

Linking the Physical and Virtual Worlds: PLM Platformization Sustains the ‘Organic’ Enterprise

CIMdata Position Paper, Part 3 of 3

Recap of Position Paper 1 of 3: The combination of scarce resources and globalization are driving an upheaval in innovation and lifecycle management. These changes are coalescing into business strategies that recognize the validity of the Circular Economy and the platformization of PLM. The Iron Triangle of better, faster, and cheaper fixes is being superseded. Skeptics overlook many enterprise-level benefits inherent in end-to-end lifecycle management and overestimate the remaining challenges.

Recap of Position Paper 2 of 3: The challenges confronting innovation and end-to-end lifecycle management are a matrix and must be addressed that way. Ideation is the fundamental rationale for lifecycle management. Platform support for ideation is the intellectual process of creating new products that are globally competitive and sustaining of the enterprise through end-to-end lifecycle management, including information governance. Platformization is the drawing together of personal productivity tools, lifecycle management at the enterprise level, and cross-functional collaboration. End-to-end lifecycle management increasingly is about sustaining the enterprise, not just creating better, faster, and cheaper products.

Key takeaways:

- *PLM solution providers are rapidly building true end-to-end lifecycle platforms intended to sustain the enterprise by enabling innovative product development, through-life product support, and organic growth—ultimately these platforms will be transparent to their users*
- *Users of “platformized” PLM can realistically expect better collaboration with their peers no matter who they are or where or when they work—thus, managers can expect better return on investment (ROI) and lower total cost of ownership (TCO)*
- *The ultimate goal of platformization is to make the infrastructure of product and process innovation completely transparent, thus enabling all forms of product-related innovation as the natural focus of the extended enterprise—fundamentally, platformization is a strategy for Business Agility, which today more than ever is not optional*

A far-reaching shift is underway in product lifecycle management (PLM)—its platformization. Traditionally, PLM’s primary function has been to develop better products, faster and cheaper. This is far different from today’s PLM, where end-to-end lifecycle management and lifetime product support lead to organic growth of the extended enterprise. Organic growth is the increase in revenues generated by meeting customer needs, as opposed to that generated through acquisitions or mergers. The extended enterprise here includes customers, suppliers, owners, operators, employees, distributors, business and development partners, regulators, and lenders.

The phrase “end-to-end” in the preceding paragraph implies managing product information from conception through the end of a product’s useful life. Again, traditionally PLM has been focused on development—figuring out what the next products should be and how to get them into customers’ hands at a profit. Thus PLM in any configuration—toolsets, suites, strategies, full-featured platforms—has historically focused on product development and engineering.

Conventional PLM configurations usually include requirements definition, CAD, data management, bill of materials (BOM) management, change management via engineering change requests (ECRs) and engineering change orders (ECOs), database connectivity, application programming interfaces (APIs), standards, and best practices leveraged with functionality for collaborating with suppliers, while managing cost, quality, and all associated intellectual property.

Two things have changed these time-honored practices: For the past 40-plus years, (1) computers have empowered product developers with CAD/CAM, simulation and analysis (S&A), digital database management, and APIs to tie it all together. Engineers' productivity has skyrocketed while the cost of mass-produced physical goods has plunged—better, faster, cheaper.

The sequel to the story of computerization is (2) end-to-end lifecycle management. As it takes hold in enterprises large and small, we realize the information generated in engineering and manufacturing—the front end of the product lifecycle—is not enough. Vital as they are, engineering and manufacturing cannot give us the full picture we need as we develop and maintain competitive products and/or services.

The rest of the product-development picture emerges from the “back end” of the lifecycle, after, or downstream from, manufacturing. Bringing end-to-end lifecycle management into sharp focus is the rapid rise of the Internet of Things (IoT). The significance of the IoT for product development is the attention the IoT focuses on real-world data from product operations and use, field service and repairs, warranty claims, and lessons learned.

This real-world, back end, downstream information is what many people refer to as the customer experience. Over time, tracking and analyzing customer experience yields valuable insights for next-generation products. Historically, many companies haven't truly understood how their products have been operated and used.

The lifecycle's frontend—product development and manufacturing—rarely spans more than a few years. The back end of the lifecycle, however, often stretches decades into the unknowable future. Hence the profound differences in the downstream back-end information from the data generated at the beginning of the lifecycle and in the factory.

Platforms: A New Construct for Innovation

To deal with this, PLM solution providers are developing highly integrated platforms as constructs of application delivery solutions. From these platforms, users will assemble the processes and workflows of ideation and product development—the building blocks of innovation—and re-assemble and reconfigure them whenever they need. Assembling and reassembling has always been done, of course, but today's product developers work with a kaleidoscope of rapidly evolving tools, systems, and strategies. Moreover, the task of assembling and reassembling building blocks gets bigger every year.

Amid globalization, enterprise functions and capabilities are more widely dispersed than ever before. “Design anywhere, build anywhere” is a reality. The amount of data to be managed is growing exponentially. A recent promotion by IBM maintains, “90 percent of the data in the world today has been created in the last two years alone.” There are no signs that this rate of information growth will slow down.

So what is PLM platformization? It is a re-architecting of software-based solution suites and the links between them. It speeds up business processes, refocuses and sharpens business strategies, and leverages innovation with agility. And lest agility be seen as an empty

objective, bear in mind that the specifics of many new technologies are freely available, sometimes going viral within days. Business agility is not optional.

Peering deeply into platformization, one sees that its ultimate goal is making the infrastructure of product and process innovation completely transparent from concept through the entire life, making innovation the natural focus of the enterprise and all of its extended-enterprise participants.

Achieving these transparent infrastructures will not be easy, however. Industrial enterprises struggle to realize value from current and recent investments in innovation strategies and enabling technologies even as the solution providers continually launch new products, architectures, and solutions.

The benefits of PLM are usually couched in terms of supporting collaboration, and ensuring quick access to the right data in the right format. The real value of PLM platforms, however, is that they embody new approaches to ongoing, repetitive tasks executed throughout the product lifecycle. As PLM platforms help users and managers find better ways to work, platformization sustains the extended enterprise.

But there are more aspects to platformization that must be addressed—great variety in workflows and procedures for approving and releasing designs, for example, and for managing subsequent changes, plus myriad process maps, formats, workflows, databases, and file naming conventions.

Even an incomplete list of what must be addressed has a broad range:

- Among engineering technologies, rapid advances in materials science and its processing, along with capturing insights and lessons learned in design, tooling and manufacturing, quality assurance, packaging, and shipping, for example.
- From the non-technical (“human”) side of innovation, tracking customer requirements; capturing engineering (and other) insights; managing compliance demands from regulators; verifying environmental sustainability; and assessing what competitors might do.
- Within the digital realm, the explosion of “unstructured” information in e-mails, voice mail, video, blogs, wikis, websites, and electronic documents scattered throughout an extended enterprise that make up Big Data. (“Structured” data is found in CAD files, solid models, spreadsheets, and relational databases.)

Given these generalizations, it can be helpful to delve further into PLM platformization.

PLM is to Ideation as ERP is to Execution

PLM is one of only two primary enterprise-level platforms; the other one is enterprise resource planning (ERP). Comparisons with ERP can dispel some confusion about the platformization of PLM.

PLM is focused on enabling product and process innovation, without which the development of innovative products and services, and the enterprise itself, cannot be sustained. In corporate terms, lifecycle management focuses on increasing the top line of the balance sheet, i.e. sales, as well as the bottom line, thanks to streamlining product development, manufacturing, and support.

ERP is essentially a platform for execution, rather than product-related ideation or innovation, and in particular the financial oversight of complex business operations. ERP strives for cost

savings and operational efficiencies that can have a significant impact on the bottom line—on profits more than on sales. Thus ERP is process-execution oriented. Business transactions are more supported by ERP than PLM.

These distinctions are reflected in enterprise organizational charts. Most PLM users and managers are in engineering units, manufacturing, field service, and repair. A large share of ERP users and managers work directly for the chief financial officer (CFO), or in finance-linked units, at the enterprise level.

These considerations bring us to the marketplace questions in the platformization of PLM. Where is the PLM market going as a product-focused innovation platform? And what can users and PLM managers expect from platformization?

For the past few years, developments in enterprise-class software have been dominated by PLM solution providers building out their platforms for innovation and lifecycle management. More than any other metric, these investments—representing dozens of acquisitions—illustrate the shift in lifecycle management from facilitating better, faster, and cheaper new products and services to sustaining the extended enterprise.

What does the future of PLM look like? Let's refer back to today's digital kaleidoscope of systems, tools, and strategies. All of these are required, because the smartphones in every purse or pocket, and intelligent devices everywhere else, are mechanical, electronic, and software.

Today's hottest new products expand technology envelopes deeply into new materials (e.g., plastics, glass, wood, metal alloys, engineered composites, and now fabrics and "wearables"). Engineering these products before manufacturing them demands much from an innovation platform: computational fluid dynamics (CFD), electromagnetics and "noise," heat transfer, shock / vibration / harshness, and much else—all of these with dozens of customer- and industry-specific permutations.

Meanwhile, woven fabrics merge everyday clothing with digital communication. Additive manufacturing (commonly known as 3D printing) is now used for countless geometrically complex products made from a fast-growing range of materials—a potentially disruptive manufacturing technology that sprang from a niche in manufacturing engineering, rapid prototyping. Additive manufacturing's big footprint and fast growth are shown in the new Horizon (AM) R&D partnership of GKN Aerospace, the UK's Aerospace Technology Institute, Delcam, Renishaw, and two universities. Horizon (AM) is funded for three and a half years with the equivalent of US\$22.5 million.

Building Out the PLM Platform

Keeping track of everything in the lifecycle post-manufacture is the huge task and opportunity of the Internet of Things (IoT). It is projected to reach 50 billion connected devices and a trillion sensors in just a few years. For some clues about how the IoT is being built, let's look at the recent aggressive moves by PTC, Dassault Systèmes, and Siemens PLM Software.

PTC is acquiring Atego (model-based systems and software engineering) and Axeda (secure connectivity for machine and sensor data). Previously PTC acquired NetIDEAS (a software hosting and technical consulting services firm), ThingWorx (a platform for building and running applications for the IoT), and Servigistics (field-service scheduling and predictive maintenance). Separately PTC has expanded its Intelligent Platforms joint efforts with General Electric Co. (GE) to close loops between product design and "production execution" on the shop floor.

Dassault Systèmes has acquired Quintiq (operations planning and optimization) and has recently acquired SIMPACK (multi-body, multiphysics, and mechatronic simulation), Apriso (manufacturing systems support), and Realtime Technology (high-end 3D visualization software and computer generated imagery relabeled 3DXcite), plus Accelrys for managing biomedical and scientific innovation. All are being melded into the Dassault Systèmes 3DEXPERIENCE Platform.

Lest the ambitions of PTC and Dassault be underestimated, the Axeda and Quintiq deals, announced in mid-2014, add up to almost half a billion dollars. PTC is paying \$170 million for Axeda; Dassault Systèmes is paying the equivalent of US\$325 million for Quintiq; PTC paid \$112 million for ThingWorx.

Siemens PLM Software acquired TESIS PLMware (integration technology and services). Siemens PLM is a leading technology provider in Industry 4.0, a European manufacturing-integration initiative. Siemens describes Industry 4.0 as having three core elements:

- Product and production lifecycles merged together on a common data model.
- Cyber physical systems that combine communications, IT, sensor networks, embedded software, automation and intelligent operations, Internet connectivity, real-time processing, and event management. Cyber physical systems even include links to Big Data, which is, after all, about separating the signal from the noise; the IoT promises to be a very noisy environment.
- Manufacturing execution systems (MES) integrated with ERP to achieve process transparency, connectivity to business data, and real-time availability.

Industry 4.0's US counterpart is the Smart Manufacturing Leadership Coalition (SMLC). SMLC describes its mission as the "infusion of intelligence that transforms the way industries conceptualize, design, and operate the manufacturing enterprise," ultimately leading to a Smart Manufacturing Platform infrastructure. SMLC is managed by the Office of Information Technology of the University of California, Los Angeles.

Given the IoT's unprecedented need for connectivity, it was inevitable that smartphone makers would jump in and Samsung was first. In a move reminiscent of Google's \$3.2 billion acquisition of Nest, Samsung bought SmartThings, maker of a mobile app for controlling utilities and household appliances. The app and the SmartThings development environment run on Tizen, the open-source operating system Samsung uses for its mobile technology. The reported purchase price was \$200 million.

Similar moves include:

- Oracle Corporation moving further into the IoT with an August 2014 agreement to acquire TOA Technologies (TOA), a provider of cloud-based field service solutions that manage and optimize the "last mile" of customer service for enterprises. TOA coordinates dispatchers and mobile employees with their customers.
- Stratasys, an additive manufacturing supplier, acquiring MakerBot—financed with an issue of \$400 million in new shares.
- Stratasys' rival 3D Systems acquiring Quickparts, CDRM Ltd., Laser Reproductions, Rapid Product Development Group, and two service bureaus that make parts for 3D Systems users. 3D Systems has made similar acquisitions in medical and surgical, Simbionix and Medical Modeling.

- Earlier PLM platformization deals, including the Autodesk acquisitions of Tinkercad and Delcam, extending its CAD/CAM solutions and integrating them into Autodesk's Cloud-based 360 lifecycle business strategy. Autodesk previously bought HSMWorks for its CAM-focused geometry kernel. Meanwhile, Autodesk has acquired several S&A software developers over the past decade: ALGOR, Blue Ridge Numerics (makers of CFdesign), Moldflow, Firehole Composites, and most recently, NEi Software.
- The technology-platform approach that Aras has taken from its inception. Aras Innovator is a modern and scalable product innovation platform with a comprehensive suite of out-of-the-box enterprise PLM business applications that run on top. Additionally, the Aras platform has integration capabilities with connectors to CAD, ECAD, ERP, MS Office, MS SharePoint, and other enterprise systems.

These deals broaden product lines and expand the acquirers' presence in adjacent market segments, where platformization grows through joint ventures, alliances, and other business tie-ups. Two mid-2014 examples among many include:

- IBM and Apple Computer agreed that IBM will resell Apple's iPhones in IBM's enormous base of enterprise customers. Analysts see the deal as a "missing link" in the IoT—enabling near-real-time analysis of unstructured Big Data from connected devices. These two icons of technology are often seen as platforms in and of themselves.
- SiliconExpert and Arena Solutions joined forces to reduce risks in supply chains of electronic components. SiliconExpert's database allows access to over 250 million components from more than 12,000 manufacturers.

Intensely innovative, although not in day-to-day product development, are the many industry consortia that serve as platforms for shared R&D.

Innovation, Status Quo, and Change

As platformization grows, pushing PLM deeper, wider, and to higher levels in the extended enterprise, the status quo will be continuously challenged. Upheavals in customary ways of

Danger Lurks in Customized, Homegrown Platforms

The many challenges addressed by platformization send a caveat to would-be platform developers in corporate information technology (IT) units and systems integrators: Don't give in to the pressure for customized code and related do-it-yourself tactics; this just leads to the implementation of a non-sustainable, "instant legacy" system.

Implementers and project managers often tell CIMdata about demands from fretful users to rewrite code and customize. Those users cling to the status quo of their workflows and processes, PLM best practices notwithstanding.

Customized and homegrown systems weigh down innovation and end-to-end lifecycle management. As time goes by, users lose flexibility and adaptability; and solutions become outmoded legacy systems. Amid tight IT budgets, support will be limited to patches and workarounds devised mainly by longtime users. The plug is pulled when those costs reach intolerable levels, which sends innovators and product developers back to "square one" for end-to-end lifecycle management. Competitiveness and sustainability suffer.

Software developers almost always insist they can't help you with customization; it's a YOYO situation, "You're On Your Own." The same especially applies to fully homegrown, "roll-your-own" solutions.

working will result in the adoption of dynamic new approaches to identify, evaluate, deploy, and integrate enabling technologies; opportunities hidden among the everyday disruptions of markets and technologies will be more easily recognized. In such an environment, best practices will be just a starting point, a first step.

Now that we have glimpsed the future of product-focused, end-to-end lifecycle management, it is fair to ask what users can realistically expect. Based on CIMdata's 30-plus years of business-strategy consulting and analysis of technology markets, we feel confident in making some predictions.

Here are two metrics that CIMdata believes are underpinning the drive to platformization:

- Metcalfe's Law, named for prominent electrical engineer Robert Metcalfe. This "law" posits that the worth of a digital network (telecommunications, originally) is proportional to the square of the number of its connected devices. A primary goal of platformization is connecting devices and their users via collaboration and interoperability.
- Moore's Law, named for Intel Corporation co-founder Gordon Moore. He observed that the number of transistors in integrated circuits doubles every two years. Software development has similar metrics, though they are more subjective than Moore's Law. From CIMdata's perspective this means that the amount of data will continue to increase at rates that demand platformization to manage effectively and efficiently. This can't be done any other way.

As noted at the outset, a dramatic shift is under way in end-to-end lifecycle management—the innovation platforms of the future are what will enable this shift.

Enabling the development of better, faster, and cheaper products has traditionally been PLM's primary justification. Today, however, PLM is recognized as the key to sustaining the organic growth of the entire extended enterprise.

By taking organic innovation into platformization, the use of scarce resources can be more easily maximized. The bottom line is that the dollars-and-cents calculation for innovative product development results in speedier return on investment (ROI) and lower total cost of ownership (TCO).

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM). CIMdata provides world-class knowledge, expertise, and best-practice methods on PLM. CIMdata also offers research, subscription services, publications, and education through international conferences. To learn more about CIMdata's services, visit our website at <http://www.CIMdata.com> or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 734.668.9922. Fax: +1 734.668.1957; or at Oogststraat 20, 6004 CV Weert, The Netherlands. Tel: +31 (0) 495.533.666.