Enterprise Innovation Management

Solutions Landscape—Connecting the Dots

Dr. Suna Polat
Director, Collaborative Innovation &
Social Product Development Practice
Dr. Ken Versprille
Executive Consultant

December 2015

CIMdata, Inc.
3909 Research Park Drive
Ann Arbor, MI 48108
+1 734.668.9922
www.CIMdata.com

CIMdata®

Enterprise Innovation Management

Sustaining profitable business growth is difficult for established enterprises in today's networked economy. Good ideas can emerge from anywhere, and the next big competitor could even be a start-up, as in the example of Airbnb in the hospitality industry. In this environment, enterprises need to reevaluate their approach to innovation. Many are aware they are suffering from inefficiencies in their innovation process due to disjointed processes and tools they have adopted over the years. At the same time, they seem to be slower to invest in new Enterprise Innovation Management (EIM) solutions that can provide competitive advantages. CIMdata conducted research to understand and address existing concerns and preempt emerging concerns of industrial firms engaged in innovation but confused and hesitant to invest in new EIM solutions. The results of the research and analysis are a clearly defined terminology and an innovation system framework, including solutions, benefits, implementation strategies, and challenges.

We categorize EIM solutions into three classes:

- *CLASS 1 (Innovation Engagement) solutions are those that encourage engagement for large group creativity by internal and external networks, individuals, and communities to address innovation needs.*
- *CLASS 2 (Innovation Guidance) solutions are those that structure and support business strategy and decision making in regards to processes that are critical to realizing on-target and profitable innovation.*
- *CLASS 3 (Innovation Delivery) solutions are those that support the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise.*

In this paper, we describe where each class of solutions adds value and what key challenges are involved in their adoption. We also offer a simple architecture that illustrates how these classes of solutions fit with each other.

We identified four categories of commonly experienced innovation challenges: Culture and Mindset changes needed when a different way of working is necessary; Innovation Alignment across the enterprise where multiple organizations are involved in goal setting, planning, and delivery; Fragmented Processes and Systems which make information sharing difficult and slow; and difficulty managing ever increasing Product Complexity.

Our research participants adopted multiple strategies to deal with these challenges. For example, to drive culture change they established an executive champion with the right qualities and trained people through a network of innovation ambassadors. They implemented governance structures and processes to help their organizations align on innovation goals and make decisions about how to achieve them. Some of our research participants have chosen to adopt more modern EIM solutions and proven best practices, but

others are still experimenting or still searching for tools to support their innovation activities.

While the modern digital solutions offer a great opportunity for those involved in the business of innovation to make their activities more visible and digitally connected across their enterprise, it is clear that tools alone are not sufficient. A culture aligned with the new strategies and solutions, and a work force with the right mindset and skills are just as critical.

Table of Contents

Introduction

Innovation in a Networked World

Innovation is the creation of a new offering—a product, a service, a business model—that customers find valuable.

Business leaders generally define the term *innovation* as the creation of a new offering—a product, a service, a business model, or a combination of these—that customers find valuable and are willing to purchase. Advanced manufacturing technologies, such as three-dimensional printing (aka additive manufacturing), intelligent controls, materials with custom-designed properties, as well as advances in sensors, cameras, mobile, connectivity, cloud computing, and analytics are redefining what is possible. In this age of a networked world with smart and connected products and services, the traditional relationships between established corporations and the industries within which they operate are blurring. In a recently published report, Thomson and Reuters[1] points out that between 2009 and 2014 Samsung has filed patents in nine of the 12 industries analyzed in their study. Google[2] and Apple[3] are now in the automotive business. The line between start-ups and established corporations is also being blurred. Who would have imagined Airbnb, a start-up in 2008, would surpass the number of room listings of the world's largest hotel chains in 2015 and be valued at $25 billion[4]? These are just a few examples of a changing innovation environment in a networked world. Welcome to a new era of accelerated innovation!

Reevaluate How You Innovate

Companies need to reevaluate their approaches to innovation.

Many leading companies have demonstrated that when managed like a business, innovation is a process that results in a predictable return on investment. In this new age, these companies now need to reevaluate their approaches to innovation. Businesses were in charge during the industrial age. Consumers and customers are in charge today. Business management used to set their direction based on annually updated linear goals against which performance was measured. Emphasis was on internal development and execution, i.e., task management. Interaction with consumers and customers only happened at the earliest stages of innovation through focus groups and product prototype testing. Insight gained from these interactions was then turned into product features and design concepts. Today, businesses compete for customers' loyalty through superior brand experiences. They need to anticipate customers' expectations in a rapidly changing world. More and more customers are engaging in social media with online product reviews and in co-creation communities. Businesses have the opportunity to continuously listen to consumers and get feedback on how effective their innovations are. But, they also need to be agile and prepared to respond quickly as new insight from the market emerges. More businesses are

[1] The Future Is Open: 2015 State of Innovation, a comprehensive analysis conducted by Thomson Reuters based on global scientific literature and patent data across 12 technology areas. http://ip-science.interest.thomsonreuters.com/SOI2015

[2] Google Self Driving Car Project. https://www.google.com/selfdrivingcar/

[3] http://www.wsj.com/articles/apple-speeds-up-electric-car-work-1442857105

[4] http://money.cnn.com/2015/06/27/technology/airbnb-funding-valuation-update/

adopting Open Innovation[5] as a strategy and seeking ways to work more collaboratively with their customers, partners, employees, and even the competition. Crowdsourcing and co-creation of ideas and products are now commonplace. In addition, these new innovation approaches are being complemented by new business models to create more value for all stakeholders. Enterprises must understand and embrace these new approaches to further develop and leverage their business ecosystems for more effective innovation that pushes them ahead of their competition.

New innovation approaches are being complemented by new business models.

Get Ready to Innovate

The challenge for traditional enterprises is how to be ready for this new age of innovation. Many are aware they are suffering from inefficiencies in their innovation process due to disjointed processes and tools they have adopted over the years. At the same time, they appear slower to invest in new enterprise innovation management (EIM) solutions than they should be, thus not realizing the competitive benefits that can be attained. CIMdata believes that this hesitancy to act is due largely to the confusion, uncertainty, and ambiguity arising from the substantial differences in terminology, solution approaches, strategies, obstacles, best practices, and benefit claims that companies hear from a plethora of solution providers. This confusion has been further inflated by the lack of confidence in how industrial companies can best employ social media and other collaborative innovation tools, both internally in product development and externally with their supply chains, customers, academia, and varying expert solver communities.

Companies are slow to invest in enterprise innovation management solutions.

The timidity to invest is of little surprise since the EIM market space is comprised of many software and service providers—old and new, large and small, general purpose and specialty—who offer innovation strategies and capabilities using quite different approaches, thought leadership, and value messaging. For example, providers of Product Lifecycle Management (PLM) solutions historically have focused their attention on product development and data management by emphasizing benefits, such as efficiencies in managing product development processes and complex product data especially in regulated products. With the increased importance of innovation in recent years, PLM providers started to add front-end capabilities in strategy, ideation, and portfolio management. Traditional PLM providers now often speak about benefits of their solutions for innovation and innovation management as a simple, natural extension of their PLM footprint. However, their communication often collides with messaging from the ecosystem that has grown around Open Innovation. Approaches such as crowdsourcing and co-creation have now become so commonplace that they challenge the traditional definition and expectations of PLM's take on innovation.

PLM's view of innovation differs from the messaging of open innovation.

[5] Open Innovation is purposefully managing knowledge flows across a company's boundaries consistent with its business model. It was first introduced by Henry William Chesbrough in the early 2000s in his book: Open Innovation, The New Imperative for Creating and Profiting from Technology. Harvard Business School Press. Boston. 2006.

With the need to perform more strategic and accelerated innovation, companies have started to adopt solutions for enterprise innovation and portfolio management in addition to and separate from project management. This can help improve their ability to target their innovation efforts given limited resources. While PLM providers see benefits of partnering with innovation management solution providers to build out their front-end capabilities and business layer, CIMdata observes that they are currently less interested in Open Innovation solutions, which we believe creates new market opportunities, such as providing support to project teams in PLM so they can solve problems faster with easy access to internal and external expert networks.

In this paper, we offer a common framework and terminology (see the Glossary) for EIM and describe how various enterprise solutions fit into this framework, along with benefits and challenges encountered. Our objectives are twofold:

1. Educate industrial firms about the next generation of solutions that will increase their ability to innovate more effectively and sustainably.
2. Help increase investment in innovation solutions and facilitate greater interest in forming strategic partnerships among solution providers for the benefit of their customers.

Research Goals and Methodology

Research Goals

The goal of the research is to define an innovation system framework and terminology.

The overall goal of this research is to understand and address existing concerns—and preempt emerging concerns—of industrial firms engaged in innovation but possibly confused and hesitant to invest in new EIM solutions, by clearly defining an innovation system framework and terminology including solutions, benefits, implementation strategies, and challenges. The framework will help companies understand how innovation management solutions fit with their current solutions, culture, and strategies.

Other specific goals are to:

- Identify common innovation challenges and present recommendations as to how to address them.
- Frame the industry drivers, imperatives to act, and relevancy of the innovation management market space.
- Identify common innovation challenges and present recommendations as to how to address them.
- Explain the classes or the taxonomy of the EIM solution space based on an innovation system framework model, and recommend a universal lexicon of terminology.

Methodology

A simple model, shown in Figure 1, depicts a high-level enterprise innovation activity system model. Leading solution providers aligned with quadrants 1 through 3 were identified by CIMdata and invited to join the research. Four

solutions providers—eZassi[6], Planview[7], Siemens PLM Software[8], and Sopheon[9]—agreed to participate and sponsor the research with partial funding. These four companies provided thought leadership interviews and briefings and demonstrated their current solutions to CIMdata.

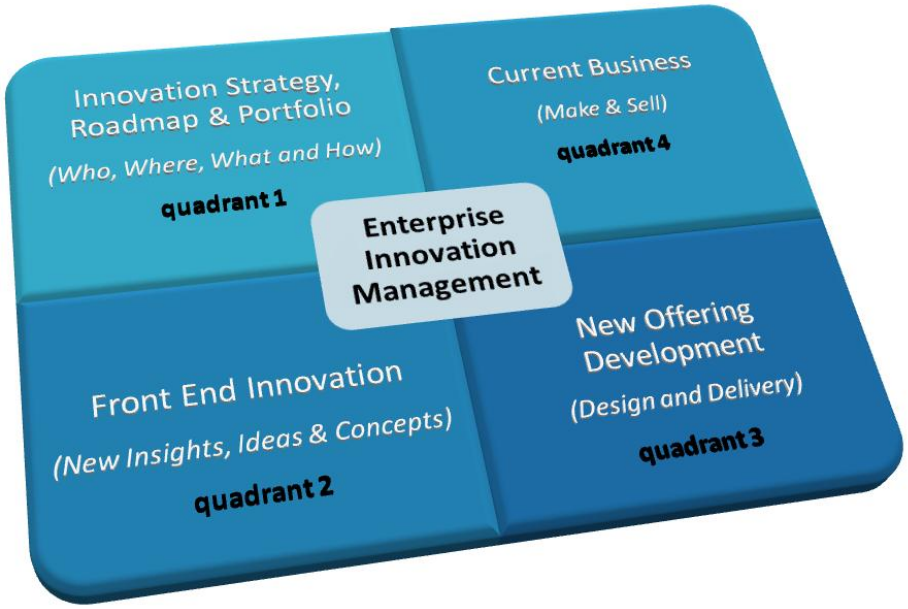


Figure 1—Enterprise Innovation Management Activity System—Key Activities

CIMdata interviewed solution provider leaders and people in industraial companies while conducting its research on EIM.

CIMdata subsequently conducted interviews with chief innovation executives in seven large enterprises. They included Electrolux, Givaudan, GOJO Industries, Henkel, Honeywell, Procter & Gamble (P&G), and Sanofi. Sponsoring solution providers identified industry executives to be interviewed, and CIMdata invited others at leading innovation companies. The responsibilities of these executives ranged from leading innovation, promoting and measuring innovation, leading choice of solutions and promoting their use, and measuring the state of their adoption to leading Open Innovation for their respective companies.

In the interviews a number of topics were explored, including their definition of innovation and the aspects included in the definition, innovation challenges experienced, solutions and adoption strategies used, failures experienced, and why failures happened. All interviews were recorded and transcribed.

Midway through the research CIMdata conducted a workshop on the topic of "innovation in the new age" with keynote speakers and panel discussions. The four sponsoring solution providers took part in this workshop and participated in a panel discussion. The model represented in Figure 1 was discussed and improvements were suggested.

All of the input from interviews and collaborative dialog were analyzed, and our key takeaways and insights are presented in this paper.

[6] www.e-zassi.com
[7] www.planview.com
[8] www.plm.automation.siemens.com
[9] www.sopheon.com

What is Innovation?

Definitions

Our research participants offered their definitions for innovation and talked about certain aspects that they emphasized in their definitions. Most commonly they described innovation based on the outcomes with a customer point of view. From a business perspective, they emphasized their strategic choices, i.e., the types of innovation they are targeting and how to get there. They also talked about all the innovation that happens on the way to the outcomes. Therefore, we defined innovation in three key aspects: Outcome-based, Strategy-based, and Journey-based.

Outcome-Based

We analyzed the participants' definitions based on frequency of certain words that we thought to be most relevant. The results are plotted in Figure 2. We then compiled a definition based on the most frequently used words: ***Innovation is a new-to-the-market product, process, or service that customers value.***

Outcome-based innovation is a new-to-the-market product, process, or service that customers value.

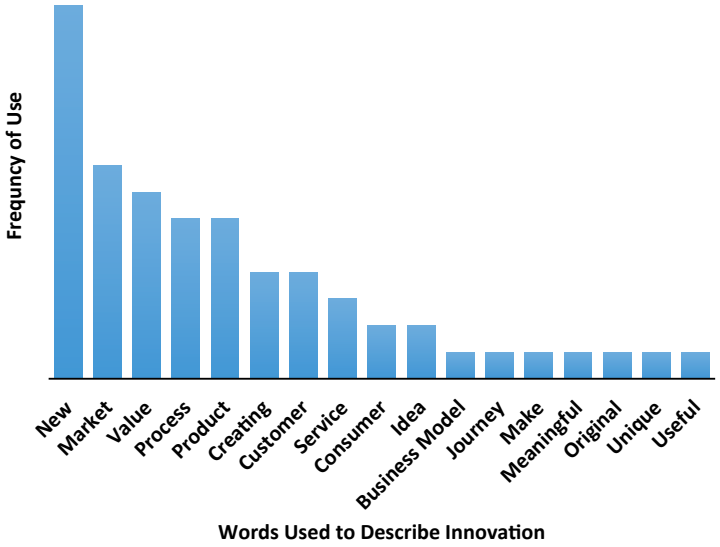


Figure 2—Vocabulary of Innovation

Dr. Chris Thoen, Chief Technology and Innovation Officer of Givaudan SA, described the outcome they are seeking from innovation as the ability to create a magical customer experience: "Like the 'wow' experience that an orchestra creates for the audience because of the way they perform a musical score, say a symphony; we want to create magical experiences through our innovation for our customers. We want customers to say 'How do you do this? I want to have more of this.'"

In general, the consensus was innovation could originate from other things that drive value but are not always visible to customers. Examples include a new way to work or a new business service. In this regard, we found a broader definition that was suggested by Dr. Huub Ruten, Vice President of Product

Research & Design at Sopheon: "Enterprise innovation often involves the holistic reinvention of the company and can span new products, new market segments, new channels, and the supply chain—all with the sole purpose of generating *new* business value for the enterprise."

Strategy-Based

When asked his definition for innovation, Mr. Mike Olosky, Senior Corporate Vice President and Head of Innovation for Adhesive Technologies at Henkel, said, "Probably the easiest way to do that is to talk about our innovation strategies. And the innovation strategy starts with our ambition statement—innovation leadership that drives profitable growth. Innovation is not just a research project. Ultimately, we want to commercialize the technologies. But the first piece is being really clear about where we wanted to grow, where we wanted to go, and how we wanted to get there."

Similarly, Dr. Mohammed Charki, Research and Development Partnership Director at Sanofi offered, "For me innovation at first is a matter of inspiration—which defines actually the strategy—and secondly, its operations, which means the tactical way you manage the innovation, be it internal or external. Classically, we speak of disruptive, transformative innovation and incremental innovation; but from business and market perspectives, there are innovations that maintain your establishment as leader in a certain market, and there are those that allow you to target new markets."

Strategy-based innovation is a set of business processes and practices, as well as organizational planning with strategic targets and choices about how to achieve the targets effectively and efficiently for competitive advantage and profitability.

These definitions highlight strategic choices that an enterprise has to make to achieve business growth from innovation. Our research participants often talked about two aspects:

1. Having a governance structure for innovation and aligning on a balanced innovation portfolio that consists of various types of innovation, for example:
   - New inventions, e.g., molecules, ingredients, processes, etc., for their existing products
     Dr. Thoen explained how he sees the relationship between invention and innovation: "An invention is essentially turning money into knowledge. An innovation, on the other hand, is taking that knowledge and turning it back into more money. You then have a self-perpetuating growth cycle." Dr. Lee Ellen Drechsler, Corporate Research & Development Director at P&G with responsibility for upstream materials and Connect & Develop, said that "Innovation is invention that makes money."
   - Reapplying existing solutions to new products and markets
   - Entering into new adjacent markets
   - Adopting new business models
     Dr. Thoen said, "We need to make sure that we are the ones doing obsolescence of ourselves rather than an outsider. Because then at least we replace one business model with another business model."
2. Approach to innovation choices, for example:
   - Investing in internal research and development

- Adopting a partnership strategy around driving innovation with suppliers and academia
- Investing in venture capital projects or start-ups
- Using crowdsourcing services with targeted communities
- Implementing new, digital innovation management solutions

Consequently, for an enterprise, strategy-based innovation is a set of business processes and practices, as well as organizational planning with strategic targets and choices about how to achieve the targets effectively and efficiently for competitive advantage and profitability.

Journey-Based

Dr. Charki also defined innovation by saying, "It is all the journey that would be needed for an idea to become a successful product or service in the market. Not only the time where we thought about it and conceived it, but it's mainly at the time we have been able to solve all the technical- or scientific- or business-related challenges that would allow us actually to bring that product to the market to the right customers."

Journey-based innovation is the definition and realization of a new solution, i.e., a process, product, service, or business approach, to a need, issue, or problem that performs better or delivers more value than any previous solution.

The idea of seeing innovation as a journey brings process aspects of innovation into its definition and is somewhat aligned with CIMdata's existing definition for innovation, namely "the definition and realization of a new solution, i.e., a process, product, service, or business approach, to a need, issue, or problem that performs better or delivers more value than any previous solution." For analysis of the EIM solutions landscape, this journey-based definition adds significant value.

Classification of EIM Solutions

The above journey-based definition points to the two sides of making innovation happen: creativity (new and better) and process (planning and realization). The innovation process can also be captured in two critical layers: a business decision layer and a knowledge and information generation and capture layer for defining a new solution. Accordingly, we classify digital solutions that support innovation into the following three classes:

1. **CLASS 1—Innovation Engagement**: Solutions that engage people's creativity. While there are many creativity techniques and tools, the focus of this paper is on digital solutions that allow large groups of people to offer ideas, insight, and solutions pertaining to the innovation needs of an enterprise. The groups could be internal or external to the enterprise.
2. **CLASS 2—Innovation Guidance**: Solutions that structure and support business strategy, planning, and decision making with regard to processes that are critical to realizing on target and profitable innovation. Examples include roadmapping, portfolio management, resource management, front-end ideation and idea management, and program and project management from idea to launch.
3. **CLASS 3—Innovation Delivery**: Solutions that support the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise (customers, design and supply partners, etc.),

spanning from concept through the life of a product or plant. This is the domain covered by traditional PLM solutions.

Solution providers in the first two classes often market their offerings as enterprise innovation management solutions. This is an element of the confusion created in the market. A brief explanation of these solutions, their benefits, and implementation challenges follows.

Access More Creative Minds and Ideas—Solve Problems Faster

Two well-known principles in creating good ideas are to apply collective intelligence and creativity by engaging diverse minds on the need, and to increase the probability of discovering great ideas by increasing the number of ideas. With the internet, advances in technology and networking, a class of enterprise solutions has grown behind Open Innovation that allows any organization to apply these principles more easily to their ideation and problem-solving activities.

Two well-known principles in creating good ideas are to apply collective intelligence and creativity by engaging diverse minds on the need, and to increase the probability of discovering great ideas by increasing the number of ideas.

Examples of this class of solutions are eZassi (a research sponsor), Imaginatik[10], Spigit[11] (by Mindjet), Brightidea[12], HYPE[13], and Innocentive[14].

The following terms are used to describe these solutions:

- Innovation Management
- Innovation Program Management
- Idea Management
- Crowdsourcing
- Co-creation
- Collaborative Ideation
- Social Ideation
- Social Innovation
- Open Innovation

While the solution providers in CLASS 1 are abundant, especially in regard to ideation and idea management, many solutions lack the sophistication and maturity needed in enterprise-grade software. On the other hand, the thought leaders in this class invest millions of dollars to develop new, proprietary software and best practices for a broader range of solutions. For example, eZassi's structured capture methodology, which enables enterprises to receive solicited and unsolicited ideas at their Open Innovation portals with better IP controls and governance, addresses a key concern of enterprises when adopting Open Innovation as a strategy.

[10] http://imaginatik.com/
[11] https://www.spigit.com/
[12] http://www.brightidea.com/
[13] http://www.hypeinnovation.com/products/hype-enterprise
[14] http://www.innocentive.com/

In this era of a networked economy, enterprises are seeing a real need to expand their aperture of capture not only for ideas and innovations that extend their current offerings but also for those ideas that are disruptive. Therefore, while the solutions in CLASS 1 might be considered emergent, they will be critical in powering new levels of fast co-creation and co-design that we see being practiced by companies like GE Appliances' FirstBuild[15] and Local Motors[16]. Strategic adoption of this class of solutions will likely create a competitive advantage by bringing the creativity of millions of minds closer to the enterprise, thereby accelerating innovation and product development cycles.

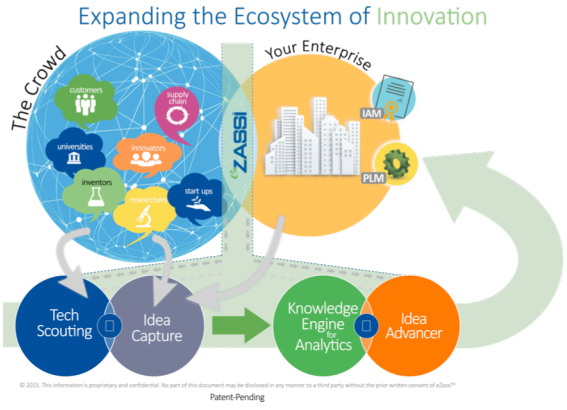
While these types of solutions are often associated with Open Innovation and Front End Innovation (quadrant 2 in Figure 1), with creative thinking they can also be applied to processes in the other quadrants. For example, globally distributed experts outside the project teams can be invited to help solve development problems (quadrant 3). An eZassi client in the life sciences industry who wanted to empower product development teams to leverage Open Innovation

[15] https://firstbuild.com
[16] https://localmotors.com

eZassi

The eZassi Open Innovation enterprise software platform includes a set of integrated solutions that help clients implement Open Innovation initiatives to accelerate decision making with high powered analytics while reducing intellectual property (IP) and regulatory risks inherent with social ideation and co-design. The eZassi platform is a cloud solution configured for each client's Open Innovation principles, strategy, and workflow with a client-branded, customized look and user interface. This configuration enables both unsolicited and solicited ideas from both internal and external sources. The cyber scouting crowd can be vast or specifically targeted depending on the client and/or challenge needs. The eZassi platform offers a Demand Generation component to further enhance the client's challenge reach to specific audiences or the entire crowd–from customers, supply chain, and universities to innovators and inventors. Sustained user engagement is heightened through the system's fully customizable gamification techniques, rewarding the challenge community through value-based rewards, such as coins, cash, gift cards, and recognition, to keep the challenge community coming back, interacting, and sharing. Platform components can be supplemented with other capabilities to enhance and foster submitter engagement and is designed for an absorbing and secure user experience.

The eZassi approach structures and digitizes the disclosure process consistent with each client's business model and stage-gate process. It has four idea capture processes, including co-design, gamified social ideation, challenge scouting, and a proprietary structured idea capture methodology. The capture process uses a set of multiple choice questions that work similarly to TurboTax, making the complex simple. During the external idea submission process, IP risk is minimized for all parties by transforming the submitter's potentially confidential information into non-confidential information received by the client. As the submitter responds to questions, an intelligent knowledge engine processes the responses and automatically creates a scored assessment report. This rich characterization simplifies and accelerates decision making on the submission and minimizes response time.



Exapnding the Ecosystem of Innovation
(Courtesy of eZassi)

The eZassi process provides specialty workflows for internal socialization and review of the submissions in a stage-gate decision process. The received ideas are analyzed, indexed, and categorized and can be socially rated internally by a specialized team. The process is supplemented with a rich set of analytics and administrative dashboard features to manage and display the status of all submitted ideas in the system. The eZassi platform enhances an organization's ability to scout, acquire, and process new ideas while automating risk mitigation.

communities to solve their difficult problems did just that. With a few clicks in the PLM system, a problem is easily posted onto their Open Innovation portal as a challenge along with approved collateral (design, simulation results, problem statement, and other relevant data). Pre-configured integration between the PLM and the Open Innovation systems determines who is allowed to participate in the challenge. In another case, global employees can be engaged in strategic questions (quadrant 1), such as "What are our competitors' offerings in your region? What new consumer trends have you observed?" Armed with smart phones with cameras, every employee and supply chain member can be a company's on-the-ground eyes collecting information to help answer questions that are typically managed via expensive services.

A key challenge in adopting these types of solutions in a large enterprise is the culture. Mr. Peter von Dyck, Chief Executive Officer of eZassi, said "Increasingly, companies are making sure that it's not just one department that has a role in innovation. They'd like to get more of their employees, partners, and supply chain involved. That kind of engagement is new, and sustaining that at a high level for ideation and innovation can be difficult. In many cases, the existing culture and ecosystem is more suited for accountability, prediction, and managing risk, so the culture is not always well-suited to really foster widespread innovation, risk taking, and openness. This cultural issue is a very difficult element for clients to initially undertake."

Another concern he mentioned for enterprises that would want to collaborate externally is how to make it safe for people to disclose the idea without potential legal risks, such as future litigation about the ownership of the idea.

Addressing these client concerns effectively is important because, according to many studies, Open Innovation is here to stay. Over 85 percent of the executives we interviewed in this research stated that they have a structured Open Innovation initiative and are currently using or exploring crowdsourcing approaches.

Managing Innovation with Speed and Agility within Constraints

With the increased importance of innovation to a company's growth, to systemize best practices and to improve decision making, many enterprises started to implement a stage-gate approach to product development in the early 1990s. As more management best practices, such as strategic planning and portfolio management, became available, companies added these to their innovation management tool kit. Discussions, collaboration, and decisions often happened in meetings, conference calls, and e-mail with content presented mostly in Microsoft Excel, Word, and PowerPoint and stored on personal computers, Share Point, or other data repositories. In a highly-variable innovation environment where change is constant, the manual effort to access and update the data locked away in these documents represents a huge undertaking (and means more meetings, calls, and e-mails.) As a result, enterprises struggle with agility and speed. The availability of modern digital

solutions that support innovation management processes with real-time connected data, sophisticated analytics, and visualization offer a huge opportunity to gain efficiency and speed.

Examples that belong to this CLASS 2 of Enterprise Innovation Management solutions are Accolade by Sopheon, Planview Enterprise, Innovation Framework Technologies[17], CA Technologies[18], and Planisware[19]. Other terms associated with this class include innovation lifecycle management, stage-gate process management, and many variations of the acronym PPM, for example:

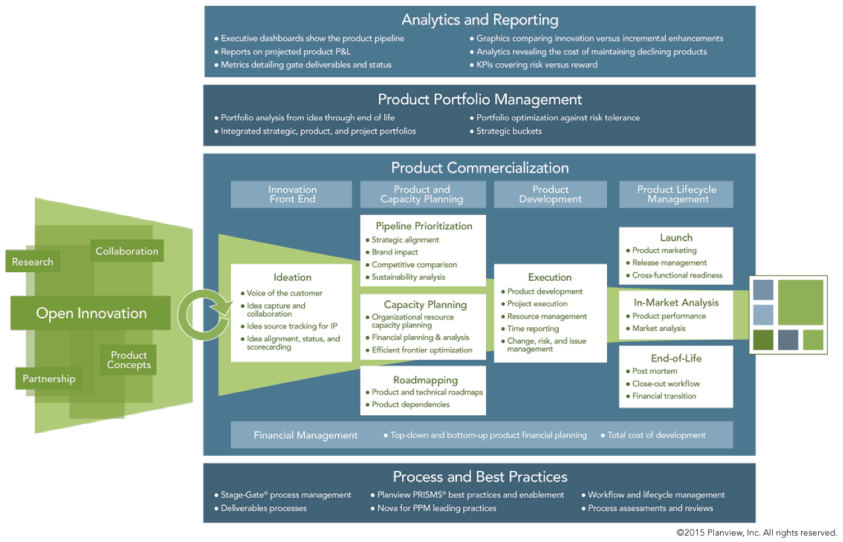
- Program and Project Management
- Project Portfolio Management
- Product Portfolio Management

While these solutions appear to have common features and functionality as indicated in the Stage-Gate Certified solutions directory[20], they have evolved from different value propositions. For example, Planview built their Planview Enterprise platform ground up, starting with expertise in project and program management (originally in the IT market) and adding the other critical EIM best practices, such as roadmapping and portfolio management, over time. Sopheon, on the other hand, took a top-down approach to architect their Accolade platform with

Planview

Planview is a portfolio management and project collaboration solution provider. The company's flagship solution, Planview Enterprise, allows the integration of planning and execution of a company's portfolios, be they projects, applications, products, or services. Planview Enterprise enables informed portfolio decisions with a strong analytics and reporting capability. The solution offers companies a centralized platform for enterprise-wide presentation of projects, with real-time status and resources applied against demands.

Planview Enterprise offers an end-to-end solution for managing innovation and product development. The journey begins with Open Innovation for front-end idea gathering. Campaigns can be established for external and internal ideation. Navigation within the solution and an intuitive user experience are key aspects for Planview Enterprise. New product ideas and enhancement ideas for existing products, as well as new insights from R&D and services, are captured with configurable and customizable front-end web pages. Ideas are then funneled into Planview Enterprise's Innovation front end to be assessed and managed.



Planview Enterprise Architecture
(Courtesy of Planview)

In Planview Enterprise, clients can set product and project priorities based on knowledge of their overall portfolios, and then apply resource and capacity planning to set a roadmap for execution. Planview Enterprise continues to manage schedules and budgets through product development and into launch. Users can then gain insights by monitoring the product financials in the marketplace. The analytics and reporting capabilities enable confident decision making.

[17] http://www.innovation-framework.com/
[18] http://www.ca.com/
[19] https://www.planisware.com/
[20] http://www.stage-gate.com/certification_directory.php

a focus on governance and executive decision making. While both providers now offer software solutions and a rich library of best practices for the entire innovation management and product development cycle, emphasis in their messaging still reflects where they started.

We should note that some CLASS 2 providers, including our sponsors Planview and Sopheon, also offer collaborative ideation solutions, which belong to CLASS 1. These offerings are sometimes made available through partnerships as is the case of Planview and Brightidea.

A key challenge in implementing CLASS 2 solutions is avoiding complexity.

A key challenge in implementing a CLASS 2 solution is avoiding complexity (or the perception of complexity). While the solution may have many sophisticated features, an approach that includes introducing all features at once should be avoided. Instead, features that address users' most critical "pain points" should be made available to create early wins. A statement from Ms. April Bertram, Innovation Management Director at GOJO Industries, describes this issue well: "Ten years ago we had a portfolio management system, and we made a mistake when we implemented it. We turned on all the features, and it was too complex. We ended up pulling the system and moving away from that after about three years."

Realizing Innovation Efficiently and Effectively

The innovation process must be calibrated to customer requirements.

PLM solution providers such as Siemens PLM Software, a research sponsor; Dassault Systèmes[21]; Oracle[22]; Arena Solutions[23]; Autodesk[24]; and SAP[25] have traditionally supported the domain of product innovation delivery. They did this historically by supporting the technical or engineering community in managing complex product data as the necessary knowledge and models (i.e., product and service concepts, designs, processes, and supply chain) were developed to bring new product offerings to the market. Today, PLM is no longer about functional process enablement. It's about extended enterprise process enablement crossing traditional organizational and system boundaries to support processes that span multiple organizations and roles. First and foremost, this means the innovation process must be calibrated to customer requirements rather than simply be a product-centric process calibrated to the technical community. As a result, the platform must integrate to a host of organizational disciplines outside the traditional engineering and program management disciplines. PLM as an innovation platform must:

- Connect with a business decision layer around portfolio choices and resource management. While some PLM providers have developed their own offerings, this connection could be accomplished by working with solutions in CLASS 2.
- Expose Open Innovation or bring internal and external communities closer to PLM to foster ideation and co-design by working with solutions in CLASS 1, as in the

[21] http://www.3ds.com/
[22] Oracle PLM Solutions
[23] http://www.arenasolutions.com/
[24] http://www.autodeskplm360.com/
[25] http://www.sap.com/solution/rapid-deployment/software/product-lifecycle-management-plm/

previous example with regard to an eZassi client empowering product development teams to leverage external communities for solving difficult problems right from within PLM. Moreover, PLM could also allow checking for redundancy or novelty of ideas as a comparative database. An enterprise's Open Innovation systems could actually interface within PLM to understand if incoming ideas are novel or redundant as they relate to the enterprise.

Proposed EIM Solutions Architecture

The complexity of extended enterprise processes, organizational requirements, and information constructs cannot be addressed by any single solution provider, no matter how large. The new business platform paradigm is one in which solutions from multiple providers must be seamlessly deployed using an architecture that is resilient and can withstand rapid changes in individual business functions or delivery modalities. Figure 3 shows a simple architecture of where and how various solutions fit together.

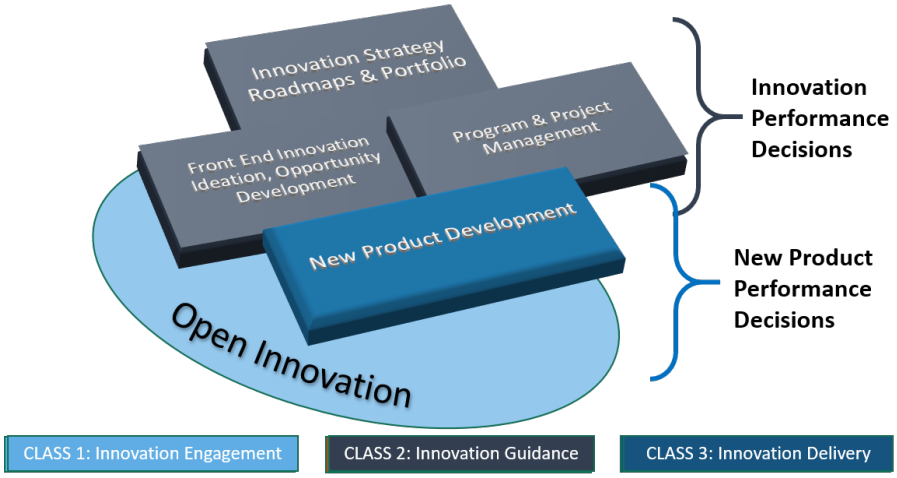


Figure 3—How the EIM Classes of Solutions Fit with Each Other

As indicated in the strategy-based definition, from a business perspective innovation is about securing the future of an enterprise. It involves a set of business processes, practices, organizational planning, and execution in which activities need to be monitored and priorities need to be assessed and rebalanced with forward- and backward-looking learning. Therefore, as a measure of innovation effectiveness, the innovation management solutions must provide easy ways for users to discover and generate insight from data, including the transactional data in quadrant 4 (Current Business, Make and Sell) of Figure 1.

When evaluating innovation management solutions, users should prioritize openness, configurability, flexibility, and adaptability–features that enable them to connect to best-of-class functionality for diverse needs that span research, design, engineering, sourcing, manufacturing, sales, marketing, service, etc., including capabilities conducive to innovation and innovation management. All four sponsors of this research offer open, configurable, and flexible architectures to connect across other platforms.

Key Innovation Challenges and Concerns

Culture and Mindset

Several executives who participated in our research brought up culture and mindset as one of their challenges.

Several executives who participated in our research brought up culture and mindset as one of their challenges. Ms. April Bertram said, "Our employees who have been with the company a long time have learned a specific way of working. Some are not comfortable engaging with customers on early prototypes that aren't perfect." Dr. Charki commented on Sanofi R&D employees' response to Open Innovation: "Not invented here syndrome still exists, partly because the organization felt a trauma when initially the management strategy and messages were interpreted as 'what is coming from outside is better than what exists inside.' The reality is people have become so focused on the internal processes, workflows, and administrative hurdles that they forgot that their primary mission is R&D, which is to be connected with innovation networks and what is going on in their scientific field."

Mr. Andy Michuda, CEO of Sopheon, pointed out that companies that implement cross-functional collaborative processes and value transparent communications across innovation teams benefit significantly more from enterprise innovation best practices embedded in their EIM solution than those that do not.

Another aspect of cultural change that was discussed is the need to create bottom-up innovation, especially with the increased number of younger generation employees who grew up with social media. Several participants pointed out that most enterprises today have processes that follow a top-down direction. This needs to be complemented with bottom-up processes supported with CLASS 1 solutions that engage employees more directly.

Innovation Alignment Across Multiple Organizations

Large enterprises are frequently organized around business verticals. It is common for the business verticals to share corporate resources when they are providers of critical knowledge and capabilities to each other. For example, they might share an upstream research and development group that investigates new and better technologies. Several research participants who had innovation leadership roles at the corporate level talked about the challenge of getting alignment on innovation targets and how to achieve these targets with portfolio choices. One aspect of difficulty was balancing the portfolio for the short-term goals, i.e., improvement and line extensions on the current products, as well as for the long-term goals, such as exploring new technologies, new markets, and new business models. The other aspect was business leaders' willingness to accept a portfolio that maximizes the overall benefits for the enterprise versus the direct benefits to their business or team.

Mr. Olosky said, "Ideally we should act like a Board of Directors that's guiding our innovation strategy and our innovation results independent of the businesses. But in reality we have an advanced research leader who cares about his team,

and we have five business leaders who care about their teams—which is great. But it's also having a balanced picture of what's the overall plan for the adhesive technologies and what's the best thing for our company. It's important to have that balanced view."

He continued to say that "One of the benefits of having a digital innovation portfolio management system is that now we can measure and track how much money we are spending in which area and alignment on where we want to go."

Fragmented Processes & Systems

Another key challenge mentioned was fragmented processes and systems that created data silos and make information sharing difficult and slow.

Mr. Lux Chakrapani, Director of Manufacturing and Technology Applications at Performance Materials and Technologies, Honeywell, said "While we have had significant success in new product development due to pockets of innovation that were very successful, the pain point has always been not having a 'single source of truth.' With low adoption of these fragmented systems, there was no way to manage our portfolio and projects effectively. This resulted in longer cycle times and very poor visibility to how financial commitments are met (or not met) at a high level of confidence. Not having a harmonized process was a key challenge initially which we tackled first. Now we are harmonizing our systems by implementing an enterprise innovation management software platform."

Ms. Bertram commented, "We do strategic and tactical portfolio management, and we manage our roadmaps across the company. One of our biggest challenges is keeping those up to date and letting everybody who touches those roadmaps make appropriate updates. We were doing it all in Excel, which is quite challenging. It got to the point where our pivot tables and Excel spreadsheets were crashing. This made information sharing very difficult. With the new portfolio management software, we are looking forward to having data in real time. It will allow us to understand how changes impact our revenue projections, and we will be able to make decisions accordingly."

On the other hand, the experience shared by Mr. Fredrik Dellby, Senior Vice President of Product Process and Global Product Line Dishcare, Electrolux, points to the importance of not overselling the benefits of creating connectivity across various systems if significant effort and investment are required: "Initially there was enormous expectation that connecting all the systems together would be the future, and we invested a lot into that. However, we didn't get the benefit we expected from it. Over the last two years we scaled it down to basics and now are trying to make it a good tool for the work it is intended to support."

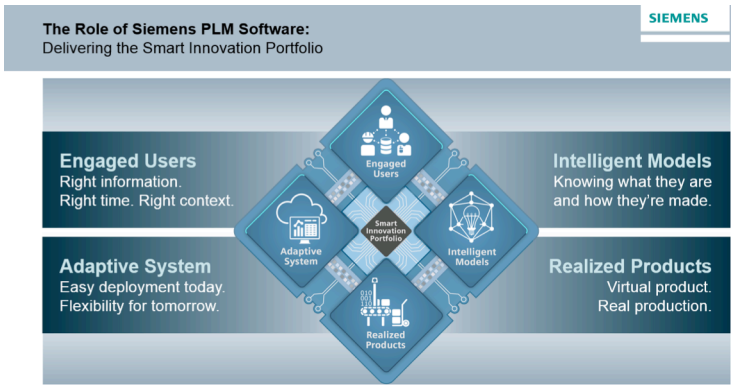
Ever Increasing Product System Complexity

Almost every product today is a system of systems. It is no longer a single item. For example, in transportation products such as cars, airplanes, and ships we have the chassis/body/hull, the engine and engine controllers, hydraulics and electrical systems, as well as the communications and infotainment systems, etc. All of these systems need to work together to provide a safe and enjoyable journey. With smart and connected products, complexity is increasing and requiring integration of multi-domain and multi-discipline knowledge and skills ranging from social sciences for better definition of the customer interface to technical disciplines, such as mechanical, electrical, chemical, computational engineering, and software. Each can be difficult to manage individually, but now it is critical that they all be integrated and managed together within the context of a product.

PLM solution providers think about how to help companies manage all this complexity and make sure products work as intended. With a system-driven design approach, products can be defined and modeled at both the

Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a global provider of Product Lifecycle Management (PLM) and manufacturing operations management (MOM) software. At the core of many of their numerous PLM applications lies the Teamcenter platform. Siemens PLM Software invests in supporting innovation and connectivity for their product development customers under the banner of "Realize Innovation." They focus on four initiatives as represented below.



Siemens Realize Innovation Initiatives
(Courtesy of Siemens PLM Software)

The first initiative is engaged users. Siemens PLM Software has a strong program around expanding the number and types of users who can easily and in a very engaged way leverage Teamcenter directly through an interface called Active Workspace. As a means of tackling growing product complexity and fostering innovation, they focus user interaction into role-based use cases working with relevant information in an intuitive manner. The second initiative is an adaptive system based on driving performance, scalability, and flexibility. Siemens PLM Software's goal is to improve openness based on a belief that their solutions must interface with any number of other enterprise systems.

Intelligent models, which build and leverage intelligence in product definitions, are used to manage and address product complexity. To be effective, companies must be able to model and validate the entire product early in the process. The concept of systems-driven product development is realized by being able to define the architecture for all systems and subsystems of a product and understand what the various interfaces and relationships are between them. Also key is the understanding of how multi-domain (mechanical, electrical, and software) products need to be developed. In systems-driven product development the user has the ability to model complete systems, not just their model shapes, and verify them. Realized products align the virtual definition with the physical product. Integrated product definition helps bridge the gap between the product's virtual definition (such as CAD) and the use cases that are based on the product's system-wide physical definition.

Within the proposed taxonomy of Innovation Management solutions, Siemens PLM Software's Teamcenter and PLM applications fall squarely into the New Product Development quadrant. Without the flexibility of an intelligent, adaptive PLM suite of tools, innovative ideas captured and managed up front have little chance of being designed and produced. With their strong position established, Siemens PLM Software can extend its growth into the Front End Innovation and Innovation Strategy quadrants of Innovation Management.

component and the system levels by using computational approaches. Simulations and tests can be done in virtual environments. Digital modeling and simulations allow rapid and inexpensive iterations to ensure products work as intended, ahead of their physical realization. However, as expressed by Mr. Dennis George, Senior Marketing Manager at Siemens PLM Software, "There is still an issue of getting people over the cultural hump of admitting that all this complexity needs to be modeled up front in the digital world." In addition, supplier collaboration is critical. An original equipment manufacturer (OEM) has to ensure that there is some compatibility between what the supplier and the OEM do and how they do it so it fits with their system and with the how other suppliers work. Ultimately, it is essential that communication and the sharing mechanism are compatible across different suppliers.

Effective Approaches to Address Challenges

We asked our research participants what solutions they found most effective in addressing their challenges. The following is a summary of what we heard.

Embrace Cultural Change

Transforming a large organization's culture is no small feat and can take years. People impacted by the change need to understand why the change is valuable and if they have the skills to operate in the new way. Several research participants emphasized the importance of having an executive champion who has the right leadership qualities. Dr. Charki said, "The champion must be able to move people and create passion and momentum around the change idea." Ms. Carrie Nauyalis, NPD Solutions Evangelist at Planview commented, "Having done this for as long as we have, we certainly recommend that there be a champion involved with some skin in the game."

Ms. Bertram described their train-the-trainer approach as a network of experts embedded in their functional organizations: "We have twenty individuals distributed across our company certified as innovation black belts who intimately know our processes and tools; they can coach individuals in their functional areas on how to effectively use them. This coaching process helps them learn the new processes and tools quickly."

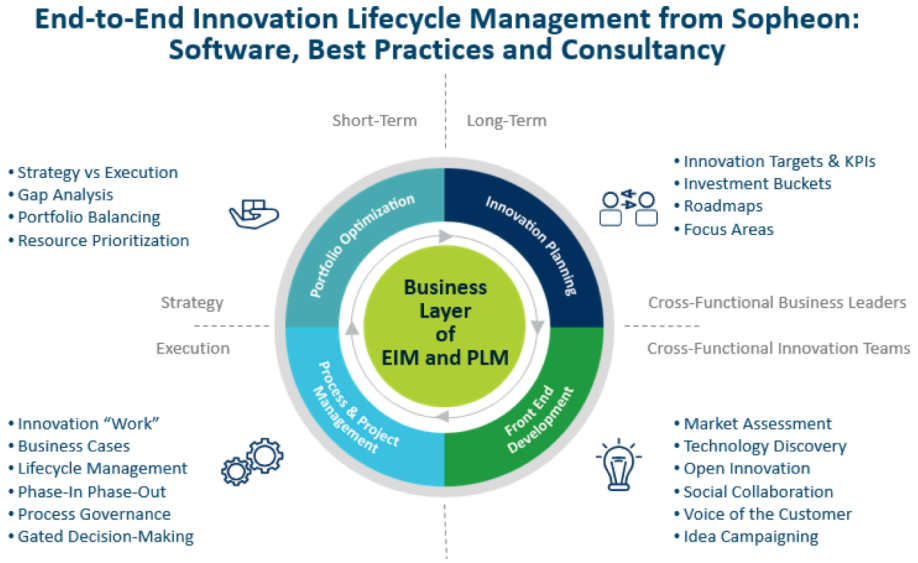
Along the same lines, Mr. von Dyck recommended assigning a new group of people around the change initiative or a program. He said, "Open Innovation is not always a legacy system in companies. Many times it's a new practice, and it's typically a new budget line item and a new software platform that's needed as well. And so, the difficulty can be in getting started, and the part that needs to be in place first is a champion and preferably a small team of people who can serve as change agents, raise awareness, and ensure that these new solutions and practices are adopted in more and more segments of the company."

Define Goals and Metrics

For any change to take root, an organization must have goals around what they want to achieve. The goal setting process anchors the people involved in the change and allows measuring progress. Ms. Nauyalis said "We recommend our clients to start with the analytics first and ensure that they are driving value." She offered that three metrics are important to their clients when it comes to EIM. First, improve time to market and reduce cycle time. Their clients experienced as much as 70 percent cycle time reduction. Next, increase the portfolio's value by selecting products better. She said "Many executives are forced to make decisions based on gut feelings, and that's been very effective for them in the past. However, with increased complexity, being able to have deep perspectives on all aspects of their innovation program helps them make decisions with confidence based on reliable data." And third, reduce cost by increasing efficiency and productivity. Their clients typically experience a 25 to 40 percent decrease in cost compared with manual processing and reporting.

Sopheon

Sopheon is a global provider of Enterprise Innovation Management (EIM) solutions, including software and deep expertise on EIM best practices covering the entire innovation management and new product development (NPD) lifecycle, from strategy to value realization in the market place.



Sopheon Innovation Lifecycle Management
(Courtesy of Sopheon)

Sopheon's software solution, Accolade, is a configurable platform that serves customer needs across the entire innovation management and new product development lifecycle, including strategic planning, roadmapping, idea and concept development, portfolio and project management, and resource and capacity planning. At the core, Accolade automates best-practice processes with an extensive set of dashboards, analytics, and reporting capabilities. In Accolade each activity is modeled as a configurable process so that customers can either implement their proven practices or choose from Sopheon's library of best practices.

As a secure information management platform, Accolade comes with an intelligent search capability that delivers valuable information relevant to the work people are doing when they're doing it to help them make better decisions and to complete their work more effectively. Accolade integrates with a large number of common enterprise tools and systems, creating an unified user experience no matter how users prefer to work; these include smooth integrations with the Microsoft Office suite, ERP, PDM, PLM, and CRM systems for the exchange of relevant data at the appropriate touch points during the innovation lifecycle. This seamless connectivity helps users be aware of changes in real time to help assess the impact on their work, leading to higher engagement, better and more collaborative decisions, less rework, and higher productivity.

Balance Technical and Commercial Aspects in Decision Making

Making informed decisions with forward- and backward-looking learning is a critical aspect of effective innovation management. In today's connected economy where good ideas can come from anywhere and with increased complexity of business with many competing priorities—short term versus long term, evolutionary versus disruptive, status quo versus new business models—creating organizational structures for effective decision making is a must. At the strategic level, these structures are multi-functional executive teams guiding innovation goals, targets, and portfolio choices. It is also common practice for projects to be completed by multi-functional product development teams.

Several research participants discussed engaging both technical and commercial perspectives when assessing and choosing options from external opportunities. For example, Dr. Thoen talked about the "kid in the candy store" syndrome: "When you go outside and start to engage with other companies, universities, and start-ups, a lot of different things look very interesting. The danger is that essentially you become the 'kid in the candy store' where every sweet, every candy looks very nice, tastes very nice, and you ultimately end up being very sick because you've now eaten too much candy." His advice is to have a good link between technical and commercial organizations when assessing opportunities so that each side corrects the other's blind spots. The commercial side keeps the scientists more honest in terms of promise of a new technology. The scientists ensure that the commercial side considers opportunities beyond six to twelve months. Digital solutions, such as those from eZassi, make tracking and collaboration involved in such decision making easier.

Allow Time for Pilots, but Avoid Getting Stuck There

Pilot programs should be about early wins.

The importance of allowing time for pilots and learning experiments was emphasized, but they should be targeted at creating early wins. Dr. Charki cautioned against getting stuck in pilot mode: "We did not go on the pilot and scale-up mode most of the time. This time we said okay, but pilot and scale-up means if we have built a car prototype, now we would like to build thousands of cars; but the prerequisite is to pave roads and deliver driving licenses to make it a sustainable and successful operation."

For the solution providers, pilots and learning experiments are about delivering value from day one. Ms. Nauyalis said, "We measure value from day one doing a current state assessment, understanding where they are today, and then we do our implementation in a phased approach addressing their most pressing needs first. We don't ever allow or recommend a customer to do a big bang implementation because it simply doesn't work because people can't adopt that much change." Dr. Huub Ruten had a similar view: "When companies automate their innovation processes there is a natural tendency to over complicate them, usually because now they can finally do all this 'cool stuff' for the first time, so why not? Unfortunately, the pain of this complexity is passed on to the people

who need to follow the processes, and it typically results in them just giving up on the processes. In the end everyone loses."

Communicate and Create Meaningful Conversations

Aligning a large organization against new goals and directions and relaying the message throughout the organization requires excellent communication through a wide range of formats, such as town hall meetings, round table discussions, and digital and print media communications. These communications are conducted and provided to create a common understanding of the change that is targeted. Dr. Charki said, "…we have noticed that people do not have the same understanding behind the work. They have not had the definition, and that sometimes leads to a failure. So to make sure that everybody has the same understanding and can get behind the work—have a culture of trust, have a culture of collaboration and participation—we started actually to write a lexicon and launched an educational and training program."

Aligning a large organization against new goals and directions and relaying the message throughout the organization requires excellent communication.

Consider Technology Enablers

In terms of how their solutions are helping customers address their own challenges, multiple solution providers mentioned the cloud as a key enabler for lessening technical requirements to install their software. Ms. Carrie Nauyalis said "Because of the cloud, the barriers for entry are now much lower. Our solution requires nothing be installed except for a web browser. While there's no technical requirement, we do have best practices of what companies should put in place as relates to enablement and adoption." Integration across solutions will get easier with more PLM providers, including Siemens PLM Software, Arena, Autodesk, PTC, and Oracle, now offering cloud options. However, Mr. von Dyck expressed frustration with the slow adoption of the cloud by end users. He said, "The large enterprises can be skeptical to go into the public cloud. They commonly want to maintain their private cloud and protect their enterprise data center. So that's one area where a solution like ours can provide a new capability, as we have a cloud implementation like Salesforce, where they can securely interact socially for ideation and innovation using our application at a minimal cost and with a minimal IT footprint."

Another aspect emphasized as a solution to improve adoption was to provide a simple and easy-to-use user interface. Mr. George said, "Our user interface is designed to be much more like a Google search engine that everybody is familiar with. Let's say a new engineer wants to know something about the engine coolant process that a previous engineer has defined. One of the things that she could do at that very high level is a search and the system automatically returns the type of information that's associated with her search and her role… it knows that if she is a design engineer she doesn't need to know the information that's related to manufacturing."

Dr. Lee Ellen Drechsler expressed her frustration with systems and tools that are being custom developed internally by saying, "If there was a way to make something we already use in our own life, like Facebook, that we could use at

our company I would be the first one to sign up. We try to create all these elaborate systems to share ideas and keep teams connected. I am pretty sure somebody already invented that. We just have to use it."

Summary and Conclusions

In this paper, we defined innovation based on three key aspects that research participants have included in their definitions of EIM: Outcome, Strategy, and Process. Next, we proposed a three-pronged classification for EIM solutions, based on their key benefits and an architecture of how these solutions fit with each other. CLASS 1 (Innovation Engagement) solutions are those that encourage engagement of large group creativity with internal and external networks, individuals, and communities in addressing innovation needs. CLASS 2 (Innovation Guidance) solutions are those that structure and support business strategy and decision making related to processes that are critical to accomplishing on target and profitable innovation. CLASS 3 (Innovation Delivery) solutions are those that support the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise. We described where each class of solutions adds value and the key challenges involved in their adoption. We also pointed out that solutions in CLASS 1 and CLASS 2 are often described by the solution providers using the same terminology, e.g., Innovation Management, which is a source of confusion for clients.

Innovation challenges fall into four categories: Culture and Mindset, Innovation Alignment, Fragmented Processes and Systems, and increasing Product Complexity.

Lastly, we described commonly experienced innovation challenges and concerns and included approaches that were found useful to address them. The challenges fell into four categories: Culture and Mindset; Innovation Alignment across the enterprise where multiple organizations are involved in goal setting, planning, and delivery; Fragmented Processes and Systems that make information sharing difficult and slow; and difficulty in managing ever-increasing Product Complexity. To deal with these challenges and concerns, research participants suggested strategies to drive cultural change. Strategies included identifying an executive champion with the right qualities, training people through a network of innovation ambassadors, and establishing governance structures and processes to help organizations align on innovation goals and the decisions of how to reach them. Some of our research participants have chosen to adopt modern EIM solutions and proven best practices to create a more agile, visual, and adoptable system and tools that support connectivity needed for fast, quality decisions; others are still experimenting and in search of tools to support their innovation activities.

There is substantial opportunity in the business of innovation to achieve better results more efficiently.

In conclusion, with state-of-the-art digital solutions, those involved in the business of innovation have a great opportunity to achieve better results faster. This is especially true for organizations that understand innovation as a system with connected activities and processes. There is no better time to make those activities more visible and digitally connected across their enterprise innovation system—from ideas and insight to innovation planning to innovation realization

in the market. A digitally connected enterprise innovation system with easy-to-use interfaces, visual dashboards, and analytics for decision support as well as modeling and simulation tools for designing and testing innovations digitally before physical realization help enterprises operate more effectively and efficiently in today's demanding innovation environment. However, tools alone are not sufficient. A culture aligned with the new strategies and solutions and a work force with the right mindset and skills are just as critical.

Glossary

Business Platform	An architecture that allows a comprehensive set of heterogeneous, functional, and process-enabling capabilities to be packaged and configured to establish and support standardized end-to-end business processes and related information access and use.
Co-Creation	A business strategy and value sharing model that focuses on building relationships with a community of innovators who are interested in working openly and collaboratively on new ideas and concepts that can be turned into physical products.
Crowdsourcing	The practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people and especially from an online community.
Enterprise Innovation Management (EIM)	Management of all initiatives and investments that allow an enterprise to renew itself in creative ways, including development of new products and processes.
Idea Management	A structured process of generating, capturing, discussing, improving, organizing, evaluating, and prioritizing insights or alternative thinking that would otherwise not have emerged through typical processes.
Innovation	The definition and realization of a new solution (i.e., a process, product, service, or business approach) to a need, issue, or problem that performs better or delivers more value than any previous solution.
Innovation Management	Management of initiatives and investments that help organizations understand and pursue the creative process in pursuit of new and unique products and processes.
Innovation Platform	A business platform designed to enable an enterprise's innovation processes. The platform helps its users create, manage, and re-use information and intellectual property for maximum business impact and effectiveness.
New Product Development (NPD)	The process of developing a new product or service for the market.
Open Innovation	Purposefully managed knowledge flows across a company's boundaries consistent with the company's business model.

Portfolio Management	Centralized management of one or more portfolios, which includes identifying, prioritizing, authorizing, managing, and controlling projects, programs, and other related work to achieve specific strategic business objectives (from PMI).
Process	(noun) An ordered sequence of steps performed for a given purpose, such as the software development process. (verb) To perform an operation on data.
Product	A generic term for whatever is produced by a process, whether goods or services. Any deliverable item of a project or program.
Product Lifecycle Management (PLM)	A strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise, and spanning from product concept to end of life—integrating people, processes, business systems, and information.
Program Management	The planning, directing, and controlling of human and non-human resources to achieve specific program or project objectives. Program management tracks factors such as technical performance in terms of cost and time and generally includes a work breakdown structure of tasks and sub-tasks. Also known as Project Management.
Project Management	The process of planning, organizing, controlling, and deploying key milestones, deliverables, and resources from conception through retirement of a project. See Program Management.
Resource Management	Monitoring and deploying an enterprise's people, financial, and physical assets efficiently and consistent with its business strategy.
Stage-Gate Process	A project management technique in which an initiative or project is divided into stages or phases, separated by control points (gates) at which specific decision criteria guide project activities and management decisions.
Strategic Planning	An organization's process of defining its driving direction (strategy), and allocating its resources to support achieving this strategy.
Strategic Roadmap	A time-based plan that drives a company from its current state towards a future state defined by its strategic plan. The roadmap defines the steps required to achieve the desired state.

About CIMdata

CIMdata, a leading 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) solutions. Since its founding over thirty years ago, CIMdata has delivered world-class knowledge, expertise, and best-practice methods on PLM

solutions. These solutions incorporate both business processes and a wide-ranging set of PLM-enabling technologies.

CIMdata works with both industrial organizations and providers of technologies and services seeking competitive advantage in the global economy. CIMdata helps industrial organizations establish effective PLM strategies, assists in the identification of requirements and selection of PLM technologies, helps organizations optimize their operational structure and processes to implement solutions, and assists in the deployment of these solutions. For PLM solution providers, CIMdata helps define business and market strategies, delivers worldwide market information and analyses, provides education and support for internal sales and marketing teams, as well as overall support at all stages of business and product programs to make them optimally effective in their markets.

In addition to consulting, CIMdata conducts research, provides PLM-focused subscription services, and produces several commercial publications. The company also provides industry education through PLM certification programs, seminars, and conferences worldwide. CIMdata serves clients around the world from offices in North America, Europe, and Asia-Pacific.

To learn more about CIMdata's services, visit our website at 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.

About the Authors

Dr. Suna Polat

Dr. Suna Polat has 25+ years of experience in technology development, product development, innovation management, implementation of strategic innovation capabilities—including modeling and simulation (M&S), open innovation, knowledge management—social technologies and social product development, and driving change and adoption. This wide range of expertise was gained through her career at Procter & Gamble (P&G), the development of her own consulting practice, and more recently her experience at CIMdata, which she joined in June 2014.

Early in her career, Dr. Polat developed expertise in transport phenomena (and CAE modeling) in academia and spent over 21 years at P&G, where initially she developed process and material technologies for diverse product categories. Later, she held various leadership roles for the implementation of strategic innovation capabilities, such as open innovation, M&S, and social innovation platforms, for which a common thread was driving organizational culture change and adoption. In her work at P&G, Dr. Polat worked with and benchmarked best-in-class companies in a range of industries including consumer goods, material suppliers, IT, oil and gas, auto, airline, and pharmaceuticals to source technology and to identify best practices and new approaches for cultivating innovation and innovation productivity.

Dr. Polat's current interests include innovation and collaboration in large organizations and networks; the effect of "culture" on organizational innovation output; the influence of communities and social technologies on employee experiences, creativity, and innovation output; effective collaboration solutions in PLM environments; and decision models supported by social technologies.

Dr. Polat holds a BS, from Middle East Technical University in Turkey, an MS from the University of Pittsburgh, and a Ph.D. from McGill University in Montreal, Canada, all in Chemical Engineering.

Dr. Ken Versprille

Dr. Ken Versprille, Executive Consultant at CIMdata, has 40 years of experience in the application of computer-based solutions to engineering and manufacturing enterprises. He has held senior positions in research and development, and consulting in the CAD/CAM/CAE/CIM fields.

Dr. Versprille joined CIMdata after 16 years as the head of the Design Creation and Validation service at the industry analyst and consulting firm, Collaborative Product Development Associates (CPDA), formerly D.H. Brown Associates. His in-depth technical research in three-dimensional geometric modeling; computer-aided engineering; and design, manufacturing, and documentation applications have helped both solution provider and industrial companies plan more effective use of technology to improve their business strategies. His research projects have spanned complex geometric design approaches, design collaboration, design automation, PLM standards and openness, and the horizontal integration of CAD across related PLM applications.

Before joining CPDA, Dr. Versprille held numerous senior level technical and managerial positions during 15 years at Computervision Corporation, reaching the equivalent position of CTO and R&D Vice President of core CAD and mechanical applications. He was a lead architect of the CADDS 4 product, which gained impressive worldwide market share in CAD, and had sole responsibility for the initial design of Computervision's 3D graphics system. After leaving Computervision to pursue independent consulting, Dr. Versprille rejoined the company as General Manager of CV-Doors, leading a new group that introduced and managed the CAD industry's first geometric kernel business.

Dr. Versprille received a Bachelor of Science degree in Mathematics from the University of New Hampshire. He earned both his Masters of Science and Ph.D. in computer science from Syracuse University, where he studied under Steven Coons, a pioneer in the computer graphics field. Dr. Versprille is recognized for publishing the first description of NURBS (Non-Uniform Rational B-Splines), the mathematical curve and surface formulation that has become an international standard in CAD and Computer Graphics. In 2005, he was awarded a Lifetime Achievement Award by The CAD Society in recognition of his outstanding contributions to the engineering software community.