Consumer-centric Product Configuration: The Key to Competitive Advantage in a Digital World

Abstract

Today's savvy consumers demand frequent product refresh. This is posing significant challenges to OEM in terms of managing product configuration in their race to deliver the right connected products at the right time. Risks of escalating costs, increasing product complexity, failure of business cases, weakening information security, and growing regulatory compliance, further aggravate the situation.

How can manufacturers stay ahead amidst the disruption? Ensuring collaboration, adopting a customer-centric mindset, and creating sustainable business models and processes, are key to competitive success. Amidst the disruption, systems engineering continues to remain relevant and fundamental to product configuration. However, it is important to combine it with information-based management using emerging digital technologies. This requires re-contextualization and re-positioning of configuration management principles to focus on customer centricity.

The paper illustrates a pragmatic approach to reimagining product configuration from a consumer's perspective, thereby transforming configuration management from the traditional static model to a dynamic one.

Product definition has evolved over time with changes outpacing their adoption

With advancing technology and evolving customer expectations, product configuration has gone through dramatic evolution (see Figure 1). It has moved from standardized configuration to mass customization, and finally to infinite product configuration.

The journey of product evolution has had numerous milestones and will continue to remain eternally progressive. Early 1900s marked the start of the product economy with empirical design facilitating volume production of standardized products but providing very little opportunity for product variations. However, with continual development and stabilization of product and process, product customization took center-stage.
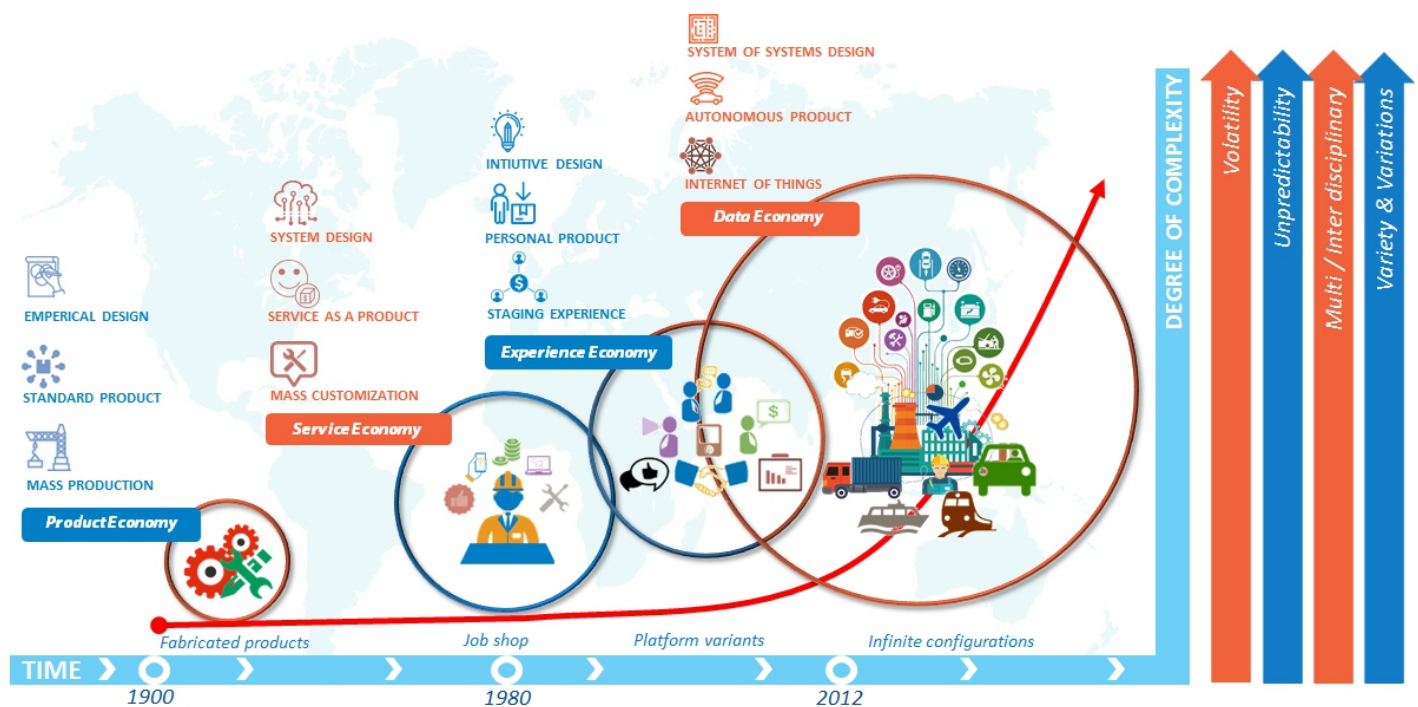
Figure 1: Evolution of product definition

Early 1960s saw the rise of service economy with increased focus on mass customization. Some of the salient features of products conceived in this phase include system design with product variations, product configurability, and real time management of supply and demand. The service-as-a-product phase was immediately superseded by the experience economy with customer experience identified as the key, and intuitively designed products and innovative business models evolved around it.

Post 2012, a typical product definition has seen infinite configurations. With global IoT market expected to reach USD

561 billion by 2022, consumers are becoming increasingly hyper-connected across multiple devices. They are looking for continuous product refreshes while aspiring to gain full control over them. As the industry gears up to transition to the fourth revolution, the data economy is ushering in an immense range of product features, enabled by emerging technologies such as IoT and advanced analytics.

Through all these transformations, product complexity has grown manifold and has reached an inflection point, making it critical for businesses to re-imagine the entire product value chain from the perspective of the consumer.

Digital Disruption is upending the classical configuration management style

Digital disruption is now challenging the traditional configuration management lifecycle and its inherent waterfall structure. Every function creates a structure around its processes, which tends to get heavy and gradually becomes outdated as it moves along the lifecycle. Classical configuration management, for instance, is highly structured comprising part information, bill of material, and other components. Such a static approach lacks modularity and fails to meet the configuration needs of complex digital products and system requirements. Its rigidity leads to time and cost pressures, and makes it unsuitable to meet consumer demands for frequent product refreshes (see Figure 2).
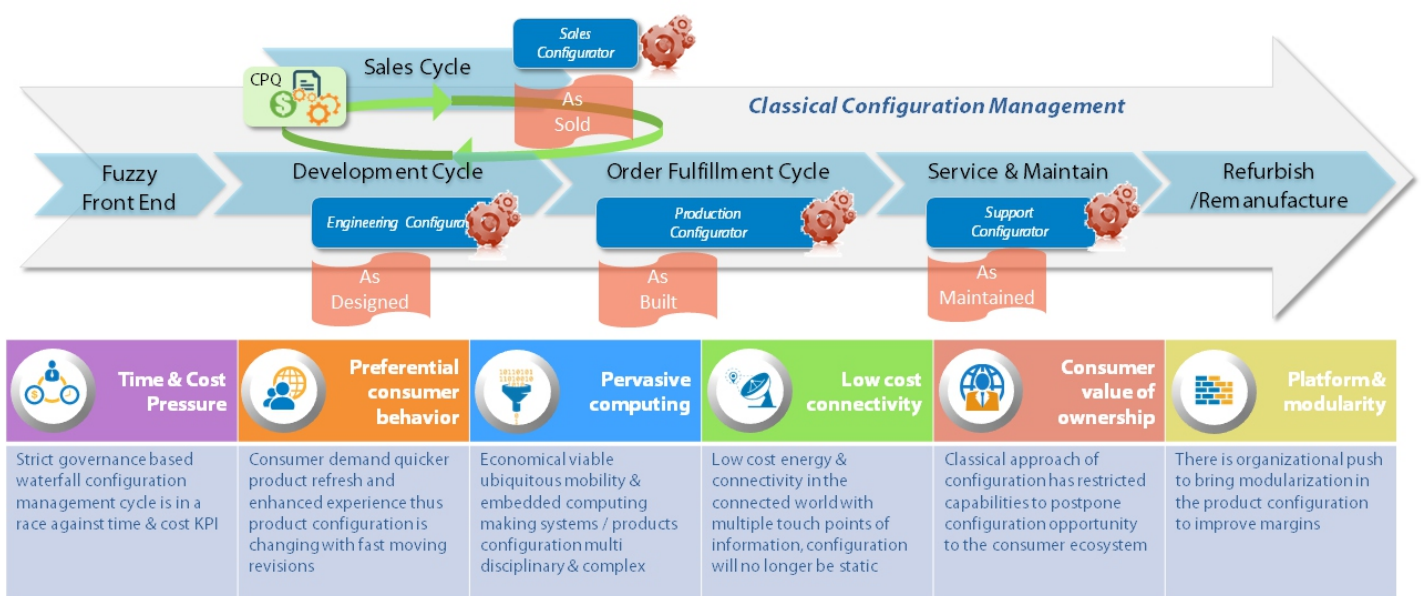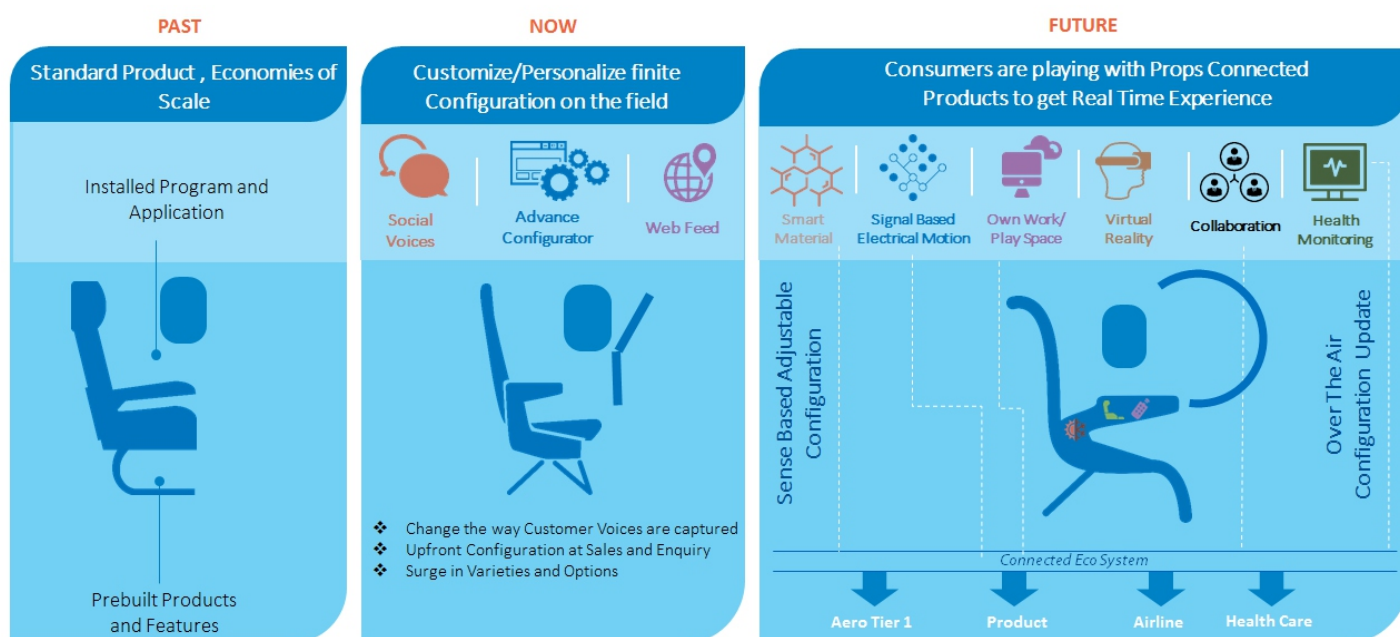

Figure 2: Roadblocks to using a classical configuration management approach in the digital age

What does this mean for businesses? Configuration management will need to be repositioned in the context of digital disruption to ensure sustained success.

Repositioning configuration management for connected, smart products and services

In the age of digital disruption, manufacturers will need to shift gears from traditional change-driven static configuration management to data-driven dynamic configuration management, ensuring near real-time responsiveness. By 2020, about 1.7 megabytes of new information will be created every second, for every human being on the planet. This means that instead of taking a structure-centric approach, product information must adopt an attribute-centric approach to incorporate rich consumer context. Given the multidisciplinary nature of digital products, such an approach will provide enormous configuration flexibility in the customer ecosystem and foster new business models that create deeper insights.
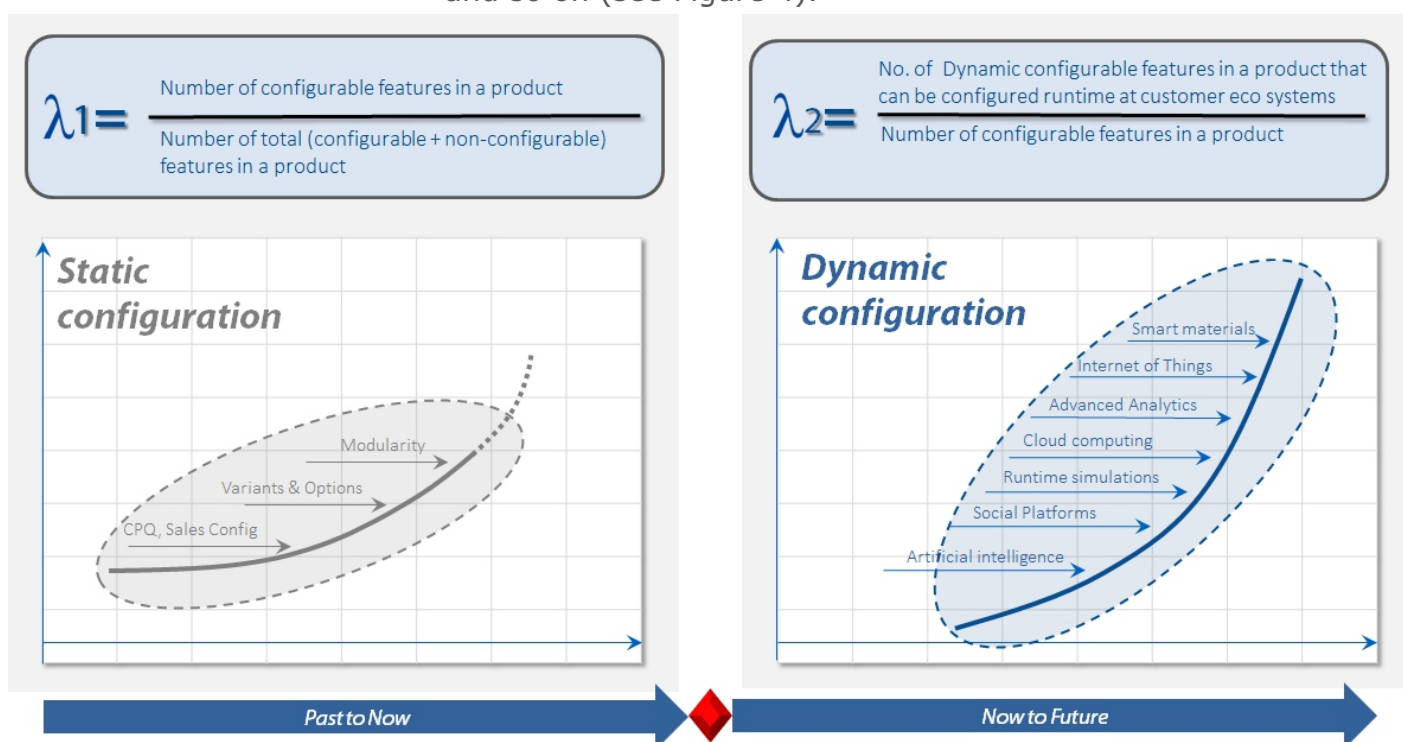
GE is an early mover in this arena. The company not only builds aero engines for sale or lease but also offers flight efficiency services on an analytics-as-a-service model by leveraging the data generated from aero engines and their surrounding ecosystem. Airbus, on the other hand, has outlined their vision for 2050 of next-gen seats in flights, leveraging advancements in smart material, AR&VR, and communication technologies (see Figure 3). The seats are designed to address the needs of connected consumers around safety, information management,

PAST	NOW	FUTURE
Standard Product , Economies of Scale	Customize/Personalize finite Configuration on the field	Consumers are playing with Props Connected Products to get Real Time Experience

Installed Program and Application

Prebuilt Products and Features

Social Voices | Advance Configurator | Web Feed

❖ Change the way Customer Voices are captured
❖ Upfront Configuration at Sales and Enquiry
❖ Surge in Varieties and Options

Smart Material | Signal Based Electrical Motion | Own Work/ Play Space | Virtual Reality | Collaboration | Health Monitoring

Sense Based Adjustable Configuration

Over The Air Configuration Update

Connected Eco System

Aero Tier 1 | Product | Airline | Health Care

Figure 3: Moving from static to connected products for superior customer experience

entertainment, and flight comfort. At the same time, they generate critical business insights for stakeholders such as aircraft producers, airlines, and healthcare and entertainment companies.

In essence, product configuration will move closer to the consumer ecosystem in the digital age as consumers demand greater control of product configurability after taking possession of the product. As a result, the focus will shift to maximizing product features that are configurable during runtime in the customer ecosystem, using embedded systems, smart materials and so on (see Figure 4).

$$\lambda_1 = \frac{\text{Number of configurable features in a product}}{\text{Number of total (configurable + non-configurable) features in a product}}$$

$$\lambda_2 = \frac{\text{No. of Dynamic configurable features in a product that can be configured runtime at customer eco systems}}{\text{Number of configurable features in a product}}$$

Static configuration

Modularity

Variants & Options

CPQ, Sales Config

Dynamic configuration

Smart materials

Internet of Things

Advanced Analytics

Cloud computing

Runtime simulations

Social Platforms

Artificial intelligence

Past to Now

Now to Future

Figure 4: Shift to maximizing configuration management in the customer ecosystem

However, it is important to note that the extent of configurations in the consumer ecosystem will depend on regulatory and compliance requirements.

Embracing the new paradigm: four key levers

Given the complexity of digital products, their definition and requirements should be mapped top-down and validated bottom-up for conformity, using a V-model (see Figure 5).

The following four key levers are critical to achieving this V-model and embracing customer-centric dynamic configuration:

1. Model-based thinking: Helps simplify the complexity of a multi-disciplinary product and its system of systems by

representing the set of connected systems and their structure, behavior, and requirements in a model-based eco system, using digital models.

2. Agile methodology: Enhances effectiveness of product development by increasing responsiveness and ability to accommodate multiple refreshes in the product to meet changing customer demands.

3. Knowledge management infrastructure: Secures the pipeline of data and builds the configuration thread, which manages the bill of information across the lifecycle of the product in conjunction with the digital twin.

4. Analytics and insights: Converts the abundant data available across the digital thread into meaningful information that provides insights for smart run time updates in product configuration.
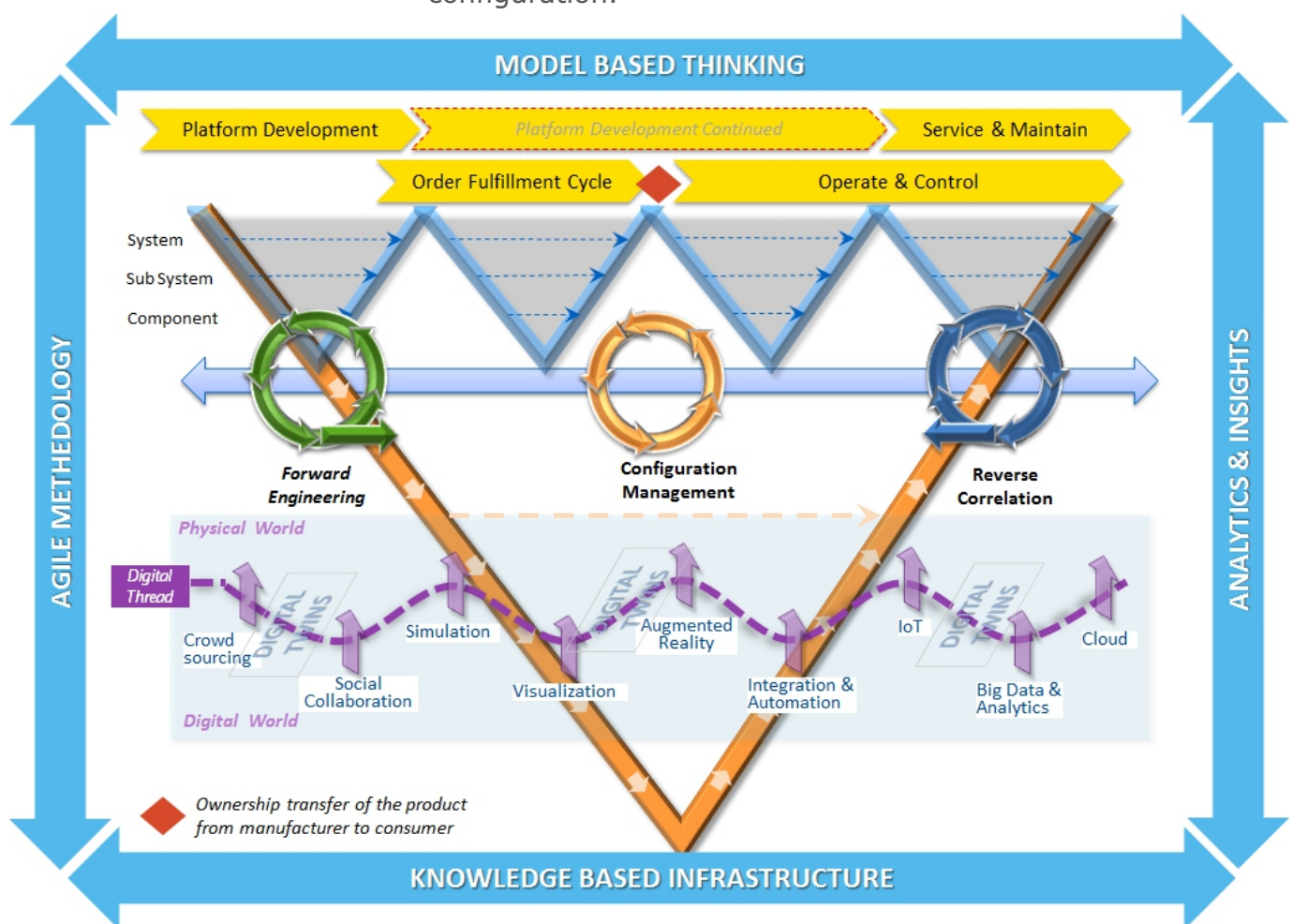
Figure 5: The V-model of product configuration

The levers enable the transformation of multiple Vs of systems engineering across the value chain into a single 'V'. The single 'V' represents the end-consumer ecosystem that comprises infrastructure, environment, and product-to-product consumer behavior, supported by the data backbone of the digital thread, enabled by forward engineering and reverse correlation capabilities. Emerging technologies provide the flexibility required to achieve this.

At the same time, emerging business architecture allows enterprises to expand the boundary of their core system with end-to-end management of data pipeline, creating a connected enterprise. Ensuring data coherence and building a dynamic configuration thread to manage the bill of information across the product lifecycle in conjunction with digital twin, is the first step towards customer-centric configuration management.

Dynamic configuration management drives competitive differentiation

Dynamic configuration management propelled by data is fundamental to postponing configuration to the customer ecosystem - a key competitive differentiator in the digital age. In achieving this transformation, organizations need to mitigate digital waste and cyber threats through robust data governance, and build a culture of innovation by demonstrating credibility of technology and systems. In addition, it is important to identify relevant data specific to consumer context and integrate configuration rules with a knowledge management framework that can be leveraged by product teams for continuous innovation. The key to success of product configuration lies in the ability of organizations to develop well-defined business models aligned with their goals and transition trajectory.

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