Phongthiya *et al.*
Journal of Innovation and Entrepreneurship (2024) 13:30
https://doi.org/10.1186/s13731-024-00389-1

Journal of Innovation and Entrepreneurship

RESEARCH Open Access

Impact of contextual factors on new product development process: evidence from a large company in Thailand

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Abstract

This research investigates the impacts of contextual factors, including organization-, project-, product-, and market-related factors, on New Product Development (NPD) process and explores how these factors shape the NPD process of the company within a specific context—a large-sized company in Thailand. By interviewing 11 managers from a large-sized company in Thailand, the findings reveal different impact of the contextual factors on the company's NPD process. Based on these findings, we develop a practical NPD model to overcome company-specific challenges and, consequently, offer valuable insights to enhance the NPD process in similar contexts. Importantly, our findings suggest that innovative companies should strategically integrate the route-to-market for radical innovation into their NPD process because it enhances the customer perception of the innovation's value before commercialization, leading to the success of NPD. Our empirical evidence fills the gaps in the literature regarding the practical configuration of NPD processes in developing countries as well as large-sized companies, acknowledging the variation in the NPD process that depends on contextual factors where innovation occurs. It also provides detailed insights beyond most existing studies that investigate correlation of factors with the NPD process and offers practical implications for management involved in the NPD process, emphasizing the need for contextual awareness in formulating effective NPD strategies.

Keywords: New product development, Contextual factor, Developing countries

Introduction

New Product Development (NPD) is a process that involves generating and selecting new ideas on firms' decision making and transforming them into products or services before launching to market (Kahn, 2019). Extensive literature has been conducted on the NPD, resulting in the development of numerous NPD models (e.g., Roberts et al., 2021; Salerno et al., 2015). Due to the diversity of contextual factors where innovation occurs, these factors contribute to the significant variations in NPD models (Van der Panne et al., 2003). For example, internal factors, i.e., organization's resources, and external factors, i.e., market and technology, play different roles in shaping the NPD models

(Van der Panne et al., 2003), making it varies greatly from context of context and different types of innovation (Durmusoglu & Calantone, 2023; Lv & Zhang, 2019). Although, scholars have attempted to develop best practice for NPD models based on successful companies to be applied universally, these models are not sufficient for managing innovation in real-world contexts (Christensen, 2013; Salerno et al., 2015). Consequently, there is no one-size-fits-all NPD model that is optimal for all contexts (Salerno et al., 2015).

From the intensive review on relevant literature, some gaps can be identified. Firstly, the majority of studies investigating contextual factors influencing the effectiveness of the NPD process (e.g., Lv & Zhang, 2019; Taghvaee & Talebi, 2023) primarily focus on external environments, organizational resources, the mission for product launch, and product innovativeness in the NPD context (He et al., 2021; Lv & Zhang, 2019; Rundh, 2023; Taghvaee & Talebi, 2023). However, these studies tend to concentrate on the correlation between contextual factors and NPD performance without conducting a more in-depth analysis of how these relationships evolve over time (e.g., Durmusoglu & Calantone, 2023; Lv & Zhang, 2019). Secondly, certain studies zoom in on specific stages of the NPD process, such as product launch phase, and neglect a comprehensive examination of the entire NPD lifecycle (Rundh, 2023; Taghvaee & Talebi, 2023). This narrow focus limits our understanding of the interplay between different components of the NPD process. Thirdly, a limited number of studies have explored the NPD process within the context of large-sized companies and in developing countries, as highlighted by Pinheiro et. al. (2019). Large-sized companies play important roles in driving innovation in the production process. Compared to small companies, large enterprises provide more training programs and invest more in R&D activities (Daksa et al., 2018). Therefore, focusing on the context of large-sized companies can be an idea to design human resource development and explore new market innovations (Daksa et al., 2018). In addition, many studies on NPD predominantly center around developed countries, particularly the UK, Denmark, and Sweden. Pinheiro et. al. (2019) advocate for future research to extend its scope to diverse settings, spanning various industries and countries, to provide more comprehensive insights into the significance of barriers and practices in different contexts. Few studies on NPD within large companies operating in developing countries tends to emphasize factors hindering the product introduction process. For instance, Adaku et. al. (2018) investigated the NPD process in Ghana and discovered that factors related to processes, products, and labour are associated with delays in bringing products to market. Jugend et. al. (2020) developed business models for launching new products in developing countries, highlighting the unique challenges faced, such as resource limitations and economic constraints. The study in developing countries is necessary because these countries rely heavily on traditional businesses such as sales and marketing. Therefore, considering the integration of innovation into the NPD process can be applied to advance the manufacturing business and drive the economy. Developing countries require models and measurements to boost R&D (Kruachottikul et al., 2023). Based on these existing studies, studies in the context of developing countries are not as comprehensive as they could be. Therefore, there is a pressing need for deeper investigations into how these factors impact the NPD process to streamline company operations for more efficient production (Adaku et al., 2018). Lastly, the stage-gate model can be

explained more comprehensively than the traditional linear operation because there are internal and external factors that can interrupt the NPD process (Salerno et al., 2015). The examination of insights into market and technology in the NPD process is required for the development of the NPD process based on the stage-gate model (Salerno et al., 2015). To address the above-identified gaps, this research pursues two objectives. Firstly, the research aims to explore the NPD process in a large-sized company in Thailand to investigate how its contextual factors affect the company's NPD process. Secondly, the research aims to configure the whole company's NPD process to suit its context and address challenges it encountered. In order to achieve these, the research has formulated three research questions:

(1) What is the current NPD process of the company, and what challenges does it face?
(2) How do contextual factors affect the company's NPD process?
(3) What is the appropriate NPD process for the company?

This research provides both literature contribution and managerial implications. Firstly, it is a qualitative study that goes insight of how to design strategies for each stage of NPD process with the different considerations in each factor. It contributes to literature that providing example of study than finding the correlation of factors influence on NPD process. Secondly, this is the managerial implication for companies in similar context to consider of all stage can identify overall flow of operation to understand that which part should emphasized on what factors. Thirdly, this study is essential to promote innovation in large-size companies in developing country and to help other developing countries that require a new growth to drive economy. Finally, the gap filling with traditional stage-gate model, this study considers beyond the traditional linear since this study emphasis on customer perception and advanced of technology to propose the strategic model for ensuring that the NPD process can run smoothy with the final product that meet customer requirement.

The structure of this research is organized as follows. The second section presents review of relevant literature that helps to develop the conceptual framework. The third section presents the methods. This is followed by the fourth section that reports the findings, and the fifth section, which provides a discussion of the findings. The last section offers practical implications, limitations, and suggestions for future research, respectively.

Literature review

New product development process

The NPD process typically involves 6 main phases called the stage-gate process (Kruachottikul et al., 2023). This model is fundamental for understanding activities aimed at improving innovation. Therefore, several studies focus on the activities within these 6 main phases (e.g., Abbasi et al., 2022; Dhargalkar et al., 2016). It serves as the baseline for NPD activities, providing guidance for companies to manage their activities and understand stakeholders within the linear system (Kruachottikul et al., 2023). All 6 phases include:

Phase 1: idea generation

The Idea Generation phase involves discovering new ideas for development. Ideas can come from external source, such as customers, other firms, universities, or research institutes, and internal sources, such as in-house cooperation between departments or business units to ensure that products will be accepted in the market (Cooper, 2000; Leithold et al., 2015). Chesbrough (2006), who introduces the concept of open innovation, emphasizes the importance of openness in maximizing the chance of discovering potential ideas for NPD. Additional to the sources of ideas, recording systems are important for archiving ideas generated during this phase, as some ideas may not be immediately usable but could be valuable in the future (Lendel et al., 2015). Therefore, knowledge management is highly demanded to store innovative ideas for future use and to avoid the repetition of idea generation. These insightful ideas not only contribute to the product concept responding to customer needs, but also guide incremental innovation (Lendel et al., 2015).

Phase 2: selection

The selection phase involves narrowing down and screening ideas generated in the Idea Generation phase (Cooper, 2000). In this phase, technical feasibility and market study are crucial activities (Cooper, 2000). It is important to screen ideas using criteria that are not too strict, as overly rigid criteria may eliminate potentially good ideas that are not yet fully developed (Verloop, 2004). The evaluation method used to screen ideas should be flexible to effectively identify promising ideas and eliminate those that are not viable. In this phase, it is essential to align selection criteria with organizational strategies to ensure that new NPD projects are consistent with company goals (Verloop, 2004).

Phase 3: development and prototype

The Development and Prototype phase aims to transform the selected ideas into a prototype (Kalogeras & Anagnostopoulos, 2012). This phase requires significant resource allocation (Cooper, 2000; Kalogeras & Anagnostopoulos, 2012). Effective collaboration between cross-functional teams is crucial in this phase, as technical staff, such as scientists and engineers, explore alternatives technologies, while marketing officers study the market and customers to provide feedback to the technical team (Kalogeras & Anagnostopoulos, 2012). Testing prototypes with the target customers to evaluate technical performance and market acceptance is also an essential step in this phase (Cooper, 2000). Therefore, effective communication channels need to be established to ensure that all stakeholders are informed and involved in the process.

Phase 4: implementation and launch

This phase involves implementation and launch of new products to market to generate profits for the company (Kalogeras & Anagnostopoulos, 2012). As the technical team fades out, the focus shifts to marketing and production activities (Cooper, 2000; Veryzer, 1998). Effective technology and knowledge transfer is crucial during this

phase to ensure the smooth transition from technical activities to market and production activities. A well-developed marketing plan is necessary for attracting customers, creating demand, and successfully commercializing products (Kalogeras & Anagnostopoulos, 2012). Also, innovation complementarities such as distribution channels and infrastructure are required for successful product commercialization (Verloop, 2004).

Phase 5: post-launch

The Post-Launch phase is crucial for sustaining and supporting new products that have been launched in the market (Salerno et al., 2015). The phase enables the collection of value feedback from customers, which is useful for incremental innovation. The marketing team play a critical role in monitoring and collecting information from customers. Salerno et. al. (2015) emphasize that the Post-Launch phase should continue util the product reaches the end of its life cycle, as it provides an iterative approach to the NPD process. This phase serves as an ongoing opportunity to improve the product and sustain its success in the market.

Phase 6: learning and evaluation

The objective of this phase is to systematically learn from and evaluate the previous NPD process to identify successes, challenges, and areas for improvement (Tidd & Bessant, 2020). By analyzing and documenting the outcomes of each stage of the NPD process, companies can identify potential shortcomings and areas for optimization. The lessons learned from this evaluation are essential for continuous improvement of the NPD process and for developing best practices (Tidd & Bessant, 2020). Moreover, enhancing organizations' learning for identifying the dynamic of market trends is necessary to keep organization at the top of markets (Amaya et al., 2022). However, despite its importance, this phase is often overlooked or conducted in an ad-hoc manner (Tidd & Bessant, 2020). Therefore, it is necessary to approach this phase in a systematic manner to ensure that valuable insights are captured and incorporated into future NPD projects.

All 6 phases of NPD process provide robust front-end practices to ensure best practice in every development project (Edwards et al., 2019). In addition to the 6 phases discussed, Lendel et. al. (2015) emphasized on the importance of incorporating a feedback loop into every phase of the NPD process. The feedback loop allows the companies to learn from actual implementation and reflect on factors such as company conditions, employee capabilities, information flow, and business processes, thereby enhancing firm's capability. By identifying problems, gaps, weaknesses, and deficiencies caused by an improper NPD process, the feedback loop facilitates continuous improvement of the NPD process.

The stage-gate process aims to streamline option generation and prioritize getting the product to market in the shortest possible time. However, it is important to note that the traditional stage-gate approach may not be suitable for all organizations (Dhargalkar et al., 2016). The NPD process should be adaptable based on customer requirements or advancements in technology (Salerno et al., 2015). The traditional stage-gate model may not accurately identify interruptions in the process. While it may result in product sales to customers, it may not address how to align product development with customer requirements (Dhargalkar et al., 2016). Therefore, there is a need to develop a stage-gate

model that considers internal operational factors and external market factors to deepen understanding of the market or await technological advancements (Salerno et al., 2015).

Contextual factors that affect the NPD process

The contextual factors, that have been identified in the literature as influencing the success of NPD process, are summarized in Table 1 and detailed below. These are divided into four types (Abbasi et al., 2022; Daksa et al., 2018), including organizational-related, project-related, product-related, and market-related factors.

Organization-related factors

Organization-related factors refer to the structure of the companies where innovation takes place (Panizzolo et al., 2010). These organization-related factors include organizational culture, structure, strategy, and slack resources.

Organizational culture refers to shared values, beliefs, and behaviours that shape the attitudes and action of employees within the company (Dziallas & Blind, 2019). The culture is essential for successful NPD as positive culture motivates employees to develop new ideas and encourages teamwork, collaboration, and innovation (Van der Panne et al., 2003). An entrepreneurial culture, for instance, supports the emergence of entrepreneurs, intrapreneurs, and product champions, and foster an environment where employees are encourages to generate and express their new ideas (Conz et al., 2023). To promote a culture of innovation, companies may offer employees free time to think about new ideas or work on informal projects and provide funding for the development of those ideas once their potential has been established (Cooper & Kleinschmidt, 1995). Employee interactions should occur informally rather than solely through scheduled meetings to enhance innovative activities. This casual interaction between employees from various departments of a company is expected to facilitate the sharing of pertinent information, ultimately boosting the company's competitive edge. Such unstructured time fosters more creative insights, which are more likely to lead to innovations compared to brainstorming sessions based on rigid timetables (Sarbu, 2022). However, a common challenge faced by many companies is that employees often have heavy workloads, leaving little time for thinking about new ideas (Lendel et al., 2015).

Organizational structure refers to the arrangement of roles and responsibilities within a company to facilitate the NPD process (Panizzolo et al., 2010). Different types of organizational structure suit different degrees of novelty of new products (Le & Le, 2023). In addition, the concept of structural ambidexterity, which refers to an adaptable organizational structure to manage the NPD process within the company (De Visser et al., 2010), highlights the importance of adopting a suitable structure for a specific NPD process (Lendel et al., 2015). For radical innovation, the concept emphasizes on

Table 1 Contextual factors

Organization-related	Project-related	Product-related + market-related
1. Organizational culture 2. Organizational structure 3. Organizational strategy 4. Slack resources	1. Resources and skills 2. Completeness and proficiency of execution	1. Market orientation 2. Degree of novelty (radical and Incremental)

doing something unique and deviating from established markets (Solaimani & van der Veen, 2022). Radical innovation entails a high degree of novelty that completely reconfigures the existing landscape, involving the acquisition and utilization of new knowledge to create entirely fresh products or services intended for new customer segments or emerging markets (Le & Le, 2023). The organizational structure, therefore, should be organic (flexible and informal) and cross-functional because it supports the concept of open innovation and increases the chances of gathering new ideas (De Visser et al., 2010). Team members from different areas of expertise in the company work together to solve problems with innovative solutions (Marion et al., 2012). In contrast, the structure for incremental innovation should be more functional (rigid and formal) and less cross-functional since incremental innovation requires less creativity and experimentation (De Visser et al., 2010; Le & Le, 2023). Functional activities can be kept in traditional roles (Le & Le, 2023). Regardless of the type of innovation, the organizational structure should be more informal and flexible at the beginning and become more rigid and formal as the projects progress (Veryzer, 1998).

Organizational structure also influences decision-making, and high bureaucracy can delay the functional integration of the NPD process. Decision-making, especially considering the autonomy of staff, is an important organizational factor that influences the flow of innovation within the company (Abbasi et al., 2022). The working team is also a part of the organizational structure (Abbasi et al., 2022). A multi-disciplinary team is necessary for any specific NPD projects, and the ratio of technical and marketing members should be well balanced according to the degree of novelty of new products (Van der Panne et al., 2003). Project leaders and product champions, who consider a product valuable and dedicate time and effort to ensure it is created and received well among customers, are necessary for NPD projects because they can help define roles and responsibilities for each member of the working team, leading to project progressing in the right direction (Lv & Zhang, 2019). Since the working team is responsible for the project along the chain of NPD, the structure of the team should operate under the minimum level of bureaucracy (de Vasconcelos Gomes et al., 2022). Finally, common goals are emphasized for the sharedness and willingness to collaborate between team members. Common goals encourage people to develop shared understandings and patterns of behaviour (Anderson & West, 1998). When resources are limited, common goals can drive employees or companies to collaborate with each other to achieve a common goal (Marzi et al., 2021).

Organizational strategy is a guideline directing the NPD (Van der Panne et al., 2003), which can be divided into three levels: corporate strategy, communication strategy and portfolio management. Corporate strategy should be clear in terms of technology and market for new products and emphasizes the role of innovation to formalize the organizational structure (Van der Panne et al., 2003). Effective communication within the company is crucial for delivering information related to the NPD, and managers play a key role in bringing new ideas and delivering massages from top management to team members (Durmusoglu & Calantone, 2023; Gish & Hansen, 2013). Applying information to communicate with team members during the development process is major role of top managers to reduce uncertainty for decision making (Akroyd & Maguire, 2011; Pan Fagerlin & Lövstål, 2020). Effective communication also brings mature core process

of NPD for an organization (Hendler, 2019). Portfolio management is an effective strategy to align new products with firm's strategy and balance short- and long-term projects (Van der Panne et al., 2003). Strategy and portfolio management are especially important during the Fuzzy-Front-End of NPD as they guide development plans and product concepts (Khurana & Rosenthal, 1997).

Slack resources are internal resources that are adaptive and flexible to changes and positively correlated with innovative performance (Conz et al., 2023). Slack resources involve an excess supply of human, social, family, and financial capital, which are crucial in the development of organizational resilience (Conz et al., 2023). For instance, firms that have an adequate slack resource will have a high degree of flexibility in allocating those resources for NPD performance (Ruan et al., 2022). The continuity of slack resources is essential for innovation (Judge et al., 2009), and less innovative firms tend to have less and discontinuous slack resources (Lv & Zhang, 2019). To establish and sustain slack resources within innovative firms, *top and middle managers* play important roles in supporting and allocating resources, including financial and human resources for generating ideas for NPD (Tidd & Bessant, 2020). They consider how to utilize employees' skills, integrate knowledge, and reduce uncertainty in the NPD process (Eslami et al., 2018; Gish & Hansen, 2013). Top managers look for overall strategies and pass them to middle managers to elaborate on strategies in practice (Lendel et al., 2015).

Project-related factors

Project-related factors are crucial for the development of new products (Abbasi et al., 2022). *Adequate resources and skills* need to be allocated to the NPD project to carry out all activities and tasks (Van der Panne et al., 2003). *Completeness and proficiency of execution* are key to the success of innovation, as they increase the chance of success (Cooper & Kleinschmidt, 1986). While some studies (e.g., Cooper & Kleinschmidt, 1995; Van der Panne et al., 2003) have indicated that resources and skills allocated to a project need to be suitable and sufficient, and that the completeness and proficiency is necessary for success of new products. They have not provided means to allocate resources, skills, and tools to facilitate excellent execution.

Product-related factors

Product-related factors relates to the characteristics of products themselves, including market orientation and degree of novelty (Abbasi et al., 2022).

Market orientation deals with the origin of ideas and product concept. Radical innovation ideas are less market-oriented and more technology-driven since customers cannot perceive the value of radical innovation they have not experienced before (Veryzer, 1998). Incremental innovation ideas, on the other hand, should be more market-oriented and customer-driven as feedback from customers is a valuable source of new ideas (Balachandra & Friar, 1997; Van der Panne et al., 2003). Both incremental and radical innovation ideas should aim to solve customer problem and align with customer value to create insightful ideas that lead to the success of innovation (Verloop, 2004). Moreover, a high value-to-price ratio also increase the chance of success (Balachandra & Friar, 1997).

Degree of novelty, whether radical and incremental innovation, has a significant impact on the shape of the NPD process (De Visser et al., 2010). Radical innovation is associated

with high risk and uncertainty due to its exploratory nature, and it often requires external competence in both technology and market to succeed (Kahn, 2019). The traditionally formal and rigid NPD model is not effective in managing radical innovation (Veryzer, 1998). Instead, radical innovation is more effectively developed under an informal, flexible structure and an interdisciplinary team to reduce risk and uncertainty and enhance internal and external collaboration (De Visser et al., 2010; Van der Panne et al., 2003). A flexible and adaptive strategy can support risk-taking projects for the growth of new markets and technologies (Knudsen et al., 2023). Radical innovation should be funded and managed at the corporate level and requires a product champion to secure and protect radical ideas throughout the NPD process (Kalogeras & Anagnostopoulos, 2012). At the beginning of the NPD process for radical innovation, less market study and low formality are required to let the ideas evolve (Salerno et al., 2015). When a radical idea is developed into a product concept, it will be evaluated based on specific criteria to decide on Go/No-Go, and the NPD process will become more formal and rigid to develop and prototype (Veryzer, 1998).

In contrast, incremental innovation is typically managed and directed at the product level and is associated with exploitative activities (De Visser et al., 2010). The competencies required for incremental innovation are generally available in-house, resulting in less external collaboration and an interdisciplinary team that radical innovation (Kahn, 2019). The primary objective of incremental innovation is to develop a new product with slightly new features and focus on an existing market where marketing and customers have already perceived the value of the products (Balachandra & Friar, 1997). Therefore, marketing and customers are a value source of ideas for incremental innovation. The traditional structure and measurement are sufficient to facilitate incremental innovation because all risks and uncertainties are already perceived in previous product version (Salerno et al., 2015). Incremental innovation prefers a functional structure (formal and rigid) (De Visser et al., 2010). The NPD process for incremental innovation tends to be more customer-driven or market-oriented to receive feedback or new ideas from marketing and customers (Van der Panne et al., 2003). Early cooperation between marketing and technical teams is required at the beginning of NPD process for incremental innovation (Balachandra & Friar, 1997; Verloop, 2004). The concept of Fuzzy-Front-End is effective to manage pre-development homework to establish the product concepts before development phase, as incremental ideas generally need to be set up at the idea generation phase (Tidd & Bessant, 2020).

Market-related factors

Market-related factors are linked with the markets and customers that are targeted by the innovations (Balachandra & Friar, 1997). They are also related to degree of novelty because market research and customer involvement are influential on idea generation in the NPD process. For radical innovation, it requires late cooperation between marketing and technical team (De Visser et al., 2010), because marketing and customer can hamper the ideas of radical innovation at the beginning of idea generation (Marion et al., 2012; Van der Panne et al., 2003). In contrast, incremental innovation requires early cooperation from marketing and customers to guide the idea generation phase and directly get new ideas from the customers. The traditional NPD approach such as stage-gate system

can be applied in this circumstance (Marion et al., 2012). Therefore, market research is compulsory for Fuzzy-Front-End to manage pre-development work (Khurana & Rosenthal, 1997) and it is key to success of incremental innovation (Balachandra & Friar, 1997).

Methods

This research employs a qualitative research design to investigate how contextual factors influence the NPD process of a specific company (Creswell, 2009; Eisenhardt, 1989). To gain a comprehensive understanding of the phenomenon, we have chosen a single case study approach (Creswell, 2009; Yin, 1994), which allows for a thorough exploration of the research problem in its context. This approach provides in-depth insights and access to critical information that is relevant to our study (Yin, 1994).

Case selection

The selection of our case was purposive, aiming to understand the impact of contextual factors on the NPD process in firms, while address gaps in the existing literature. Specifically, there is a lack of research on the NPD process configuration in developing countries and in large-sized companies. To address these gaps, we selected a leading large-sized company in Thailand that strives to be the business leader in ASEAN and deliver high value-added products to its customers. This company has over 30,000 employee and is committed to R&D, investing over £10 million in 2009 alone, accounting for more than 10% of the private sector's R&D investment in Thailand (National Science Technology & Innovation Policy Office, 2013). This company provides a vest array of products and service to its valued customers. Its organizational structure comprises three distinct functional department, namely Technology Department (TD), Marketing Department (MD), and Management and Administration Departments (MAD). The managers of each department are categorized into three levels according to the management hierarchy: top, middle, and general manager. The middle managers are responsible for supervising the functional department, taking guidance from top managers. The general managers operate at the operational level under the direction of middle managers.

Data collection

We adopted semi-structured, face-to-face interview methodology to gather data from 11 managers at different levels who have experience in the NPD process of the company. The various perspectives provided by managers at different levels ensure that the phenomena are not only examined through a single type of data but also allow for a comprehensive understanding of the issue (Rundh, 2023). We interviewed one top manager from TD, seven middle managers (four from TD, two from MD, and one from MAD), and three general managers (two from TD and one from MAD). The top manager provided their perspectives on the NPD process, while the middle managers shared information regarding department-level activities, and the general managers discussed the actual operations related to the NPD process. The interviews were conducted between January 2021 and April 2021, and each interview lasted from 45 to 90 min, generating valuable and comprehensive data. Each interview was conducted in Thai with audio-record, then, it was translated to English by one author. After that, the other two authors

Table 2 Summary of the interviews

Interviewee	Duration (minute)	Management level	Department
A	45	Top	Technology
B	60	Middle	Technology
C	60	Middle	Technology
D	60	Middle	Technology
E	60	Middle	Technology
F	60	Middle	Marketing
G	60	Middle	Marketing
H	60	Middle	Management and administration
I	90	General	Technology
J	90	General	Technology
K	90	General	Management and administration

finalize the translation before the analysis of data. Table 2 presents overview of the interviews.

Data analysis

For our data analysis, we followed Dey's (1993) three-stage process of description, classification, and connection. In the description stage, we provided a comprehensive account of the NPD process of the company based on the interview findings (presented in "What is the current NPD process of the company, and what challenges does it face?" section), which aided our understanding of the phenomenon under study. In the classification stage, we used a thematic analysis approach to identify themes in the interview data that were related to the conceptual framework (Eisenhardt, 1989). In the connecting stage, we employed pattern matching to analyze the coded data and answer our research questions (Yin, 1994). We started coding by reading interviews and label with code names. Those codes were rechecked and, then, some were merged (Gioia et al., 2013). To improve the reliability of our study, we employed triangulation by comparing the interview data with other data sources, such as reports and websites. We manually coded and analyzed all interviews and supporting data and used spreadsheet software to manage and assign codes and relationships between codes in the data. We considered codes and themes from the topics or discussion that related to research questions (Dutton & Dukerich, 1991). Finally, we integrated our findings into a diagram of the company's NPD process and the contextual factors that impact it.

Findings

In this section, we present our key findings in response to our research questions.

What is the current NPD process of the company, and what challenges does it face?

Based on the findings, the NPD process of the company comprises four key phases: Idea Generation, Selection, Development and Prototype, and Implementation and Launch. While the company does not standardize the Post-Launch and Leaning and Evaluation phases in its work procedure, the interviews revealed that some operations related to these two phases are operated.

Phase 1: idea generation

This phase is to generate new ideas and the responsibility for generating ideas is shared between technical and marketing staff who work cross-functionally as a team. Managers from TD and MD emphasized that *"new ideas for both radical and incremental innovation derive from customer pain points, trend forecasting, and technology scouting from outside. As such, it is imperative for technical and marketing staff to collaborate in generating ideas that are market-oriented and have the potential to provide value to customers".* However, two key challenges were identified in this phase. Firstly, the lack of tools to facilitate activities can result in an insufficient number of ideas for NPD. Secondly, the marketing staff may lack technical knowledge to support technical staff to generate new ideas.

Phase 2: selection

This phase is to refine new ideas generated from the Idea Generation phase and select those to develop into a product concept. To refine the ideas, the company conducts a preliminary study of technology through literature search to identify key technologies that are essential for NPD. The market preliminary study is also conducted to identify market potential of ideas. As a middle manager from TD stated: *"The marketing team should consider the route-to-market of new products, particularly for radical ones, during the Selection phase to identify their market potential."*

The refined ideas are translated into technical specifications, and trade-offs are made to maximize the possibility of successful NPD. TD and MD staffs benchmark the product specifications with those of competitors and explore similar products that provide the same values to customers. This process narrows down new ideas to a product concept with technical specification that align with customer needs. The technology alternatives for the products are also clarified to visualize the technology landscape, including whether to leverage existing technologies or invest in new ones. Ideas are then screened based on technology and marketing criteria, and the selected ideas move to the product portfolio. Middle managers from MD and TD emphasized the need for the product portfolio to align with corporate and balance short-term, medium-term, and long-term projects to manage risks and uncertainties of innovations.

However, the interviews revealed two main challenges in this phase. Firstly, the marketing and technical staffs lack the ability and tools to translate customer needs into technical specifications, as well as low-quality criteria to select ideas, leading to wrong decision or hesitation to make decisions on Go/No-Go of ideas. This leads to a non-systematic screening of new ideas, resulting in a weak screening process in the NPD process. Secondly, when the screening process is weak and non-systematic, many ideas—whether potential or non-potential—can pass through the screening process, resulting in an overload of the product portfolio with a high number of projects. As a result, the product portfolio is not aligned with corporate strategy, and the efficiency of resource allocation is low. The route-to-market should be considered in this phase to evaluate the possibility of new product success and to inform MD as early as possible so that they can start to develop a new route-to-market.

Phase 3: development and prototype

The objective of this phase is to turn product concepts into prototypes and test them with the customers or lead-users to gather feedback for improvements, called market trials. The MD involves in this phase to identify the customers or lead-users and test prototype with them. After testing, customer feedback is given to the technical team for redesign, resulting in an iterative process between the MD and TD before the prototype is finalized.

Based on the findings, the prototypes are classified into three stages: Alpha, Beta, and Final. The Alpha prototype is typically produced by computer-aided design or mock-up material to illustrate the product concept, with low cost and fast production. The Beta prototype is further developed using real material in the laboratory scale, demonstrating functions that are similar to the market-version products. The Final prototype, resulting from many feed-back loops between TM and DM, is manufactured using the real material in mass production. For high investment production process, the Final prototype can be manufactured using Original Equipment Manufacturers (OEMs) to reduce the risk and uncertainties. For radical innovation, collaboration with external actors is conducted in this phase to acquire key competence. Middle managers from MD and TD emphasized the need for marketing involvement in developing route-to-market for radical innovation, which includes distribution channel, market development, after-sale services.

One major challenge in this phase emphasized by a manager from MD is that *"in some case, the MD involved too late in the NPD process, thereby hindering the ability to make necessary changes to the prototype. As a result, the final product may fail in the marketplace".*

Phase 4: implementation and launch

During this phase, the Final prototype is scaled up to mass production. A general manager from TD pointed out that *"a feasibility analysis focusing primarily on the investment return is carried out to identify the way to mass production."* Furthermore, two middle managers from TD stressed that *"the production department is more involved, and technical staff is focused on transferring knowledge to the production department."* One challenge agreed and highlighted by all managers was the lack of route-to-market for radical innovation.

Phase 5 and 6: post-launch and learning and evaluation

Only a general manager from TD mentioned activities related to the Post-Launch and Learning and Evaluation phases. *"The MD needs to collect feedback from customers and send it back to the technical team to improve the products. As comments are collected, they can be used as input for incremental products."* Although the Post-Launch and Learning and Evaluation phases are not standardized in the operational procedure of the company, these phases are conducted informally.

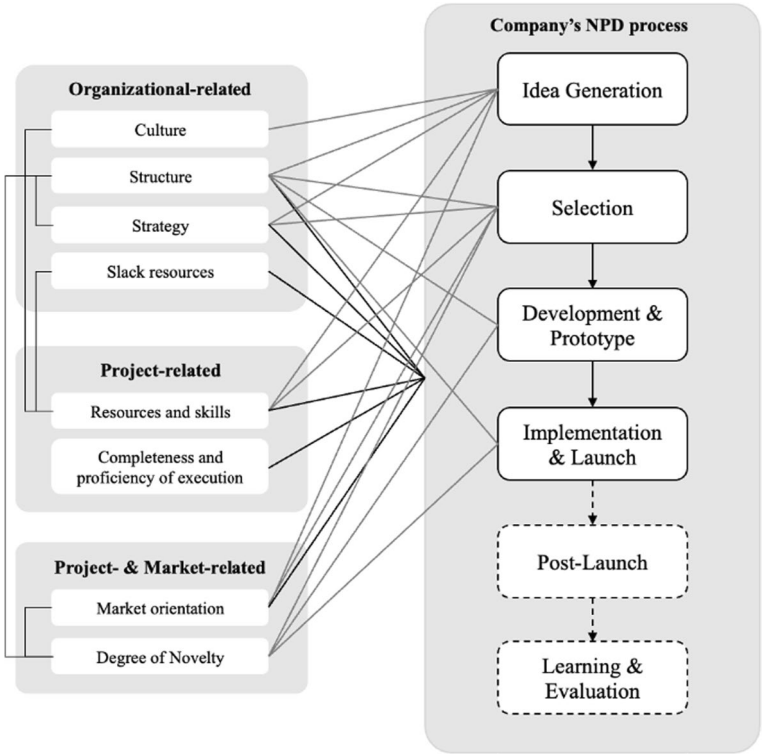

Fig. 1 Impact of contextual factors on NPD process of the company

How do the contextual factors affect the company's NPD process?

The impact of contextual factors on the NPD process of the company is presented in Fig. 1. The diagram highlights that specific factors have an impact on the entire NPD process, while others significant affect specific phases. It was also observed that some factors enhance each other.

Organizational-related factor

The data structure of the findings related to the impact of organizational-related factors is presented in Fig. 2

Organization culture. Most mangers agreed that *"our culture … supports employees to think about new ideas".* However, "*we do not have free time to think about them".*

Organizational structure. According to all managers, the company adopts the concept of structural ambidexterity to facilitate both radical and incremental innovation. For incrementation innovation, the structure is rigid and formal, as the stage-gate process is deployed. In contrast, for radical innovation, the structure is flexible, and becomes rigid in the latter stages of the project. "*This flexibility supports collaboration with external sources of knowledge to acquire the competencies needed for NPD, which is in line with the corporate strategy that emphasizes speed in R&D.*"

The radical innovation projects require multi-disciplinary team-based working, while incremental innovation projects only require function and cooperation from different departments. Therefore, "the company *reorganizes the team structure for developing new*

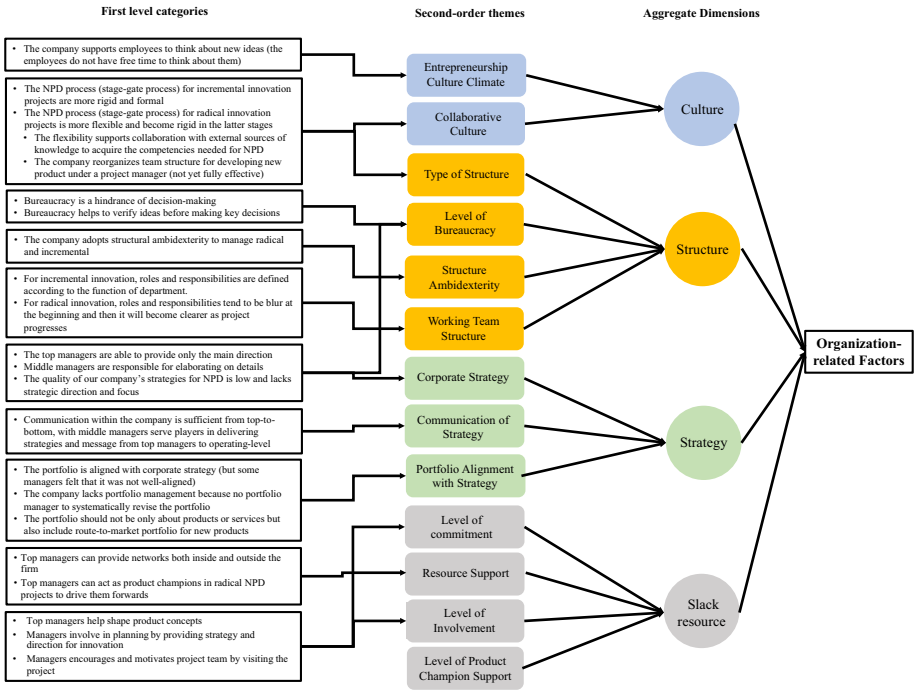

Fig. 2 Data structure of organizational-related factors

product under a project manager to facilitate collaboration among units." However, this reorganizational structure is not yet fully effective, as some departments have not yet relocated their team members to work under the project manager, weakening the manager's authority to control team members.

The roles and responsibilities of team members in radical innovation projects are defined by the project manager, with initial ambiguity being resolved as the project progresses due to the unique nature of work. The authority of the project manager is critical for defining the members' roles and responsibilities. Without such authority, the manager may face difficulty in managing team effectively. Conversely, for incremental innovation, the department managers identify roles and responsibilities due to established team structures and NPD processes. Some challenges related to the working team mentioned in the interviews include unclear roles and responsibilities of project leaders and team members, a lack of common goals among team members resulting in low priority projects being put on hold, unclear performance measurement for team members, inadequate communication among stakeholders such as top-to-top and department-to-department, leading to low synchronization of data and slow decision-making, and insufficient business incubator activities.

The findings revealed a controversy between the effects of high bureaucracy on the NPD process, with one manager cited that "*bureaucracy is a hindrance of decision-making*", while another stated that *"bureaucracy helps to verify ideas before making key decisions."* Hence, the optimal level of bureaucracy needs to be achieved for an efficient NPD process.

Organizational strategy. While the corporate strategies of the company emphasize the importance of innovation, they lack clarify and specificity for effective execution.

Managers at different levels expressed concerns about low quality of the corporate strategies and their broad nature, which made it difficult to achieve goals efficiently. *"The quality of our company's strategies for NPD is low and lacks strategic direction and focus, leading to inefficient execution and difficulty achieving goals".* They further highlighted their responsibilities to create strategic focus and direction, with top managers providing mainly general direction and middle managers responsible for elaborating on details to achieve goals. The cooperate strategies should be prolonged and include performance measurement to attain goals effectively.

Regarding strategy communication, most of the managers mentioned that: *"communication within the company is sufficient from top-to-bottom, with middle managers serving as key players in delivering strategies and message from top managers to operating-level employee."*

However, there was controversy about the alignment of portfolio with the company's strategy. While some managers felt that the portfolio was aligned, other felt that it was not well-aligned. This perspective reflects the current situation of the company, as the corporate strategy is broad and lacks focus. The lack of alignment between corporate strategy and portfolio was attributed to team members not following the screening process and allocating projects that are not aligned with the strategy to the portfolio. The main challenge at the portfolio strategy level is that "*the company lacks portfolio management*", as there is "*no portfolio manager to systematically revise the portfolio.*" This leads to several consequent problems, such as too many projects in the NPD pipeline and a lack of synchronization between radical and incremental innovations. This synchronization is essential to ensure that the radical innovation substitute incremental innovations that are nearly out of their product life cycle. A middle manager from MD emphasized the importance of including portfolio for new products in the overall portfolio that *"the portfolio should not about only products or services but also include route-to- market portfolio for new products".*

Slack resources. To support adequate resources in terms of human and funds and to drive radical innovation, the roles of top managers were emphasized in the interviews. A top manager from TD stated that *"top managers can provide networks both inside and outside the firm to solve problems in NPD process".* While a middle manager from TD mentioned that *"top managers can act as product champions in radical NPD projects to drive them forwards".*

It is also reported that the top managers get involved in NPD projects for decision-making purposes, with some managers mentioning that *"top managers help shape product concepts, especially for radical ones, by providing strategic direction".* This highlights the importance of top managers in NPD, particularly in radical projects that require intensive collaboration and communication.

Project-related factors

To effectively execute the NPD process, it is necessary to have *adequate resources* and *a working team with appropriate skills*. Unfortunately, the interview findings suggest that the company is facing a shortage of personnel who possess the requisite skills for the NPD process, particularly in soft skills such as open-mindedness, communication, and negotiation (Fig. 3). The lack of qualified project managers to drive innovation projects

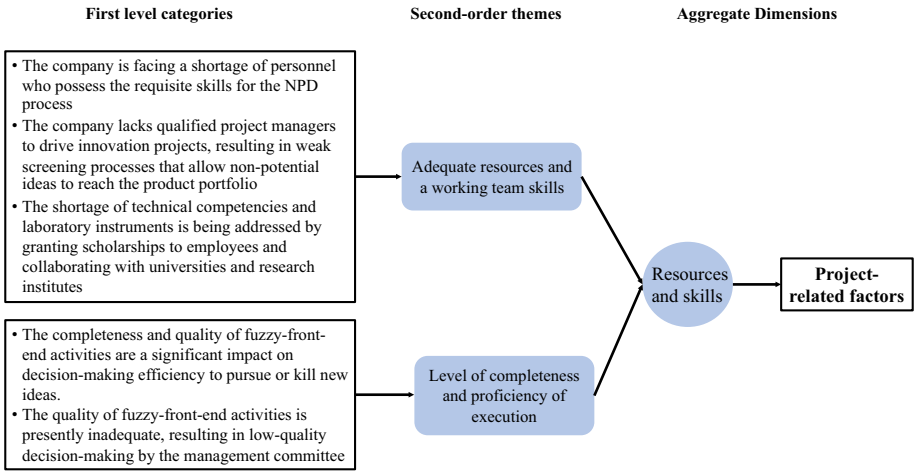

Fig. 3 Data structure of project-related factors

is also a concern, possibly resulting in weak screening processes that allow non-potential ideas to reach the product portfolio. Moreover, team members need to develop entrepreneurial skills and holistic knowledge to think critically and holistically from ideas to products, particularly for radical innovation.

Regarding resources, top and middle managers highlighted the need for internal resources to absorb knowledge and facilities available from external partners. *"The shortage of technical competencies and laboratory instruments is being addressed by granting scholarships to employees and collaborating with universities and research institutes."*

The completeness and proficiency of execution is a crucial factor that enhances the success rate of innovation projects in the company, as emphasized by three middle managers from MAD and MD that *"the completeness and quality of fuzzy-front-end activities are a significant impact on decision-making efficiency to pursue or kill new ideas".* However, two middle managers and a general manager pointed out that *"the quality of Fuzzy-Front-End activities is presently inadequate, resulting in low-quality decision-making by the management committee".* In short, the company lacks adequate measures to evaluate the effectiveness of Fuzzy-Front-End activities.

Product-related and market-related factors

Market orientation is a key focus for the company, with many managers emphasizing the importance of aligning innovation with customer requirements to solve existing problems. While existing literature suggest that radical innovation tend to be more technology-driven, and incremental innovation is more market-oriented, in practice, both type of innovation in the company are market-oriented with varying degree of technology-driven (Fig. 4). As a middle manager from MD noted that *"radical ideas are not only technology-driven but also capable of solve customer problems."* Additionally, a general manager from TD explained that *"ideas for radical innovation are initiated by technical staff and confirmed for market potential by the MD."*

Degree of novelty (radical innovation). The marketing team's involvement is crucial in identifying customer pain points and matching new technologies with customer needs, reducing the number of non-potential ideas entering the NPD process.

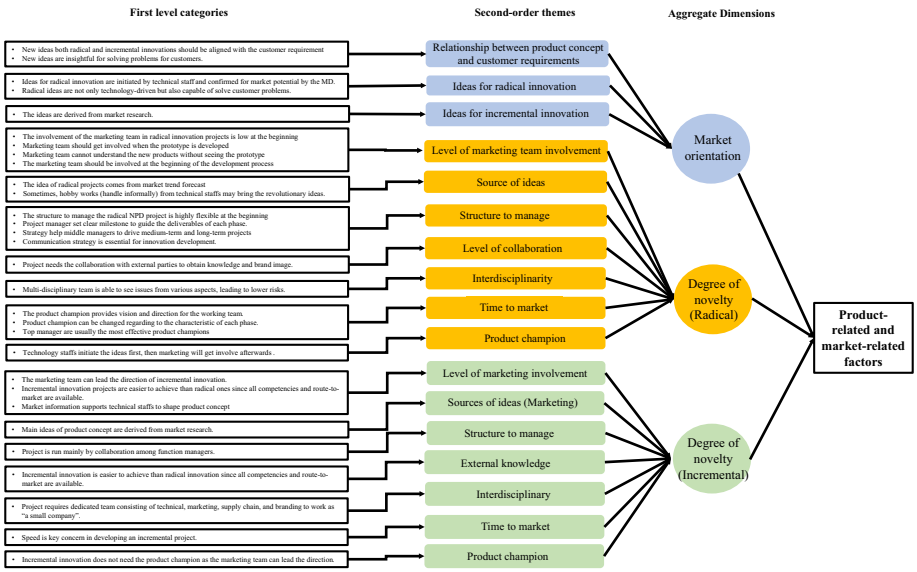

Fig. 4 Data structure of product-related and market-related factors

However, there was controversy. On the one side, some managers highlighted that *"the involvement of the marketing team in radical innovation projects is low at the beginning but increase as the project progress,"* and *"they should get involved when the prototype is developed because marketing or even users cannot perceive the values from products that they have not experienced before,"* because *"they cannot understand the new products without seeing the prototype."* However, a TD manager argued that *"the marketing team should be involved at the beginning of the development process to help shape the product concept and ensure marketability."*

Although there was a controversy, most managers agree that the marketing team plays a vital role in the NPD process for radical innovation. Firstly, they help provide market information to the technical team, helping team to match new technologies with customer needs and make inform Go/No-Go decisions. Secondly, they help identify lead users for radical innovation products, testing prototypes with customers and collecting feedback for product revisions. Lastly, they develop new route-to-market, which is crucial for radical innovation products as existing routes may not work well. Although the literature suggests that the radical ideas are mainly initiated by the technical team and that the marketing team's roles is to match radical products with market, the findings of this study suggest that the company's radical ideas are not solely initiated by the technical team. The marketing team also provides information related to the customer problems, which is useful in generating new ideas for radical innovation.

Some challenges in the radical NPD process were identified in the interviews. Firstly, *"the company lacks specific criteria for evaluating radical ideas,"* as pointed out by a manager from MAD. This hinders the decision-making process of pursuing or discarding ideas. Secondly, the lack of technology scouting capability creates hesitancy in collaborating with external partners due to uncertainty in identify the right partners. Thirdly, intellectual property rights create potential issues, especially

in collaboration with universities. As the top manager mentioned: *"The creation of win–win solutions that address the right of IP is crucial."*

In term of the product champion, all managers agreed that having a product champion is highly necessary for radial innovation. *"The product champion provides vision and direction for the working team and thinks holistically from idea generation to product launch," "the top manager are usually the most effective product champions as they can make decisions, facilitate collaboration among departments, and manage conflicts by setting common goals for radical innovation team."* Furthermore, product champion should possess knowledge covering all technology, marketing, and production to balance the weight of tasks in radical NPD projects.

Degree of novelty (incremental innovation). The findings indicated that the involvement of marketing team in incremental innovation projects at the beginning of the process is crucial to provide information on customer's requirements and market analysis to guide the product concepts, such as market size and potential sales. The marketing and technology teams should work together for iterative information exchange to ensure market-oriented incremental innovation.

Most of the competencies necessary for incremental innovations are already available within company. Therefore, the need to collaborate with external partners is relatively low, and internal collaboration is highly demanded. The manager from TD emphasized that *"incremental innovation projects are easier to achieve than radical ones since all competencies and route-to-market are available within our company".* Incremental innovation projects also take shorter time to develop and do not need product champion, as *"the marketing team can lead the direction of incremental innovation".* However, the *"marketing team's limited workforce to conduct market research and analysis is a challenge in managing market-oriented incremental innovation projects in the company".* Therefore, the TD manager has been attempting to increase marketing knowledge within the technology team to help the marketing team conduct initial market research and analysis.

Discussion: what is appropriate NPD process for the company?

This section discusses how our findings can contribute to the configuration of the existing NPD process in the company and is divided into three parts: the NPD process, contextual factors, and the configuration of the company's NPD process.

New product development process

To enhance the company's effectiveness of the NPD process, several improvements can be made. Firstly, the company's NPD process blueprint should be extended to include Post-Launch and Learning and Evaluation phases. These phases will enable the collection of customer feedback and its incorporation with the re-innovation of incremental innovations (Tidd & Bessant, 2020). They will also help in gathering feedback on the NPD process from previous projects to facilitate continuous improvement of the NPD process (Lendel et al., 2015).

Secondly, effective enforcement and continuous enhancement are crucial. This can be achieved by establishing clear criteria to measure compliance with the NPD process blueprint, and by dedicating a team to monitor and measure compliance. This will

contribute to the improvement of the implementation process and ensure successful implementation of NPD strategies.

Thirdly, a knowledge management system should be established to archive generated ideas for future use and prevent the duplication of knowledge and ideas (Lendel et al., 2015). This system also provides access to technical and marketing knowledge for both teams, addressing the issue of lacking a process to store unusable ideas for future use. Additionally, the route-to-market for radical innovation should be included as a key deliverable in the Development and Prototype phase, ensuring the involvement of marketing. Our findings can address the suggestions made by Lendel et. al. (2015), which emphasize the importance of knowledge management for storing ideas to be used in the future. This helps bridge the gaps in our case, particularly in acquiring knowledge related to marketing and technology for production. Finally, to enhance the effectiveness of the Idea Generation and Selection phases, appropriate tools should be utilized, and quality measurement should be implemented. Prioritizing tools that facilitate the generation of new ideas and translation of customer requirements into technical specification can further improve the completeness and proficiency of execution. Different phases require different tools and monitoring techniques. For instance, while a knowledge management system is necessary from the initial phases (Lendel et al., 2015), extracting knowledge about customer requirements may be more relevant during the Development and Prototype phase (Kalogeras & Anagnostopoulos, 2012). Implementing quality measurement is necessary to ensure that the results from each phase are qualified. Effective Fuzzy-Front-End activities can lead to successful NPD process, and this can lead to improved innovative performance for the company (Cooper, 2000).

Contextual factors

To improve the company's NPD process, several changes need to be implemented. Firstly, the company needs a more specific and efficient strategy formulation process, where top managers provide overall direction, and middle managers elaborate on how to execute the strategies. As the roles of top and middle managers are emphasized in overall strategic design, middle managers play an important role as the individuals who relay messages from top managers to the team (Durmusoglu & Calantone, 2023). A new work procedure should be established to ensure that the strategies are specific and feasible.

Secondly, the synchronization between strategy and portfolio should be improved, and a formal portfolio management team consisting of middle management should be appointed. The quality of execution depends on the effectiveness of middle managers, so it is essential to have a dedicated team to manage the portfolio.

Thirdly, team-based working should be strengthened by formally appointing a project manager for each NPD project and relocating team members under the authorized project manager. This action can delegate authority for each project decision-making, which is related to organizational factors that support the flow of innovation activities throughout the NPD process (Abbasi et al., 2022). A set of new measurements should be established to evaluate member performance. For radical innovation, a matric organizational structure is suitable, where team members work under the project manager but remain in their original departments to meet function goals (Lendel et al., 2015). To be effective, the matrix structure needs common goals to motivate collaboration and clarify

roles and responsibilities. For incremental innovation, a project organizational structure is appropriate, where team members are relocated from functional team departments to the project team (Lendel et al., 2015). Formal designations are necessary to ensure multidisciplinary teams can perform as a small company.

Additionally, a common goal should be established for every department related to the NPD process to strengthen collaboration and reduce silo-working (Lendel et al., 2015). The timing for the marketing team to be involved in a project should also be standardized in the NPD process to ensure that they get involved at the right time (Solaimani & van der Veen, 2022). For radical innovation, the marketing team is suggested to get involved after the product concept is visualized by a prototype since fresh ideas are created for new customer segments (Solaimani & van der Veen, 2022). The marketing team will analyze potential customers based on the prototype concept and develop a marketing plan (Solaimani & van der Veen, 2022). For incremental innovation, the marketing team should be involved at the beginning to provide input on customer needs for generating product concepts as there is nothing new to disrupt the new market (De Visser et al., 2010). The knowledge of customers related to the product can be analyzed for the marketing plan from the first phase (De Visser et al., 2010). A set of criteria should be established to evaluate radical innovation in the Selection phase. The criteria should not be market-oriented but lean toward technological advancement and value-to-customer. Salerno et. al. (2015) identified gaps in the linear traditional stage-gate process, advanced technology and the analysis of customer requirements should be considered to ensure product satisfaction. Even though radical ideas are fresh, the linkage with suitable technology for the flow of following phases is crucial to prevent process stoppage with technology (Salerno et al., 2015). Although the criteria are more flexible, they must be aligned with the corporate strategy and portfolio. For radical innovation, product champions are necessary. The product champion should have balanced competencies including technical, marketing, and operation aspect to facilitate holistic thinking. For radical innovation that is highly risky and requires high investment, the suitable person to be the product champion should be top managers such as the Chief Executive Officers because they are well-versed in the overall strategic plan of the entire NPD process (Durmusoglu & Calantone, 2023). In addition, slack resources should be established in TD and MD, whether existing or new resources. For existing resources, free time should be provided for employees to think about new ideas or explore new technologies since the development of innovation requires adequate time for staff to think and experiment (Ruan et al., 2022). Alternatively, new resources can be appointed to do full-time job for technology scouting and idea generation. A resource called business incubator should also be established to develop market for radical innovation. The business incubator can focus on developing a new market for radical innovation and ensure that the route-to-market is taken into account. The business incubator consists of not only marketing but also production and supply chain teams to support commercialization of radical products where the route-to-market does not existent.

Finally, soft skills, especially for collaborative and entrepreneurial mindset, should be promoted to support collaboration and holistic thinking in the working team because the entrepreneurial mindset is a crucial part in stimulating new ideas and recognizing

potential opportunities (Conz et al., 2023). This can be achieved through training or on-the-job training programs.

Configuration of the company's NPD process

The configuration of the NPD model for the company, as depicted in Fig. 2, shows how managerial implications based on our findings address the challenges faced by the company. The implications are applied on two main levels of management: structure and resources. The structure level deals with how responsibilities and activities are established (Dziallas & Blind, 2019; Panizzolo et al., 2010), while the resources level provides the potential of organization to continue turning actions to achieve goals (Dziallas & Blind, 2019). All implications resulted are formalized in structure level to acquire necessary resources, and the expected results will be generated in result level. Additionally, the NPD process is modified to include the Post-Launch and Learning and Evaluation phases.

To start with, a new work procedure for strategy formulation is applied in the structure layer. The top managers provide the main direction, and then middle managers formulate strategic how-to and focus for execution. A new team consisting of middle managers who formulate strategic how-to and focus will be members in this team to manage the portfolio, linked with portfolio management. In the Idea Generation phase, a knowledge management system is deployed to store generated ideas for future use, provide access for technical and marketing working team to marketing and technical knowledge, solve problems of inadequate team member capabilities and non-systematic screening new ideas, and support the alignment of product and corporate strategy. New resources, including tools and slack resources for idea generation, should be formally established in increase ability to generate insightful ideas. A performance measurement for marketing involvement will be added to indicate when the marketing team needs to be involved in the NPD process, specifically during the Idea Generation phase for incremental innovation and Selection phase for radical innovation. Another important measurement is for the quality of Fuzzy-Front-End activities, coupled with new criteria to evaluate radical innovations to increase efficiency in selecting ideas to pursue. To maximize the chance of success for radical innovation, the route-to-market is assigned as one of the key deliverables in the Implementation and Launch phase to ensure that the route-to-market is taken into account by the project team.

Moreover, modifications are implemented to affect the entire NPD process chain. Firstly, a new performance measurement called compliance with NPD blueprint is implemented to enforce the implementation of NPD process. A monitoring team is required to monitor and report the degree of compliance with NPD process, which can also ensure the market of prototypes of the new product. Secondly, an innovative culture that includes an entrepreneurial and collaborative attitude is promoted via soft management, which provides suitable development programs for innovative performance. Finally, team-based working is strengthened through the formal appointment of a project manager and team, relocation of team members, and setting common goals for every stakeholder in the project, which grants authority for project managers to lead and direct the projects (Fig. 5).

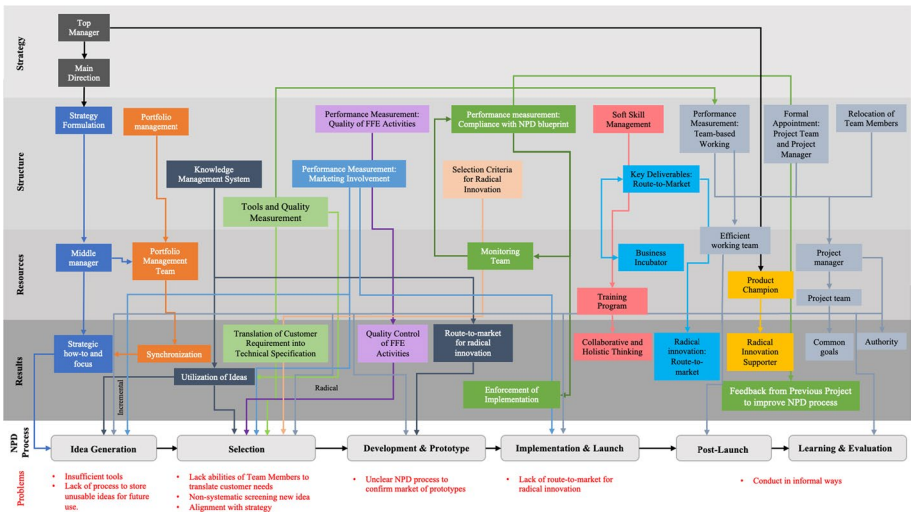

Fig. 5 Configuration of the NPD process for the company

The findings of the NPD process and contextual factors make a significant contribution to the literature. This study addresses gaps identified in previous research by providing insights into the blueprint process, whereas earlier studies primarily focused on go/no-go decisions (Marzi et al., 2021). The study delves deeply into knowledge management, an aspect that has been broadly mentioned in previous literature but lacks detailed exploration on how knowledge management can support the NPD process, such as through knowledge repositories linked to knowledge transfer (Lendel et al., 2015).

For managerial implications, the configuration of the NPD process clearly identifies the role of management levels in participating in the NPD process. This model can serve as a guideline for them to initiate overall strategic planning. The role of management levels is crucial in strategic design and communication of work functions to operational staff, which can drive the organization's innovation process (Durmusoglu & Calantone, 2023). Furthermore, this model is derived from qualitative methodology, which involves in-depth analysis beyond merely examining the relationship of factors in the NPD process (Abbasi et al., 2022; Daksa et al., 2018). Therefore, this study underscores the importance of qualitative considerations and offers valuable lessons as an initial guide for developing activities specifically tailored to the NPD process.

Limitations and suggestions for future research

Proposing a NPD framework is highly beneficial for launching technology and conducting research for commercialization, incorporating analysis of external factors and regulatory constraints (Kruachottikul et al., 2023). However, previous studies on NPD process and contextual factors, such as Salerno et. al. (2015), have indicated that different context requires different NPD processes. However, these studies have not made specific improvements on any NPD process, as they have researched multiple cases leading to big-picture conclusions. To address this gap, this research has taken

a single case study to provide in-depth and insightful information to specify facets to improve. Future research can further compare and conclude the influence of contextual factors on NPD process by conducting research in other companies.

This study primarily uses qualitative research methodology to explore the mechanisms and reasons behind specific phenomena within the chosen field of study (Rundh, 2023). Nevertheless, this study does not establish causal and effect relationships which could be achieved through a quantitative approach (Adaku et al., 2018). Future research could expand upon these findings using quantitative methods to explore causal relationships and emphasize the impact on NPD performance.

It should be noted that this study focuses only on the context of the large-sized company in Thailand; whereas previous studies, such as Love and Roper (2009) and Song and Xie (2000), have indicated that the relationship between contextual factors and NPD process is varied according to national culture. Additionally, De Visser et. al. (2010) have indicated that national differences lead to different structures and performance of the NPD process. Therefore, the results from this research may not be best applied in the context of other countries, but the companies can learn how we configurate the NPD process of the company based on our findings. Future research can also conduct international comparison to compare the results from this research with those from other studies.

Interestingly, this study uncovered an aspect, namely route-to-market, that has been largely overlooked in the literature on NPD processes. Route-to-market, which is the development of market and supply chain, is necessary for radical innovation because customers often cannot perceive the value of radical innovation at the time of commercialization, leading to the failure of such innovation. To address supply chain development, companies should develop necessary competencies, including distribution access, service capability, and customer relationships (Solaimani & van der Veen, 2022). For market development, Salerno et. al. (2015) has identified a phase named waiting for market which is the phase for the company to put effort into developing the market for radical innovation. This phase starts by entering niche market (i.e., the lead users) to test the prototype and identify market potential. If the market is not worthwhile, the project will be temporarily halted. Then, the company allocates resources, especially the marketing team, to develop the market by exploring new markets, growing infrastructure, and market institutions or creating cognitive models according to patterns of customer needs and product specifications. In addition, Dziallas and Blind (2019) suggested the external route-to-market to exploit external capabilities via market alliances, manufacturer and supplier collaboration that can help companies to acquire complementary assets and increase availability and customer value. Therefore, it is recommended future research in the NPD process domain to include route-to-market as an important factor to be taken into account and conduct research on how to develop the market for radical innovation to fulfill the requirement of route-to-market.

Abbreviations

NPD	New product development
TD	Technology Department
MD	Marketing Department
MAP	Management and Administration Departments

Acknowledgements
This research is supported by Chiang Mai University (CMU) junior research fellowship program and Science and Technology Park (STeP), Chiang Mai University.

Author Contribution
All authors have contributed equally to this paper.

Data availability
Data Supporting this study are included within the article and/or supporting materials.

Declarations

Competing interests
The authors declare that they have no conflict of interest.

Received: 1 February 2024 Accepted: 13 April 2024
Published online: 19 May 2024

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