New Product Development Effectiveness: A Pathway to Sustainable Competitive Advantage

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Abstract-- **New Product Development - NDP is a major source of competitive advantage to companies. Decades of quality research lead to substantial developments. Time-to-market was substantially reduced. The elimination of non-value-adding activities and a controlled, almost error-free flow from idea to launch resulted in substantial reduction of NPD expenditures yet improvements in project quality. Considering how increasingly challenging it is to launch successful products in the market, the question becomes is that enough? This study aims at discussing the idea of a greater emphasis on creativity may lead to a more effective NPD process. A more effective NPD process will in turn generate development of outstanding products; consequently increase revenues, profitability, brand value, stock performance and ultimately sustainable competitive advantages. In terms of organization, firstly this study will contain a literature review about pertinent NPD. Secondly, a conceptual model of NPD enabling both creativity and efficiency, consequently NPD effectiveness will be proposed. Finally, conclusions, limitations, and opportunities for future research will be discussed.**

I. INTRODUCTION

In their thought-provoking book, Shenhar & Dvir [1] talked about the importance of projects for the renewal, growth and innovation within organizations. Taking a specific look at a special type of project, Brown and Eisenhardt [2] claimed new product development (NPD) is the key to how organizations diversify, adapt and ultimately reinvent themselves. NPD is the engine of renewal and survival, notably for manufacturing firms [3, 4]. Similarly, Hoppmann et al [5] argued that most impacts in cost, quality, and manufacturing lead-time are done during NPD rather than during manufacturing. More specifically, those impacts may be determined as early as during the development of a product concept [6]. Manufacturing efficiency is no longer an order-winning strategy [7]. Source [8] claimed no amount of optimization can overcome waste locked-up in poor design. Considering the productivity (i.e., sales by expenditures) of New Product Development – NPD, the great majority of highly productive firms launch new and unique benefits to customers [9]. In brief, NPD is a major source for competitive advantage for many companies [10, 11, 2]. Successful companies are those able to launch desirable products at a faster rate than their competitors.

Decades of quality NPD research lead to substantial developments. Time-to-market was substantially reduced. The elimination of non-value-adding activities and a controlled, almost error-free flow from idea to launch resulted in substantial reduction of NPD expenditures yet improvements in project quality. Considering how increasingly challenging it is to launch successful products in the market, the question becomes is that enough? Using current literature this paper is designed to discuss the following hypothesis. **Hypothesis 1**: an approach to NPD that will enhance both creativity and efficiency may be able to increase value to customers[i] by increasing benefits generated (e.g., better targeted, novel products) and reducing effort to acquire (e.g., lower costs, shorter delivery times), thus increasing NPD effectiveness. **Hypothesis 2**: A more effective NPD process will lead to the development of outstanding products, consequently to increased revenues, profitability, brand value, stock performance and ultimately sustainable competitive advantages. In terms of organization, firstly this study contains a literature review about pertinent NPD theories. Secondly, a conceptual model of NPD enabling both creativity and efficiency, consequently NPD effectiveness is proposed. Finally, conclusions, limitations, and opportunities for future research are discussed.

II. LITERATURE REVIEW

In order to build a foundation for the conceptual model to be discussed later in the article, this section includes a summary literature review on new product development with a particular interest on the process, the development team, and knowledge dynamics within the process.

Referring to NPD body of knowledge, one of the most influential is the idea of breaking-down the process into a sequence of stages [12, 11]. The model so-called Stage-Gate aimed at faster cycles with less rework. At about the same time, a radically different approached emerged – Concurrent Engineering (CE). Different than stage-gate, concurrent engineering proposed some level of overlapping between development stages. The first reference to overlapped development phases is found on study [13]. The idea was more clearly proposed by source [14] and made popular in West by source [15]. Trying to explain why the American automobile industry had lost its edge to Japanese counterparts, study [16] then study [17] mentioned the lack of integration of development phases and cited study [14] as a reference. CE became a dominant approach due to the success of Japanese companies such as Toyota.

[i] Based on source [74]

Source [15] provided one of the most commonly referred definitions of concurrent engineering:

> *"Concurrent Engineering is a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers, from the outset, to consider all elements of the product life from conception through disposal, including quality, cost, schedule, and user requirements."*

The idea was later consolidated by [18]. Author [19] updated his stage-gate model to allow overlapping of main development stages. The author talks about a "fluid & adaptable" process with "fuzzy" gates dependent on the situation. This seems in-line with [14] original idea.

Following the trend, Lean product development (LPD) validated some aspects of CE (e.g., overlapping of phases), but proposed a more structured way of reducing non-value added activities [8, 20, 21] from the process. Lean product development also contributed to the new product development toolset [22].

Product development should be made more flexible [23]. The process should be fluid and dynamic during initial stages and made gradually more concrete toward the end [24]. Firms should start with high level concepts to mitigate the competitive impact of NPD (i.e., changes in design are costly and impact competitiveness of products). This view was later corroborated by the idea of front-end-loaded new product development [8] and the idea of early involvement of lead or emergent users [25].

According to [26], the project team must be cross-functional with most relevant areas for NPD present, as it is very important to develop the product based on a collective and multifaceted perception of customers' view. It actually helps to take into account all relevant aspects about products from manufacturability to customer's perception of value. The team should be composed by people from different functions, consequently complementary skills, but shared goals, convergent objectives and a common approach to have the work done. Moreover, besides technical expertise individuals are expected to have good communication skills, tolerance to uncertainty, flexibility, and independency [27]. Collocation is highly desirable and management must be by project not functional. The team should work together in a conversional distance.

Concurrent Engineering brings together all relevant knowledge for NPD [26]. Traditionally functions tend to focus on different, sometimes conflicting aspects of a new product. Hence, a richer picture of the product is brought to life [28]. They came from different specialties, thus have received different formal education, and they have always experienced NPD from different perspectives [29]. Complementarily, according to [30] innovation occurs at the boundaries of disciplines and specializations.

Concerning group creativity, when the development of new ideas—ideation is based on existent ideas it is called bounded ideation, or convergent thinking. When ideation starts entirely based on new ideas it is called unbounded ideation or divergent thinking [31]. It is arguable that no company wants to reinvent the wheel and "not invented here" is no longer in line with the state-of-the-art of the innovation process [32]. Therefore, ideation in NPD is likely to count on bounded ideation at least during defining phases of product development. More specifically, the process starts with an idea and divergent. As it moves downstream becomes more convergent toward a product and service to be offered to the market [33] .

When the subject is team formation, diversity is a key factor to foster creativity [34, 35, 36, 37, 38, 39]. Not only diversity in specialist knowledge is desirable but also diversity in experience and even in cultural background is expected. Heterogeneity is seemed as a brewer of innovativeness, because people are always enforced to see things from different perspectives [40]. Source [41] goes beyond that and stated that dissent, competing views, and even conflict stimulate creative thought.

The team should work in an organic way [42]. This is particularly true in the early stages which mean tasks and responsibilities are created, cancelled or adjusted ad-hoc. In latest stages better planned and structured [36]. Another factor is group tenure or longevity. More specifically, if communication, group memory shared goals and trust are improved after several projects working together, diversity considered important for group creativity is reduced [37, 42]. A temporary team is recommended when tasks are clear, with clear outputs and planned risk, and when distinctive expertise is required. A permanent team is required when tasks are ad-hoc, goals and performance indicators are general, people are expected to work with autonomy and there is a lot of risk taking [36]. Usually, creative teams have in common good interpersonal dynamics; they work well together. Creative teams have energy, motivation and the work matches individual and group objectives in a positive loop. There should be fewer rules, openness; more participation and the group encourage its members to come up with new ideas [42]. The team should share goals and trust each other [38, 43].

There are strong findings relating the use of cross-functional teams, subtle control, and well-communicated leadership & vision with reduction of NPD lead-time and the increase of NPD productivity [2]. Concurrent Engineering can reduce development cycle between 30 and 70%. Also, that CE could reduce time-to-market between 20 and 90%. CE could even increase sales between 5 and 50% [44].

In a revered work, Wheelwright and Clark [45], who proposed development imperatives (see table 1).

TABLE 1 DEVELOPMENT IMPERATIVES, SOURCE WHEELWRIGHT AND CLARK (1992)

Required Capability	Driving Force	Implications
Fast and responsive	Intense competition; Changing customer expectations; Accelerating technical change	Shorter development cycles; Better targeted products
High Development Productivity	Exploding product variety; Sophisticated discerning customers; Technical diversity	Leverage from critical resources; Increased number of successful developments per engineer
Product with Distinction and Integrity	Demanding customers; Crowded markets; Intense competition	Creativity combined with total product quality; Customers integrated with truly cross-functional development process

According to the authors, as a result of the development of outstanding products a firm may open new markets, attract new customers, leverage existing assets, build new competences, and improve company's reputation. A modern approach to the relationship between product development and corporate performance is provided by Cagan & Vogel [46], who associated the creation of breakthrough products to the competitive advantage of firms. Outstanding products increase sales, improve profitability, and brand value, and consequently stock performance. Operational and stock performances are essential for a sustainable competitive advantage, therefore, developing and launching outstanding products contributes to build sustainable competitive advantage.

III. THE MODEL

Five dimensions are used (i.e., Principles, Perspectives, People, Process and Product) to describe this conceptual model. Figure 1 visually displays them.

A. Perspectives

Perspectives stemmed from well-known approaches to new product development and innovation. They help explain the logic of the model. The first perspective essentially refers to the model as an open system. Lead-customers, suppliers, research system, even competitors could potentially provide inputs to the system. The second perspective is about concurrent engineering. Briefly, the same open logic is applied internally with extensive employment of cross functional teams and also cross-fertilization amid projects. Concurrent engineering also refers to overlapped development phases. The third perspective is set-based engineering, which is about considering as many options as possible throughout product development, postponing important decisions to later and consequently bringing flexibility to the process. The final perspective is somewhat a limitation for the other three. This model is better suited to an early technological follower company in the pursuit of disruptive innovation. This innovation is likely to be based on

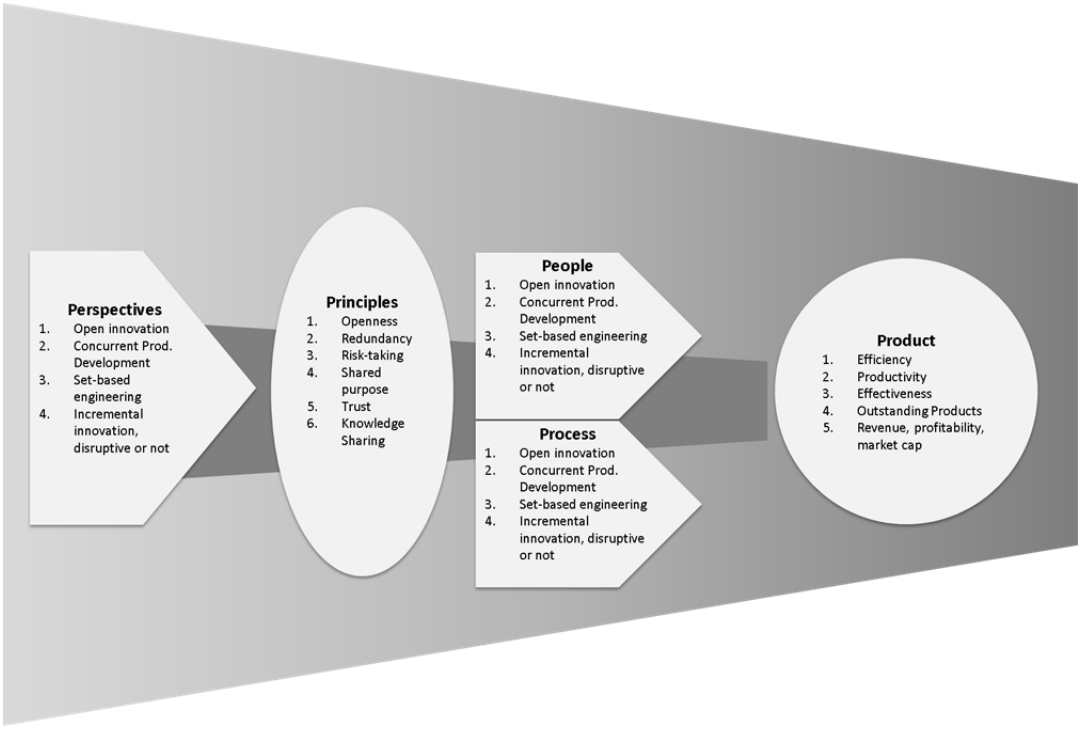

Figure 1, an Effective New Product Development Process

the combination of existing technologies into the building of a novel product.

B. Principles

Principles refer to necessary conditions to enable the model. They should guide the *modus-operandi* of firms and organizations expecting to benefit from it. Firstly, there should be a culture of openness and risk-taking, in which teams are allowed to pursue multiple, sometimes redundant solutions and an eventual failure is accepted as part of the process. Secondly, this culture should be built on a deep sense of shared purpose. Lastly, deriving from the previous two points there should be an environment of trust, in which knowledge sharing is the norm.

C. People

The third dimension – People - is about the development team. It is about characteristics of the people in the team as it is about how the team is organized, which is better envisioned within an organic metaphor. First the team should be diverse from various perspectives. All relevant functions to product development should be represented, which means diversity in terms of knowledge base. Also, the team should display diversity in terms of level of experience and tenure within the firm. This way, positive aspects of the company culture will be reinforced while new ones could be introduced. Finally, when applicable, the team should be culturally diverse. Second, in terms of organization, firstly the teams should form ad-hoc and tenure should not exceed the completion of the project. The idea is to avoid over time buffering the effects of team diversity. Moreover, a matrix-like structure is recommended. Individuals are assigned to a cross-functional project team yet remaining connected to their functional structure. In doing this way, the aforementioned benefits of cross-functional teams are maintained while a certain level of peer (i.e., functional) support is added to the mix. Third, teams should remain collocated during most of the development timeline or at least during critical transitional phases. Collocation would help create team identity and intimacy and the rubbing of shoulders will over time help with sense-making around project decisions, particularly in the case of contrasting views, even if a certain level of attrition is naturally generated. Fourth, a heavy-weight project manager who can make sure project's needs take precedency over functional interests is a must. This heavyweight project manager should also be able to champion the project's interests before top management.

D. Process

The fourth dimension is probably the most straightforward as it relates to how the model would actually work in reality. First, as earlier already discussed the process should be open and inputs from outside sources considered. Second, also as previously discussed development phases should be overlapped to allow multiple perspectives of the development process and even product life cycle to be considered at any giving time. Third, the process starts divergent from the product concept stage and become more convergent as it moves toward product launch. The more variety and novelty of ideas and solutions considered during initial phases the better chances of success at the end of the process. Fourth, the process is made convergent by the use of rapid prototyping and iterative cycles (i.e., I1, I2, I3 ...In), complemented by the appropriated metrics & tools [22]. Nevertheless, the process should be kept flexible and adaptable. Fifth, the process should follow the metaphor of a force field moving, smoothly and nearly spontaneously with ideas flowing from concept to final product. Figure 3 visually summarizes the process.

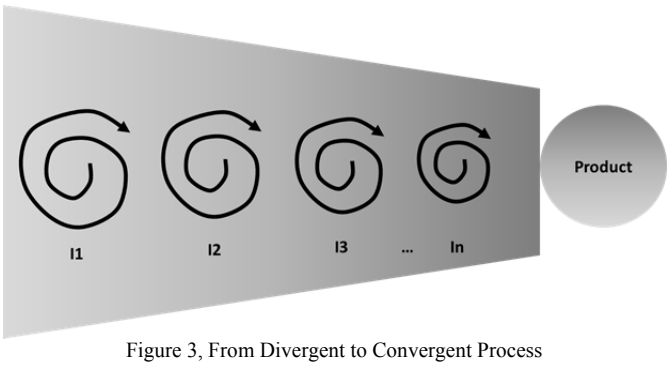

Figure 3, From Divergent to Convergent Process

E. Product

The last dimension refers to expected outcome of the process. At first, by relying on well-established approach to product development like concurrent engineering and lean product development the model is expected to help new product development process to become more efficient (e.g., expenditures, time-to-market) and productive (e.g., number of completed projects by NPD workforce). Subsequently, and more importantly the concept of product effectiveness, which means a product development that enables sustainable competitive advantage. In a nutshell, better target products with superior value proposition lead to superior sales and profitability, which in turn improves stock performance and overtime solidifies brand image. Such virtuous cycles are essential for sustainable competitive advantage. Figure 4, borrowed from previous work [47, 43], summarizes the idea behind NPD effectiveness.

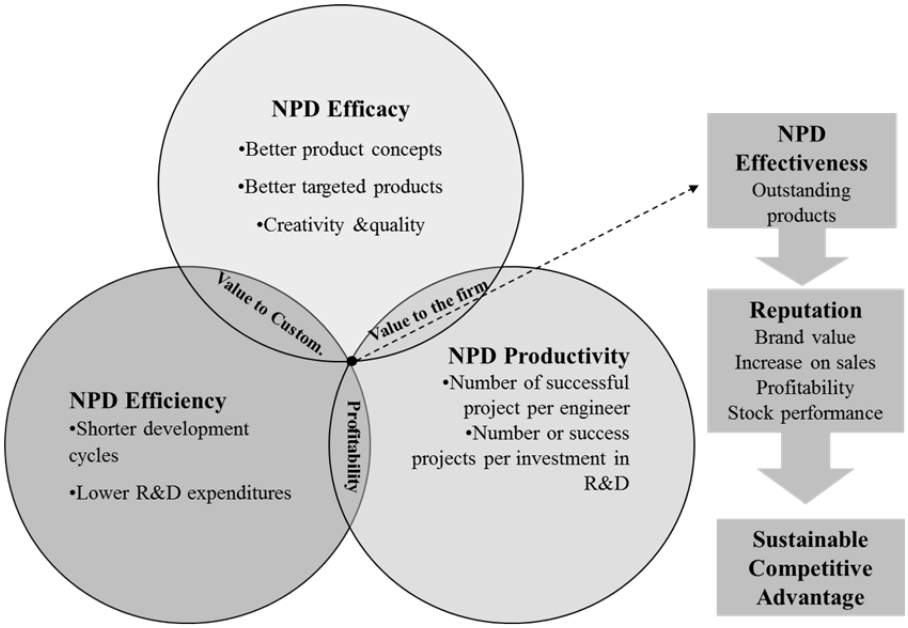

Figure 4, NPD Effectiveness

IV. CONCLUSION

The main objective of this paper was to further develop the discussion about the need to emphasize creativity in new product development as well as efficiency, which would then constitute a more effective NPD process. For that purpose two hypotheses were discussed. The first hypothesis is about a model of NPD that will improve both efficiency and creativity, ultimately value to the customer. In the light of literature review, the conceptual model proposed does that. It proposes the development of better product concepts, which are turned into outstanding products with a superior value proposition. Such process is expected to require less effort yet being more productive; that means better value to the firm. Efficiently generating a larger number of successful products will increase the firm's profitability. The second hypothesis is justified by logic of a sequence of successful products, increased sales and profitability over time help building the firm's reputation, brand, consequently market cap - a virtuous cycle that leads to sustainable competitive advantage. The relevance of this study lies on the idea of reigniting the discussion about NPD. Such discussion is aimed at preventing an otherwise mature research field to become stale by focus on an arguably less approached perspective (i.e., emphasizing creativity over control and efficiency in NPD). Despite all the impressive body of research about NPD and the vast amount of tools and practices companies have been using, it is becoming increasingly harder to launch successful products. It is now common to see once world leaders in their fields finding themselves one bad product line away from irrelevance or bankruptcy (e.g., Blackberry, Nokia). Cases like that are material prove that further investigation is still required.

In terms of limitations, the model needs to be perfected and validated by future research. The natural pathway should to test the conceptual model using a multiple case study. From the five dimensions proposed variables could be developed and data from case companies used to validate the model. Validating the conceptual model may lead to development of frameworks to be used in practice. To develop more practical applications of the conceptual model may lead to yet new opportunities for research. Such potential studies should be designed to answer to the need for yet a new paradigm in NPD research.

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