Product Spark: Igniting Innovation in the Digital Age

RICHARD ABIOLA OGUNSOLA

Abstract- The fast digitalization of products and services has, over the years, transformed the business model, customer relationships, and innovation processes across industries globally. Advances in artificial intelligence (AI), the Internet of Things (IoT), and information and communication technologies (ICT) have all led to Smart Products and digitally enabled services that are constantly transforming the nature of value creation, delivery, and capture. However, most companies still struggle to transform their digital potential into sustainable product innovation, despite these opportunities. This gap between technological capability and innovation output is one of the key issues product leaders and digital strategists face today. Hence, this paper presents the concept of Product Spark, a strategic trigger mechanism, which sparks innovation in digitally transformed settings. Drawing from literature on Smart Products, digital transformation, resistance to innovation, and automation of services, this study develops a conceptual framework to examine how digital readiness, strategic intent, human creativity, and market sensitivity combine to generate breakthrough innovation.

Index Terms- Product Spark, Smart Products, Digital Transformation, Resistance to Innovation, IoT, Service Automation, Digital Readiness

I.   INTRODUCTION

The growth of information and communication technology (ICT) and artificial intelligence (AI) has made the digitalization of products and services faster than ever before, transforming industries and redefining interactions between society (Huang and Rust, 2018; Rust and Huang, 2014; Shim et al., 2019). I the age of the Internet of Things (IoT), Smart Products, including sensors, software, and connectivity functionalities, are becoming more interactive with users, environments, and other systems in real time (Ng & Wakenshaw, 2017; Novak and Hoffman, 2018). These developments have bridged the gap between physical products and digital services, and introduced new forms of competition that reward those capable of continuous, systemic innovation.

According to Rijsdijk et al. (2007), Smart Products are devices embedded with information technology, i.e., microchips, software, and sensors that can gather, process, and generate data that complements their essential functionality. Furthermore, Schweitzer et al. (2019) note that their integration with AI has allowed them to provide personalized services and adjustable features that fundamentally change the dynamic between consumers and the objects they engage with daily. Simultaneously, AI-driven service automation, such as robo-advisors in financial services, shows the growing interdependence between digital products and digital services, where the boundary between product and service is increasingly difficult to draw (Marinova et al., 2017). However, despite these developments in technology, digital transformation is not a sure way to innovation success. Companies often implement a high level of technologies, invest vast sums of money in digital infrastructure, and amass large amounts of data, but cannot turn them into products and market competitive advantages. This disjuncture between digital capability and innovation output indicates the need for a critical ignition mechanism-a situation or combination of circumstances that alters slumbering digital potential into vigorous innovation output. In this paper, the conceptualization of this mechanism is Product Spark. This paper aims to develop a conceptual framework of how Product Spark emerges and how firms can systematically create the conditions for its ignition in digital-age environments.

II.   LITERATURE REVIEW

2.1 Product Digitalization: The Smart Product.
The Smart Product has become a focal point of the research on digital innovation. The emergence of IoT has significantly increased the product connectivity, which allows rich interaction among devices, systems, and users in contexts that were previously inaccessible to digital mediation (Shim et al., 2019). Smart Products combine the IT features such as

sensing, processing, communication, and storage that enhance intelligence, self-governing activity, and interactivity, developing products with the ability to respond flexibly to the behavior of the user and the environmental context (Rijsdijk et al., 2007).

However, with the spread of Smart Products in academic and commercial settings, studies have not been conceptually clear on what a Smart Product really is, which has led to fragmented and inconsistent definitions across disciplines, impeding cumulative theoretical development (Raff, 2019). Nonetheless, interdisciplinary research considers Smart Products from an innovation management perspective, information systems, and marketing; however, these and other perspectives have rarely been integrated into a single framework (Astley, 1985; vom Brocke et al., 2009). This conceptual fragmentation is not merely a scholarly inconvenience but also limits organizations' ability to develop strategies for Smart Product innovation and confuses comparative learning across industries. Thus, there is a need for an integrative framework that bridge digital technology and innovation outcomes, which is both theoretical and practical.

2.2 Services Automation and AI Digitalization.
In line with the revolution of physical products, service industries have undergone profound automation and the deployment of AI. Financial services Robo-advisors are a type of AI-based self-service technology that provides personalized investment advice with minimal human effort (Marinova et al., 2017). Such systems are representative of a larger change where AI replaces judgment-based work that used to be done by trained human professionals. Though automation is efficient and more accessible, it also negatively affects social norms and relationships of the service interactions, which companies should navigate with caution, not to lose the trust that underpins the customer relationships (Schweitzer et al., 2019).

The innovation resistance theory provides a pessimistic response to the optimistic accounts of digital adoption. It implies that consumers can actively or passively oppose new technologies because of their perceived risks, inertia, or because the new technology disrupts the cherished relational norms (Talke and Heidenreich, 2014). Relational quality and interpersonal trust are still influential predictors of adoption and continuity in service situations despite the clear-cut demonstration of better automated alternatives (Rijsdijk and Hultink, 2009). The implication of this insight is significant to the strategy of digital innovation: technological competence is not enough to create adoption and continued usage. Digital innovation has to consider not only technical feasibility, but also behavioral, psychological, and relational dynamics, which determine how users can actually interact with new technologies in their everyday lives.

2.3 The Missing Link: From Digital Capability to Innovation
While literature on digital transformation offers a detailed description of organizational restructuring and technological integration, and the research on consumer behavior elucidates how people react to Smart Products and automated services, there is a considerable gap in our knowledge about how companies systematically transform digital preparedness into innovative product results (Reinartz et al., 2019). Studies on digital transformation is more likely to tell us what changes when firms go digital; it is not as informative as to what organizational and leadership conditions precondition the changes to generate real innovation or simply reconfigure operations.

This gap is consequential. Most organizations that have already undertaken initial digital transformation initiatives, such as modernizing infrastructure, shifting to cloud platforms, and data accumulation, are unable to turn that base into breakthrough product innovation that creates a sustainable competitive advantage. The ignition process that transforms digital capability into innovation output is, in the literature available, under-theorized significantly. This gap is the driving force behind the conceptual contribution of this paper: the Product Spark framework, which aims to explore the circumstances under which digital capability becomes an innovation reality.

III. THE PRODUCT SPARK FRAMEWORK

Product Spark is the crossroads of organizational and technological circumstances that trigger breakthrough product innovation in digitally transformed companies. It is an active condition that arises when four mutually reinforcing dimensions are strong and coherent enough. The framework recognizes the following dimensions as the key building blocks of the innovation ignition process: Digital Readiness, Strategic Intent, Human Creativity and Multidisciplinary Integration, and Market Sensitivity and Relationship Awareness. All the dimensions are required but not sufficient on their own; it is their combination and interplay that creates the spark.

3.1 Digital Readiness

Digital readiness is a measure of the quality and richness of the technological infrastructure, data capacity, and AI integration of a firm. Embedded IT capabilities, including sensing, connectivity, processing, and data generation, are the core of Smart Products, without which the potential of innovation will remain inactive (Rijsdijk et al., 2007; Shim et al., 2019). The infrastructure is not the rightmetric, but rather the ability of the firm to use the infrastructure to generate insights, rapid prototyping, and responsive product development. A highly digitally prepared firm has not only the equipment of the digital era but also the organizational acquaintance, information literacy, and technical combination to utilize the equipment with intentionality in the service of innovation objectives.

Digital readiness is, thus, a threshold variable and a variable. Organizations with connectivity, data capacity, and AI integration below a certain minimum are not able to reliably produce Product Spark; their digital potential is structurally limited. However, the difference between highly innovative companies lies not in the size of their technological holdings but in the quality of their integration, the extent to which digital infrastructure is integrated into strategy, decision-making, and cross-functional processes in a way that enhances and not burdens human creativity and purpose.

3.2 Strategic Intent

Strategic intent describes how the leadership is oriented towards innovation, how clear the digital vision of the firm is, and how consistent its dedication to transforming digital investment into innovation outcomes is. Organized and collective knowledge in an organization has a significant positive impact on the cumulative knowledge building and the ability to implement it in practice, as it has been shown in earlier conceptual frameworks (Astley, 1985; Liu et al., 2011). Without a strategic intent that clearly connects digital capabilities to innovation objectives, even well-known organizations are likely to squander their digital potential on unrelated efforts that produce small gains in isolation but do not result in breakthrough innovation when combined.

Strategic intent has a directional role in the Product Spark framework. It directs the digital preparedness to particular innovation prospects, makes the choice of resource allocation decisions, strengthening instead of disintegrating the innovation priorities of the firm, and generates the organizational legitimacy that cross-functional innovation teams need to experiment boldly. The enablers of Product Spark are leaders who can communicate a powerful and consistent digital innovation vision, and who can work to align organizational structures, incentives, and measurement systems with that vision. Their will converts potential capacity into action.

3.3. The multidisciplinary integration and human creativity

There is no level of technological capability or strategic clarity that will produce actual innovation unless it is supported by human creativity, the uniquely human ability to see unforeseen relationships, redefine issues, and imagine possibilities that have not yet been embodied in data or prior experience. The need to adopt multi-method and multifaceted approaches to innovation research is always accompanied by the emphasis on integrative thinking that unites different disciplinary viewpoints (Venkatesh et al., 2012; Agerfalk, 2013). The digital era is typified by innovation at the convergence of technical know-how and marketing acumen, information systems ability, service design

sensibility, and user empathy. These intersections are not automatic or accidental, but need to be designed. The systematic development of the environment in which individuals with varying expertise, training, and mental models are exposed to common problems is thus a vital facilitator of Product Spark, which is known as multidisciplinary integration. The cross-functional innovation teams that include engineers, designers, data scientists, marketers, and customer experience professionals impose a more diverse and richer repertoire of problem-solving strategies than any one of the functions alone could produce. The activating mechanism that converts the raw materials of digital readiness and strategic intent into new and valuable outputs of innovation is human creativity.

3.4 Sensitivity and Relationship Awareness to the market.

The fourth dimension of the Product Spark framework recognizes the fact that innovation does not take place in a social vacuum. The consumers are not passive receivers of technological advances; they are active users, adapters, resisters, and redefiners of the innovations that companies introduce to the market. The innovation resistance theory is a reminder that digital products and services that challenge the cherished relational norms, present perceived risks, or require users to change their behavior significantly have high adoption barriers irrespective of their technical merits (Talke and Heidenreich, 2014; Schweitzer et al., 2019). The ability of the organization to identify, interpret, and act on these dynamics before they solidify into resistance is thus a critical input to sustainable innovation; this is known as market sensitivity.

Relationship awareness builds on this logic to the system level of market ecosystems. Companies that not only know what their customers appreciate in the present but also how these values and expectations are changing, what relationship conventions their industry operates under, and where the limits of acceptable technological disruption are today, are in a better position to develop innovations that are widely adopted and create sustainable competitive advantage. Market sensitivity will make sure that Product Spark creates innovation that the market is actually prepared to accept, rather than technically impressive products that consumers lack the motivation or trust to embrace.

3.5 The Interaction Mechanism

Product Spark happens when the four dimensions mentioned above intersect strongly and coherently. While digital readiness provides the fuel for technological and data infrastructure on which innovation is built, strategic intent guides, and the vision of the leadership and organizational commitment drive the fuel to achieve its objectives. However, human creativity is the spark, the creative ability to find and create truly new solutions at the point of convergence of technology and human need. Market sensitivity offers the life-sustaining oxygen, the continued responsiveness to the expectations of the users, relational processes, and conditions of adoption that enable innovations to endure and propagate beyond the initial implementation.

This intersection is not a single event but a dynamic and progressive state that companies need to work on. Companies that invest in one or two of these dimensions will realize that the innovation processes will not be sustained, but rather sputter. The ones that build all four dimensions at the same time and establish the organizational conditions in which their continual interaction takes place are the ones that produce not sporadic sparks but a culture of continuous breakthrough innovation.

IV. FROM SPARK TO SCALABLE INNOVATION

Once ignited, Product Spark does not automatically translate to scalable innovation. It starts a developmental process that, when properly controlled, passes through a series of iterative phases, each phase builds on the deliverables of the previous one, and brings new challenges and requirements. This pathway is significant to managers who aim to transform the innovative vitality of the early innovation into lasting organizational and market effects.

The first stage is Insight Generation, where companies use the data collected by the networked devices and online platforms to detect unmet user needs, latent demand patterns, and new opportunities

in the market (Shim et al., 2019). This phase is the one that is closest to the digital readiness aspect of the framework; the companies that have effective data resources and analytics infrastructure can more easily derive actionable insights out of the streams of information that their products produce. The second stage, Prototype Development, is where the wisdom is converted into real product concepts in an iterative process combining IT capabilities with service design concepts and user experience concepts. The multidisciplinary cooperation that is highlighted by the human creativity aspect of the framework is necessary in prototype development.

The third stage, User Validation, is where market sensitivity becomes essential. Prototypes are experimented on actual users, and the results are used to uncover and deal with innovation resistance, relationship issues, and adoption barriers before they become deeply embedded (Talke and Heidenreich, 2014). Those organizations that view user validation as a form of compliance and not as a form of real learning are likely to find out that there are adoption issues, only to find out after large numbers of resources have been dedicated to the full development. Scaling through Ecosystems is the fourth and last stage, where validated innovations are integrated into larger systems of IoT and service platforms to realize network effects and increase their scope (Ng and Wakenshaw, 2017). A stratified and layered approach to conceptualization and scaling, as the Smart Product literature shows, has a significant positive impact on the scalability and sustainability of digital innovations (Raff, 2019).

V. MANAGERIAL IMPLICATIONS

The Product Spark model has several practical implications for managers who are going through the issue of transforming digital capability into sustained innovation. The initial and arguably the most obvious implication is the need to invest beyond technology. Innovation requires digital infrastructure, such as servers, sensors, data pipelines, and AI models, but does not need all of them. Organizationsthat consider technology investment the main or only source of digital innovation are in the habit of discovering that their potential lies idle due to the absence of strategic focus, creative ability, and market understanding. The

alignment of leadership on a definite and ambitious vision of innovation is just as significant as the quality of the technological basis on top of it.

The second implication is on the standardization of internal definitions and the conceptual framework. Studies have constantly shown that companies that have common and well-expressed understandings of their core innovation constructs come up with more coherent strategies and implement them more efficiently (Zablah et al., 2004). The lack of clarity on what a Smart Product is, what the digital transformation should do to the product strategy of a particular firm, or what success would be like of a particular innovation project leads to miscommunication, the allocation of resources, and the wastage of efforts by various teams that are in fact working towards different objectives.

The third implication emphasizes the relevance of cross-functional integration of teams. Digital age innovation is not a location in any organizational function. It is a fruit of the fruitful collision of the viewpoints based on innovation management, information systems, marketing, design, and customer experience. Companies that physically isolate these functions, such as siloed reporting relationships, performance measures that are functional-specific, or cultural practices that discourage cross-boundary teamwork, are structurally inhibiting the multidisciplinary integration that Product Spark needs. Lastly, the framework emphasizes a proactive effort to strike a balance between automation of services and the expectations of customers that are relational. The automation that ignores the nature, richness, and standards of the customer relationships it facilitates runs the risk of destroying trust and causing resistance, despite the automated service being more technologically superior than its human counterpart (Schweitzer et al., 2019).

VI. CONCLUSION

The use of AI, IoT, and ICT has changed the nature of products and services in the digital era irreversibly. However, the accumulation of technological capability is not the only factor that leads to innovation success in this environment. This paper

explored Product Spark as a theoretical engine that discusses how the digital readiness, strategic intent, human creativity, and market sensitivity should intersect to convert the slumbering digital potential to breakthrough innovation. The framework addresses a real and practical gap in the current body of literature: the lack of a theoretically based explanation of why certain digitally enabled firms innovate with such a consistent and robust rate of output and other, equally well-endowed firms fail to produce any meaningful output of innovation.

By integrating interdisciplinary insights from Smart Product research, digital transformation theory, service automation literature, and innovation resistance scholarship, the Product Spark framework contributes to knowledge development across academia and offers conceptual clarity and actionable directions for firms seeking to cultivate the conditions that ignite and sustain innovation. The framework's emphasis on the interaction between four dimensions, as opposed to the independent growth of one of them, echoes the integrative and systemic characteristics of the process of innovation in multi-layered digital settings.

REFERENCES

[1] Ågerfalk, P. J. (2013). Embracing diversity through mixed methods research. European Journal of Information Systems, 22(3), 251–256. https://doi.org/10.1057/ejis.2013.9

[2] Astley, W. G. (1985). Administrative science as socially constructed truth. Administrative Science Quarterly, 30(4), 497–513. https://doi.org/10.2307/2392694

[3] Huang, M.-H., & Rust, R. T. (2018). Artificial intelligence in service. Journal of Service Research, 21(2), 155–172. https://doi.org/10.1177/1094670517752459

[4] Liu, F., Tong, J., Mao, J., Bohn, R., Messina, J., Badger, L., & Leaf, D. (2011). NIST cloud computing reference architecture (Special Publication 500-292). National Institute of Standards and Technology. https://doi.org/10.6028/NIST.SP.500-292

[5] Marinova, D., de Ruyter, K., Huang, M.-H., Meuter, M. L., & Challagalla, G. (2017). Getting smart: Learning from technology-empowered frontline interactions. Journal of Service Research, 20(1), 29–42. https://doi.org/10.1177/1094670516679273

[6] Ng, I. C. L., & Wakenshaw, S. Y. L. (2017). The Internet-of-Things: Review and research directions. Marketing Theory, 17(1), 3–20. https://doi.org/10.1177/1470593116666Communications

[7] Novak, T. P., & Hoffman, D. L. (2018). Relationship journeys in the Internet of Things: A new framework for understanding interactions between consumers and smart objects. Journal of the Academy of Marketing Science, 47(2), 216–237. https://doi.org/10.1007/s11747-018-0608-3

[8] Raff, S. C. (2019). Products and services in the digital age: Findings of a multi-perspective approach (Doctoral dissertation, RWTH Aachen University). RWTH Aachen University Repository.

[9] Reinartz, W., Wiegand, N., & Imschloss, M. (2019). The impact of digital transformation on the retailing value chain. International Journal of Research in Marketing, 36(3), 350–366. https://doi.org/10.1016/j.ijresmar.2018.12.002

[10] Rijsdijk, S. A., & Hultink, E. J. (2009). How today's consumers perceive tomorrow's smart products. Journal of Product Innovation Management, 26(1), 24–42. https://doi.org/10.1111/j.1540-5885.2009.00332.x

[11] Rijsdijk, S. A., Hultink, E. J., & Diamantopoulos, A. (2007). Product intelligence: Its conceptualization, measurement and impact on consumer satisfaction. Journal of the Academy of Marketing Science, 35(3), 340–356. https://doi.org/10.1007/s11747-007-0040-6

[12] Rust, R. T., & Huang, M.-H. (2014). The service revolution and the transformation of marketing science. Marketing Science, 33(2), 206–221. https://doi.org/10.1287/mksc.2013.0836

[13] Schweitzer, F., Belk, R., Jordan, W., & Ortner, M. (2019). Servant, friend or master? The relationships users build with voice-controlled smart devices. Journal of Marketing

Management, 35(7–8), 693–715. https://doi.org/10.1080/0267257X.2019.1596447

[14] Shim, J. P., Avital, M., Dennis, A. R., Rossi, M., Sørensen, C., & French, A. (2019). The transformative effect of the Internet of Things on business and society. Communications of the Association for Information Systems, 44, 129–140. https://doi.org/10.17705/1CAIS.04406

[15] Talke, K., & Heidenreich, S. (2014). How to overcome pro-change bias: Incorporating passive and active innovation resistance in innovation decision models. Journal of Product Innovation Management, 31(5), 894–907. https://doi.org/10.1111/jpim.12130

[16] Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36(1), 157–178. https://doi.org/10.2307/41410412

[17] vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., & Cleven, A. (2009). Reconstructing the giant: On the importance of rigour in documenting the literature search process. In Proceedings of the 17th European Conference on Information Systems (pp. 2206–2217). ECIS.

[18] Zablah, A. R., Bellenger, D. N., & Johnston, W. J. (2004). Customer relationship management implementation gaps. Journal of Personal Selling & Sales Management, 24(4), 279–295. https://doi.org/10.1080/08853134.2004.10749038