Building Futuristic Smarter Products: Towards a Framework for Innovation-centered Product Management

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Abstract

To a certain extent, software product management has, in the past, been driven by market analysis fed in from the product marketing team, and requirements elicited from customers. Today, product management for futuristic smarter products, being designed on the foundation of artificial intelligence, automation, connected things and pervasive computing, calls for an approach focused on technology and innovation. At this juncture we may need to think of tools and processes for software product managers, that are re-pivoted on technology and enable development of new generation smarter products. In this paper we propose a set of tools and processes that can help adapt or augment current product management processes, giving primacy to technological innovation. The proposals are based on observation of the characteristics and evolution of several 'smart' products, some of which are mentioned here for illustration, as well as a small survey of best practices being followed in different organizations.

Keywords: smarter products, opportunity matrix, product transformation charter, organizational structures

Introduction

Software product managers usually maintain a detailed analysis of the market landscape in the form of a Market Requirements Document (MRD). These inputs are translated into a list of desirable features in a Product Requirements Document (PRD), which also leads to a product roadmap updated at regular intervals. Traditionally, product requirements are driven by customer use cases and are technology-agnostic; the product development team is at liberty to choose an appropriate technical approach for the implementation of a requirement. The requirements themselves are usually prioritized and selected, based on the business case including potential revenue impact.

That process does not necessarily change for product management of smarter new generation products, but may have to be complemented by a concurrent process of ideation and innovation. Herein, a product manager may not be content to start from requirements and hand-off their implementation to the developers, but occasionally start

from a given disruptive technology (like artificial intelligence, or blockchain) and inquire what opportunity it offers to transform a product or portfolio. Sometimes organizations simply count on a talented engineering team to generate random sparks of bright ideas. It is more desirable that product management designs an enabling process that encourages a steady pace of in- novation and sustainable competitive advantage in the face of disruptive technologies. Since product managers often lead with limited authority, organizational culture and structures could play a role in the overall success of such initiatives.

In this paper, we first take note of a few salient characteristics of smarter new generation software products. Then, we present a set of tools, artifacts and best practices that can enable product managers to infuse advanced and disruptive technologies into their products in a way that befits the product and the overall business. We believe that these tools, artifacts and best practices can gradually mould into a product management framework for building new generation smarter products, with a conscious effort to embrace disruption. We also allude to certain aspects of organizational behavior that would be congenial for these product management efforts to yield enduring results.

Smarter Products

Michael Porter and John Heppelmann (2014) defines 'smart connected products' in the manufacturing domain and how they are transforming competition, as follows: "Once com- posed solely of mechanical and electrical parts, products have become complex systems that combine hardware, sensors, data storage, microprocessors, software, and connectivity in myriad ways". We will focus on smart software products (that includes software embedded in physical systems like cars and medical devices).

As product managers, when we ideate on building a smarter product, which could be a 1.0 product, or a new, overhauled version of an existing product, we can't depend only on the MRD and a spreadsheet of customer requirements. While those inputs are valuable and may be factored into the final product anyways, a smarter product is born out of imagination and inspiration that has to spring up from within the organization. There obviously can't be a method for reimagining a product, but there are at least a few elements of smartness that can offer a few clues for the product management team. Product managers should drive a discussion with various stakeholders, pivoting on some of these smart traits, so that a pool of ideas emerge. When driving the discussion, product managers may allude to a generic problem that each of these elements are good at solving, and the value of solving such a problem for the end customer. The stakeholder teams may be able to take a cue from this and think of a specific feature that is unique, innovative and adds smartness to the product.

Some elements of smartness, generic problems they solve, and the kind of value they bring to the end customer, are listed below. They may not be exhaustive, but cover most of the

smart traits we find in software products today. For any given product, many, if not most, of these smart traits may be relevant.

Intelligence: A software should be able to make intelligent decisions. This may often boil down to identifying where AI algorithms can be effective, but there are other manifestations of intelligence like self-adaptivity. AI algorithms typically fit well where there is scope for recognizing some pattern like human beings do, or even better. A really simple example would be utilities to monitor CPU, memory and I/O usage of a server that have existed for over two decades. If we were to re-implement from scratch today, we would obviously think of adding in-built anomaly detection. Using adaptive bit rates in video-conferencing is another instance of intelligence. Intelligence reduces the need for human oversight and intervention, and could potentially bring home an awe-inspiring user experience.

Automation: Automation is now taken for granted - software products differentiate on how far they stretch the limits of automation. Tax filing software can read, verify and fill up data from invoices, reconcile with bank account statements and even transfer tax amount into a wallet using banking APIs. Customer support chat-bots can auto-generate service requests and even ring up a support engineer. Automation enables reliable streamlined business workflows, efficient customer support and so on.

Connectivity: The network effect of connected devices and applications far outweighs the value of point applications themselves. Supply chain, for example has been revolutionized by the application integration wave of the past two decades and IoT over the last few years. For product management, the value of network connectivity lies not just in connecting software, but business processes and people, seamlessly at planet scale, and integrating IT with OT (operational technology).

Data Insights: Applications and devices not only consume data, but generate new data themselves, leading to a data flywheel pattern. A data discovery exercise can reveal how much of this data is being analyzed and presented, and what opportunities exist to build more data-driven innovative features, integrating internal and external data sources, including physical devices. Networked applications and unprecedented processing power enables fast (often real-time) and insightful analysis and visualization.

Smart User Experience: User experience is often the key differentiator in consumer- facing applications, like ecommerce, education and entertainment. Seamless user experience across devices with powerful personalization techniques at the backend, is an imperative. Re- cent and emerging technologies like conversational agents and Augmented Reality / Virtual Reality are showing tremendous promise.

Smarter Security: Security is among the most intensely researched areas of computing rand the kind of innovation we have seen in device, application, network and data security over the past few years, is unprecedented. There is opportunity to

design significantly more robust end-to-end security complying with the latest standards and regulations. Biometrics, encryption, multi-factor authentication and fraud analytics have matured into far less breachable techniques. Blockchain may be effective in extending the security ring all the way to physical assets (even vaccines supplied to health centers).

Device Scale Factor: Today, there is scope for innovation simply by rethinking the form factors at which software is deployed. Health monitoring and personal wellness applications are usually distributed across server-side components, mobile apps and even wearables. Machine learning platforms, suitably modified, can run on mobile phones and embedded chips, opening up new opportunities for innovation (like Intel Habana). Similarly IoT-based applications are distributed across edge devices and the cloud.

Convergence: We often come across converged infrastructure (like compute, storage and network). But convergence is a smart trait that can manifest in many different ways. Even a software message bus that traditionally supported business-to-business message passing functionality, may be converged with MQTT support needed for IoT applications. Con- vergence leads to an extension of the platform and support for an extended set of related use cases. Even a software platform like Android converges functionality for camera, email, video player, biometrics, sensors, gaming console, and so on.

XaaS: Product managers need to think of ways in which on-premise software can be offered partially, or fully as a remote service. An intriguing case in point is cloud telephony (contrasted with a Private Branch Exchange). Such transformations of a product offer not only innovative choices to the customer, but also new revenue models for the business.

Smart Architecture: Product management may not be too concerned about architecture, but certain elements of architecture may influence the overall success of the product. Firstly, interconnected and integrated system of systems should have a contemporary flexible component-based architecture that allows rapid and nimble development. Services offered by off-the-shelf underlying platforms that the product relies upon, determine how fast innovative features can be delivered. Extensibility of the platform (for example, through APIs) encourages innovation from ecosystem players.

This is a good set of 'smart traits' that product managers should try to inculcate into software products or portfolios. Obviously a few of them may not be relevant for a particular product, but most would. And there may be a few other smart traits or technology drivers (like quantum computing) that we need to watch out for, over time. This list should be fairly thorough but may not be exhaustive.

Opportunity Matrix and Product Transformation Charter

Once the relevant set of smart traits is identified, it is recommended that an opportunity matrix like the one shown in Table 1, is created for the product management team. This captures some of the opportunities for disruptive innovation in a given product or portfolio, at a high level. The table below is skeletal and for illustrative purposes only. While all the smart traits above are included, there could be many more items in the 'Technology Drivers' and 'Potential Innovation' columns. Optionally, a fourth column with a few examples (like adaptive bit rate in the first row) can be added. This matrix would be the starting point for product management to tee off a conversation with R&D and other stakeholders around technology-infused transformation of the product or portfolio.

Table 1: Illustrative Example of An Opportunity Matrix

Smart Trait	**Technology Drivers**	**Potential Innovation**
Intelligence	AI	Reduced human supervision Advanced User Interaction
Automation	Infrastructure Automation Robotic Process Automation	Streamlined business workflows Super-responsive customer support
Connectivity	IoT Ubiquitous WiFi, 5G	IT ◄► OT Integration
Data Insights	Scalable Big Data Analytics in batch mode and real-time	Ingenious insights and data visualization
Smart User Experience	Conversational AI, NLP, AR / VR	Personalized and seamless user experience across devices
Smarter Security	Advanced biometrics, fraud analytics, blockchain	End-to-end security across software and even physical assets
Device Scale Factor	Edge computing, System-on-chip, wearables	Deliver functionality through mobile and embedded applications
Convergence	Converged Infrastructure, hyper-converged platforms	Extended platform with support for extended set of related use cases
XaaS	Cloud Computing	Flexible subscription models with minimal upfront investment
Smart Architecture	Microservices, Containerization, APIs	Nimble product development, nurturing developer ecosystem

An opportunity matrix is pivoted on the technology dimension. Instead of mapping a requirement to technical approach, we ask, given a technology, what opportunity does it bring to transform a product.

Product Transformation Charter: Crawford and De Beneditto (2015) recommend creation of a Product Innovation Charter (PIC) for new products. "The PIC is a document prepared by senior management designed to provide guidance to the business units on the role of innovation". We retain the core idea of a PIC but would like to generalize it for developing brand new products as well as revamping existing products by infusion of disruptive technologies. Accordingly, we propose that product managers create a Product Transformation Charter, in which the opportunity matrix should be a quintessential artifact.

We posit that Product Transformation Charter (PTC) is essential for infusing advanced technology into a product *in order to induce disruptive innovation (without being limited to requirements elicited from customers and inputs from product marketing).* Since the world of technology is witnessing an unprecedented wave of disruption through AI, Robotics, IoT, AR / VR, and so on, a software product that does not proactively embrace advancement, will contrast poorly against those which do, even if a regular stream of customer requirements are factored into the release train. The contrast would be like how a Hollywood sci-fi or action movie of 1990s would tell apart easily from one made in 2021, in terms of special effects, photography, sound and so on. It would be imperative for both mind-share and market- share, that product management (along with other stakeholders) considers not only customer feature requests, but also how each disruptive technology is relevant to the product they are working on. That is where the Product Transformation Charter comes in, as depicted in Figure 1.

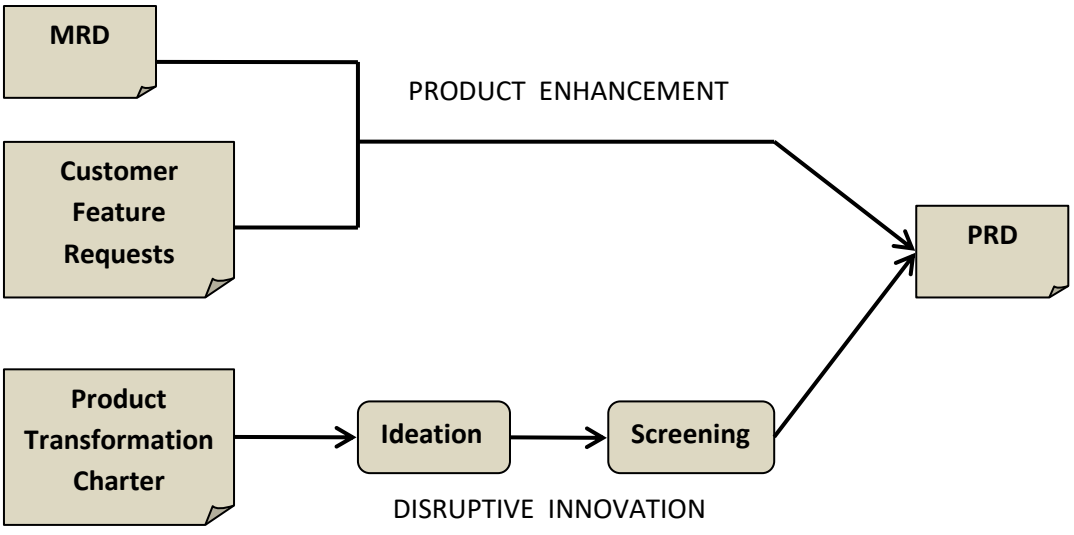

Figure 1: Product Transformation

MRD vs PTC: Traditionally, an MRD focuses on customer segmentation and targeting, competition, outbound marketing and pricing strategy, market expansion and the like, that are rooted on the current landscape (Lehman and Winer, 2005). This analysis is extremely important and the authoring team has a lot on its plate already. MRDs alludes to technology drivers, but usually in relation to customer and competitive analysis as it stands now. A PTC sets sight on the future, and is aimed towards driving innovation ahead of customer demand and competitive pressures. For example, an MRD could refer to competition using RFID-enabled assets moving across a supply chain whereas, a PTC could flag an opportunity to use blockchain for tamper-proof asset identification. Amalgamating the two could give rise to a muddled artifact and is generally not desirable.

Transformation Charter to Product Features

The 'Potential Innovation' column in the opportunity matrix should be broad-based and reflect expectations of product management on the transformative power of each smart trait, without restricting R&D from thinking beyond and proposing other innovative capabilities.

The discussion between product management and R&D should be aimed at evolving a set of more tangible and specific product features on the theme of each smart trait. We are reminded of the film Jurassic World (2015) where it is felt that "*no one's impressed by a dinosaur anymore.. These days, kids look at a Stegosaurus like an elephant from the city zoo.. Consumers want them bigger. Louder. More teeth*". In response scientists apply advances in gene splicing to 'design' (and not breed) a species called 'Indominus' that would be fifty feet when fully grown.

Design Thinking and Product Workshops: For starters, product management should continue to organize product workshops with different stakeholders (probably an offsite for a week). But here, requirements are meant to evolve rather than being handed on a platter, through brainstorming. Design Thinking tools may be explored if appropriate.

Digital Transformation: Often clues for offbeat innovation lies in appreciating the digital transformation roadmap of key customers or sectors the product caters to. For a core banking platform it would be worth listening to financial institutions and how they plan to adopt fintech. For manufacturing resource planning (MRP), Industry 4.0 initiatives of major customers would be relevant. Participation in industry forums and consortia could help in evolving product strategy.

Process Map: Kotler (2001) talks about a 'Customer Activity Cycle' (kind of Process Map) to analyze how a customer is using a product today, and how different steps in the process can be improved and optimized in future. This also applies to futuristic innovation. Capt. Nikunj Parashar and his team at Sagar Defence developed an unmanned boat called 'Waste Shark' for cleaning waste from rivers, shielding workers from health hazards. Earlier it had to be remote-controlled manually from the shore, but an improved version

uses Computer Vision (object detection algorithms, illustrated in Figure 2 and Figure 3 below) to learn and identify waste on its own.

Figure 2: Illustration of Object Detection Algorithm at work - original image

Figure 3: After running object detection program (a technique used in unmanned cleaning of rivers)

Co-innovation: Sometimes an idea needs validation from domain experts. Customers can complement the technical knowledge of the product team with practical insights, without which the requirements could turn out to be amorphous. In agritech, applications based on usage of sensors and monitoring are being built. But whether the information presented can make a real difference to experienced farmers is moot. There is scope for involving experienced farmers and figuring out which use cases to focus on, when applying technologies like IoT and AI.

Sandbox Environment: For some of the more complex proposed features, and those depending on very recent advanced technologies, a prototyping effort may be needed even to have more clarity on the requirements themselves. Opportunity may be taken to interact and iterate with potential users by creating a sandbox for internal and select external users to play with initial prototypes. Facebook iSandBox allows users to try out various use cases related to Augmented Reality.

Business Drivers

Once product management and other stakeholders have translated a Product Transformation Charter into a more specific set of candidate requirements, it is necessary to prioritize the requirements and see where they fit in the product roadmap. But futuristic innovation is a function of strategic intent. David A. Aker (2008) defines strategic intent (echoing Hamel and Prahalad) as "strategic vision coupled with sustained obsession with winning at all levels of the organization". These requirements are a bit different in that they are hard to quantify in terms of a business case, sales forecast and internal rate of return. Nevertheless a few principles may be applied, in bottom-up manner, to help screen them.

Kano Model and Perceptual Map: A few existing tools for evaluating product features can be effective even in the context of futuristic requirements. We can place each of the requirements under a given theme (say 'Intelligence'), on a Kano Model, as in Figure 4, and get an idea of customer expectations around them. Performance features that are not already in place should be high priority (like voice search below), while the delighters should be taken up next. The perceptual map can be used on a couple of important themes (say 'Intelligence' and 'Connectivity') to understand which areas need attention, in relation to competitors, as in Figure 5.

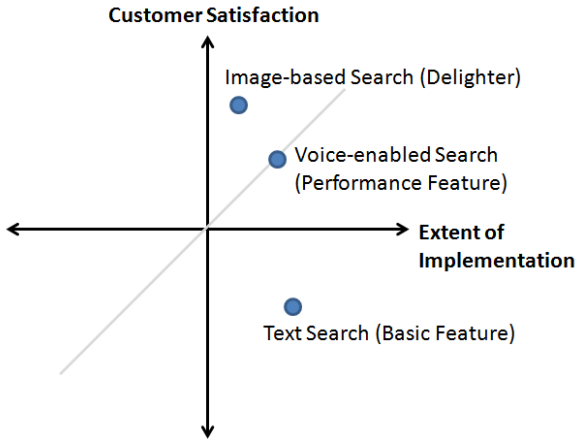

Figure 4: Example of Kano Model applied to search functionality in software applications

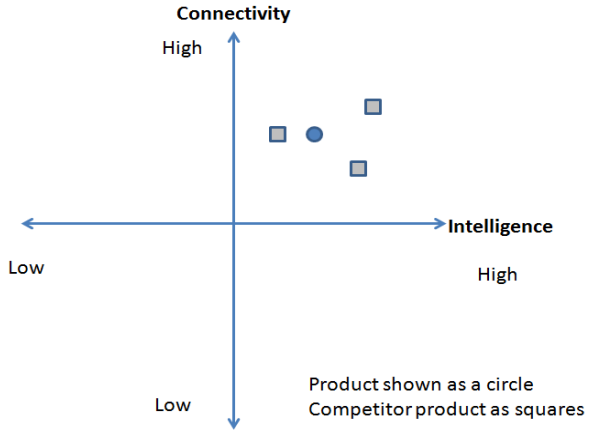

Figure 5: Illustrative Example of Perceptual Map involving 'smart' traits

Market Expansion: We can place some of the proposed features on the market growth matrix (also known as Ansoff matrix, illustrated in Figure 6), and assess, how they can positively influence the underlying quadrant. This assessment can be conjoined with the priorities of the executive leadership, in terms of which quadrants they are focusing on, and accordingly, a proper importance or weightage deduced for those features.

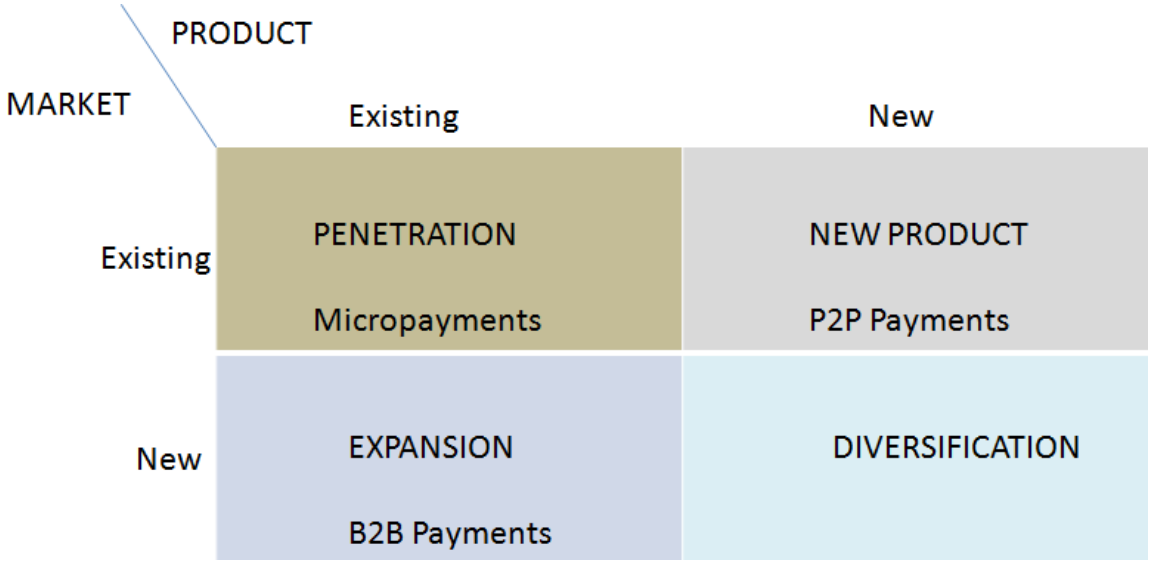

Figure 6 Figure 6: Illustrative Example of Ansoff Matrix applied to a hypothetical Payment Gateway platform

Leadership and Vision: But more than any other criterion, the organization's ability to be in a leadership position and its vision for the future, should determine which proposed features are prioritized and selected. Product Management should create a roadmap based on some of the broad smart traits mentioned earlier, and some of the key features under consideration from each. This roadmap should be first discussed internally up to the CXO level. Then it may be refined and bounced off key clients and partners under non-disclosure agreement and with safe harbor statement. Product management should assess how up- beat internal and external stakeholders are on the firm's leadership and vision, vis-à-vis competitors, and may consider their inputs to revise the roadmap.

Organizational Structures

Innovation succeeds in organizations with intrapreneurial mindset and a certain tolerance for taking risks even if it means making a few mistakes. In addition, a few organizational structures may play a positive role in this endeavor.

CTO office: Not all software development organizations have a separate research wing, and even if they have, they may operate as a unit totally independent of product development. Instead, in many pure software product vendors, a CTO office with dedicated resources to research on futuristic technologies is being set up, aiming for breakthrough product innovation. Product Management must set up a dotted line relationship with the CTO office and provide inputs and own the results that can potentially be plugged into the product.

Technical Product Manager: A well defined technical product manager role can help in refinement and attention to detail in implementation of futuristic requirements. While senior product managers define a high level Product Transformation Charter, a technical product manager can zoom in on each requirement in depth, and liaise with

development team on a frequent basis. Product management leadership may talk about an advanced recommendation engine for an ecommerce platform. A technical product manager can delve into recent techniques like active learning, which combines machine-driven decisions along with inputs of humans-in-the-loop, to take this feature to the next level.

Parallel Release Trains: Futuristic smart features may have to be implemented on a parallel release cycle without risking the stability of the existing product, until they reach a phase of development, when they can be merged into the core product. This means not only two different release cycles, for a certain duration, like in Figure 7, but also two teams (and possibly even smaller development units) carved out in a way that both release cycles have able leadership, engineering talent and project management skills.

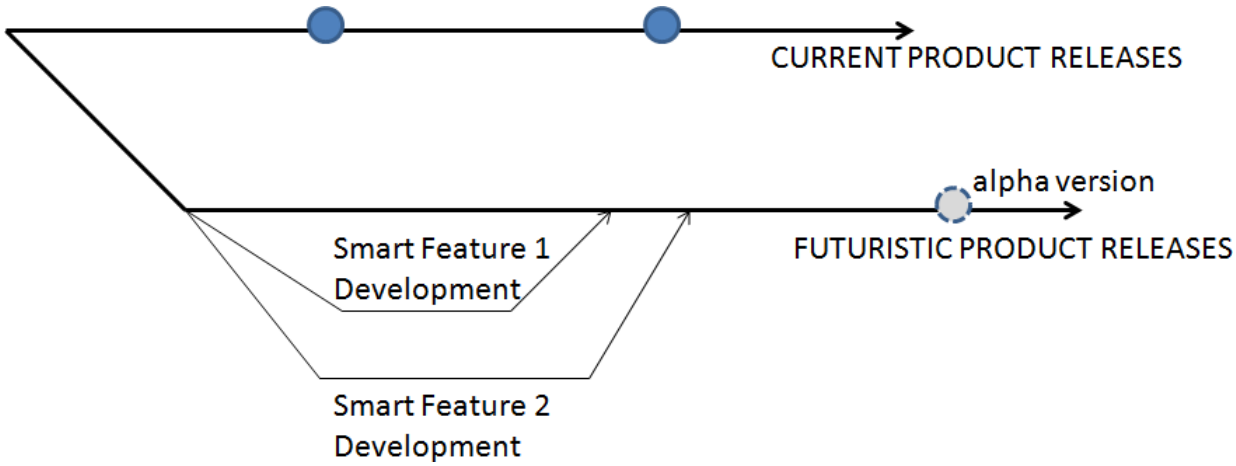

Figure 7: Concurrent Product Releases

Intrapreneural Independence: Sometimes it may be worth setting up a semi-autonomous sub-organization to own and build out some of the breakthrough features, end-to-end. Or, equivalently, challenge intrapreneurs to come up with solutions to hard problems. SAP Labs has an in-house accelerator program that allows employees to work in a group like a small start-up operating within.

Risks and Caveats

Product Management has to mitigate certain unique risks that come with futuristic innovation.

Protecting Existing Customer Base: Not only a road-map for the product, but also a roadmap for customer adoption of new capabilities, is needed. Efforts have to be balanced between the existing product and the envisaged product. Assumptions on customer readiness to try out new technologies (like 5G, or AR / VR) have to be reasonable. At the same time there has to be openness to cannibalize existing products over a certain timeframe when appropriate.

R&D Budget: On one hand, if R&D spend is not increased, a firm will risk being out-competed in the era of disruptive technologies. On the other hand, questions will be raised on the viability of some of the initiatives, especially from the CFO organization, since it may be difficult to express some of the strategic intent in numbers. Product Management may need supporting executive directives to make progress.

IPR Protection: The smartest possible way has to figured out for IPR protection, considering some of the uncertainties around futuristic capabilities, and the pace of disruption. For example, provisional applications allowed by the USPTO and similar facilities available in other countries can be explored.

Ethics and Compliance: We can never underestimate the question whether a smart feature should be implemented even if it can be implemented. The question will not only be about compliance (like, whether there is a data privacy concern, or whether a technology like social media can be misused), but also about ethics (like concerns about educational technologies leaving out a section of society). Proactive discussion between product management and internal and even external experts on law, ethics, and compliance is highly recommended.

Conclusion

There is no formula for thinking and innovation, but product managers can't wait for new ideas to come up in the age of brisk technological disruption. They have to lead the discussion with stakeholders and re-imagine a futuristic product that is appropriately infused with next generation technologies. In this paper, we explained how a Product Transformation Charter can be the central artifact around which smart features can be envisioned and their business impact can be assessed. These are broad guidelines, based on which each organization can create an enabling process for ideation and innovation, suited to its organizational structures and culture. Finally, although beyond the scope of this paper, technological disruption should not be seen in isolation, but in conjunction with economic and environmental disruption.

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