

Enabling Enterprise Agility for Development of Complex Products—TCS Approach

CIMdata Commentary

Key takeaways:

- *Competitive pressures are increasing faster than ever, driving manufacturers to move beyond lean to a more value driven approach, fueled by adaptability and empowerment.*
- *The agile approach is well developed for software and is rapidly emerging as a methodology to develop manufactured products and respond to change by identifying and leveraging marketplace opportunities.*
- *Agility is a paradigm shift— TCS’ approach to Agile Product Development for Manufacturing is holistic and uses a multi-dimensional approach to guide an organization step-by-step along the journey.*
- *TCS’ agile approach has been matured based on the imperatives of a variety of customers including automotive and industrial OEMs and Tier 1 suppliers. Agility is a significant capability outcome for manufacturers who adopt Neural Manufacturing¹ which has seen accelerated adoption due to the COVID-19 pandemic.*

New products are always exciting, whether for consumer or business customers. It’s just human nature to get excited about something potentially better. Within competitive landscapes such as the automotive and industrial equipment markets, CIMdata sees massive, rapid product changes and new entrants disrupting markets. Electrification, ubiquitous connectivity, and autonomy are the major trends driving the changes and opportunities. In the emerging business models, purpose driven ecosystems are playing a critical role as they evolve to deliver the full scope of customer requirements.²

Adapting to trends and disruptions creates significant risk for established companies, who often struggle to adapt quickly. While lean manufacturing is a common improvement strategy, just taking waste out of the production system or even the administrative processes is not enough to maintain competitiveness. Startups are often more flexible and adaptable. Complex products such as automobiles, transportation systems, and complex machinery require scalable, well-defined processes and excellent execution in addition to advanced technology.

One of the biggest risks in product development is a market shift during the product development timeline. Hardware development still primarily uses a phase-gate or waterfall approach centered around pre-prototype, prototype, and production physical builds to verify the product, manufacturing, and supply chain processes. For complex products with a development timeline of 1 to 3 years or more, a change in the market landscape or customer requirements can be catastrophic. While there are many islands of automation including MBSE, CAE, and virtual commissioning solutions that can shorten timelines these technologies are commonly implemented within the context of the current phase-gate approach.

Manufacturing companies have been investing significantly in software enabled products to make them connected and intelligent. As software becomes an integral part of a product’s architecture, its development must be tightly coupled with hardware development,

¹ <https://www.tcs.com/content/dam/tcs/pdf/Industries/manufacturing/abstract/neural-manufacturing-covid-19.pdf>

² Research for this commentary was partially supported by Tata Consultancy Services.

necessitating elimination of data and process silos. Many of CIMdata's customers note that software development controls the critical path in their product development process. Software development typically follows an agile dialect and gets functionally tested during the development cycle. To stay competitive, manufacturers need to reduce their dependence on physical build milestones and leverage techniques used to develop software. Incremental development methodologies such as agile can reduce product development risk and speed the incorporation of new technology and features.

Agile Development

Over the last 20 years, variants of the agile development process have become dominant in modern software development. Agile methodologies dominate commercial software development especially in cloud related applications and have made significant inroads in enterprise software development. The incremental delivery shortens the feedback loop minimizing the risk of missing changes in customer requirements. While CIMdata has noticed that industrial embedded software development still lags somewhat, this discipline is now beginning to adopt agile principles rapidly due to the well understood benefits as well as advancing electronic hardware capabilities.

The agile methodology has advanced over the past few years into overall product development within industrial companies. Management has recognized the benefits in the software world and is trying to leverage those processes and knowledge to improve hardware and physical product development. Standups, sprints, epics, and user stories are agile software development terms being adopted broadly within broader product development. An important difference between software and hardware is testing. Historically, physical testing was needed for physical products. The issue of getting to a testable physical product or even element of a product takes time as the parts to assemble the physical product need to be produced. When parts need to change, the production cycle needs to be repeated taking yet more time. Virtual analysis and testing using analysis software can occur in near-real time enabling rapid feedback, issue identification, and resolution. The inertia of the physical world makes adaption of agile processes complex and slower than with a pure software product.

Agile for Manufactured Products

As companies try to improve, they are more and more often evaluating their product development process. Growing complexity is driving companies to change, and CIMdata has observed model-based systems engineering (MBSE) as the approach being adopted to address complexity. By automating the well-defined approach of systems engineering, MBSE is enabling companies to restructure product development operations to manage complexity and reduce risk. Applying the agile concept to MBSE increases the velocity of learning within an organization reducing the risk of a product missing customer requirements. As software content grows in products and increasingly provides differentiation, it is becoming natural to structure products as building block features that are combined to meet requirements. The features and the interfaces between features are managed as functional and logical items that are realized as physical items. Within this construct features are systems and products are systems of systems.

A powerful concept in agile software development is minimum viable product (MVP). A MVP is a version of a product with just enough features to be usable by early customers who can then provide feedback for future product development.³ Getting a product with the core set of

³ <https://www.techopedia.com/definition/27809/minimum-viable-product-mvp>

features into user’s hands for evaluation enables the product developers to learn what works and what doesn’t. Requirements are then updated, feature definitions modified, and the next iteration of MVP developed and delivered.

Agile concepts were initially developed for software, but many are applicable, and adaptable to hardware development. They work very well for systems that have both hardware and software. Agile also provides the opportunity for manufacturers to add features in subsequent releases which traditionally are tied to a single product launch date.

Customer and market expectations are increasingly changing faster than the development lifecycle, causing a backlog of late changes and disrupting product launches

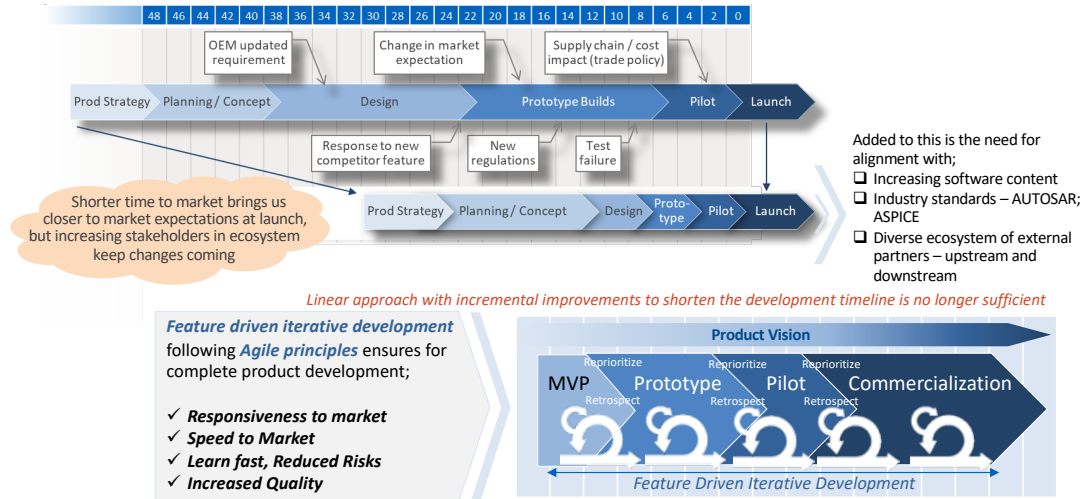


Figure 1 – The Iterative Development Process as Applied to Complex Products (Image courtesy of TCS)

TCS’ Approach

Tata Consultancy Services (TCS), a leading global IT services, consulting, and business solutions organization has been using agile for software development and MBSE for years and has been working with clients to help them adopt both practices. *“TCS has been working with global companies in the Engineering and Product Development arena. As businesses continue their quest to delight customers with innovation in their products and services, Agile Product Development provides the critical lever to balance speed to market, flexibility, adaptability, and profitability. TCS AutoAgile and IndustrialAgile are custom-tailored frameworks to significantly improve the outcomes for respective businesses.”* said Mr. Regu Ayyaswamy, Global Head, Internet of Things & Engineering Services, TCS. These products are based on some of the concepts recently published by TCS in a white paper entitled [Neural Manufacturing—The next step in the evolution of location-independent agile manufacturing](#). TCS defines Neural Manufacturing as an intensely networked set of partners aligned to a common purpose, where value chains are responsive, adaptive, and personalized, with intelligence built on the ‘edge’ of networks.

An engagement to deploy agile product development consists of three phases—assessment, model customization, and model adoption.

Assessment Phase

The assessment phase shown in Figure 2 shows the categories and dimensions used to evaluate client operations.

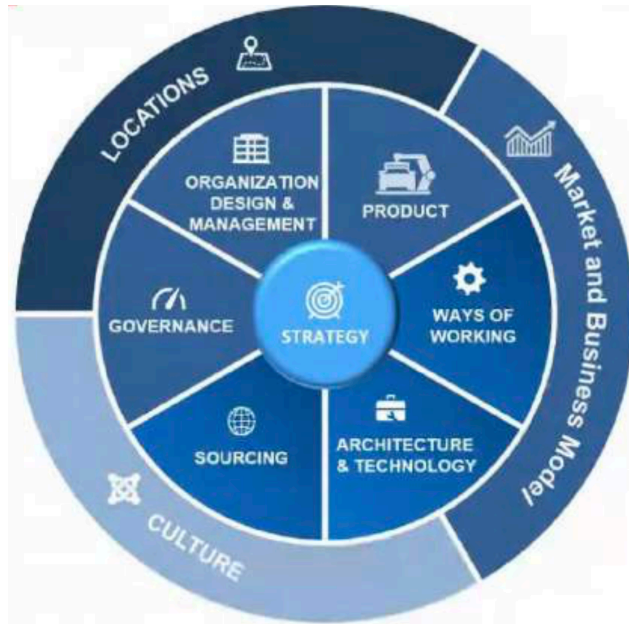


Figure 2—TCS' Assessment Dimensions for Agile Product Development
(Image courtesy of TCS)

CIMdata agrees with TCS that the successful implementation of agile product development requires more granularity than the typical people, process, and technology criteria. TCS' model has a well-defined set of dimensions and sub-dimensions that must be addressed to successfully transform. During CIMdata's discussions with TCS, they reviewed examples demonstrating the application of agility to complex physical products including the shift several automakers made from producing automobile systems to ventilators to support the response to COVID-19 and noted how they applied automation to speed assessments. A key point TCS emphasized was that culture is the dominant dimension, so ensuring a robust organizational change program to support the transformation is a critical success factor. Every organization has its own strengths and weaknesses. At one US auto OEM, TCS noted that they focused on governance and ways of working.

Model Customization Phase

Within the model customization phase, TCS uses the characterization developed from the assessment to tailor their tool framework to fit a client's needs. Tools support product decomposition into features, organizational alignment and role decomposition, and MVP feature lifecycle. In the development of these tools, TCS has studied well known industry leaders and also leveraged their own decades of experience. Decomposing physical products into features is analogous to epics and user stories in software development. CIMdata sees this as a good way to transfer understanding from software development to product development.

Model Adoption Phase

The final deployment phase is model adoption. Of course, TCS' process follows an agile approach. Capabilities are built and rolled out incrementally across an organization through piloting, expansion, and sustainment phases. Mr. Gary Bandurski, GM Executive Director of Global Electronic Components and Subsystems commented: *"GM is rolling out SAFe practices and principles throughout our product development process to improve our business agility. This approach to feature development enables our engineering teams to*

swiftly meet and exceed customer expectations.” Scalable Agile Framework (SAFe) is GM’s chosen agile dialect. Figure 3 shows the milestones of the deployment process.

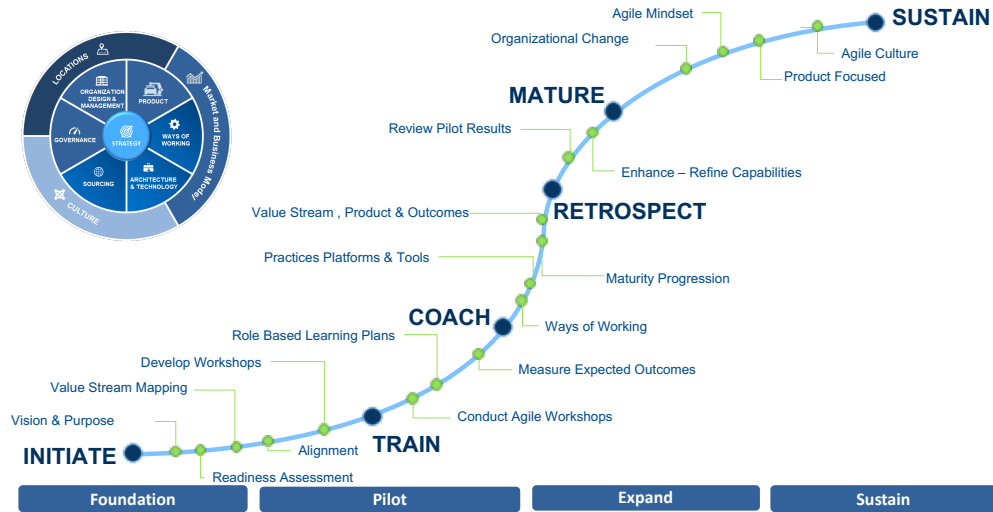


Figure 3—TCS' Deployment Approach for Agile Product Development
(Image courtesy of TCS)

Conclusion

As companies compete, they are always looking for advantages. Today, market competition shifts and advances at a never before seen pace, and traditional manufacturing focused improvement processes such as lean and Six Sigma are not sufficient to ensure success. TCS, an automotive and industrial manufacturing thought leader, is rolling out an offering to support the implementation of agile that supports full product development rather than just software development. The approach complements MBSE, a well understood product development methodology. CIMdata recognizes the value of combining these approaches and applauds TCS' initiative in bringing this offering to market. While TCS' initial launch is focused on automotive and industrial companies they note that the approach is generally independent of industry vertical and can be adapted to a wide range of industries. CIMdata recommends that companies looking to ensure their products hit their target markets effectively check out TCS' approach to agile product development.

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.