an incremental change of one or two percentage points of increased efficiency through data analytics. The real breakthrough, however, lies in the fact that the kind of computing, data management, software and analytics capabilities making these savings possible are no longer limited to large multinational corporations. The democratisation of technology has brought enterprise IT to small to medium-size businesses SMBs, making it possible for smaller players to derive gains from analytics, too.

Industry 4.0, the fourth industrial revolution, capitalises on these evolutions in automation and connectivity to offer a decentralised production model at plant level, from the design stage through to supply chain interaction, manufacturing, distribution and customer service. The Industrial Internet covers these same processes, only with a reach well beyond the walls of the manufacturing plant. In both contexts, machines, analytics and people all interact. The enhanced efficiency made possible by Industry 4.0's embedded systems, automation and robotics can be further enhanced by the Industrial Internet's potential to interconnect entities and relay powerful analytics in real time to harness the value in raw data.

BUSINESS DISRUPTION THAT BRINGS OPPORTUNITY

Data-driven operational excellence will enable manufacturers to achieve as-yet-unseen levels of productivity and product quality. The transition from M2M and plant networking to full-scale IIoT presents interesting challenges that manufacturers will have to address, however. The key lies in transitioning from the relatively closed environment of connected factories as they exist today. Most were designed only to communicate within the plant network, not necessarily with the outside world.

With the right infrastructure to implement decentralised production control, industrial assets will configure themselves automatically, enabling more flexible production planning and control. By crossing integrated databases and deploying advanced analytics, manufacturers will also be able to benefit from automatic detection of inefficiencies and prediction of quality issues. New software-defined machine infrastructure will virtualise machine functionality in software, decoupling machine software from hardware. Industrial assets will be automatically and remotely monitored, managed, and upgraded. A shift to preventive, condition-based maintenance will take place, enabling machines to be serviced before they even break down. With the advent of zero unplanned downtime, production line stoppages and factory shutdowns will become a thing of the past.

In the same way that brands are investigating opportunities to engage differently with consumers, the Industrial Internet is helping the entire supplier ecosystem to re-think the way it works. Networked embedded systems and automation, the development of new software products, and the delivery of new services like analytics-driven services will transform the way supply chain players interact. More business insight will be derived from data and shared as connectivity and automation are increasingly deployed. Sophisticated new forms of multilayer decision support will help to guide both business strategy and operations management. New revenue streams will also be created by capitalising on business insight derived from the mass collection of data. Although the benefits of IIoT are very real and equally attractive, exposing company information to the risk of hacking, viruses and destructive malware is a serious consideration, as is data protection. As a result, new data security standards and protocols will more than likely emerge in the years to come.

CONNECTING THE DOTS WITH PRODUCT LIFECYCLE MANAGEMENT (PLM)

Garment manufacturers today strive to be more agile and efficient in the face of increasing complexity, globalisation and cost pressures. Regularly confronted by changing market conditions and consumer preferences, they aim to build an infrastructure sufficiently robust to support their geographic expansion and extensible and scalable enough to benefit from flexibility.

The digitalisation of processes—from concept to finished product—offers the most direct path to achieving these goals. This entails the creation of digital value chains enabled by specific Product Lifecycle Management (PLM) capabilities. Only a platform specifically developed for the fashion industry, connecting all players in real time and providing a 360° view can guarantee optimal management of a fashion collection lifecycle.

To derive the most value from the opportunities that will abound in the age of the Industrial Internet, manufacturers will have to incorporate IIoT into their PLM roadmap. Their long-term PLM strategy must not only align with corporate vision and goals, but also take into account disruptive new technologies, shifting supply chain dynamics and emerging standards and security protocols. By supporting their strategies with an integrated PLM solution, manufacturers can empower their operations with the right infrastructure and capabilities to tap into a world of opportunity beyond the plant, gaining competitive advantage along the entire product lifecycle.

Leveraging the product lifecycle from design to production is critical to designing and manufacturing on-trend fashion. Having product visibility at each step of collection development is key to reaching business objectives and preserving brand equity. The right PLM roadmap can furthermore support innovation and increase margins, enabling brands to extend their range and grow. To ensure maximum control over product quality and cost, PLM software solutions enable manufacturers to streamline each step of the collection development process, enabling collaboration and control from planning to creation to pre-production. PLM platform capabilities offer a complete, constantly updated view of the full range of business processes in order to manage priorities, expedite development cycles and reduce time to market.

PIONEERS OF INDUSTRIAL IOT

Connectivity in production environments is nothing new, and pioneers of industrial IoT have been adding smart elements to their manufacturing hardware for some time. A pioneer of industrial IoT in the cutting room, Lectra first endowed its Vector fabric cutting solutions with built-in connectivity in 2007 and today offers a full range of value-added smart services including remote monitoring and predictive maintenance.

This experience on the ground was also instrumental in shaping the development of Lectra's Fashion PLM product, which draws on 40 years of experience in garment manufacturing to cover every stage of the collection lifecycle. By relying on native connectivity where the digital and physical worlds meet, its capabilities help companies track production planning, resources and costs, as well as manage complex relationships with external suppliers, boosting their overall performance. Lectra's goal with the advent of the Industrial Internet is to streamline processes by synchronising the interaction of people, materials and costs, enabling creative designers and technical teams to collaborate seamlessly regardless of location, accelerating the approval process and reducing costs. A pioneer of industrial IoT in the cutting room, Lectra first endowed its Vector fabric cutting solutions with built-in connectivity in 2007 and today offers a full range of value-added smart services including remote monitoring and predictive maintenance.

NGC
new generation computing

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FINANCIAL YEAR 2015/16

15

NEW CUSTOMERS OF RFA PLM, INCLUDING:
Jump Design Group | Brian Brothers (Jordan Craig) | Xcel Brands
Echo Design Group | Dreamwear Inc. | Jenny Yoo Collections
Elan International | IHL Group | Orchard Brands | Bluestem
AlphaBroder

125

OVERALL NUMBER OF ACTIVE CUSTOMERS
of PLM within the RFA industry, excluding customers cited as new in 2015/16

25,000

TOTAL NUMBER OF INTERNAL USERS WORLDWIDE

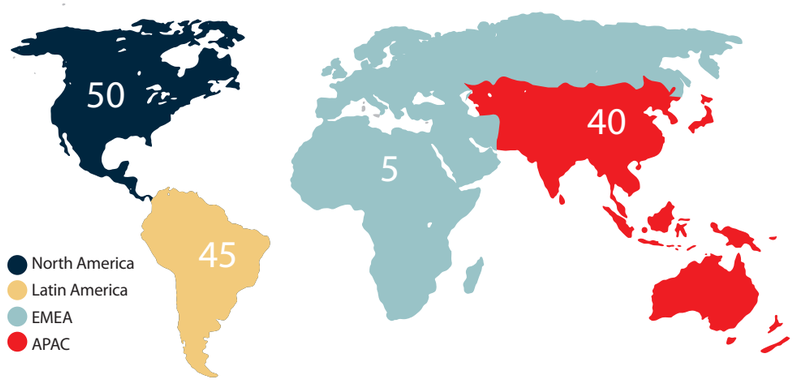
40,000

TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE

140

NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
$11-20 million

Implementation & services revenue:
$11-20 million

All maintenance revenue:
$8-10 million

R&D investment:
$6-10 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

NGC continues to add new capabilities to our PLM 3.0 "PLM as a Platform" offering, which serves as an enterprise hub for the entire product lifecycle. NGC's PLM synchronizes information from systems including forecasting, planning, production, sourcing, compliance, point-of-sale and social media. This provides visibility and connectivity across the entire enterprise, both upstream and downstream, and eliminates organizational silos – a significant advantage for NGC customers. Global brands and retailers rely on NGC's PLM as a strategic platform to drive lead time reduction both in planning and production, since issues that occur anywhere can be immediately identified and resolved. Connecting information and reacting quickly to problems and opportunities are the two most important ingredients in reducing lead times, and NGC's PLM gives brands and retailers the ability to shave weeks and even months from their product lifecycle.

NGC continues to expand the capabilities of our PLM as a Platform offering. New features include our ability to integrate demand signals (from POS and e-commerce systems, for example); this gives NGC customers the ability to react quickly to consumer demand, so they can accelerate or cut back on production, based on sales trends.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

Lead time optimization is the #1 requirement in order to compete in the fashion industry now and in the future. Consumer trends are changing more rapidly than ever, and brands and retailers must increasingly think in terms of "in-season replenishment," with the ability to position materials and reserve production lines with their factories. Successful brands and retailers are the ones that can design and produce merchandise the fastest, and companies can't do this without a PLM-as-a-Platform system.

The Internet of Things is another key trend shaping the industry. IoT holds great promise for ensuring more accurate inventories by tracking and managing inventory throughout the supply chain into the stores, and on to the consumer after the purchase. IoT will ultimately allow retailers to track the movements of a product throughout the store floor, and also direct customers to coordinating items such as pants and shirts that can complete an outfit. While the IoT is in its early stages, these are features that could become commonplace in PLM systems in the near future.

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FINANCIAL YEAR 2015/16

8 **NEW CUSTOMERS OF RFA PLM, INCLUDING:**
C&A | Academy Sports | Skechers | Cosmo Lady | Hallmark

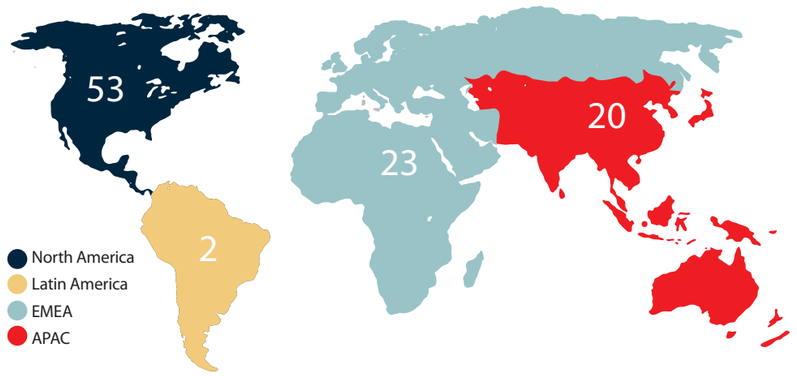
92 **OVERALL NUMBER OF ACTIVE CUSTOMERS**
of PLM within the RFA industry, excluding customers cited as new in 2015/16

68,900 **TOTAL NUMBER OF INTERNAL USERS WORLDWIDE**

20,915 **TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE**

70 **NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D**

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:
$11-20 million

Implementation & services revenue:
$11-20 million

All maintenance revenue:
$11-20 million

R&D investment:
$6-10 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

Next Generation FlexPLM is an open solution that leverages IoT for (1) the delivery of Role Based Apps; (2) greatly enhancing the Digital Design Tools to bring a richer experience, connecting into social media and trend streams; (3) expanding our solution with key software and services partners such as Optitex, First Insight, Nexgen Packaging, MESH01, and ITC InfoTech; and (4) setting the stage for our industry leading vision of the Retail Transformation Journey.

Digital Design Tools enable retailers and brand owners to bring their concepts to life. These tools focus on streamlining the designer's experience to efficiently capture their inspirations, incorporate social media trends as needed, conceptualize their designs, enrich them with development data, and manage them in PTC FlexPLM.

Next Generation FlexPLM comes pre-packaged with an Internet of Things platform, PTC ThingWorx, that enables retailers and brand owners to easily connect devices (such as RFID systems, beacons, and mobile devices), systems (such as FlexPLM, ERP, POS), and external data (such as social media platform) together. Included with the ability to ingest data is PTC's world-class predictive analytics engine, ThingWorx Analytics, that can analyze the data feeds and yield actionable insights that can improve decision making during the product planning, design, sourcing, and selling activities.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

On the technology front , the use of IoT technologies will "come of age" in the Retail space over the next two to three years. Not only will IoT be an enabler for retailers and brand owners to improve the consumer buying experience, it will support supply chain optimization and better decision making during the product planning, development, and sourcing processes. On the business front, PTC sees a shift where retailers and brand owners alike will increasingly strive for 3 major goals over the next 5 years in order to stay competitive:

- **Seasonless:** Adopting a "seasonless" model of releasing products to market. This model is characterized by continuous delivery of new products to market every month, week, and even day.
- **Personalized:** Developing personalized products that can be customized at "buy time". In an effort to capture consumer loyalty, retailers and brand owners will increasingly release products that can be tailored by consumers to suit their preferences.
- **Transparent:** Enabling bi-directional supply chain orchestration. To effectively executive continuous product delivery to market and provide personalized products, retailers and brand owners will need and find ways to automatically monitor and optimize their suppliers. The suppliers will also need automated visibility into impending product plans and specs.

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The Retail Transformation Journey:
The Future of Retail Product Design & Development

The Retail & Consumer (R&C) industry is undergoing a massive transformation, fueled by the digital consumer, fast fashion, and a 'need for speed' — shortening the product development cycle. With a focus on omni-channel and the consumer experience, you still have to bring the right products to market, at the right time and price; all of this at a time when your supply chain is becoming more global and complex than ever.

The Internet of Things (IoT) is poised to revolutionize the way that retailers address these transformation challenges. IoT provides unparalleled sources of data from connected consumers, products, stores, systems and supply chains, enabling faster time-to-market, products that are personalized to specific consumers' preferences, and greater transparency across supply chains.

The Retail Transformation Journey

The Retail Transformation Journey (RTJ) is the name we give to the process whereby applications of IoT in Retail Product Design and Development (PD&D), can power a digitally-enabled PD&D transformation. We identified four key process pathways that include:

1. Planning Products
2. Creating/Designing Products
3. Sourcing Products
4. Selling Products

These pathways interact to create a synergised PD&D process. For example, utilising customer personas in planning drives the creation of products, which targets the selling of products specifically to that persona. The success of those targeted products then loops back into the planning of new products, seeding the design.

Our aim has been to create a roadmap for achieving Retail PD&D transformation – one that we split into three phases. These phases lead to the ultimate goal of agile, continuous product delivery, informed by the voice-of-the-customer, and delivered through a highly-transparent supply chain.

This diagram describes the three phases of transformation that make up the Retail Journey:

1. Understand – focus on gaining basic insights into historic sales to inform better assortment planning, leverage voice of the customer, and enable basic vendor collaboration
2. Advance – refine market insights to plan by channel, advance PD&D efficiency through 3D design and Augmented / Virtual Reality, develop increased supply chain partnerships and dynamic costing
3. Outperform – shift to a season-less planning model, design/develop to detailed customer personas with personalized products, full transparency with suppliers, including analytics driven sourcing enabling a continuous fulfillment model to market

This article will focus on how IoT and Augmented Reality (AR) in Retail will enable R&C companies to progress to achieve the "Outperform" phase of this Journey.

IoT and AR Enables the Retail Transformation Journey

We believe that a combination of a robust IoT platform, innovative AR toolset, and proven PLM platform will emerge as the best way for R&C companies to achieve this Retail Transformation for the four key process pathways.

Defining the Profile of an IoT Platform for the R&C Industry

An IoT platform (such as PTC's ThingWorx) is a suite of components that enables:

- Remote data collection and management from connected devices and sensors
- Integration with internal and 3rd party systems
- Development of applications that aggregate, analyse, and visualise device and system data

The right IoT platform should integrate with any connected device or system, and also blend in machine learning and predictive analytics – both of which can be leveraged by PLM throughout the PD&D process.

Augmented Reality coupled with an IoT Platform for the R&C Industry

IoT-connected AR is changing the landscape for the enterprise. AR can be used to create a dynamic user experience by overlaying useful data on top of real-world physical objects. By incorporating AR into your IoT strategy, you can dramatically improve PD&D and customer in-market experiences.

Using IoT and AR to Plan Products

The planning of a product line in a PLM tool like FlexPLM can be optimised by connecting both historic and real-time sales data, industry trends, and consumer sentiment. This analytical data is converged with customer persona data, along with product features, pricing, and channel delivery.

The result is a set of dashboards that provide a continuous view of what is selling, why certain products are selling, and what in-market factors are impacting sales. With this information, merchandisers and designers can determine what actions will improve product acceptance in market: raising revenue, sell-through, and net margins.

With AR solutions (such as PTC Vuforia), merchandisers and store operations can visualise where products should be positioned by store profile to maximise revenue.

IoT-provided analytics can determine high performing products and feed AR to visualise optimum store layout, enabling real-time planning in a season-less model that collects channel-rich product requirements that drive PD&D.

Using IoT to Create and Design Products

By coupling an IoT platform with a proven PLM solution, planning requirements can be delivered to product design, enriched with features important to customer persona/market, price points critical to market acceptance, and personalisation options that support consumers' buying choices.

With this IoT-provided information, designers can review assortment requirements in PLM. They can develop products using a targeted design process by leveraging the requirements as guidelines. As candidate product designs are created, they can be evaluated pre-sample to determine if they will resonate with consumers. This evaluation is achieved by leveraging an IoT platform like ThingWorx to connect with social media platforms for consumer testing. The test results are integrated back into PLM, giving designers access to the voice of the customer during the PD&D process. Designers can move ahead knowing that what they are designing is fit to market.

IoT and AR technologies can also improve PD&D efficiency. Cycle time can be reduced by utilizing 3D virtual samples. IoT connectivity can deliver development data in PLM – such as material, colour, and design patterns – to 3D design systems such as Optitex. AR can be used to improve the sample evaluation process by overlying critical measurement data onto physical samples – allowing tech designers and vendors to more accurately view measurement values.

Using IoT and AR to Source Products

As designers move their product designs through the PD&D process in PLM, product developers and sourcing are working collaboratively with suppliers to determine who can best meet their production needs. This process can include ensuring that materials are available, and that sustainability metrics and costing are evaluated in real-time based on updates made to the product specification. This is achieved by integrating supply chain partners using an IoT platform to connect the right information at the right time in the process.

Since IoT enables connectivity between systems, the right IoT platform can retrieve real-time fabric availability and cost from a mill while a product developer is developing the BOM for a given style. Device connectivity can be used for supply chain tracking. RFID tags and bar code sensors/scanners can automatically track raw material production and procurement, as well as finished goods production progress. This visibility into a supplier's performance enables smarter sourcing decisions for season-less delivery.

Pre-production samples can be scanned in factory using AR object recognition (such as the capabilities found in Vuforia) to assess whether production facilities are achieving the intended product requirements. This can drive supply chain optimisation which is needed to execute continuous season-less product deliveries and personalised products.

Using IoT and AR to Sell Products

Product placement in market is now aligned with the plan that achieves the right products in the right channel at the right price and at the right time.

IoT can then be used to enhance the consumer buying experience. It can deliver a frictionless buying experience for consumers by serving relevant product data to a shopper while in-store. Information, such as availability of sizes and colors retrieved from connected inventory systems, or product features retrieved from PLM can be delivered via loyalty apps and in-store digital signage. IoT data connectivity can be used to retrieve a consumer's buying behaviours from a CRM system, then analyse it against products that meet the consumer's criteria, and deliver that information via "intelligent mirrors" as recommended products to the consumer in a fitting room.

IoT can also track consumer behaviours online and in-store to evaluate the level of interest a consumer has with a given product and whether there are barriers preventing a conversion to sales. By leveraging an IoT platform, connected RFID, and beacons, it is possible to track how long a consumer browses a given rack of clothes; detect when a consumer takes an item into a fitting room; and whether the consumer purchases the item. If an item's sales are low, IoT and analytics can provide insight into merchandisers, designers, and developers to seed the PD&D process – such as customer apathy for a given product's design or a fit problem based on try-on events.

Outperform your Competitors by Taking the First Step on your Retail Transformation Journey

At PTC, we have a clear vision of how IoT will deliver compelling benefits to the Retail industry. This article provided an overview of the Journey's pathways and phases, along with an introduction to some of the key enabling solutions to help you get there. Every journey begins with a first step, and in this case, the first (next) step is yours to take. Our goal is to work with retailers and brand owners to develop a customised roadmap for their company's specific journey. The roadmap is designed to help brands and retailers achieve their ultimate vision for the future of the IoT, while ensuring that they realise significant value at each step along the way.

TXT

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FINANCIAL YEAR 2015/16

6 **NEW CUSTOMERS OF RFA PLM, INCLUDING:**
Campomaggi | Dior | ECG (Group ShopInvest) | Kenzo Missoni | Loewe

140 **OVERALL NUMBER OF ACTIVE CUSTOMERS**
of PLM within the RFA industry, excluding customers cited as new in 2015/16

5,100 **TOTAL NUMBER OF INTERNAL USERS WORLDWIDE**

3,400 **TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE**

N/A **NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D**

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)

REVENUE & INVESTMENT INFORMATION

Licensing revenue: **N/A**

Implementation & services revenue: **N/A**

All maintenance revenue: **N/A**

R&D investment: **N/A**

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

TXT's PLM continues to provide a truly end-to-end solution. Many major retailers recognise the large benefits available, in terms of flexibility, efficiency and reactivity, through the integration of core PLM capabilities with Merchandise and Assortment Planning and Supply Chain. Latest advancements are in the areas of:

Master Data Management: As PLM is often the originator of new product information we have extended our capabilities to handle both product information (new product set up detail), as well as additional associated data such as managing store fixtures and window display areas for which products are intended.

Product Portfolio Management: PLM must manage both developed and bought branded goods along their lifecycle from launch to end. TXT Retail customers are using the flexibility and connectivity of the TXT common data mart to capture suppliers' product catalogue data, then select, validate, analyse, and feed back into planning, creative and development processes.

Cloud: Our close partnership with Microsoft ensures TXT customers leverage either on-premise or Cloud as purely a commercial decision.

Mobility: the increased use of mobile is driven by factories and stores. The greatest enhancements have been in use cases for Sales and Store Teams, where mobile applications must be device independent to deliver data to every team member.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

Assortment Planning and PLM integration is now recognised as the key element of Retail end-to-end solutions. Where planning, development and order collaboration are closely integrated, this ensures the accurate planning and execution of customer driven assortments.

Supply Chain Collaboration and PLM ever closer: With ever more complex distributed organizations it is essential that fashion companies have visibility on quality, progress, and interception of delays to gain reactivity from the supply network.

Use of Big data and other growing sources, such as IoT and social communities: Huge quantities of information around customers can substantially help decisions on which products to develop, assort, replenish. The common data mart must be open, flexible and provide real time connectivity to change focus of data use in step with the evolving objectives of the retail business.

Cloud PLM: leveraging the benefits Cloud can provide in terms of collaboration, productivity, scalability.

Mobility at 360 degrees: share concepts through mobile, but also negotiate with suppliers, collect orders, manage assortments.

Analytics & Monitoring: The call for agility and the need to boost new products' success is implying fashion companies put increased emphasis in integrating analytics all along the process (product success analytics, customer analytics/ manufacturing analytics/suppliers analytics)

ONE END-TO-END SOLUTION TO PLAN, DESIGN, DEVELOP, ASSORT AND *SELL*

TXT Product Lifecycle Management

Design, Collection Development, Costing, Quality Assurance

Integrated Merchandise, Assortment Planning and Supply Chain Collaboration

Monitoring, Workflow and Calendar Management

Mobile technology: the right user, the right data, the right time

TXT Product Lifecycle Management is an end-to-end PLM solution. Its unique value is the ability to extend core PLM capabilities such as Creative design, Collection Development and Costing not only to Sourcing and Supply Chain Collaboration, but seamlessly to Merchandise and Assortment Planning. Designers benefit from tangible insights into market demand, business and strategic goals right from the earliest phases to design what sells. Planners can associate visuals to the numbers, and define and specify the best assortments that sell what has been developed.

- All functional business roles on the "same page"
- Collections that balance the creative and business perspectives
- Minimized reworking, faster time to market

TXT Retail is a leading provider of end-to-end Merchandise Lifecycle Management solutions for Fashion, Luxury and Footwear
For more information: www.txtretail.com

TXT RETAIL
ASSORTMENTS PLANNED FOR SUCCESS

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PLM is not an Island

the value of an end-to-end approach, connecting planning, design, and the supply chain, including IoT

Apparel and Fashion companies have never before been faced by so many complex challenges, all the result of a more demanding, digital and mobile shopper who wants to purchase exciting new products exactly as they wish, where they want, and when they want. Supporting this demanding shopper tests complex global supply chains traditionally built for cost effective delivery, with a greater need for speed and variety, as shoppers require Retailers to localise assortments with ever more frequent product change outs.

Competitive advantage now favours the retailer who has the capability of "economic rapid action", bringing new products to market quickly, yet streamlining the number of items developed to just the needed items, eliminating the cost and time wasted in creating new products that in the end will never see a store shelf. Competitive advantage includes creating continuous excitement, fresh new products in a store supporting a more frequent shopper visit schedule. And lastly, competitive advantage means the effective management of all the costs and components of developing and deploying products, proper raw materials management, production scheduling, quality management, delivery costs and, of course, inventory deployment based on sound investment principles and in accordance with dynamic assortment and line plans.

END-TO-END PLM: A REALISTIC OPPORTUNITY

Today, an End-to-End PLM approach integrating Planning, with Design and the Supply Chain is widely acknowledged as a top performance driver. When planning, development and order collaboration are closely connected, superior customer driven assortments can be created, coupled with fast reaction to in-season market changes.

Traditional PLM helps companies speed up design and product development by managing in a central repository the hundreds or thousands of designs, colour libraries, bills of materials, costs sheets that a new collection generates. Organisations are building on this success to embrace more strategic end-to-end PLM projects that:

- Integrate design with line and assortment planning
- Set joint development strategies with supply chain partners
- Identify KPI's & analytics to measure performance of products, channels and processes over time and achieve continuous improvement.

Specifically, companies can leverage on End-to-End PLM technology to build a cross-organisational process where all members agree to the same strategies and concepts at the earliest stages of the merchandising cycle, and then execute on those strategies effectively and accurately.

- Product development can contribute to both strategic and detailed planning requirements based on their deep insight into market trends and customer behaviour
- The design perspective is reconciled with cost objectives from the earliest phases of the product development cycle, narrowing the focus to working on the "smartest" products, eliminating delayed decision making and incremental costs
- In addition, even with a global supply chain, plans can be agreed with material suppliers, and contract manufacturers, who from the concept phase, share one version of the truth: The same understanding of the product line, targets and schedules.

INTEGRATE DESIGN WITH PLANNING FOR A CUSTOMER-DRIVEN STRATEGY

Customer expectations have never been higher, but despite having access to huge amounts of customer oriented data, true insights are still hard to determine and even harder to leverage. Sales information, loyalty data, social networks, surveys, online product recommendation, and browsing data all add to the raw information we have to influence our product selections and constructions, but truly leveraging this information is still a work in progress.

To make the most of the information at hand, innovative apparel companies create strong links between the product innovation phases and assortment and line planning.

The broader connection to a consumer-driven strategy using planning and customer insights as a guideline in the development of new products helps drive demand by designing products that consumers are most likely to purchase. The best product portfolio collection results from decisions taken throughout the collection lifecycle: new product introductions, markdowns, promotions, end-of life planning. Taking full control over product planning and design, coupled with visibility to actual performance, leads to maximising value for both the customer and the company, resulting in getting the most out of innovation.

INTEGRATE THE SUPPLY CHAIN FOR BETTER EFFICIENCIES

The fashion industry - fast fashion in particular - is notable for having a large number of stakeholders and experts who have to work in concert to deliver optimal products to stores and fulfilment centres. Global supply chain and longer lead times support the "cost effective" side of the equation but at the same time create challenges for developing an agile, customer focused supply chain. This leads to the necessity of working quickly, making decisions early, narrowing the focus to "just those products that count" yet making all of these decisions from a well informed and accurate basis. A single decision such as repeating an item, or the identification of a need for a particular type of new itemneeds to ripple from concept to shelf in as streamlined a fashion as possible, with all stakeholders contributing their skills and disciplines to effective execution.

With the right Product Lifecycle Management solution (like TXT PLM), fashion companies can streamline the work and processes for all stakeholders

PLM – PUTTING THE CUSTOMER AT THE CENTRE OF PRODUCT DEVELOPMENT DECISIONS, AND THE NEXT FRONTIERS OF TECHNOLOGY

With advanced, innovative Product Lifecycle Management solutions (like TXT PLM), fashion companies can streamline the work and processes for all stakeholders involved with creating and managing their collections: Merchandisers & Designers, Product Managers, Developers, Buyers, Sourcing Managers, Testing teams, and Suppliers. PLM's unique value is the ability to extend core capabilities such as Creative design, Collection Development and Costing not only to Sourcing and Supply Chain Collaboration, but seamlessly to Merchandise and Assortment Planning.

Designers gain tangible insights from planning inputs and in season performance information: How are new ideas working, which are the best performing products and attributes, what kinds of customers are looking at what types of trend. These activities and information bring development ever closer to the market. And it's not all about numbers, planners can now associate visuals and images to the numerics so that this integrated, End-to-End planning and product development process becomes more intuitive and ultimately ever more accurate.

New innovations in technology add new potential to this end-to-end equation by providing a greater ability to satisfy Customer requirements throughout the product lifecycle, by marrying the increasing availability of information that can be acquired through IoT capabilities, with better product management capabilities.

Data about customer preferences can now be acquired from a variety of sources including new in store devices such as Bluetooth Beacons, yielding information not just about what the customer is buying, but also what the customer is looking at, through both proximity data as well as dwell time. In some ways this is the equivalent of an in person "web search" which as we know provides an opportunity to better understand customer preferences which can influence the next set of products to be designed and built.

Fulfilling customer requests from any inventory source requires accurate and real time on hand information, a competency that still eludes most brick and mortar retailers. Here the IoT in conjunction with RFID technology yields the possibility to accurately create an "available to promise" transaction for an online shopper with 100% knowledge that the on hand unit required to fulfil an order does actually exist and can be reserved to meet a customer demand.

As well as these critical capabilities of understanding customer behaviour to influence assortments, and supporting extremely accurate and real time in stock, connecting smart devices as IoT capabilities can yield a variety of new possibilities: Smart Devices located throughout the design and manufacturing process helps pin point delays and opportunities to speed product development and balance workload station by station. Smart devices can notify multiple parties about the status and movement of product from creation through completion. Traffic and logistics, for example, can better schedule when they know the exact location and status of work in process to finished goods.

IoT is certainly an "early stage" development, but the potential capabilities derived from IoT hold the opportunity to solve a number of long standing issues facing Retailers and Manufacturers improving the quality of the Customer experience.

www.visual-2000.com

FINANCIAL YEAR 2015/16

16

NEW CUSTOMERS OF RFA PLM, INCLUDING:

Chef Works | Yumi | Closet London | Ango Mode
JV Apparel | Lamarque

56

OVERALL NUMBER OF ACTIVE CUSTOMERS

of PLM within the RFA industry,
excluding customers cited as new in 2015/16

6,000

TOTAL NUMBER OF INTERNAL USERS WORLDWIDE

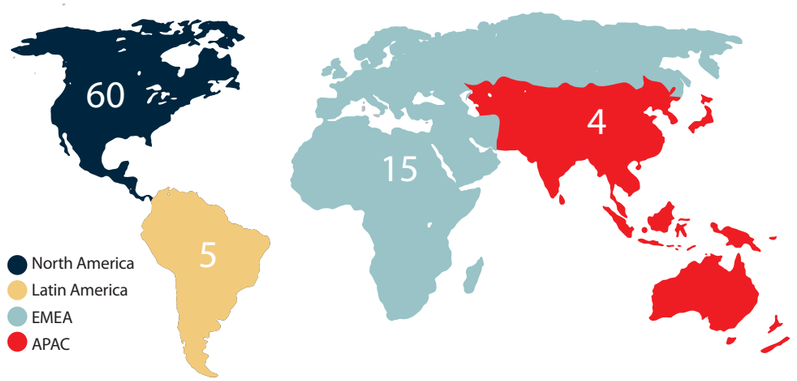
2,000

TOTAL NUMBER OF EXTERNAL USERS WORLDWIDE

17

NUMBER OF RESOURCES SPECIFICALLY ENGAGED IN R&D

TOTAL NUMBER OF RESOURCES FOCUSED ON THE RFA INDUSTRY BY REGION:
(Excluding those cited as R&D-specific resources above.)



REVENUE & INVESTMENT INFORMATION

Licensing revenue:

$1-2 million

Implementation & services revenue:

$1-2 million

All maintenance revenue:

$3-4 million

R&D investment:

$0-2 million

TELL US WHAT YOU FEEL HAS CHANGED AND / OR ADVANCED IN YOUR PRODUCT OFFERING THIS YEAR TO DIFFERENTIATE YOUR COMPANY FROM OTHERS IN THE RFA PLM MARKET.

Throughout the last year, the Visual PLM.net development team has continued to focus on unifying, streamlining and standardizing its data management and workflows to allow for more efficient communication both within and outside PLM.

One of our notable updates has been the introduction of an advanced Product Information Management (PIM) system. PIM, in Visual PLM.net, now allows users the ability to seamlessly and exhaustively share product information with systems outside PLM. For instance, users can now easily push new products and product updates to their own ecommerce stores, including Magento and Shopify or even 3rd party marketplaces like Amazon, all from within PLM.

For better workflow, our digital asset management functions have been improved. Users can now update digital assets on a comprehensive "where-used" basis, to simplify file modifications. Furthermore, users now have the ability to mass update items directly within the search results page and our Adobe Illustrator plugin now has support for Adobe Cloud.

Improving the communication between all users of Visual PLM.net has also been an area of focus. We've created a web annotation tool as well as the ability to create mass requests between internal users and external suppliers.

TELL US WHAT YOU BELIEVE ARE THE MOST IMPORTANT TRENDS SHAPING THE NEAR-TERM FUTURE OF THE INDUSTRY – EITHER IN TERMS OF TECHNOLOGY OR BROADER MARKET FORCES.

Coinciding with the increased adoption of IoT and omni-channel best-practices, Visual 2000 foresees data integration and synchronization as the driving force for improvement among PLM providers.

As the amount of connected devices grows and sensor usage increases, correspondingly, so too will the number of data sources at the disposal of a given company. The benefits of this are numerous. For instance, within PLM, this data could provide designers with meaningful product performance data, allowing for greater alignment between creative direction and company objectives. Designers will be able to take advantage of greater knowledge about how their products are used and worn.

However, these benefits cannot be fully realized without first being able to efficiently and meaningfully process and decipher the data that these connected devices produce. As a major component of an apparel business, PLM will, by necessity, become deeply linked with a network of connected devices.

As a result, being connected end-to-end is requisite for any business hoping to take advantage of IoT and is why Visual 2000 predicts that data management will become a distinguishing feature of advanced PLM solutions. And, by being omni-channel capable out-of-the-box, Visual PLM.net is at the forefront of this evolution.

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VISUAL 2000 INTERNATIONAL END2END SOLUTIONS

How to Engineer IoT Success:

Beyond Big Data

BY
CHARLES
BENOUALID

When Mark Weiser, former Chief Technologist at Xerox PARC, was writing "The Computer of the 21st Century", the internet had been scarcely running for more than a few years. Only months prior had Microsoft released Windows 3.0 and the first Starbucks outlets were just opening. The disruptions caused by the internet were still to come. Yet, it was in this 1991 paper that the Internet of Things was first defined.

Although first theorised over two decades ago, the Internet of Things still assumes the same principle: "many computers share each person". In other words, whereas the era of the personal computer assumed a one-to-one relationship between computers and people, the era of IoT respectively assumes a many-to-one relationship.

For those optimising business processes, this is highly significant. IoT's ubiquity of connected computing means that people and processes can be tracked, and thereby optimised in places never-before possible. Despite being overlooked in conversations surrounding it, Weiser suggested that the Internet of Things ought to bring simplicity through ubiquitous smart technology. With the potential for universally pervasive sensors and connected devices, IoT providers should leverage their access to large datasets to reduce the tasks in a given workflow or automate workflows altogether.

Thus, the upcoming challenge for companies managing IoT is to make sense of and reduce the complexity of data created from countless IoT devices, whether it be structured or unstructured data. With the proper IoT backbone, businesses not only stand to benefit from enhanced analytic data, but truly autonomous supply chains and self-regulating systems.

CURRENT STATE OF IOT

In the 25 years that have followed since the writing of "The Computer of the 21st Century", many technological improvements have been developed to make its vision into a reality. Apple has recently required that app developers support IPv6-only networks in their apps, and services such as IFTTT [If This Then That] and Zapier have cropped up to coordinate tasks between what IoT devices we currently have.

Furthermore, it's hard to overstate the effect that cloud-computing has had on making IoT possible. Advances in pre-compiled Big Data have empowered even the smallest devices with the ability to perform tasks that would have been reserved for more capable devices. Battery and processing limitations, innate to mobile devices, are now mitigated by outsourcing tasks to dedicated computing platforms.

Even though many retailers are still wrangling with the ins and outs of omni-channel, progress is being made to reconcile the Internet of Things with the world of apparel, footwear and accessories. Adidas recently announced that it is returning some of its production to Europe. In Germany, it plans to entirely automate the production of some of its footwear lines with a manufacturing floor comprised of only robots. These robots, of course, will come loaded with an army of sensors. But for most companies beginning their foray into IoT, the use cases are not so drastic.

While "wearable" IoT devices, such as Bluetooth headsets, fitness trackers, and other communication devices have been creeping into consumer apparel for years, retailers are becoming increasingly interested in the applications of RFID technology as a "hidden wearable". Companies such as the GAP and American Apparel are collecting more data and increasing efficiencies by integrating RFID tags into the fabric of their products. The benefits of RFID tagging are very much bidirectional.

In one instance, RFID tagged apparel can be used to track consumer behaviour during and following a purchase: allowing for a one-to-one relationship between a consumer and their item. This information can prove highly valuable to a marketing department. Coupling detailed consumer behaviour information with the right analysis can provide businesses with greater sales.

In another instance, RFID enabled garments can be used to vastly decrease costs. Tagged clothing can be packed more quickly and be efficiently tracked along the entire manufacturing process using bulk scanning techniques. They can also be used to analyse the efficiency of manufacturing processes. For instance, it is far more cost efficient to invest in RFID sensors to identify and rectify the bottlenecks of an existing factory floor instead of installing a new one. Of course, the growth of RFID usage is no surprise. However, it's use-cases have been evolving with greater complexity and, correspondingly, we've integrated its compatibility into our core omni-channel offering.

In the context of IoT, there is limitless potential. Completely disparate systems can be fully tracked and connected to create unique and surprising optimisations.

Product velocity metrics could be applied to optimise warehouse productivity. An ecommerce warehouse could alter the locations of its inventory on-the-fly based on real-time sales or traffic data. We've been using this concept to reduce average picking and packing times and increase the overall productivity of a warehouse. In another case, fashion designers will be able to capitalize on cloud computing to use their mobile devices to reverse lookup previous designs.

But the reality is that most savings that will be attributed IoT aren't known yet. Predictions range anywhere, from lower insurance rates to decreased energy costs. However, these benefits are only possible with supporting infrastructure that can identify and signal important data to the right person. Without a system to decipher the myriad of data sources provided by the IoT, companies will be left paralysed.

BEYOND BIG DATA

On the face of it, IoT presents us with a problem of data. With the promise of self-organised supply chains and predictive analytics, companies will, without question, need to be connected end to end. And, of course, the daily usage of IoT devices will engender the creation of large datasets concerning user behaviour, sensor data and sales data. However, the information will be useless without both a complete data-picture and an accurate model for data interpretation.

Omni-channel systems are a start, but the Business Intelligence of the IoT era will require all departments, from marketing to distribution, to be connected. This is why we have developed our omni-channel, end-to-end solution as the enterprise backbone with a strong focus on BI: it lays the foundation for IoT. Accordingly, we have made all of our solutions, including PLM, omni-channel ready, so that each module can be, at a minimum, easily connected to any other.

With the right end-to-end foundation in place, businesses can truly capitalise on IoT. With the help of machine learning, IoT systems will learn to identify correlates for anomalies between disparate data sets without human intervention. Using IoT's endless stream of data, weak-points and inefficiencies will be discovered in and between all parts of a business.

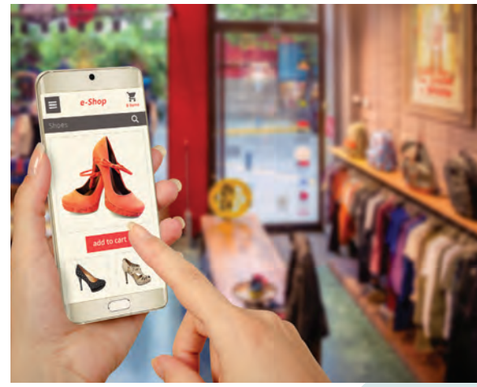
For instance, imagine all of the possible sensor data that could be collected from shipping and logistics processes or within manufacturing processes. Now imagine comparing performance data between both processes to discover bottlenecks. It is possible to see a future where data between systems is shared and interpreted holistically to identify supply chain or project management bottlenecks that occur between each system. Furthermore, increased sensor usage on the factory floor and predictive analytics will allow smart objects or assets to self-diagnose faults and alert the appropriate technician before they occur. The IoT will compel us to go beyond Big Data by analysing the data between Big Data sets.

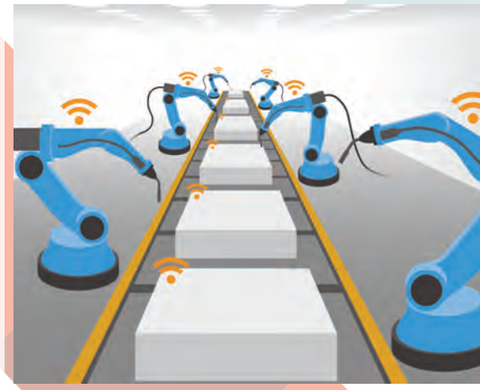
Of course, offering this depends on the power of the system handling the data. An adaptation of the Anna Karenina principle on happy families says it best: All efficient systems are the same. All inefficient systems are inefficient in their own way. The right process for one business isn't necessarily the same for another. Delivering the right solution depends on addressing the context in which a problem exists.

Ultimately, this highlights the data-challenge posed to IoT solution providers. If an IoT system is to properly utilise the data it consumes, it must be able to understand and learn to identify problems and inefficiencies that are one-of-a-kind.

Certainly, there is much ground to be covered before any of these practices become commonplace. But, as progress towards IoT inevitably continues, fashion production processes will continue to become inextricably linked to their data. Physical processes and digital processes will become one in the same. If anything, the promise of IoT tomorrow underscores the necessity of implementing an end-to-end solution today.

In the context of IoT, there is limitless potential. Completely disparate systems can be fully tracked and connected to create unique and surprising optimisations.





PLM Consultant Profiles

THE GOAL OF THIS REPORT (AND THE ANNUAL REVIEWS AND 5TH EDITION REPORT THAT PRECEDED IT) IS TO PROVIDE VENDORS AND CUSTOMERS ALIKE WITH THE INFORMATION THEY NEED TO MAKE INFORMED INVESTMENTS IN PLM AND EXTENDED PLM TECHNOLOGIES SPECIFICALLY DESIGNED FOR THE RETAIL, FOOTWEAR AND APPAREL INDUSTRY.

For the third year running, we invited a select few of the world's leading apparel PLM consultancy practices and advisors to provide readers with some insight into their methods, the work they have undertaken to date.

Although selecting the right solution represents a significant part of this decision-making process, truly modern PLM and E-PLM projects extend far beyond the software level. And the extent of the whole-business transformation that an effective PLM project entails means that the services of experienced, independent advisors are now as sought-after and scrutinised as the PLM platforms themselves.

This trend has been supported by our market analysis: customers of core PLM in the fiscal year 2014/2015 were 10% more likely to solicit expert help than in the previous year, and this year's statistics reveal further growth in customers' using a consultant or advisory practice to develop their ROI analysis, or plan their implementation. Indeed, our 2015/16 customer survey demonstrated that third party implementation partners are now responsible for more post-implementation support than ever before, and that customers were able to exert greater influence over their choice of these partners than at any other time.

Coupled with the mounting pressures of long-term partnerships and change management that face any business seeking to explore the full potential of PLM, these figures are the reason that, for the third year running, we invited a select few of the world's leading apparel PLM consultancy practices and advisors to provide readers with some insight into their methods, the work they have undertaken to date, and their perception of their roles within a rapidly-changing industry.

The following pages collect profiles of both proven consultancy practices – offering services from selection and implementation, to change management, training and support – and comparatively new entrants to the market, reflecting the explosive growth our industry continues to undergo.

Depending on their history, available resources, and industry experience, an advisor or consultancy practice may offer a host of different services. Some will help clients to select a solution from a thorough knowledge of the market; some will assist their clients in implementing that solution and ensuring buy-in from the executive to the user level. Some will conduct a complete evaluation of the client's apparel-specific processes and technical environment; some will work within a scientific framework to consolidate the client's product development master data ahead of implementation. Some will do all of these things and more, while others will attempt instead to bend cross-industry boilerplate methods to fit the difficult and idiosyncratic world of apparel.

It is vital for customers to remember, then, that not all consultants are equal – and we are happy to report that a better informed market is already beginning to hold its advisory partners to the same standards as its PLM suppliers.

A new apparel practice from a business that has typically focused on entirely different verticals, for example, should not be compared to a proven advisor who has catered to the retail, footwear and apparel industry for a number of years. Indeed, we note that several renowned international firms have continued the growth of the apparel PLM practices they opened last year. Although these expanding practices can (and often do) also hire experienced apparel PLM experts to held establish their operations, a period longer than twenty-four months is still required to build the kinds of methodologies, tools, and process frameworks that apparel-specific consultants should boast as standard.

Conversely, larger consultancy practices can – and more than likely will – leverage international reach and a comparatively large pool of strategic resources to provide more comprehensive management services than their smaller, more specialised counterparts. It is important for customers to make the distinction between these broad strategic services and the kind of detailed knowledge that a specialist will have of the extended product development landscape.

Whatever their size, customers should exercise caution when it comes to locating a truly independent and impartial advisor. Many consultancy practices obtain the bulk of their work from a single vendor in a partnership arrangement. And although this does not necessarily imply that the business is tied exclusively to that vendor (indeed, many practices have established partnerships with more than one PLM vendor) it does increase the likelihood of that advisor having a preference for a particular solution, particularly when unexpected growth has forced a vendor to effectively promote that partner to the status of preferred or primary implementer.

Whatever their size, customers should exercise caution when it comes to locating a truly independent and impartial advisor.

Customers, therefore, should continue to ensure that any third party they opt to work with is experienced with their chosen vendor and solution – to the same degree they are with any other vendor on their roster.

Although many of the fundament principles remain the same – customers are seeking the same industry experience, financial stability and long-term partnership potential – between selecting a PLM vendor and choosing the right advisor, there are a number of ways in which the two are distinct. To that end, each of the consultancy practices that appears in this section was asked to provide a selection of key information: their status as vendor partners, multi-vendor services providers with a small pool of expertise, or truly vendor agnostic; and insight into their tactical and strategic strengths. We also asked each practice to enumerate the RFA PLM experts they employ on a global basis, and to name the marquee retailers and brands they have worked with to date – where that information is publicly available.

Prospective and existing customers of PLM are not, however, the only parties interested in the experience, expertise and international reach of consultancy practices and advisors. As the results of our multi-year PLM customer surveys reveal, vendors' internal resources – for pre-sales, sales, technical demonstration, implementation and change management – are being stretched by multiple concurrent implementations, leading most to establish partnerships with third parties.

Needless to say, these third parties have limitations of their own, and vendors should be as cautious as customers when it comes to satisfying themselves of the competence and availability of subject matter experts within any advisory practice - no matter how large or experienced they may seem on the surface.

Owing to the relatively small sample size and the difficulties inherent in comparing drastically different services on a like-by-like basis, WhichPLM's publications have not previously, and do not this year, contain any analysis or evaluation of the consultancy practices listed in this section. Instead, we encourage prospective clients to undertake their own due diligence when working with any third party – whether they were selected directly, or nominated (either openly or covertly) by a vendor partner.

NB: As with our PLM vendor profiles, the final responsibility for the accuracy of all information contained within this section remains the responsibility of the companies listed. Although WhichPLM has made every effort to quantify and verify the information provided to us, nothing in these pages should be construed as an endorsement or assessment of any consultancy practice or advisor, and WhichPLM has no responsibility or liability for the content of advertisements that appear adjacent to these profiles.

WHICH PLM SOLUTIONS / SUPPLIERS DO YOU WORK WITH? IF YOUR SERVICES ARE VENDOR-AGNOSTIC, PLEASE SAY SO.

PTC Retail PLM & ARAS PLM

LIST YOUR IMPLEMENTATIONS OF RFA PLM ACCOMPANIED BY THE NAME OF THE SOLUTION THEY CHOSE WHERE THIS IS PUBLIC INFORMATION.

1. Devanlay Lacoste - FlexPLM 2012
2. Brooks Brothers – FlexPLM Implementation, 2012
3. Brooks Sports – FlexPLM Implementation, 2013
4. LC Waikiki – FlexPLM Implementation, 2014
5. C&A – FlexPLM Implementation, 2016

WHAT DO YOU CONSIDER YOUR PRACTICE'S STRATEGIC, TACTICAL AND IMPLEMENTATION STRENGTHS TO BE IN THE REGION OF RETAIL, FOOTWEAR AND APPAREL LIFECYCLE?

ITC Infotech is a pioneer in providing consultative PLM services for Retail, Footwear and Apparel Industry with 120+ PLM implementations for 50+ leading Retail & Consumer Goods companies. We enable quick value realization for customers by extensive usage of best practices templates, tools and accelerator frameworks leveraged from our rich domain and implementation experience over the years. Our PLM Value Roadmap & Diagnostic services help Retailers ascertain ROI from their PLM investments and recommends the best possible solution roadmap to attain more value over time.

We have worked with PTC to co-develop solutions in new and emerging areas like Mobility, IoT and Sustainability to help Retailers solve their new age product development challenges. Our consultants are adept at approaching client's Product Development practices with an experts view to provide a value centric approach that is aligned not only to industry best practices but also a best fit for the organization.

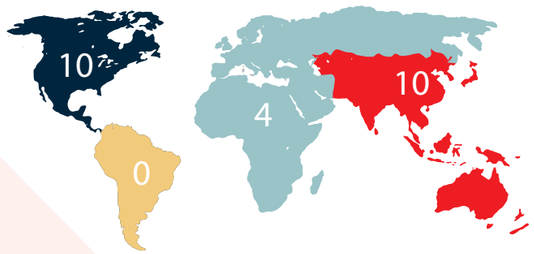
PLEASE PROVIDE THE NUMBER OF QUALIFIED DOMAIN EXPERTS YOU HAVE SPECIFICALLY FOCUSED ON IMPLEMENTATIONS IN THE RFA SECTOR, SEPARATED BY REGION AS FOLLOWS:

North America: 10

Latin America: 0

EMEA (Europe, Middle East, Africa): 4

APAC (Asia Pacific): 10



TELL US WHAT YOU SEE AS THE TWO MOST IMPORTANT EMERGING TRENDS FOR RETAILERS AND BRANDS (PARTICULARLY FASHION, FOOTWEAR AND ACCESSORIES) IN THE COMING YEAR?

1. Analytics: With easier access to information, consumers today are better informed and more demanding. To be able to differentiate, fashion brands need to continuously innovate their designs and dig deeper to understand, as well as, fulfil the customers' ever-changing demands. We know that retail is an information-driven industry and it captures a huge amount of structured and unstructured data. This data is a gold mine and can be used by the retailer to make intelligent buying decisions, when effectively analysed.

2. Virtual Mirror: Virtual Mirrors make it easier for the customers to virtually try on as many outfits as possible and in various sizes before making the buying decision. It also saves the store employees the pain of re-folding numerous garments and arranging them back on shelves. By giving an opportunity for matching and accessorizing the clothes, Virtual Dressing Rooms have potential for up-selling products to customers.

TELL US WHAT YOU SEE AS THE TWO MOST IMPORTANT EMERGING TRENDS FOR SUPPLY CHAIN MANUFACTURING (PARTICULARLY FASHION, FOOTWEAR AND ACCESSORIES) IN THE COMING YEAR?

1. Sustainability: Fashion Retail industry is claimed to be the second largest polluter in the world, after oil. Environmental impact magnifies exponentially at each level of global supply chain, starting from Planning & Design to Disposal. The best way to tackle the problem is to take an approach of measuring the environmental impact and validating whether the products are green, even before they are produced.

2. Internet of Things: Digital age customers are demanding and retailers must cater to them thoughtfully to earn brand loyalty. With the Internet of Things (IoT) breaking down physical barriers between retailers and customers, the retailers can now control user experience across touch points, while keep a close eye on the supply chain. IoT enables smart and connected retail infrastructure that goes beyond integrations, better visibility into supply chain, store automation & analytics, and Omni-channel customer engagement.

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ITC INFOTECH

Business-friendly Solutions

A big leap forward

Internet of smart retail, footwear and apparel

"YOU DON'T HAVE TIME TO BE TIMID. YOU MUST BE BOLD AND DARING."
SAID THE LUMIERE IN BEAUTY AND THE BEAST.

Growing up with fairy tales and the fantasy world, we have always wondered how brilliant it would be if all the things around us could communicate just the way the candelabra, wardrobe, feather duster, pendulum clock did in the Beauty and the Beast.

So, it's all about communication and making things talk! Maybe it's all possible now in the modern era with the advent of the Internet of Things.

Internet of Things, no more a buzzword, it is in fact the next captivating thing on the bucket list of the digitalisation era. Every business is now getting ready to be smarter. The Retail, Footwear and Apparel (RFA) industry is also keen to embrace the latest technologies to be relevant to the millennials who are at home with their smart and connected devices.

RESHAPING THE RETAIL FOOTWEAR AND APPAREL LANDSCAPE:

Leading RFA players are already investing heavily in the IoT – realising its potential to touch nearly every area from design to development, production, and operations through to customer engagement. IoT in the Apparel industry is helping to understand how to interpret, manage and make the most of product, sales and customer data to streamline the flow of information, enabling real-time decisions, and enhanced consumer experience. IoT has the potential of making every step intelligent - from factory floor to store shelf. This is an example of how IoT is currently transforming the back end of retail supply chain post production.

> Understand how to interpret, manage and make the most of product, sales and customer data

TRANSFORMING CUSTOMER EXPERIENCES:

There is a big change in the way RFA players are looking at their instore offerings. Today's tech savvy customers need a seamless blend of physical and digital services leading to a "wow" experience. Instore sensors, beacons, virtual mirrors which cross sells, smart device enabled trial room assistance, skip-the-queue automated checkouts, are all devices which could enable that "wow" experience. Services like pushed, personalised notifications, purchase history based up-selling, product usage and authenticity guidance, after sales notification and service alerts are some of areas retailers are concentrating on to provide the ultimate customer experience. Offering value with ease of shopping at every touch point is key to differentiate yourself from the competition.

This seamless experience has grown beyond the store boundaries, and unified commerce is the step further to serve the customer what they need, no matter where or how they want to shop. Retailers are leveraging mountains of data produced at channels with connected devices to deliver the best multi-channel experience.

ENABLING INSIGHTS; MAKING BETTER DECISIONS

There are several existing systems and platforms that enable retailers to streamline and align their business processes. These tools hold abundant data which can be useful to bring significant insights. Established tools like Product Lifecycle Management, Enterprise Resource Planning and Supply Chain Management in retail have already proved their worth as wise investments to greater business growth.

The technologies for IoT can help integrate sensors with back-end systems for data analysis to drive decisions. At ITC INFOTECH LTD, we believe in a transformational journey that starts from a device whose data is on-boarded onto a platform for analysis, from which we can deliver decisions relevant to all stake-holders. Thus, one can imagine an application on a device to pull data from RFID tags from a store or a warehouse in the RFA space. This application can apply logic right at the point where data originates so that decisions are not delayed due to data travel up and down the stack.

Further, data from multiple RFID tag readers across multiple stores are aggregated on the cloud instance for summary level reports for consumption across the organization. Advanced data analytics can run probabilistic scenarios or classification strategies to push promotions instantaneously. These strategies can also influence departmental or even organizational level campaigns and initiatives.

POSSIBILITIES, AND THE WAY FORWARD:

The current IoT offerings widely cover the supply chain, distribution and front end customer experience. These are some other possible areas of interest where IoT can be leveraged:

PRODUCTION TRACKING

To complete the 360 Degree view at product lifecycle from development to store shelf, it is vital to track and regulate the activities beginning at production level. Tracking of material usage and movement of parts and products through the production line will give real time visibility for quicker actions and smart decision making. Tagged articles will increase traceability to strengthen the ability to deliver the products faster to market. Data generated at every stage can be significant to add to proactive and autonomic analytics capabilities, making production a smarter and intelligent environment for superior results. This way product developers will get insights into production milestones on the go without resorting to actually requesting the information from vendors.

SAMPLE ROOM TRACKING

Sampling is one the most crucial activities for minimising lead time. Big brands and retailers who are involved in multi-level sampling with various stakeholders find it difficult to manage the process in the most cost efficient manner. Standardisation, cost reduction, and efficient tracking mechanisms are therefore the key to achieving quicker time-to-market. Real time tracking can be a boon in bringing some semblance of order to a chaotic sample room.

Tagging can help design teams to trace, track and manage multiple samples at every stage of sampling across seasons. This way a traceable sample room can help product developers identify quickly a previous season's style to enable better decision-making for the coming season.

ASSEMBLY LINE SUPERVISION

Breakdowns in an assembly line can add to delayed lead-times. A line operating slower than usual can cause lost sales due to missed timelines. This becomes even more problematic if the bottlenecks are not known at the earliest for timely intervention.

Smart sensors can enable machines for an entire line to raise alarms beforehand on irregularities, allowing factory operators to solve these issues swiftly. Tracking detailed Information on any process delays can therefore enable effective decision making. Automated notifications and remote access on areas for attention, due for maintenance and part replacements can help in avoiding unanticipated interruptions. Connected machines that have a digital identity and are able to predict and fix potentially disruptive issues, will soon take intelligent production to the next level.

AUGMENTED SAMPLING AND VIRTUAL TRADE SHOWS

Augmented is the new reality. Its benefit in terms of presenting intricate details with an added simulation are tremendous. It can add value to the product development cycle by assisting in the sampling process. 3D samples can be added to an augmented reality (AR) platform to provide realistic pictures even before the physical samples are in place, therefore giving early visibility to the development team. Motion capture, smart annotations, and virtual fitting on forms can be of great help for designers during fitting sessions.

Virtual fashion portfolio- Presenting an elaborate virtual collection even before it is available can be a cost effective and smart way of doing trade shows and collection building.

CUSTOMER SERVICE WITH SUSTAINABILITY INITIATIVE

Fashion runs its course with lightning speed. With changing styles frequently leaving last year's in the trash, disposing of unwanted garments is one of the most pressing environmental concerns for the industry. Sustainability and ecological best practices have begun to appear more prominently in the fashion world, since footwear and apparel production and disposal are cited as some of the biggest contributors to pollution. Retailers are now taking measurable steps to invest in sustainable methods in production to compensate for damages.

But is it possible for retailers to also provide quality customer services to foster further values to sustainability initiatives?

Every product brought to the consumer has an impact on the environment. Many Consumers today do not know the extent to which these products impact the environment, but this is something the IoT could change. Smart recycling alerts when a garment reaches its end-of-life, for example, might provide the prompt people need, and may even include instructions for upcycle for a second use, or directions to the nearest recycling centre.

We live in a highly connected world where an entire industry worth of resources can respond to a seemingly simple event of buying a pair of shoes at a local store. Such a connected world has vast implications on driving operational efficiencies and the overall strategic outlook for the future of the industry.

I guess the 'Lumiere' was foresighted, it is definitely the time to be bold and adopt to the world of magnificence. Rise to the world of IoT-enabled RFA!

KALYPSO

www.kalypso.com

WHICH PLM SOLUTIONS / SUPPLIERS DO YOU WORK WITH? IF YOUR SERVICES ARE VENDOR-AGNOSTIC, PLEASE SAY SO.

Kalypso provides objective services designed to transform and optimize the end-to-end innovation and product development process for retail, footwear & apparel (RFA) clients. Our services span from PLM assessments to strategy, process and organization alignment, requirements definition, selection, and implementation planning and execution. These services can be delivered independently or with a strategic PLM solution partner. We are vendor agnostic and work with any PLM vendor that best suits our client's needs. In RFA PLM we collaborate with PTC, Dassault, Oracle, and Bamboo Rose based on market fit and demand.

LIST YOUR IMPLEMENTATIONS OF RFA PLM ACCOMPANIED BY THE NAME OF THE SOLUTION THEY CHOSE WHERE THIS IS PUBLIC INFORMATION.

Kalypso does not publicly share client names. Our team has conducted over 100 PLM implementations across numerous industries. More specifically, we have helped numerous RFA clients tackle significant PLM issues and opportunities, including:

- PLM transformation/implementation for hardlines and softlines for an international toy and children's apparel retailer
- PLM assessment, requirements definition and selection for a $10B+ hardlines and softlines home goods retailer
- Product and material development assessment, software selection, end to end process redesign and implementation strategy for a leading branded performance footwear, apparel and equipment wholesaler/ retailer
- Multi-year, multi-brand, global PLM transformation implementation for $3B+ apparel and accessories manufacturer/ retailer
- Multi-year, multi-brand, global PLM transformation for a $70B+ do-it-yourself retailer
- PLM transformation/implementation and managed services for a $3B+ apparel and hardlines catalog retailer
- PLM assessment, requirements definition and selection for a $2B+ apparel manufacturer

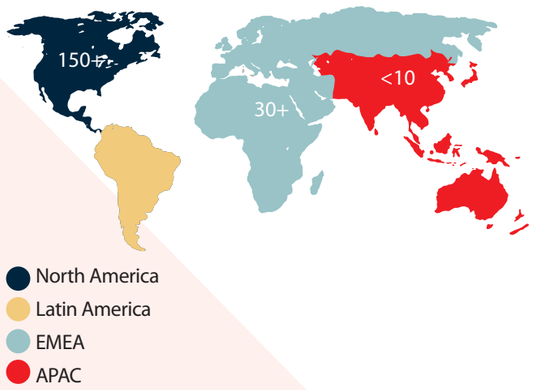
PLEASE PROVIDE THE NUMBER OF QUALIFIED DOMAIN EXPERTS YOU HAVE SPECIFICALLY FOCUSED ON IMPLEMENTATIONS IN THE RFA SECTOR, SEPARATED BY REGION AS FOLLOWS:

North America: 150+, including resources located in our Monterrey, Mexico near-shore technology center.

Latin America: We serve Latin America from our US/Mexico geographical centers.

EMEA (Europe, Middle East, Africa): 30+, including a near-shore technology center in Hamburg, Germany.

APAC (Asia Pacific): Less than 10. Our resources in APAC primarily interface with the Asia based sourcing operations of our clients from North America and EMEA.



WHAT DO YOU CONSIDER YOUR PRACTICE'S STRATEGIC, TACTICAL AND IMPLEMENTATION STRENGTHS TO BE IN THE REGION OF RETAIL, FOOTWEAR AND APPAREL LIFECYCLE?

In a word – transformation. We help companies become more innovative and differentiated in the market through dramatically improved, scalable and sustainable capabilities throughout the broadly defined product development lifecycle. We do this by developing vision, strategy, business cases and roadmaps; by operationalizing these strategies into efficient processes and organizations; and by enabling them through industry leading technologies.

Our firm's exclusive focus on the broadly defined product development lifecycle, combined with deep RFA industry experience, allows us to help retailers evaluate and apply new, transformational capabilities that leverage a PLM foundation - including 3D product creation, voice of the customer, crowdsourcing, smart connected products/wearables, predictive analytics, material innovation, open innovation and innovation portfolio management.

We are particularly valuable to clients who seek to transform their product development capabilities by making significant simultaneous improvements to process, technology and organization. Many of our recent engagements have focused on helping clients move disparate brands, categories (e.g. softlines and hardlines), divisions, functions, and/or geographies to a common set of processes and unified PLM platform.

We employ proprietary, industry-specific methodologies, leading practices and tools, including:

- EVOLVE framework - a proven approach to accelerate the return on incremental investments in PLM
- Accel for Hard Goods - an accelerated delivery model that results in faster ROI for PLM

TELL US WHAT YOU SEE AS THE TWO MOST IMPORTANT EMERGING TRENDS FOR RETAILERS AND BRANDS (PARTICULARLY FASHION, FOOTWEAR AND ACCESSORIES) IN THE COMING YEAR?

Product development will change more in the next 5 years that in the last 15. PLM is necessary to transform the product development lifecycle, but it's not sufficient for the future. Going forward, leaders are pulling a new set of transformation levers to drive substantial change, including 3D product creation, voice of the customer, crowdsourcing, smart connected products/ wearables, predictive analytics, material innovation, open innovation and innovation portfolio management. This requires an ecosystem of adjacent technologies that leverage PLM. To succeed, retailers need to have a point of view on the future, build a strong case for investments, run strategic experiments and bundle these levers together into transformational programs.

TELL US WHAT YOU SEE AS THE TWO MOST IMPORTANT EMERGING TRENDS FOR SUPPLY CHAIN MANUFACTURING (PARTICULARLY FASHION, FOOTWEAR AND ACCESSORIES) IN THE COMING YEAR?

First, RFA companies will see a big leap forward in the potential to innovate methods of make, ranging from 3D printing to local manufacturing centers to the application of robotics in the manufacturing process. Second (and related), will be the shift to product personalization via mass customization, i.e. being able to apply technology and manufacturing techniques to deliver unique product to smaller and smaller consumer segments at scale.

VIEWPOINTS ON INNOVATION

viewpoints.io/retail

Understanding the New Innovation Levers

Product development will change more in the next 5 years than in the last 15. PLM is necessary to transform the product development lifecycle, but it's not sufficient for the future.
Going forward, leaders are pulling a new set of levers to drive substantial change.

3D Product Creation · Voice of the Customer · Crowdsourcing · Smart, Connected Products / Wearables · Predictive Analytics · Material Innovation · Open Innovation

These levers will require an ecosystem of adjacent technologies that leverage PLM.

Top Six Things Retail Executives Need to Know About PLM Transformation
by Vipin Goyal and Steve Riordan
read more at **kalypso.com/sixthings**

7 Reasons Why IoT Matters to Retail, Apparel, and Footwear Product Leaders
by Steve Riordan and Chad Markle
read more at **viewpoints.io/rfaiot**

3D Adoption in Retail – Avoiding the Deployment Trap
by Chad Markle and Traci Stapleton
read more at **viewpoints.io/3dapproach**

Transforming Product Development in Hard Goods
by Traci Stapleton and Vipin Goyal
read more at **viewpoints.io/hardgoods**

Closing the Product Innovation Loop with the Voice of the Customer
by Steve Riordan and Tommy Mitchell
read more at **viewpoints.io/retailvoc**

Six Critical Success Factors for Data Governance
by Sonia Parekh
read more at **viewpoints.io/sixfactors**

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subscribe at **viewpoints.io**

A KALYPSO PUBLICATION

WHICH PLM SOLUTIONS / SUPPLIERS DO YOU WORK WITH? IF YOUR SERVICES ARE VENDOR-AGNOSTIC, PLEASE SAY SO.

Vendor Agnostic. We work with Centric, Visual 2000, Infor, PTC, Gerber, and Lectra.

LIST YOUR IMPLEMENTATIONS OF RFA PLM ACCOMPANIED BY THE NAME OF THE SOLUTION THEY CHOSE WHERE THIS IS PUBLIC INFORMATION.

- Ben Sherman – 2012/2013 – PTC
- Kwintet – 2012 – Gerber
- Marsylka – 2014/2015 – Visual 2000
- Tally Weijl – 2014 – Centric
- Build a Bear – 2013 – Centric
- Voice/Gresvig Sports – 2012/2013 – Lawson
- Local Boyz – 2016 – Visual 2000
- Closet Clothing – 2016 – Visual 2000
- Mountain Equipment Co-op – 2015/2016 – Visual 2000
- Seasalt – 2015/2016 – Visual 2000
- Pentex – 2015 – Visual 2000
- Studio One – 2016 – Visual 2000
- Trekmates – 2015/2016 – Visual 2000
- Boden – 2016 – Centric

*Plus 4 other clients in 2015/2016 who do not wish to be identified.

Over the last 6 years we have implemented in excess of 30 systems from PTC, Lectra, Gerber, Lawson/Infor, Visual 2000, Freeborders and Centric.

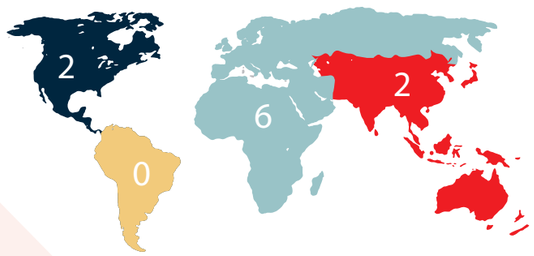
PLEASE PROVIDE THE NUMBER OF QUALIFIED DOMAIN EXPERTS YOU HAVE SPECIFICALLY FOCUSED ON IMPLEMENTATIONS IN THE RFA SECTOR, SEPARATED BY REGION AS FOLLOWS:

North America: 2

Latin America: 0

EMEA (Europe, Middle East, Africa): 6

APAC (Asia Pacific): 2



WHAT DO YOU CONSIDER YOUR PRACTICE'S STRATEGIC, TACTICAL AND IMPLEMENTATION STRENGTHS TO BE IN THE REGION OF RETAIL, FOOTWEAR AND APPAREL LIFECYCLE?

Deep understanding of the methods and processes used within the RFA sector. The knowledge and experience of our consultants both in the RFA industry and in implementing software systems within it. Ability to handle all aspects of an implementation including selection, business process re-engineering and definition, system configuration, onsite training and documentation, report writing and development and support services. As a team PDP is there from the initial concept right through to Go Live and beyond a true partnership.

TELL US WHAT YOU SEE AS THE TWO MOST IMPORTANT EMERGING TRENDS FOR RETAILERS AND BRANDS (PARTICULARLY FASHION, FOOTWEAR AND ACCESSORIES) IN THE COMING YEAR?

Collaboration between the Retailer/Brand and the Supplier(s). Most companies still do not bring their external suppliers into PLM but this is now starting to change and 2016/2017 should see this become the norm rather than the exception.

Internet of Things (IoT) – A lot is being done to enable the IoT and PLM is at the forefront of combining different technologies (Electronics, Computing, Communication etc) with the ever changing landscape of Clothing, Footwear and Accessories .

TELL US WHAT YOU SEE AS THE TWO MOST IMPORTANT EMERGING TRENDS FOR SUPPLY CHAIN MANUFACTURING (PARTICULARLY FASHION, FOOTWEAR AND ACCESSORIES) IN THE COMING YEAR?

Collaboration is still the most important function for the extended supply chain. The growing trend of End to End solutions combining PLM and ERP means that this is even more important in providing a seamless communication and tracking system that enables all partners to participate and visualise the complete supply chain.

PRODUCT
DEVELOPMENT
PARTNERS

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+44 (0)7515 741852

Led by Perry Bonney, Product Development Partners provides expert consultation services to companies in the retail, footwear and apparel industries who are looking to implement new software or enhance their existing product lifecycle management environments.

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PRODUCT DEVELOPMENT PARTNERS

Joining the dots

Connectivity, APIs, digital transformation, and the IoT

The retail, footwear and apparel industry is rife is with acronyms. As anyone used to talking about PLM knows, the three-letter version makes for snappy marketing, but truly articulating the concept of product lifecycle management requires us to reel off the full words.

The same goes for the Internet of Things (IoT), which is certainly easier to say in its acronym version, but which demands an deep understanding of its constituent words, and appreciation for their history in order to truly grasp.

To use a few additional acronyms, the PDP (Product Development Partnership) team has been operating in the RFA (Retail, Footwear & Apparel) sector since computers found their way into our industry in the late 1980s. At that time, the first CAD (Computer Aided Design) and CAM (Computer Aided Manufacturing) solutions were beginning to reach the market, and forward-thinking brands and retailers were jumping on board what was then fashion's first real digital revolution.

The IoT wasn't on anyone's minds back then – because, until the early 1990s neither was the Internet itself. But nevertheless, from a digital perspective, the apparel industry was beginning to deal with software that had either a direct or indirect link to the end product: physical garments, footwear, or accessories.

That software also opened the door to one of the industry's biggest ongoing problems: integration. At the time, proprietary data formats were common, but since the volume of software solutions was considerably lower than today, the challenge was not the languages these systems spoke, but rather how close they could be placed to another in the physical world.

Unlike today, when TCP/IP over wide area networks (WANs) is the accepted standard for moving information around the world, in the earliest days of CAD and CAM, we would run cables between network cards. Sharing pattern pieces, markers, numerically controlled data, CAD files and so on was a question of making underfloor or ceiling channels between rooms, departments, floors, and even buildings.

> IoT is being introduced, promising a grand vision for system-to-system and system-to-hardware connectivity.

Around the same time, enterprise (and acronym-heavy) systems like Product Data Management (PDM), Enterprise Resource Planning (ERP), Material Resource Planning (MRP) and others emerged. But while these were "web-enabled" later in their lifespans, they, too, lived in the prototypical "data siloes," entirely disconnected from another, and from other software and hardware solutions throughout the business. This lead to a situation that will be familiar to many readers: the need to manually key the same sets of data into multiple different locations, and the problems inherent in this approach (duplicated work, redundant data, data error, administrative overhead) are well documented.

Fortunately for technical teams (and office managers) we have progressed beyond the need for spiderwebs of physical cables, but even with a wide area network spanning the globe, manual data re-entry remains a thorn in many businesses' sides.

For retailers, brands, agents and manufacturers, the need to integrate and connect solutions remains as acute today as it was thirty years ago. And although integration has become common, it's typically been handled via bespoke work – some of which PDP was also historically involved in – and ours is still an industry packed with proprietary information.

It's into this environment that the IoT is being introduced, promising a grand vision for system-to-system and system-to-hardware connectivity that promises to up-end the way we design, develop, market, sell, and even how we live the rest of our lives. The same underlying technology that will power connections between fabric cutters and PLM will fuel driverless public transport and connected cities.

So while I understand many are likely to groan at the idea of another acronym coming along and promising to change the world, the IoT is simultaneously a new face on an age-old need, and potentially the biggest opportunity our industry has to redefine the way we think about design, development, production, and consumer engagement.

When we think about integration and communication, the concept of an open Application Protocol Interface (API) has already changed the way software development communities in other industries operate, and the same is likely to happen in RFA. Using the common language of the Internet, so-called RESTful APIs allow platform holders to open up their proprietary rulebooks, and enable both first and third party developers to automate interactions between their own software and, in our case, the PLM or E-PLM solution at hand.

And while not all PLM vendors have yet embraced the idea of open APIs, I and the rest of the PDP team believe that doing so will be essential to empowering brands and retailers with the new kind of connectivity promised by the IoT.

As for what form that empowerment takes? This will be up to the brands and retailers themselves, aided by independent experts, to decide. For me, the first step will be that decades-old one: connecting solutions. Any business considering its IoT strategy should begin by mapping its existing solution stack, understanding the inputs and outputs of technologies – software and hardware – that might conceivably need to talk to one another. Next, they should carry out a value analysis, looking into the real-world benefit(s) of connecting these solutions to each other, and to the digital backbone that is an intertwined PLM & ERP platform.

From there, the starting point for actually deploying the IoT in your business will of course vary depending on that value analysis Broadly speaking, though, if you're a retailer you might want to start your project by connecting "Things" in the form of physical goods (via dumb tags like product bar codes, passive RFID tags for products, or GPS enabled tags) so that you can begin to track products in stores, in warehouses, and on trucks. This preliminary step will be key to later ones, such streamlining product lifecycles and logistics, or reinventing design, marketing, or retail concepts to react to the ever-changing demands of customers.

ARE WE THERE YET?

Whether you're a brand, retailer, or manufacturer, the odds are that this isn't the first time you've hear about the IoT. Technology vendors – particularly those selling PLM and ERP – have already begun to gear up their marketing and investment in the emerging technologies, advertising 24/7 supply chain visibility and collaboration, real-time communication and retail intelligence, augmented reality, virtual sampling and a huge array of other opportunities – all powered by the Internet of Things.

You could be forgiven for being a little sceptical, since vendors have been known to over-promise, but in fact the revolutionary potential of the IoT will – at least in theory – make all of this and more possible. By connecting a huge range of hardware, goods, garments, solutions, software, and machines, the IoT could realistic change almost everything we take for granted today.

No longer will we need to chase merchandisers to check on the status of contracts & orders; we will be able to track each order or single product via mobile apps, all the way to the consumer.

The ability to see where a product or contract order is at any time will improve the logistics and transportation processes. Ask yourself how many times you've heard of a delivery company (local or international) being told goods are ready to ship, only to find that's not the case upon arrival. We all know what late shipments mean for everyone.

> Technology vendors – particularly those selling PLM and ERP – have already begun to gear up their marketing and investment in the emerging technologies.

In the future the IoT will also help to enable "Mass Customisation." Based upon insights taken from consumers in real-time, retailers will see online trends happening on their dashboards – for example, what materials and colours consumers are looking at right now.

The following are just a few examples of how this connected, reactive intelligence might transform the way we think about apparel production.

MATERIAL & PRODUCT SAMPLING

Every brand, retailer, agents or manufactuer develops samples, be they materials, components or fully completed products. Via smart RFID labels and tags, we would be able to track and locate these samples at every stage of the design and production process, and better understand the true monetary value of these samples at any point in time. We could also track samples being used in the sales process and their return to stock.

MANUFACTURE

Smart sensors in NC Cutting machines will enable businesses to track which products are being cut at any point in time. These same smart sensors will also be able to monitor the health of the machines and warn the cutting operators of any issues – like an overheating motor. Without this automatic monitoring we often find factories with hundreds of machinists simply waiting for cut work; this results in late orders, which in turn results in missed sales and even penalities for the manufacturers! The same can be enabled for any critical hardware used within the manufacturing process that is using moving parts and computer chips (material inspection machines and spreading machines, for example).

The Internet of Things has truly arrived and, although we have a long way to go with regards to connecting and communicating with everything, our RFA technology landscape is moving fast. The race between technology vendors across the world is on, and although progress may seem slow in our industry compared to others, RFA appears to have reached the conclusion that the IoT is indeed inevitable, and PDP is open to working with brands and retailers to help map its impact on the future of the industry beyond the acronym level.

WHICH PLM SOLUTIONS / SUPPLIERS DO YOU WORK WITH? IF YOUR SERVICES ARE VENDOR-AGNOSTIC, PLEASE SAY SO.

Infor Fashion PLM

LIST YOUR IMPLEMENTATIONS OF RFA PLM ACCOMPANIED BY THE NAME OF THE SOLUTION THEY CHOSE WHERE THIS IS PUBLIC INFORMATION.

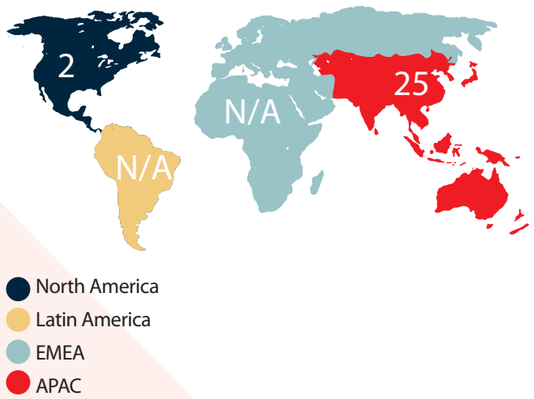
Ptex Solutions have been involved in several Infor Fashion PLM (earlier known as Freeborders PLM and Lawson Fashion PLM) implementations. This includes providing different services to our customer. The time period mentioned below is when we provided the services to the customer.

- ITC Limited (India - 2006)
- Reliance Retail (India - 2007)
- Gini & Jony (India - 2007)
- Aditya Birla Retail (Madura Fashion & Lifestyle Division) (India - 2008)
- Colorplus Fashions (India - 2009)
- Peacock (UK in 2009)
- Weissman (USA in 2010)
- Club 21 (Singapore in 2010)
- TAL (Hong Kong in 2010)
- Big Strike (USA in 2012)
- Darice (USA in 2013)
- CUK Clothing Limited (UK in 2013)
- Badger Sportswear (USA – 2014)
- HH Brown (USA - 2015)
- Future Retail Limited (India – 2015)
- Indus League (India – 2016)
- Ziera Shoes (New Zealand – 2016)
- The Apparel Group (USA – 2016)

* Plus 14 other customers that do not wish to be named.

PLEASE PROVIDE THE NUMBER OF QUALIFIED DOMAIN EXPERTS YOU HAVE SPECIFICALLY FOCUSED ON IMPLEMENTATIONS IN THE RFA SECTOR, SEPARATED BY REGION AS FOLLOWS:

We have a team of 25 Business and Technical Consultants based in India, and 2 in the USA. However, we have travelled to many countries for Implementation. This includes US, UK, Europe, UAE, China, Singapore, Hong Kong and New Zealand.



WHAT DO YOU CONSIDER YOUR PRACTICE'S STRATEGIC, TACTICAL AND IMPLEMENTATION STRENGTHS TO BE IN THE REGION OF RETAIL, FOOTWEAR AND APPAREL LIFECYCLE?

With a decade long service in PDM and PLM for RFA, Ptex Solutions have been involved in 32 PLM projects that are Retailers, Brands, Sourcing, Manufacturing, Apparel and Footwear companies. Ptex is a software services company that focuses only in Retail, Footwear and Apparel space.

Founder, Prasham Kamdar's association with the fashion and textile industry goes back several decades, due to his family business of garment manufacturing. He therefore understands the importance of having a team with domain experts. At Ptex, Business Consultants have education qualification from Fashion Institutes and or have the background of prior work experience in RFA. This has allowed Ptex to develop PLM implementation methodology that incorporates industry best practices and addresses customers' requirements.

TELL US WHAT YOU SEE AS THE TWO MOST IMPORTANT EMERGING TRENDS FOR RETAILERS AND BRANDS (PARTICULARLY FASHION, FOOTWEAR AND ACCESSORIES) IN THE COMING YEAR?

The world of fashion has the capacity to change faster than ever in the digital era. The two emerging trends for Retailers are Internet of Things and Smart Clothes with Wearable Technology. They are separate at the same inter connected topics.

Internet of Things can facilitate proximity marketing, to contactless checkout and everything in between. Retailers can collect data that can help them to understand their customer behavior, their preferences and send and personalized offer to their customer.

The other topic is Smart Clothes. Various companies have piloted wearable technology. But it has not been a main stream offering to the customers. However, it is only matter of time that these Smart clothes sold by every retailer. Just imagine Smart clothes with smart fabrics that optimize wearer comfort by adjusting temperature to preferred temperature, omits fragrances or fabric that could change colour.

TELL US WHAT YOU SEE AS THE TWO MOST IMPORTANT EMERGING TRENDS FOR SUPPLY CHAIN MANUFACTURING (PARTICULARLY FASHION, FOOTWEAR AND ACCESSORIES) IN THE COMING YEAR?

Sustainability practices are lead by the developed nations however this cannot happen without the support from the suppliers and vendors from developing nations. By manufacturers switching to sustainable manufacturing practices they can save money by reducing your water, power and electricity use. Right system will allow manufacturers to track and analyse every step of your process, helping them to determine where they can make the most effective changes.

Lets us combine Sustainable manufacturing with IoT. The desire to drive down costs by driving up efficiency using IoT technologies is having a huge effect on the sustainability practices across major manufacturing industries. From the ability to remotely monitor and automate the energy efficiency of devices and equipment in the field to tacking the location and condition of assets, personnel and inventory levels, the IoT has amounted to nothing short of a revolution in supply chain management.

Market Analysis 2015/16

For years the PLM market for retail, footwear and apparel has been misunderstood by customers and misrepresented by vendors and analysts alike. For the sixth year running, WhichPLM's market analysis – always exclusive to this publication – is designed to set the record straight, building on the framework developed and refined over five years' worth of previous research and investigation.

WHICHPLM MARKET ANALYSIS APPROACH

This RFA PLM market analysis follows the framework first adopted by WhichPLM in our 2013 Annual Review, which in turn built on the customer satisfaction and PLM adoption analysis approach initially taken in 2010. Now in its sixth iteration, we have steadily refined our Market Analysis - everything from our data collection methods to our core metrics - all with the single goal of presenting what we believe to be the most accurate, unbiased snapshot of the PLM market for retail, footwear and apparel.

Over the coming pages we have again reviewed the RFA PLM market at a global level, analysed the customers it comprises (segmented by Tiers, according to size and turnover), and examined the geographical spread of PLM adoption and its effect on the total international market size in the fiscal year 2015/16. We have also considered the drivers shaping the future direction of the market, updating these to reflect changes in market attitudes since our 5th Edition. Finally, we present the implications of twelve months' worth of research in three executive summaries tailored for the different sections of WhichPLM's audience: software vendors, consultants, and existing and prospective customers.

As always, WhichPLM is grateful to the vendors that contributed their time and effort to provide the information we requested, and those that share our desire to build a unique, transparent analysis of the global PLM market each fiscal year. Building on the reputation established by our previous publications, vendors, consultants and customers alike now clearly recognise how transparency and clear metrics of measurement can serve the international PLM market for retail, footwear and apparel as a whole.

As has been the case in all of our previous publications, this market analysis covers "pure" PLM for the RFA space only. For the avoidance of doubt this includes all of the following areas: retail, brands, manufacturers, sourcing agents, footwear, apparel, accessories, home furnishings, textiles, handbags, car seats & soft trims. As with last year's focus on 3D working in our 5th Edition, our special editorial attention to the Internet of Things featured elsewhere in the publication does not influence this analysis in any way. The scope of the research, intelligence and analysis seen over the following pages remains constrained to the market for core PLM solutions, rather than the wider set of extended PLM solutions that range from supply chain management and execution to 3D CAD and store visualisation.

As in previous years, the Glossary section at the rear of this publication includes a full definition of all terms used in this analysis, and clarifies the meaning that WhichPLM associates with each term. The definition of PLM itself, and our definition of a financial year are both important examples of why reference to the Glossary section can be helpful in understanding this analysis. Readers should not hesitate to look up any terms that are unfamiliar to them, or to refresh themselves on our interpretation of more common ones.

As always, WhichPLM has taken great care this year in obtaining, cataloguing, collating and analysing information from across the RFA PLM market – both from our long-running customer survey, and from direct conversations with the industry's premier vendors. With an identical format to last year's 5th Edition, the process of collecting refreshed information from each of the vendors for this analysis was smooth, leading to the most accurate sales data we have received to date, and allowing for a heightened level of comparison and interpretation in these pages. And although our analysis team continues to push back, validate and check for simple mistakes in the information given to us, we are now in our strongest position when it comes to enforcing our criteria with vendors, and we are very seldom provided with inflated or falsified sales information – a significant change from even a few years ago, when misinformation was fairly common.

Each of the supporting vendors (many of whom also appear in this publication's PLM vendor listings, and have shared their opinions on the subject of the IoT) has shared publicly available PLM sales data from the fiscal year 2015/16, and under non-disclosure agreements they have also each shared the identity of private sales. To maintain the accuracy of our global market analysis and compare these results to those we obtained in previous years, we also asked each vendor to provide further insight into global sales trends.

In the same vein, we have maintained our multi-year focus on the number of new name PLM sales as the key measure of the market, rather than other metrics such as seat numbers and revenue achieved – both of which are harder to secure and contrast, and are often entirely private, even in the context of relationships as strong as those WhichPLM maintains with key PLM vendors. As was the case in our previous publications, we have also been careful to discern between real sales of modern PLM, and PDM and E-PLM sales that, despite being grouped with PLM sales by some vendors, do not meet the inclusion criteria set out in our glossary.

Although WhichPLM is based in the United Kingdom, our online and print publications adopt a truly international perspective, and ours remains a growing, global readership, including vendors, customers and analysts who are distributed worldwide. For ease of comparison and in recognition of this international reach, we continue to use the US Dollar (USD) as a common currency.

INTERNATIONAL READERSHIP OF WHICHPLM

WhichPLM Readership by region, averaged over the 2015/16 fiscal period, is as follows:

EMEA	26%
ASIA	11%
AMERICAS	63%

Although these figures are not necessarily representative of the makeup of the PLM market in the same period – as the remainder of this analysis will demonstrate – they can serve as an indicator of PLM interest, which is to say a method of predicting potential future trends in the industry.

As these data demonstrate, North and South America constituted a large portion of WhichPLM's audience in this period, and while the Latin American countries make up only a fraction of this overall percentage, it is important to note that the USA and Canada do not account for all 63%, and that general PLM interest – if not necessarily sales - in South America is mounting.

While many of the global market's largest and most prolific vendors are truly international – with major offices in capitals and second cities on every continent – several of them are also headquartered in North America, and it stands to reason that their marketing efforts may be most immediately felt on their home turf. This, coupled with several large public events hosted in the USA, would account for the rise in readers arriving at WhichPLM from the United States and Canada.

Since the period this analysis covers – our 2015/16 financial year – ended, the distribution of WhichPLM readers has become more evenly balanced, with readers from the EMEA and Asia-Pacific regions visiting more frequently. Our Analysis team will keep close watch to see whether this remains the case for the entirety of the fiscal year 2016/17, and further conclusions will be drawn in this space in our 7th Edition Report.

OUR QUALIFICATIONS

These Reports form only part of WhichPLM's constant industry analysis and comment, and the last twelve months have further solidified our position in the RFA industry - a uniquely privileged one that enables us to speak from a perspective no other RFA PLM analyst or industry publication can:

- WhichPLM has been an independent source of information and advice to prospective customers looking for RFA PLM solutions (not to mention existing users of PLM) since 2008, and our audience has grown in absolute terms each year since the company was established.
- WhichPLM's editorial and executive board has deep international industry knowledge and expertise, born out of hands-on experience of design, development, selection and implementation of apparel-specific PLM and ERP products.
- WhichPLM has benchmarked many of the market's leading solutions and vendors, and has a deep understanding of the functionalities, capabilities and business potential of modern RFA PLM solutions, as well as a clear and well-documented roadmap for its future.
- WhichPLM team members have worked alongside all the market's primary vendors, but these relationships do not colour our analysis; our publications and services remain entirely unbiased.
- WhichPLM has received considerable praise for its efforts to create a fair, informed, and growing market. Our Annual Reviews (which became our numbered "Editions" as of last year's 5th Edition) are routinely cited as vital tools in large-scale digital transformation initiatives by PLM vendors, customers, and analysts.

For all this, however, the intelligence contained in these pages would not have been possible to assemble without the aforementioned participation of the premier PLM vendors, as well as those brands, retailers and manufacturers who contributed to this year's customer survey, helping us to provide an up to date view of the sharp end of the market.

Thanks to this approach, now firmly established and in its fifth iteration, we are able to present a more comprehensive and robust view of the RFA PLM market and its true scale than ever before – and certainly one that we believe remains wholly unique and useful.

THE RFA PLM MARKET

In the conclusion of the market analysis section of our 5th Edition (covering the fiscal period 2014/15), we predicted that the worldwide RFA PLM market would grow by 17% in 2015/16.

These predictions were revised slightly downwards from growth predicted in our previous report – the Annual Review 2014 – in light of slower than anticipated sales in the upper end of the market in the preceding year.

In practice, significant acceleration in the PLM market for smaller businesses (necessitating the creation of another Tier below the ones WhichPLM has previously measured, as detailed in our "Customer Tiers" table and accompanying explanation) and a resumption of PLM interest among some of the world's biggest brands and retailers combined to create actual growth of 25% when the new name sales market is measured as a whole.

In previous publications (most notably our 2014 Annual Review, but also last year's 5th Edition) we have referred to the achievement by PLM of critical mass, and this perception continues for the fiscal year 2015/16, with PLM outpacing expectations to continue with double-digit growth, as well as reaching – through lower-cost, rapid deployments – an entirely new and rapidly expanding sector of the market.

To place this continued double-digit growth in context, IT industry analyst firm Gartner predicted 7.5% annual growth in Enterprise Application Software for 2015 - a growth rate that was anticipated to continue on average for the following four years, until 2019. Both the significant growth we have seen in 2015/16, and our predictions for the coming twelve months are therefore considerably, yet justifiably, higher than the global average for other enterprise software markets.

The Market Sizing section of this analysis explains the raw numbers behind these calculations, and this detailed explanation is not repeated here. It should be noted, however, that we have been conservative in our estimations of the "hidden" PLM market – those sales that are not covered explicitly by this publication – when it is entirely conceivable that up to a hundred additional such sales may exist outside the purview of this analysis.

Rather than indulging in pure speculation, however, the WhichPLM team remains steadfast in its commitment to analysing only those vendors who meet our inclusion criteria, respond to our requests for information, and those about whom we can draw confident conclusions, rather than confusing the market.

Compared to the distribution of sales we saw in our 5th Edition, the top-level international composition of RFA PLM sales in the period 2015/16 can be broken down as follows, into EMEA (Europe, the Middle East and Africa), Asia-Pacific, and the Americas (the USA, Canada, and Latin America):

REGION	2014/15	2015/16
EMEA	36%	40%
Asia	13.5%	23.5%
Americas	50.5%	36.5%

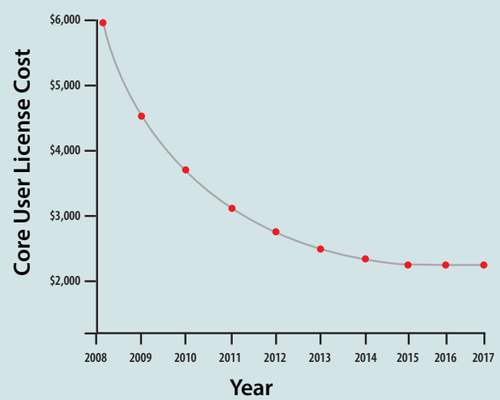
Comparing this year's figures to those from our 5th Edition, the most concise measure we have of overall PLM market distribution reveals that European and Asian sales have increased as a percentage share of overall sales volume, while sales to North and Latin America have decreased.

The geographical drivers for PLM adoptions are analysed in more detail later in this section, but at a high level the likely influences behind this change of sales concentration are:

- The continued expansion of several key PLM vendors into Asia – particularly India and China.
- The evolution of manufacturers in Asian countries into private label brand owners, and the increased competitiveness of these domestic brands versus foreign imports with a growing Chinese consumer base.
- Greater uptake of external (or supply chain partner) PLM licenses, with collaboration between supplier and customer eventually leading to PLM adoption where that supplier becomes a brand owner in its own right.
- Relative stability in the European market. Taking account of the fact that the period analysed in this report ended before the turmoil caused by so-called "Brexit" (the UK's exit from the European Union), greater confidence was exhibited by European brands and retailers in their ability to profit from PLM.
- The aforementioned emergence and immediate explosion of the Tier 4 market, carrying through PLM's "crossing the chasm" to its logical next step, with subscription-based or low cost PLM now available to the smallest brands, retailers and startups.

It is important for readers to remember, though, that the volume of sales to smaller businesses does not equate to the most revenue being derived from the lower Tiers of the market. A subscription-based sale of PLM to a boutique brand with five or fewer users is an entirely different prospect from a large enterprise implementation, where additional roll-outs and phases of the PLM project can account for hundreds (or potentially thousands) of additional licensed users within internal departments and across their network of supply chain partners.

The cost of acquiring and implementing PLM for both big and small businesses, however, has continued an overall downward trend. Based on feedback from PLM project teams and end users, the ratio of software to service spend (i.e. the average cost of acquiring a PLM license versus the cost of going live with a new PLM environment) has now hit its lowest ebb, with 1:2 being common in the mass market, and 1:1 becoming the norm for lower sized companies (Tiers 2-4). The subscription-based model of cloud deployments may make this metric obsolete in the future but, for the purposes of this immediate analysis, we can be confident that the total cost of owning core PLM is perhaps the lowest it has ever been.



Core license cost is defined as the price an average customer of PLM pays to obtain a single, named read / write user license to use core PLM software modules. It is one of the simplest metrics by which total cost of ownership (TCO) can be judged, and reductions in this cost – coupled with the ongoing move towards equal software to services spend ratios - are often cited by vendors and analysts as helping to lower the 'barriers to entry' of PLM.

Two important caveats apply to this ongoing downward trend. First, while the cost of a core PLM license may have decreased, prospective PLM customers should remember that module cost – the price of additional software modules that a customer may be required to purchase in order to have a complete solution – has demonstrably risen over the same period of time. Secondly, the license model may shortly be upended by the rise of subscription-based PLM platforms, so it is critical that customers compare like-for-like solutions, including all required modules, and comparable deployment methods and pricing structures when analysing their TCO.

At the same time as relative costs have reduced, the capabilities of PLM have improved considerably – as evidenced by the total satisfaction seen in this year's Customer Survey responses, and WhichPLM's own web-published Supplier Evaluations. Over the last decade we have seen most PLM solutions increase their processes from an average of 10 (confined primarily to product design and development tech-packs) to the 40+ processes that are typically found in a modern PLM solution. A business of any size or scope buying PLM today will gain access to some combination of the following cutting-edge functionality: trend, storyboarding, merchandising, 2D creative design, deeper supplier collaboration, RFQ, Mobile and the start of CSR, 3D, Supply-Chain visibility, and marketing modules, to name just a few of the most notable recent additions.

It is important for customers (and consultants alike) to note, however, that not all of the latest functionality is added to both big enterprise and small business PLM products. Some vendors now cater to Tier 3 and Tier 4 customers by offering a tailored (or, less charitably, "stripped down") version of their flagship PLM solution that includes only the essentials that they feel smaller companies will need.

Irrespective of customer size, however, PLM's value proposition is now more potent than ever before: solutions often include modules and capabilities that were not previously regarded as being part of core PLM, or that fell under the umbrella of E-PLM and attracted an additional cost to the customer to implement. As previously mentioned, some of these may only appear in particular versions of the product, and some in particular may attract an additional cost no matter how the base PLM solution is acquired, but broadly speaking PLM in 2016 is a capable, compelling, and increasingly cost-effective proposition for virtually any RFA business.

In our 2014 Annual Review, we devoted considerable attention to PLM's having "crossed the chasm", which is a term coined by Geoffrey A. Moore to refer to the yawning gap that technologies – either consumer or enterprise – must bridge in order to transfer their success amongst early adopter into the mass market. We revisited this analysis in last year's 5th Edition, when we concluded that PLM had now seen broad adoption amongst what Moore calls "early majority pragmatists," or those members of the mainstream who have become sufficiently educated to see the potential of PLM.

In that 5th Edition, our analysis team concluded that significant market potential remained untapped amongst Moore's "late majority conservatives," or those in the mass market who prefer to withhold their investments until a product is proven beyond doubt by the majority.

While it would be tempting to write that PLM had begun to make inroads with these businesses, we believe that not yet to be the case; while the emergence of Tier 4 as a potent sector of the market has had a dramatic impact on this year's figures, these boutique brands and startups cannot rightly be called "conservative". Instead, we believe that the PLM market has remained just at the cusp of the most precipitous part of Moore's upward curve, but that the potential audience for that stage has widened as a result of the influence of cloud technologies, other enabling tools, and new market pressures.

Also unchanged is PLM's ability – often paired with ERP – to form the centre of a comprehensive, extended information ecosystem and deliver compounded benefits to customers. This echoes Moore's model, which mandates that a functionally complete solution is required in order for any product (Moore talks particularly about "disruptive" ones) to achieve mass market penetration and ongoing success.

As always, these positive conclusions and caveats are both borne out by our customer surveys, hands-on research, and other evidence collection. The return on investment potential of RFA PLM is today well-understood by the newly-expanded majority market, and reference selling based on reliable, proven experience is now considered essential, as the benefits of PLM – reduced cycle time, better margins, enhanced collaboration – are balanced against the risks inherent in improper research, preparation and partner selection.

ABOUT OUR TIERS

Throughout this section and elsewhere in this year's publication, we refer to customers as falling into five distinct "Tiers". In a market where PLM sales to the middle and lower portions of the spectrum are growing at an increasing rate, it is important to differentiate – especially for the purposes of market estimations – between a sale to a large, multinational, multi-billion-dollar organisation and one to a single-territory boutique brand. For the purposes of revenue and license quantity analysis alone, the former sale will likely be worth substantially more than the latter, and it is only possible to build fair and reasonable market estimations when these disparities in value and size are taken into account.

For clarity's sake, our customer Tiers for retailers and brands are delineated as follows:

TIER 0 Also known as the "super tier", customers who fall into this category demonstrate annual revenues in excess of $10 billion, and are typically multinational organisations.

TIER 1 With revenues of between $1 billion and $9.9 billion, Tier 1 customers may share equal domestic renown to their larger counterparts, but lack the sheer sales volume and international impact that would elevate them to the super tier.

TIER 2 Encompasses a wide variety of retailers and brands in what is commonly referred to as the "mid-market". These companies demonstrate revenue of between $500 million to $999 million.

TIER 3 Takes in those smaller organisations that fall below the revenue threshold of Tier 2 – typically single-territory or boutique retailers and brands with revenue from $100 million up to $499 million.

TIER 4 Newly added for the 6th Edition, this Tier encompasses businesses – typically emerging designers, extremely small brands, or retail startups – that fall below the Tier 3 bracket, turning over $99 million or less per year.

CUSTOMER TIER	PERCENTAGE OF NEW NAME SALES
Tier 0	2%
Tier 1	13%
Tier 2	12%
Tier 3	18%
Tier 4	55%

While we have carried over the four Tiers originally established in 2014 in this year's report - allowing us to maintain consistent comparisons between financial periods – readers will also note that we have now introduced a fifth, called Tier 4.

This action was taken in the interests of clarity; in our 5th Edition, the lowest Tier we then tracked encompassed all PLM customers with revenues of $499 million and below, and accounted for 77% of the market in terms of new name PLM sales. When similar percentage figures were observed in 2015/16, we decided to introduce greater granularity into this analysis, and to divide what was Tier 3 in two. Those customers with annual revenues lower than $99 million are now presented separately from those with turnovers between $100 million and $499 million, since the forces driving their adoption of PLM are, in many instances, different from those driving slightly larger organisations.

At the upper higher end of the market, it remains clear that Tier 0 sales are significantly larger than the sales within the smaller Tiers (particularly Tiers 3 and 4), and in reality the value of such major enterprise sales can heavily distort the perception of what the average sale consists of. This is one of the primary reasons that WhichPLM does not track dollar value as a major metric for comparing PLM sales by region or between vendors, and why we do not encourage customers in any other Tier to base their strategic goals or value assumptions on the actions and results of the world's largest businesses.

In line with the figures we saw in 2014/15, though, these highest echelons of the market account for very few new name sales. Just 2% of sales are from Tier 0 customers this year, and Tier 1 sales have risen by only 4% in the last twelve months.

Following a noteworthy fall of 24% between the period 2012/13 and 2013/14, the recovery of the Tier 2 sector of the market remains consistent. The size and composition of Tiers 3 and 4 are discussed in greater deal later in this Analysis.

GEOGRAPHIC TRENDS IN RFA PLM

This section will analyse the international adoption of PLM in what we believe to be the most noteworthy regions highlighted in the "Regional Potential of PLM" section that appears later in this Analysis. Broadly speaking, key PLM vendors are heavily focused on their own local markets, and the establishment of offices further afield – while increasingly common - is typically taken as a strong indicator of market potential in those locations. Put bluntly, successful PLM vendors do not tend to invest unwisely in new markets.

This effect is evidenced by the continued – albeit steadily decreasing - dominance of the USA in its proportional share of sales, underpinned by the work of American vendors like Centric Software, Gerber Technology, Infor, NGC and PTC. Similarly strong in their home markets are: Dassault Systèmes (France); Human Solutions (Germany); Koppermann (Germany); Lectra (France); and Visual 2000 (Canada).

This is not to say that these vendors are focused solely on their local customers, and indeed a number of these have begun to work elsewhere to considerable success. The following regional analysis looks at some of the forces that are shaping this international expansion, and arrives at a historic milestone for the global PLM market.

China is now the world's second-largest PLM market by number of new name sales – a status it has never achieved before in the time that WhichPLM has been evaluating the market.

CHINA

Analysts (WhichPLM included) have long predicted an explosion in PLM adoption in the former manufacturing strongholds of Asia. Since our first formal Market Analysis – covering the period 2012/13 – sales to Chinese customers in particular have risen steadily. In that initial analysis, the Chinese market for RFA PLM accounted for just 1% of global new name sales – a figure that rose to 4% in 2013/14 and remained at that number in 2014/15.

Suddenly, though, that predicted, precipitous rise in PLM adoption in China appears to have begun. While sales to Hong Kong-based companies have risen by just 1.5% since 2012/13, those to businesses based on the mainland have jumped 6%.

Indeed, China is now the world's second-largest PLM market by number of new name sales – a status it has never achieved before in the time that WhichPLM has been evaluating the market. And while we have previously written about the forces influencing growth in the Chinese PLM market, it is worth revisiting and extrapolating on these here, since a tipping point appears to have been reached.

In China, and indeed across Asia, the growth in proportion of PLM sales (also particularly evident this year in India, where a stable market has begun to emerge) supports our long-held hypothesis that the maturation of larger manufacturers, who are now becoming brand owners in their own right, is one of the primary forces driving adoption.

As highlighted in our 2014 Annual Review and last year's 5th Edition, multiple recent research publications by McKinsey & Company have showcased the partial shift of Western brand sourcing operations from China to Bangladesh and to other countries such as Vietnam, Indonesia and Cambodia. This growing shift away from manufacturing dominance, analysts suggest, is being driven by increased sophistication of the Chinese domestic consumption market, coupled with significant cost increases - especially salaries for local workers.

In light of these changes, the Chinese government has recently introduced subsidies to help facilities transition to automated methods, and to modernise in a way that it hopes will allow a good proportion of its manufacturing expertise (and the income it generates) to remain in-country. Robotic factories certainly change the traditional manufacturing / consumption equation somewhat, and we predict that the world may see the emergence of completely integrated Chinese apparel businesses that produce, distribute, and retail entirely in-house, from raw cotton to point of sale. But it remains to be seen whether manufacturing as an independent industry and large-scale employer can avoid the same fate in China that it suffered in the USA and Europe.

Nevertheless, this move towards a brand and retail market is a significant boon for the PLM industry, which is accustomed to looking to the USA and Europe – in that order – for its target customers. This is evidenced by the hosting of a 2017 PI Apparel event (the New York City version of which our editorial team has covered for the past two years) in Hong Kong. WhichPLM also knows of several PLM vendors who have been prescient enough to establish firm operations in China – often brought about through existing links with the country's manufacturing base – and who will now be able to capitalise on opportunities in the industry's second-largest market.

In conclusion, the Chinese market for PLM is now a third of the size of the American equivalent, and as even more flexible, affordable variants of PLM and E-PLM technologies emerge, WhichPLM believes that these two territories will begin to equalise – or perhaps even trade places – in terms of sales volume in a much shorter period than the industry as a whole has been expecting.

NORDIC COUNTRIES

While Chinese, Indian, and other Asian brands now enjoy success in their home markets – and only occasionally outside – the Nordic countries have rapidly become a force to be reckoned with both domestically and on the international stage.

In 2014, fashion was Sweden's fastest-growing export, and in our 2015/16 fiscal period, sales of PLM to the country rose 3% compared to the previous year. The same is true of Norway, although Norway has historically shown higher adoption rates than its Nordic neighbours). PLM sales in Denmark have increased year on year, and Finland also appears to have emerged as a small but stable market.

Taken in isolation, these figures appear relatively minor but encouraging; combined they reveal that the Nordic countries now account for 8% of new name PLM sales by volume. This places the combined might of Sweden, Denmark, Finland, and Norway ahead of traditional luxury mecca Italy, equal to France – crucible of the runway show – and only a percentage point behind the UK.

It is entirely possible that continued international success and further investment by PLM vendors in the region will push the Nordic countries into becoming the third-largest PLM market within the next two to three years.

UNITED KINGDOM

PLM adoption in WhichPLM's home country has fluctuated considerably since we began analysing the market.

From a high of 13% in 2012/13, the UK's share of new name PLM sales dropped sharply to 6% in 2013/14 and remained there for the following year. In 2015/16, that share has begun to climb again, reaching a middle ground of 9% that earns the small island the position of third largest market by volume.

To provide some context for this apparent instability, we remind readers that the 2012/13 figure was distorted by some of the largest PLM deals in UK history, and did not reflect the status quo from years prior. We now consider the figure of 6% to be more representative of the country's baseline position, making this year's 3% increase upon that number noteworthy for several reasons.

Foremost, the increase in UK sales this year is likely to be indirectly related to the large market splash we saw in 2012/13. Many of these sales are from the middle market – typically high street or mall-based retailers – who, we believe, were influenced by the success of those larger deals. In the Market Analysis portion of our 5th Edition, we said the following:

"This seeming shortfall in sales is believed to have been driven more by a question of the timing and phasing of projects, rather than a lack of potential demand in the country. This is validated by the increasing number of inquiries being received by WhichPLM from UK based companies looking to understand more about PLM and the benefits that its adoption can bring. [The UK market] is anticipated to recover again in 2015/16."

And while this prediction appears to have been borne out, and the UK has a chance of becoming a buoyant market again, it does not on its own account for the rise in PLM adoption we have seen in the UK in this financial year. For a variety of complex reasons – the lack of a language barrier is likely to be a significant and obvious one – North American PLM vendors large and small have made considerable inroads into the UK market. Centric Software, Gerber Technology, PTC, TradeStone, and Visual 2000 have all signed noteworthy deals in the country in recent memory, while European vendors do not appear to have been able to transfer their install base for hardware and creative tools into PLM projects nearly as often.

A timelier analysis of the UK's future – looking beyond the scope of the fiscal period 2015/16 - is included in the "Long Term Market Forces" section of this Analysis.

USA

The kind of growth we see, in relative terms, in some countries must come at a cost to others, and in 2015/16 the United States is footing much of the bill. From a high watermark of close to 40% of new name sales (recorded in 2013/14), the USA has fallen to 30% this year.

This was neither unexpected nor unforeseen, however; the USA has led global PLM adoption by a huge margin for as long as WhichPLM has tracked the industry, and the country is home to many of the market's leading PLM and E-PLM vendors. Unlike other large countries - China, for instance - the USA has also long played host to one of the largest domestic consumption markets for apparel, footwear, and accessories, creating fertile ground for brands and retailers to sprout and grow in relatively compressed timeframes. The headquarters of many of the world's biggest international retailers are located in the USA, and most – if not all – of these have adopted PLM at least once.

The maturity of the American market is not confined to the brands and retailers themselves, however. At the time of this publication (autumn 2016), the American apparel software market has been through a full five generations: three of PDM, one of bespoke "toolbox" PLM, and now the modern strain of configurable solutions. Much of the market's share of sales volume has come from the steady march of brands and retailers along this path, and while we certainly do not believe that the American market is saturated for modern PLM, it may be that this previously-sizeable pool of captive customers is approaching bedrock.

MARKET SIZING

Drawing on our primary metric of new name RFA PLM sales and applying our own exhaustive cost calculations, the WhichPLM team has reached a number of conclusions regarding the overall market size for the financial period 2015/16, including some adjustments to take account of the following factors:

- Minor changes in the list of premier vendors that qualified for inclusion in this report, or who opted not to be included.
- The unwillingness of a small number of vendors to provide the requisite level of insight into their sales within the defined annual period.

These adjustments were made prior to this analysis, and have therefore been included in this accumulated market size and all geographical analysis, and their effect will therefore be felt in any analysis of the underlying trends. The effects of these adjustments are not significant, and remain consistent with the evidence visible in international and Tier-based adoptions.

This table demonstrates the method by which our analysis team calculates the total cost for a sale in each customer Tier, including each of the individual elements that are taken into account. These elements are based upon the variation in estimated typical costs and effort required to implement solutions across the different Tiers. Multiplied out, this table then shows the total value of the Tiered segments of the market, and it is followed by another table and accompanying interpretation that provide a monetary size for the market as a whole.

For Tiers 0-3, this calculation table is based up upon the same assumptions as used in our 5th Edition, since the underlying forces remain the same. The table takes account of the typical numbers of users, internal to external user ratios, percentage maintenance costs, and the services implementation days required across each of these Tiers.

The introduction of Tier 4, however, is slightly more complex than it may seem at first glance. While we introduced this new Tier as a way of providing more granular insight into a segment of the market that was previously accounting for 77% of all sales, this has the corollary effect of introducing a broader conversation regarding PLM payment structures that is considered in greater detail in the "Long Term Market Forces" section of this analysis.

In summary, though, maintenance is removed from the calculation table in Tier 4 because this cost is factored into the monthly subscription fees that the vast majority of these small brands and retailers pay in lieu of traditional licenses. These are not all cloud sales in the truest sense, but almost all are priced according to a "rental" structure, with traditionally-upfront fees segmented into monthly billing periods whether the underlying deployment method is pure cloud, hybrid cloud, managed services, Software as a Service, or some combination of these.

Legend for below table

- Per user license costs are based on an equivalent, traditional licensing model, and do not take account of subscription /cloud deployments.
- Service days includes only supplier days which the customer pays for – total costs and time could potentially be much greater when internal costs and hardware upgrades are factored in. Last year's research suggested a ratio of two to one in man days of internal resource compared to external.

	Tier 0 (5 sales)	Tier 1 (28 sales)	Tier 2 (26 sales)	Tier 3 (36 sales)	Tier 4 (119 sales)
Average seats per customer:	2,000 (comprised of 750 internal and 1,250 external)	600 (comprised of 200 internal and 400 external)	300 (comprised of 100 internal and 200 external)	75 (comprised of 50 internal and 25 external)	25 (comprised of 20 internal and 5 external)
Total seats this year:	10,000 (comprised of 3,750 internal and 6,250 external)	16,800 (comprised of 5,600 internal and 11,200 external)	7,800 (comprised of 2,600 internal and 5,200 external)	2,700 (comprised of 1,800 internal and 900 external)	2,975 (comprised of 2,380 internal and 595 external)
Typical per user license cost:	$1,000 internal, $500 external	$2,500 internal, $500 external	$2,250 internal, $500 external	$2,000 internal, $500 external	$1800 internal and external (average annual subscription)
Total license cost this year:	$6.9 million	$19.6 million	$8.5 million	$5.9 million	$5.4 million
First year maintenance (as a percentage of software license costs):	18%	20%	17%	15%	N/A
Total maintenance this year:	$1.2 million	$3.9 million	$1.4 million	$0.9 million	N/A
Typical number of service days to conduct implementation:	2,000 man days	600 man days	300 man days	100 man days	20 man days
Total service days this year:	10,000	16,800	7,800	3,600	2,380
Typical service costs per day:	$1,750 per day	$1,500 per day	$1,250 per day	$1,000 per day	$1,000 per day
Total service costs this year:	$17.5 million	$25.2 million	$9.8 million	$3.6 million	$2.4 million

Taking these differences in costing models into account, the composite total of licensing, maintenance, and servicing reveals a total size for new name sales in the RFA PLM market in 2015/16 of $112.2 million. This represents a significant increase on the same figure from 2014/15 ($89 million), but is not the highest single market size for a fiscal year that WhichPLM has observed.

On balance, this is encouraging news for the RFA PLM industry, since it represents an increase in market size of 26% when judged in monetary terms. For further analysis of the implications of these figures, turn to the "Long Term Market Forces" section of this Analysis, since we now move on to a more detailed look at the geographical composition of this overall market size.

The illustrations accompanying this analysis present the geographical distribution of new name RFA PLM sales in 2015/16 in two ways: as a heatmap, with different concentration levels coloured according to the legend beneath the map; and as a table, displaying this year's data alongside the same figures from the periods 2013/14 and 2014/15. While WhichPLM holds the same set of historical data for the fiscal year 2012/13, this has been excised from this publication as its ongoing relevance is limited.

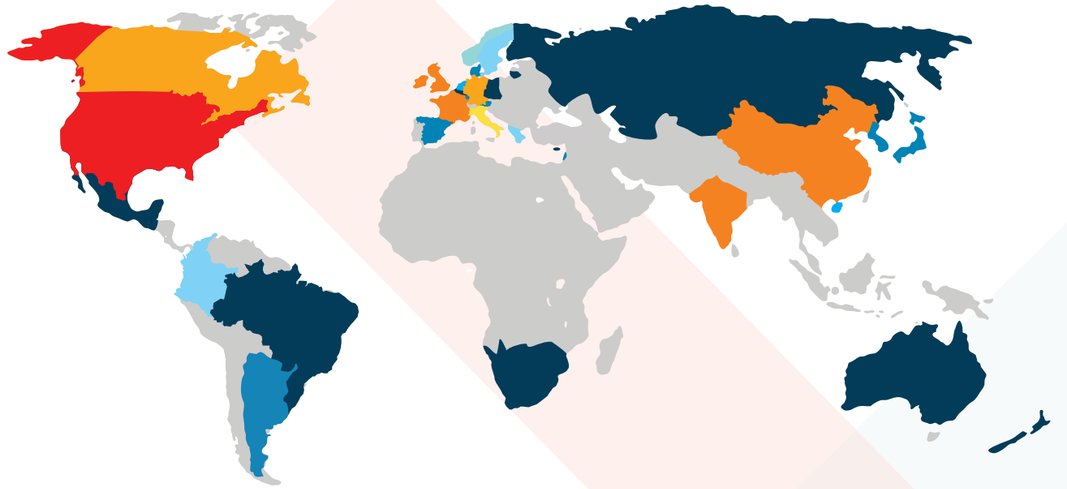
As outlined in the "Geographic Trends in RFA PLM" section of this Analysis, significant changes to the global marketplace have taken place this fiscal year, but in more general terms the market remains one where the bulk of sales occur in just six countries (defined as those with market share greater than 5%).

Despite variances in the positions of different countries in that overall topography, this has remained the case for every year that WhichPLM has analysed. The period 2015/16 is no different: the USA, China, UK, France, India and Canada are the only countries with market of 5% and above, although as per previous commentary, the Nordic countries fall into this group when their respective individual shares are combined.

TOTAL RFA MARKET SIZE FOR 2015/2016

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Total
License Costs	$6.9 million	$19.6 million	$8.5 million	$5.9 million	$5.4 million	$46.3 million
Maintenance Costs	$1.2 million	$3.9 million	$1.4 million	$0.9 million	Zero	$7.4 million
Service & Setup Costs	$17.5 million	$25.2 million	$9.8 million	$3.6 million	$2.4 million	$58.5 million
Composite Total	$25.6 million	$48.7 million	$19.7 million	$10.4 million	$7.8 million	$112.2 million

REGIONAL ADOPTION OF RFA PLM



United States	30.0%	Norway	3.5%	South Korea	1.0%	Mexico	0.5%
China	10.0%	Turkey	3.0%	Spain	1.0%	New Zealand	0.5%
United Kingdom	9.0%	Sweden	3.0%	Switzerland	1.0%	Poland	0.5%
France	8.0%	Hong Kong	2.0%	Belgium	0.5%	South Africa	0.5%
India	6.0%	Netherlands	1.5%	Brazil	0.5%	Tunisia	0.5%
Canada	5.0%	Denmark	1.0%	Finland	0.5%		
Germany	4.0%	Israel	1.0%	Guatemala	0.5%		
Italy	4.0%	Japan	1.0%	Lithuania	0.5%		

SHARE OF TOTAL RFA PLM SALES BY COUNTRY (%)

Country	2013/14 percentages	2014/15 percentages	2015/16 percentages
Argentina	0.0%	1.0%	0.0%
Australia	1.5%	0.5%	0.0%
Austria	1.5%	0.0%	0.0%
Belgium	0.5%	1.0%	0.5%
Brazil	0.5%	0.0%	0.5%
Canada	5.0%	5.0%	5.0%
China	4.0%	4.0%	10.0%
Colombia	0.0%	2.5%	0.0%
Denmark	0.5%	0.0%	1.0%
Finland	0.0%	0.5%	0.5%
France	6.5%	6.0%	8.0%
Guatemala	0.0%	0.0%	0.5%
Germany	2.5%	6.0%	4.0%
Greece	2.5%	0.0%	0.0%
Hong Kong	0.5%	1.0%	2.0%
India	2.5%	6.0%	6.0%
Israel	0.0%	0.5%	1.0%
Italy	12.0%	5.0%	4.0%
Japan	1.5%	1.0%	1.0%
Lebanon	0.5%	0.0%	0.0%
Lithuania	0.0%	0.0%	0.5%
Luxembourg	0.0%	0.5%	0.0%
Mexico	0.5%	4.0%	0.5%
Netherlands	2.0%	1.0%	1.5%
New Zealand	0.0%	0.0%	0.5%
Norway	3.0%	0.5%	3.5%
Poland	0.0%	0.0%	0.5%
Romania	1.5%	0.0%	0.0%
Russia	0.0%	0.5%	0.0%
South Africa	0.0%	2.0%	0.5%
South Korea	0.5%	1.0%	1.0%
Spain	2.0%	2.0%	1.0%
Sweden	1.5%	0.0%	3.0%
Switzerland	0.5%	0.0%	1.0%
Taiwan	0.5%	0.0%	0.0%
Tunisia	0.0%	0.0%	0.5%
Turkey	0.5%	4.5%	3.0%
UK	6.0%	6.0%	9.0%
USA	39.5%	38.0%	30.0%

These primary sales regions are joined – influenced by both PLM's penetration of the mass market and a number of geopolitical factors – by a growing list of smaller countries that together taper into a long tail.

In 2015/16, the largest consumer of PLM by sales percentage remains the USA, which still accounts for almost a third of all sales. As explained earlier in this Analysis, however, that dominance appears to be eroding over time; the United States has seen its share of the RFA PLM market reduce by close to 10% since its highest watermark of 39.5%.

It should come as little surprise to analysts and businesspeople that the biggest threat to the American PLM hegemony is China, which now accounts for 10% of new name sales in 2015/16 (or 12% if Hong Kong is included), and which – if current growth rates continue – will equal or overtake the USA's market share within four years.

Outside of these two pole positions, the market is then focused around nine further countries with statistically significant uptake of PLM. These include the UK, France, India, Canada, Germany, Italy, Norway, Turkey, and Sweden – all with sales concentrations of 3% or above.

The remainder of the market is then accounted for by eighteen other countries whose shares of new name sales have been smaller or more sporadic over the course of 2015/16. It is important to note, also, that ten further countries who have appeared in our Market Analysis for previous fiscal years were not represented this year – no attributable sales that met our assessment criteria took place in these regions.

Contrasting this year's geographical distribution against those seen in previous years, noteworthy changes – excluding those detailed earlier in this Analysis - include:

- Italy: as the home of luxury, the Italian market accounted for more than 12% of sales in 2013/14, and while this dropped to 5% in 2014/15, expectations were that some ground might be recovered in subsequent years. A further decline in 2015/16 suggests that ongoing turbulence in the high fashion market – and perhaps saturation in the same – has made this unlikely in the near future.

- India: driven by similar – but not identical – forces to the Chinese market, India has quietly ascended the ranks of PLM market share to become statistically significant in just four years. Often grouped in with other "emerging markets," India has this year outpaced stablemates like Turkey to enter the top five RFA PLM markets in the world, suggesting its emergence has already taken place.

- Latin America: In our 5th Edition, WhichPLM predicted "significant growth in interest in PLM solutions" across South America, and while this interest is evident in WhichPLM online readership, it has not yet manifested in raw sales figures. Argentina has returned to a zero share; the Brazilian market remains small; Columbia, too, has lapsed to a nil share; and Mexico has dropped a full 3.5% since 2014/15. We would caution readers against reading too much into these figures, however, as the complex political and commercial landscape of South America is likely to exert its influence on a market that WhichPLM still believes will emerge strongly in years to come.

It should be noted that, for the countries in the long tail, with only a handful of new name sales each year, there is no great statistical significance to the variations year by year.

LONG TERM MARKET FORCES

On the basis of the data collected for this Market Analysis, and the responses provided to our Customer Survey, the RFA PLM industry has stabilised just in time to be disrupted.

At a time when customers – including all of those who responded to this year's survey - are generally satisfied with the process of buying, implementing, and working with PLM, disruptive forces threaten to upend the entire selection, pricing, and deployment model upon which the industry is built. In a year when American vendors in particular aligned themselves for significant international success, the USA's dominance of the new name PLM market seems poised to start unravelling. And in a fiscal period when overall market size reached an equilibrium between the heights of 2013/14 and the comparative lows of 2014/15, it appears as though the primary sources of that monetary value stand on somewhat shaky ground for the coming five-to-ten year term.

We have already analysed the geographical stimuli underlying these changes, but as readers who examined our raw market sizing data will have observed, the most prominent force driving adoption of PLM – at least in terms of new name sales – is technological in nature.

Recent Gartner research – also cited in our 5th Edition - identified that over half of enterprise licensing comes from what that firm refers to as "alternate consumption models", or the various combinations of hybrid cloud, managed services, Software as a Service (SaaS), and general off-site hosting models that can be collected under the banner of "the cloud".

The RFA PLM market in 2015/16 is that conclusion writ large. More than half of the sales made in this period were to Tier 4 businesses who, in the vast majority of cases, implemented PLM off-site, and now pay for combined software licensing, maintenance, and support in a single, rolling subscription or rental agreement. And while these deployment methods are currently quite heterogeneous, we believe this combination of different off-site hosting models to be a transitional phase between traditional deployments and the eventual ubiquity of a pure cloud model.

From a technological perspective, this seems inevitable, and the precedent for this transition has been set by both consumer-grade and enterprise software in other industries. Microsoft's Office productivity platform is primarily sold on a subscription basis – although offline versions remain available – and the Adobe Creative Cloud, which sees heavy use in the RFA industry, has been the only way of acquiring new versions of Photoshop, InDesign, and Illustrator for more than three years.

Indeed, the value proposition for fashion brands and retailers is, if anything, more potent than either of these examples. Essential word processing, spreadsheet manipulation, and design functionality changes very infrequently, making buying these kinds of tools outright a more cost-effective option for businesses that do not need to live on the bleeding edge. In retail, footwear, and apparel, however, even core functionality must evolve rapidly to keep pace with market forces, and new modules are added frequently as technology matures – all of which conspires against the concept of lengthy on-site implementations and delayed milestone releases for all but the biggest businesses.

For reasons that vary from the practical to the superstitious, Tier 0 and Tier 1 companies are unlikely to lead the charge towards pure cloud deployments. Businesses of this size and scale have, after all, never been challenged by the affordability or the practicality of implementing PLM on-site. For smaller businesses, however, fully-featured, subscription-based PLM promises to mitigate or eliminate all of the principle barriers to entry: high upfront cost, investments in infrastructure and hardware, lengthy implementation periods, costly customisation, and a difficult onboarding process.

But while the value for this sector of the market – which already accounts for more than 70% of new name sales – is readily apparent, the same cannot be said for all PLM vendors. Although software to service ratios have all but equalised, we must remember that these are commercial enterprises, not charities, and their priorities will always align with the richest veins of revenue.

While there is certainly no question of larger PLM vendors abandoning the lucrative upper Tiers, as other tranches of the market move towards cloud deployments the industry as a whole will face a significant challenge: namely that pursuing volume will not lead to increased revenues without fundamental changes to business models.

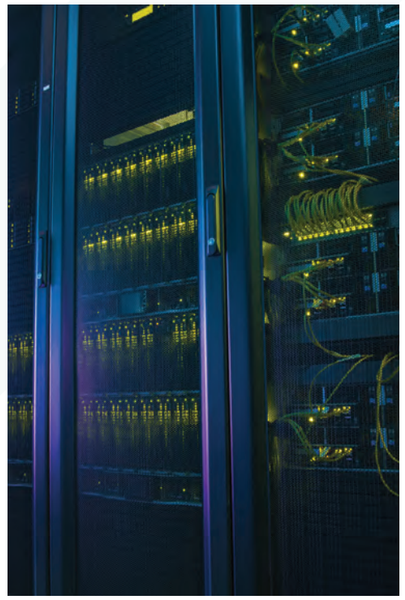
At first blush, it appears logical that vendors should target the largest sector of the market by volume – particularly since it is also likely to be the fastest-growing, with startups able to launch viable ecommerce operations and begin working with the same CAD tools as multinationals for a combined cost of around $100 per month. Pursue that line of enquiry further, however, and we observe that Tier 1, despite making up only 13% of new name sales by volume, represented more than 44% of the industry's overall monetary market size in 2015/16. Conversely, Tiers 3 and 4 combined – the logical short-term targets for subscription PLM – accounted for 73% of new name sales by volume, but made up only 14% of the RFA PLM industry's overall market size.

While the attraction of chasing a huge, expanding segment of the market is obvious, practically speaking the only vendors capable of doing so are those who have never operated under a traditional licensing / maintenance model, and those whose other portfolio products can compensate for a short-term shortfall in revenue should they decide to establish themselves in the "volume" sector.

We should remember, however, that vendors targeting only that bulk market segment are by no means guaranteed success. With only slow (and potentially sporadic) initial income streams, these vendors will need to fund expenditure on their distributed computing and storage infrastructures, since the same standards of security and scalability will apply to both the upper and lower tiers of the market.

In the longer term, of course, the choice of which slice of the market spectrum to pursue may disappear, leaving the volume SME market as the only option. In 2015/16, the upper echelons of the markets (Tiers 0 and 1) are profitable, but also vanishingly finite; once all the largest brands and retailers are using modern PLM, it will take years or even decades for challengers to grow sufficiently to replenish this market sector, and technological innovation alone may not be able to attract these multinationals to invest again in a new generation of solution.

Contrast this with Tiers 2, 3 and 4, which collectively account for a potential market of more than 100,000 small-to-medium businesses, and it becomes apparent that RFA PLM is set to become an SME-focused industry, in line with the progress suggested in the "crossing the chasm" model, and in WhichPLM's own predictions. These are startups and growing businesses who are



increasingly looking to compete with major players, and who consequently require access to the same tools and technologies as those bigger organisations.

This creates not just a potential market, but a captive one.

Finally, as a UK-headquartered publication, WhichPLM must mention the so-called "Brexit," or the country's democratic decision to leave the European Union. Although the referendum leading to this decision took place after the financial period 2015/16, it may have a profound impact on the European RFA industry – and therefore its PLM market – until stability is achieved. And while the UK RFA PLM market has recovered considerable ground this year, its continued growth is far from certain.

The long-term effects of Brexit are as yet unknowable, but prominent Creative Directors, commentators, and analysts have expressed concerns that the UK economy will begin to contract. While none of these figures is an economist, an undercurrent of unease remains about the future of the UK fashion industry, which may be able to eventually negotiate new opportunities and attractive tariffs with other regions, but which for now stands to lose preferential access to one of the world's largest single markets for apparel consumption. The UK fashion industry may also now be denied EU funding for small and medium businesses – the precise targets for the volume PLM market - in the order of hundreds of millions of Euros.

MARKET PREDICTIONS

Our prediction of 17% growth in new name RFA PLM sales in 2015/16 was met and exceeded. The industry grew by 25% on the basis of new name sales, and a similar amount – 26% - when judged in monetary terms. This being the case, we are confident in predicting 17% growth – averaged across all Tiers - in 2016/17.

WhichPLM online readership has historically proven to be a strong indicator of future market growth, and while this remains buoyant and actual growth outpaced our reined-in expectations for 2015/16, the complexities outlined earlier in this analysis have led our team to temper expectations – particularly as the industry begins to wrestle with the implications of its evolution into an SME-focused market, and economic instability threatens to rattle Europe.

Our overall market growth prediction is built up from expectations that the sales to Tier 0 size businesses will remain consistent, Tier 1 will decrease by 10%, Tier 2 will grow by 16%, Tier 3 will grow by 40%, and Tier 4 will grow by 26%. These growths by Tier level are based upon the aforementioned captive Tier 3 and 4 audiences, and the potentially diminishing market in the upper tiers.

As in all previous Market Analysis sections, this year's market sizing is measured on the basis of new name sales and does not reflect the potentially significant roll-outs of new licenses to existing customers. While our analysis team is confident that new name sales remains the most efficient and informative method of analysing the RFA PLM market, its monetary value may be dramatically larger if a total contract value perspective were taken instead.

PREDICTION ACCURACY ASSESSMENT

As internationally-renowned analysts and publishers, WhichPLM has a well-established history of making predictions for the future of the PLM industry for retail, footwear and apparel.

Although these have, generally speaking, proven accurate, the growth predictions indicated in this analysis are made at a particular point in time (this publication being released in the autumn of 2016) and are therefore based upon the best information available at that time. No prediction is guaranteed, although our conclusions are based upon clear content, context, and a strong basis for anticipated growth.

MARKET ANALYSIS IMPLICATIONS

Given the depth of the market analysis covered in this report, and the desire of WhichPLM to directly address the concerns and interests of its key readers, we now set out what we believe to be the key findings from this analysis in three executive summaries, each tailored for the needs of a particular type of reader.

EXECUTIVE SUMMARY FOR PLM VENDORS

In our 5th Edition, we advised vendors to keep careful watch on competitors who were pursuing expansion in new territories, and while our expectations that sales would begin in earnest this year in Latin America – primarily Colombia, Mexico, and Argentina – have not yet been met, those vendors who chose to target the Nordic and Chinese markets will now be vindicated, with the latter now the second largest market by volume, behind only the USA.

Similarly, those vendors – and they are primarily North American – who persevered with the difficult, fluctuating UK market may have been rewarded this year, as PLM was adopted by a series of mid-market, high street or mall-based retailers following in the footsteps of Tier 1 and Tier 0 businesses who paved their way in previous years.

Greater granularity in this year's analysis has revealed that an overwhelming majority (73%) of PLM sales in 2015/16 were to SMEs with a turnover of less than $499 million, and most of these (55% of the overall market) were to even smaller businesses, with turnovers less than $99 million. The majority of these used off-site hosted, subscription-based models of some kind.

A financial analysis, however, shows that this large – and growing - sector was responsible for just 14% of the market's overall monetary size, suggesting that the smartest vendors are those who have varied their investments and targets, rather than aiming exclusively at high or low-end businesses.

Any established vendor re-evaluating their strategic priorities for the coming three-to-five year period should consider diversifying in a similar way: pursuing traditional deals in exciting markets like China and the Nordic countries, and offering compelling, low-cost alternatives to the emerging volume sector in proven markets. It remains to be seen whether cut-down versions of PLM comprising only small business essentials, or fully-featured PLM on the cloud will win out in this latter segment, but vendors must ensure that a smooth transition from one to the other exists for small businesses expecting dramatic growth.

As has been the case with all of our previous publications, the few vendors who opted out of inclusion in this year's report will hopefully see from this market analysis framework and our earlier vendor profiles that they have not helped to reinforce their own position by remaining quiet. Indeed, they have only served to add a layer of confusion between customers and their true character and capabilities, and WhichPLM strongly encourages such vendors to ensure they contribute fully to next year's report.

WhichPLM has no reservations in recommending cloud-based PLM to customers, but we encourage them to be careful that the solutions they evaluate contain all the functionality they expect.

EXECUTIVE SUMMARY FOR PLM CUSTOMERS

In every sense, RFA PLM is now a buyer's market. Customer satisfaction is at an all-time high; solution capability is strong and constantly improving; total cost of ownership of traditional deployment models has levelled out at its lowest ebb for decades, and non-traditional models – i.e. "the cloud" – have all but eliminated barriers to entry for even the smallest businesses.

Unlike other industries, where the move to subscription pricing and cloud hosting felt forced, it should be considered a natural evolution for RFA PLM. The tools that brands and retailers need to compete domestically and internationally can be evaluated more easily, deployed much more quickly, seamlessly updated with new modules, and their cost can be spread over affordable monthly instalments.

But while WhichPLM has no reservations in recommending cloud-based PLM to customers, we encourage them to be careful that the solutions they evaluate contain all the functionality they expect. Often, subscription PLM is a cut-down "essentials" version of the vendor's enterprise product, and while many smaller businesses will be satisfied with these core competencies, others may not.

Just as with size, customers in almost any geography are now able to consider an investment in PLM, with many of the industry's leading vendors diversifying their customer bases to account for significant growth in Asia and Northern Europe. Wherever they are located, however, prospective customers should take steps to ensure that the vendor resources who will be conducting their implementation (or those responsible for managing the support portion of their subscription) have sufficient business process expertise, as well as the technical capabilities to deliver the project efficiently.

As we have in previous years, WhichPLM must also continue to caution customers who intend to approach a vendor who does not appear in this publication. While we do not assess the functionality of any solution or the roadmap or resource availability of any vendor outside of our dedicated Supplier Evaluations, the openness and relative transparency of most of the industry's key PLM vendors serves only to accentuate the guardedness with which the others treat their product, fiscal stability and their approach to the retail, footwear and apparel industry.

While readers should not assume that the presence of a vendor in these pages represents an endorsement of that company or its PLM solution, any vendor who is unwilling to divulge information to an impartial industry body should be subject to heightened scrutiny at the time of shortlisting and selection.

EXECUTIVE SUMMARY FOR PLM CONSULTANTS

Implementation consultants reviewing this market analysis should pay particular attention to the geographic developments and emerging trends outlined in our executive summary for vendors, since the same considerations apply to resourcing in these emerging markets.

Advisory practices with operations in the UK, the Nordic countries and China are now in a privileged position, since vendors will now be looking ally themselves with proven consultancy firms – particularly those who can demonstrate in-house experience and expertise specific to RFA PLM and E-PLM, and whose delivery capabilities can be scaled up to both meet unpredictable demand and to cater to a more diverse customer base.

Similarly, consultants should carefully consider their role in an increasingly SME-driven future market, with a greater volume but shorter duration of implementation projects. Service and implementation days will not disappear completely, however, and although online try-outs of PLM will eventually become more common than in-person demonstrations, the complexity and whole-business scope of a modern implementation will still require many businesses to employ an independent analyst to aid in final selection.

And while eventually onboarding and some degree of change management will be handled through online, in-app training, in the near future these disciplines remain the preserve of experienced professionals. A new generation of tech-savvy customers is now in the market for a new age of intuitive, affordable technologies, and the smartest consultants will begin taking immediate steps to secure their place in the market.

Finally, we apply the same caution to those vendors who are absent from this publication here as we do in our executive summary for PLM customers, since partnerships must be approached from a perspective of mutual benefit, and any vendor unwilling to divulge sales information to WhichPLM should be treated as an unknown.

THE FUTURE OF PLM

TO CAP OFF A PUBLICATION PACKED WITH FIRSTS – TOTAL CUSTOMER SATISFACTION, THE ASCENDANCE OF THE CHINESE RFA PLM MARKET – THIS FEATURE ALSO REPRESENTS THE FIRST TIME THE SPECIAL FOCUS OF A WHICHPLM REPORT HAS FED DIRECTLY INTO THE SUBJECT OF THE PUBLICATION THAT FOLLOWS. IN LAST YEAR'S 5TH EDITION, OUR EDITORIAL COVERAGE OF 3D WORKING BEGAN AND ENDED NEATLY, AND THAT PUBLICATION CLOSED WITH A SOFT INTRODUCTION TO THIS YEAR'S THEME: THE INTERNET OF THINGS.

Befitting a subject that WhichPLM believes will transform not just the RFA industry, but the world at large, a discussion of the IoT has no logical cut-off point, and dovetails with several other key challenges and opportunities that we – and other analysts – have identified as being the future of the industry. As a result, this short feature is intended to bridge the IoT coverage contained in this publication with the special focus that will shape our 7th Edition: big data and machine learning.

These topics, as we will see, are inextricably tied to the IoT. The editorial features contained earlier in this publication make mention of a world suffused by data streams, where brands, retailers, and manufacturers of all shapes and sizes must be capable of defining which data matter to them, and using the insights gleaned from it in order to make informed decisions.

Charles Benoualid of Visual 2000 neatly captured the essence of this interrelationship between big data and the IoT: "The key to big data is understanding that it's the output of the IoT, not the IoT itself, that companies are going to be able to leverage or gain value from."

It is impossible to broach the topic of big data, however, without first addressing its legacy. As buzzwords go, big data is perhaps one of the most loaded: some businesses are convinced they have it when they do not; others desire it without really understanding why; and others still have it and are frustrated by their inability to obtain value from it.

In short, big data means different things to different people, and its history makes objective discussion of it difficult, as Chad Markle from Kalypso explained:

"Executives have long memories. So many companies made massive investments in infrastructure for the purposes of data warehousing and business intelligence, and while there was some success in managing Big Data that way, there was also a lot of failure."

WhichPLM believes that, while its negative connotations cannot be ignored, big data is a subject the industry must tackle head-on. As the IoT becomes more mainstream, the volume and variety of data that brands and retailers in particular collect is only going to increase, and unless those businesses take a proactive stance on ascertaining which information streams are relevant to them, big data may become dead data.

"The challenge with Big Data is the speed at which its size has grown," said Ravi Anand of ITC Infotech. "More data has been generated in the last two years of the apparel business than in the entire five decades before them. But just generating data for every conceivable point is not going to help you; it's only going to confuse you. You need to figure out which data points are relevant to your key performance indicators."

> AS BUZZWORDS GO, BIG DATA IS PERHAPS ONE OF THE MOST LOADED

As Anand rightly says, the actual collection of data is not a significant challenge. The market is rife with data warehousing and business intelligence and integration platforms that can skim, pull in, and archive terabytes or petabytes of information in the cloud. But while simply collecting and storing data for later analysis may have once seemed like a manageable approach, the need has already emerged for a different strategy – one that Britta Riedl of Koppermann believes will be crucial in the very near future:

"How data is handled and utilised will need to change significantly in the future, as the prevailing principle is simply that gathering and archiving data is the goal and not the journey. In addition to developing numerous impressive innovations the RFA industry in particular is unfortunately lacking when it comes to expedient data generation and

THE KEY TO OVERCOMING THIS CHALLENGE, WHICHPLM BELIEVES, LIES IN DISTINGUISHING BETWEEN THE AFOREMENTIONED HISTORICAL (OR DEAD) DATA, AND LIVE DATA – INFORMATION THAT IS ACCESSIBLE, ACCURATE, UP-TO-THE-MINUTE, AND RELEVANT TO REAL WORLD APPLICATIONS.

utilisation. A significant increase – or an oversupply – of data makes balanced and sustainable structuring downright essential."

As the difference in value potential between data storage and data usage suggests, big data is widely misunderstood – even by some of those early adopters that the market at large assumes have been able to generate real results from their reams of information, as Rob Tiffany from Microsoft explained:

"The companies that have had significant machine to machine integration – using protocols like MQTT or AMQP – for some time now have huge piles of data that is completely un-analysed. Other companies tend to be disappointed when they learn that they don't really have "big data" like this, but they needn't be; no machine or human has ever looked at it, and realistically those businesses need a PhD-level statistician to make any real use of it. Instead, the IoT is going to be the source of the kind of big data I think people should be looking for: lots of little pieces of real-time, streaming information from disparate sources that is going to be aggregated and combined."

Although Tiffany's base of experience in M2M data integration is unique, his attitude towards big data is shared by many of the industry figures that WhichPLM interviewed for this publication.

"At the end of the day, a great deal of what we get as a result of the use of the IoT technologies is going to fall into the bucket of big data," said Bob McKee of Infor. "You are going to receive a lot of streams of consciousness, all non-normalised data, so you will have to find the connection between those data points. This is one of the biggest challenges to making use of large batches of data from a diverse group of sources."

The key to overcoming this challenge, WhichPLM believes, lies in distinguishing between the aforementioned historical (or dead) data, and live data – information that is accessible, accurate, up-to-the-minute, and relevant to real world applications. The challenge for businesses, then, will be to ensure that the real-time data streams coming from IoT technologies are usable in the moment, rather than becoming archival information, valuable only in the abstract sense. As an industry, we must make choices and investments in the very near future that will enable us to make concrete use of valuable information as it comes in, imbuing it with relevance for users in the immediate term, as Helmuth Ludwig of Siemens explained:

"Lots of data is not necessarily the same as big data. To make huge volumes of information useful, the key element is context. The temperature in a factory, in isolation, doesn't tell me anything – but if I know the temperature change for a certain machine during the execution of a particular task, I can interpret that information to inform an action. This is where the concept of the "digital twin" comes into play, because we can do more than just observe those kinds of changes; we can simulate them in an accurate replica of the production environment."

The concept of the digital twin was central to much of the discussion around 3D working contained in our 5th Edition publication, where high-fidelity digital assets were found to be extremely valuable in either supplementing or replacing physical garments for a range of different scenarios. For big data purposes, however, what Ludwig refers to is information-driven simulation and modelling of essentially any stage of the product lifecycle, from marketing to manufacture. And in an industry where these and other processes are increasingly being conducted in different software solutions, it will be vital that brands and retailers seeking this level of live or simulated visibility have data that is intelligible across multiple different solutions, as Charles Benoualid from Visual 2000 explained:

"Businesses need a strategy for making sense of the data they're capable of collecting: an interpretative software or application layer that allows them to pool, analyse, and share information. In the medium term, I think this could manifest itself as large data clouds, where vendors will find ways, through web APIs or other interfaces, to combine basic data scraping with intelligent analytics to generate usable, actionable information. As an example, I could have the ability to know the geographical distribution and customer makeup of sales of orange t-shirts in autumn 2016. But to get that intelligence, I need the analysis to be taken from a live picture across multiple different systems; if it's just my chosen system, it's a biased view by default."

Provided this degree of integration and interoperability is realised, however, WhichPLM firmly believes that data will become the key currency of the RFA industry – even more so than today – and that fashion brands will need to follow the example of consumer technology companies for best practices in data management. This is a view shared by Philippe Ribera of Lectra:

"I believe that data will be the centre of the next generation of the fashion business. The IoT and other smart services are a way to capture that data, and make it visually available to inform your decisions. From a B2C point of view, the biggest players in big data are companies like Facebook, Amazon, and Google, who can track millions and millions of data points and adjust pricing in real-time, for example. In B2B applications, the volume of data will be smaller, but machine learning will help create clear, understandable business benefits for our customers. We will arrive at the point of being able to simulate a great deal of the design and development process, and work according to a design-to-cost approach, improving margins and saving brands and retailers money."

Moreover, Charlotte Kula-Przezwanski of Columbus Consulting believes that, for the next generation of fashion industry professionals – accustomed to working with advanced, intuitive consumer technologies - this kind of real-time insight will be expected:

"I think the future of the IoT is curating data - that's how decisions are actually going to get made. A lot of the younger people working in retail today are accustomed to receiving a lot of information, but they need to be able to use it to take immediate action. It has to be relevant. They're managing so many more products for so many more channels that they have to act quickly, based on information they know is accurate, rather than looking at historical data and making an educated guess. Now, a sign-off meeting can be based on factual evidence - data taken from consumer feeds, or scraped in real-time from other sources - and buyers can have greater confidence in their range planning decisions. It doesn't take away the human element of retail planning; it just gives the people involved more evidence to work from, leading to less emotionally-driven decision making."

LIKE IT OR NOT, AI HAS ALREADY PENETRATED THE CONSUMER TECHNOLOGY INDUSTRY, AND NOW OTHER MARKETS ARE SLOWLY BUT SURELY CATCHING UP

If interpreting these boundless volumes of data in the moment sounds like a task too large for any human – or group of people – that is because it is. Gigantic data sets of the kind collected under the big data label are already too difficult for people to parse without assistance from algorithms, and the emotional aspect of decision-making that Kula-Przezwanski refers to can make objective assessment of the results difficult to achieve.

It is here that big data becomes intertwined with the concepts of artificial intelligence, cognitive computing, and machine learning, which are not necessarily all the same thing. Whatever we choose to call it, however, the topic of how much control of our personal and professional lives we are willing to cede to computers has long been a sensitive subject, and although WhichPLM did not set out to research AI, our interviews revealed that it was impossible to consider the future of the IoT without it.

While discussion of the IoT is coloured slightly by scepticism about the short-term viability of what sound, on the surface, like science fictional concepts, talking about AI is almost universally – at least outside of technology executives and analysts – seen as one of the last taboos. The same people who may be comfortable talking about connected soda bottles may balk at the idea of machine learning predicting next season's trends, or automatically handling stock allocation and replenishment.

But like it or not, AI has already penetrated the consumer technology industry, and now other markets are slowly but surely catching up, and Rob Tiffany cited several examples of platforms that are already conducting intelligent analysis of real-time information:

"As they collect more and more information, brands and retailers will need automated, advanced analytics tools to sift through that data as it comes in - to find the needle in the haystack that a human being would never see. That requires a lot of compute power - whether it's in-flight, in-memory analysis or batch processing of terabytes or petabytes of data to look for anomalies or exceptions – and cloud-based machine learning platforms like Azure Learning or the open source Apache Spark can help."

Although many of the consumer applications of machine learning (conversational assistants like Viv, Siri, and Amazon's Alexa (pictured below right in its Echo device form), and the neural networks that power our media recommendations) are matters of convenience, the largest technology companies on the planet are investing billions in developing AI that can be useful in enterprise applications and beyond, by complementing rather than replacing human intelligence. "The mechanisms of machine learning we see today – back chaining neural networks, deep learning concepts – are about machines being able to spot trends that humans can't," said Mike Anderson of The PTR Group. "Not that humans are necessarily physically or cognitively incapable of spotting these things, but that there is so much data that we simply can't see through it."

Anderson hints at the fundamental unease that many people have around artificial intelligence: the fear of being superseded and made redundant – literally and figuratively. We do not have the space to tackle these philosophical concepts here, but WhichPLM believes, at least in the short term, that AI will act in a first-stage role, interpreting information too diverse, too voluminous, and too complex for humans, and presenting it in a digestible format from which people can make better decisions. Julia Fowler from EDITED is keen to emphasise this collaborative role between human and machine, believing that there is a place for both in the future of fashion:

"For objective tasks like performance analysis, machine learning is already more effective than human analysis. One very basic reality is that the sheer amount of data being collected would overwhelm a whole team of people trying to keep up. When you consider, for example, that just one mid-to-large e-commerce retailer can introduce 3,500 new products per week, on top of all the price adjustments made to existing products, sellouts, restocks, and more, it's asking too much for people to stay on top. Now imagine you're asking them to do that for thousands of brands and retailers around the world. There's no way. Machine learning doesn't have those limitations; not only can it watch product movement in real time, it can contextualise that information and make it available instantly."

"However, when it comes to prediction, data is a great asset, but it's not a replacement for human intuition and experience," Fowler went on to say. "What it does is give fashion retailers an instant way to see their markets and go from there. It cuts out the mundane hours spent collecting and processing data by hand, and lets humans spend more time doing what computers can't. So it's a genuine partnership."

But while Brion Carroll from PTC agrees with the view that machine learning can be employed to serve a range of different, innately human job functions, he also believes – and WhichPLM agrees – that achieving this level of symbiosis between people and software will require many businesses to completely rethink the way they manage data:

"While traditional Business Intelligence is about bringing information in and normalising it, IoT platforms and middleware can fetch data from everything from CRM to products in stores, and make it available instantly. It doesn't have to be moved, or consolidated, or homogenised. And that, I believe, is where the real analytical value is going to come from: machine learning gives us the ability to create a synergistic view of all that information, pick out nuances we never could, and synthesise it into something useful that can provide information for planning, designing, sourcing and so on."

Obtaining value from a combination of the IoT and AI, then, will not be straightforward, and if assembling a business case for IoT can prove problematic, then doing the same on the basis of the potential of machine learning will be even more, as Chad Markle from Kalypso explained:

"Selling the idea of advanced analytics or deep machine learning to an executive without a specific use case is not likely to work. Simply saying that one day we will have all this data and computers will help us find and act upon trends we couldn't even conceptualise – even though it is technically true – will be a very hard sell. The high tech industries understand this principle, and it is a fundamental part of their business models, but retail and apparel are much less interested in investing towards a conceptual future."

Next year, WhichPLM will publish our analysis of precisely this struggle: examining the roles of AI and machine learning in making use of big data; looking at future business cases, and, as always, discussing the ROI potential of investing in cutting-edge technologies.

WHICHPLM BELIEVES, AT LEAST IN THE SHORT TERM, THAT AI WILL ACT IN A FIRST-STAGE ROLE, INTERPRETING INFORMATION TOO DIVERSE, TOO VOLUMINOUS, AND TOO COMPLEX FOR HUMANS, AND PRESENTING IT IN A DIGESTIBLE FORMAT FROM WHICH PEOPLE CAN MAKE BETTER DECISIONS

Image provided by Amazon

LOOK FOR WHICHPLM'S 7TH EDITION PUBLICATION, DUE IN AUTUMN 2017, AND BOASTING A SPECIAL FOCUS ON BIG DATA AND MACHINE LEARNING ALONGSIDE OUR ONGOING ANALYSIS AND EDITORIAL COVERAGE OF THE PLM MARKET FOR RETAIL, FOOTWEAR AND APPAREL.

BACK ISSUES OF PREVIOUS PUBLICATIONS ARE AVAILABLE UPON REQUEST FROM WWW.WHICHPLM.COM

Glossary

WhichPLM has a history of introducing new ideas to the industry, and coining terms to better define and encapsulate existing ones. The concept of Extended PLM (E-PLM) originated with us several years ago, and throughout our editorial, analytical, and advisory work, we have helped to define (or re-define) many common industry acronyms and terms.

Throughout this publication, readers will find those industry acronyms and common terms used or alluded to by both our in-house team and this year's pool of advertorial and feature contributors. While we have made every attempt to define these where they first occur, the nature of the WhichPLM Report means that not every reader will approach its content in a linear fashion, cover to cover.

In order to avoid confusion and provide absolute clarity for all common acronyms and phraseology, this glossary collects concrete definitions from PLM experts of what we consider to be the most useful, contested, and popular PLM industry terms, arranged in alphabetical order.

2015/16

Each WhichPLM publication represents a retrospective look at the financial year that has gone before it, this Report included. Our 5th Edition, released in autumn (fall) 2015, examined trends, market analysis, topics, events, end user feedback and more – all originating from or pertaining to the fiscal year 2014/15, while the publication you hold in your hands contains the same content, but from the financial year 2015/16. As a British company, WhichPLM defines a fiscal year as beginning 1st April of the originating year, and ending 31st March of the following one - so when we refer to "2015/16" in these pages, we mean the period from 1st April 2015 to 31st March 2016 rather than both full calendar years.

3D and 3D working

Many of the editorial features and analysis in last year's 5th Edition placed a significant emphasis on the RFA industry's transition from two-dimensional working to a three-dimensional equivalent. This transition can take many forms, from the introduction of 3D CAD tools (distinct from their 2D equivalents) into design rooms, to the use of offline 3D rendering to populate product catalogues. There is likely to be no single, agreed-upon point by which a fashion organisation could be said to have completed this transition, but broadly speaking we consider 3D working for RFA to be characterised by the creation and use of high fidelity, three-dimensional assets at one or more stages of the product lifecycle.

Artificial Intelligence (AI or A.I.)

A catch-all term, sometimes used interchangeably with Machine Learning, that refers to various approaches and manifestations of intelligent software (often inextricably tied to its host hardware) that is capable of some degree of autonomy and self-directed learning. Broadly speaking, AI is programmed with initial rules, axioms, and parameters, but given the facility to advance its understanding of simple or incredibly complex data sets in order to make decisions and determinations that were not originally coded for. Debates rage about how far heuristics and neural networks may eventually be able to replicate, or even exceed, the capabilities of human consciousness. NB: Not to be confused with Ai, which is a common abbreviation of Adobe Illustrator.

CAD

An acronym for Computer Aided Design, which collectively refers to any software platform – including peripherals and hardware accessories – that enables a designer to work digitally rather than on paper, to agreed-upon and replicable standards of measurement.

Cloud

A catch-all term for any application, deployment, or strategy that involves distributed processing or storage. Historically, these were split into Software as a Service (SaaS), Managed Services, and a host of other labels, but while the differences between these approaches remain, WhichPLM considers the most important distinction today to be between whether a solution is hosted on-site (i.e. on hardware owned and maintained by the customer) or off-site, in data centres owned and maintained by the vendor. While this is not always the case, a cloud deployment is often tied to a subscription pricing model, rather than the traditional upfront license / ongoing maintenance model.

E-PLM

Shorthand for "extended PLM", E-PLM is a catch-all term referring to any of a massive variety of product development related applications or data repositories that should rightly be considered a part of the product development environment for the purposes of integration and data integrity. Today, digital transformation initiatives centre around the creation of a unified technological environment comprising E-PLM, PLM and other enterprise solutions.

ERP

Enterprise Resource Planning is often cited as being one of two large business systems that sit at the heart of a modern retail or brand environment – the other being PLM itself. ERP is more financially and logistically-oriented than PLM, and although this is not an exhaustive definition, the simplest method of delineating the two is to remember that PLM handles all product development tasks, passing its information on to ERP at the point that a product becomes a reality and enters the ordering, shipping, allocation, and selling process.

External user

We define an external user as an active, individual license situated outside the parent company – typically within the offices of one of its geographically distant supply chain partners. These users will likely have restricted access to the PLM solution, so the functionality of an external license should not be automatically considered equivalent to an internal license. Prospective customers should also note that vendors' approaches to these licenses differ dramatically: some provide free-of-charge external user licenses; some assign a license fee; some choose not to distinguish between these and internal users; and still others offer a stripped-down "vendor portal" instead, and do not recognise the term "external user" at all.

GA

General Availability (or GA) is used to refer to the most up-to-date version of a PLM solution (or indeed any software) that is currently available to a paying customer, and that is fully maintained. Prospective customers of PLM should not buy a solution on the basis of functionality or modules that are not listed as being in the GA release – unless their own due diligence has identified commitments that it will be added to the GA release in a satisfactory timeframe.

Internal user

We define an internal user as an active, individual license situated within the confines of the parent company – either its own offices, satellite locations, or international representatives.

Internet of Things (or IoT)

An old term, today repurposed as a way of labelling an interconnected, internet-enabled future of devices, products, machinery, white goods, garments, and essentially anything that might feasibly become connected in the near future. As a contentious and hotly-debated (not to mention widely-advertised) term, this publication is dedicated to exploring its definition in greater detail, before moving on to analyse its short and longer-term implications for the retail, footwear and apparel industry. The most important thing to note, however, is that "smart" should not be read as synonymous with "connected", since a considerable proportion of the value that fashion brands, retailers, and manufacturers are able to derive from the IoT will involve passive (or "dumb") nodes that are connected to the same networks as smartphones, driverless cars, and intelligent home automation systems.

License

A PLM solution is typically sold on a license basis, with each individual user that the customer predicts will need access to the solution (whatever their role) charged an individual license fee at an agreed rate. This applies to both internal users and external users. Pricing for both types of user can be subject to volume pricing. The word "license" may also be used to refer to the actual agreement between customer and vendor.

Maintenance

While vendors' own definitions of the term "maintenance" vary, WhichPLM defines it as the ongoing contract between customer and vendor that stipulates the provision of help desk support facilities, as well as access to bug fixes and enhancements to the licensed solution provided as GA (see adjacent page). This does not typically include the costs of the implementation itself or any hosting costs, since these are usually factored into what are referred to as "first year" costs, alongside licensing and more immediate services.

New, signed customer

Readers will find this phrase throughout our Vendor, Consultant and 3D Profiles, as well as our Market Analysis section. Where it is used, we are referring to a business that has, in the period we define as 2015/16, signed a deal with – the case of the PLM Vendor Profiles - an apparel PLM vendor to acquire that vendor's PLM solution ready for implementation across one or more brands, and with any number of licensed users. Customers who adopted a different solution from the same vendor without PLM – CAD, for instance – do not fall within this definition, and neither do customers of ERP, warehouse management and so on, unless they bought and adopted those solutions concurrently and in addition to PLM. For the reasons stipulated in its definition, PDM does not qualify as PLM for the purposes of the WhichPLM Report, and customers of PDM (and CPM) are not included in overall figures or statistics for 2015/16, falling well outside the scope of this publication. Similar criteria apply for customers of 3D solutions.

OOTB

This acronym stands for "Out of the Box", and refers to a pattern whereby preconfigured PLM solutions have become simultaneously more feature-rich as standard, and more streamlined to deploy. As a result, vendors applied the OOTB label to their solutions, claiming that they offer a robust product development environment as-is, with little or no costly customisation, and reduced implementation services. These claims vary in their truthfulness, but in WhichPLM's opinion, no PLM solution can be considered truly "out of the box", and prospective customers must be mindful of the need for effective configuration and almost mandatory customisation when evaluating the marketplace.

PDM

An acronym that saw widespread use prior to the year 2000, when Product Data Management solutions were considered to be the best possible tools available to retailers, brands and manufacturers seeking to modernise their product development environments. As the name suggests, these systems were focused on the production, cataloguing and communication of product data – typically in the form of a PDF "tech pack". Although these solutions were later web-enabled, refined and enhanced as the industry progressed, eventually more fully-featured, web-based solutions that handled a greater variety of processes emerged, and PLM replaced PDM in virtually all of the territories WhichPLM covers. No major vendor focuses on selling PDM systems today, and the majority that previously did have established clear transitional programmes to move their legacy PDM customers to their modern PLM platform.

PLM

An acronym used in place of its longhand version, Product Lifecycle Management. Considered to have suspended CPM (Collaborative Product Management) in approximately 2003, PLM is a suite of tools (often collectively called a "platform") that enables retailers, brands and manufacturers to optimise their product development processes, consolidate their data, and create a centralised, contemporaneous, collaborative backbone for the people, products and processes that together make up the lifeblood of their business. Although the acronym itself originated in the aerospace and automotive industries, today there are many vendors who provide proven PLM solutions to the retail, footwear and apparel industry, either as their sole focus, or as one vertical amongst many.

Resourcing

Where we refer to a given vendor's "resourcing", or where (such as in this publication's Vendor Profiles section) we have requested statistics to support a vendor's "resources by region", we are referring to individuals in the employ of the vendor who work in the area of PLM for retail, footwear and apparel. This does not typically include third party implementation or development partners, but these may fall under the umbrella of "resources" where an extremely close relationship has been established between the vendor and its partners over the course of many years. It is clearly desirable that these individuals have direct RFA industry experience in addition to deep product knowledge, but sadly this is not always the case, and in order to draw a distinction between pure numbers and what we consider to be "real" apparel industry staff, we use the phrase "expert resources".

RFA

A common industry acronym, RFA stands for retail, footwear and apparel, and is widely-used shorthand for the fashion, accessories, jewellery, footwear, toys, and automotive and home furnishings upholstery / textiles industries.

ROI

Return on Investment refers to the main metric by which implementations of any enterprise system is typically judged: financial performance relative to the required investment. Despite some reductions in the total cost of ownership of PLM, the expenditure involved in licensing, implementing, and maintaining a modern solution remains significant. As a result, PLM projects should only be undertaken when a clear ROI business case has been assembled – an objective analysis of how soon and in what form the chosen solution can be expected to deliver a financial return greater than the cost of obtaining it.

Seat

Essentially interchangeable with "license", seat refers to an active, maintained individual software license – i.e. a human being occupying a seat at a desk, performing a job role, and actively using the software in question.

UI / UX

These two acronyms are not – despite common misuse – interchangeable. UI refers to the user interface of a given piece of software – the actual design and interactivity components through which the user experiences raw functionality. UX, on the other hand, is a farther-reaching term, used to denote the broader experience of actually working with that software. UX will include UI, but will also factor in other aspects like speed, social collaboration, click rates, the flow of information and more.

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Interviewees (listed alphabetically by surname):

- Guy Alroy, VP of Product, Optitex
- Scott Amyx, CEO, Amyx+
- Ravi Anand, General Manager & Practice Head for RFA and IoT, ITC Infotech
- Mike Anderson, CTO and Chief Scientist, The PTR Group
- Kevin Ashton, Author and Technology Pioneer
- Charles Benoualid, CEO, Visual 2000
- Mark Burstein, President of Sales, Marketing and R&D, NGC
- Brion Carrol, VP of Retail & Consumer Global Business Development, PTC
- Michele Casucci, Founder & CEO, Certilogo
- Peter Charness, SVP Americas & Global CMO, TXT Retail
- Chris Colyer, Worldwide VP for Consumer Goods & Retail, Dassault Systèmes
- Guy Gourtin, VP Industry & Solution Strategy for Retail & Fashion, GT Nexus
- Julia Fowler, Co-Founder, EDITED
- Andrey Golub, Founder & CEO, Else-Corp
- Quach Hai, Product Management Director, PTC
- Andy Hobsbawm, Co-Founder & CMO, EVRYTHNG
- Uwe Hennig, CEO, Detego
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- Warren Tucker, Partner leading Digital Group, PWC
- Lorna Ward, Partner, PWC
- Ronald Watson, VP of Product Management, Centric Software

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