

Navigating the New Product Development Process: A Case Study of a Startup's Journey from Ideation to Commercialization

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Abstract: New Product Development (NPD) is a critical yet challenging aspect of business development, with failure rates ranging from 40% to 80%. This challenge is particularly pronounced in startups, which form the backbone of most developed economies. Despite their importance, startups often struggle with NPD, with some studies suggesting a failure rate as high as 90%. This research paper contributes to the existing literature by examining the NPD journey of a technology startup, Plugable. Plugable, an Irish enterprise in the mobility sector, aims to create a platform similar to Airbnb for private Electrical Vehicle (EV) chargers. The paper traces the journey of two products the company attempted to launch. The first product did not reach the launch stage, leading the business to revise its strategy and develop Plugable. At the time of writing, Plugable is at the prototype stage, having secured €50,000 in external funding and won several national business awards. The case study provides several key learnings for entrepreneurs in the NPD space. It underscores the importance of accurately defining the problem statement, the critical role of validation, and the significance of assembling the right team to develop an effective go-to-market strategy. These findings contribute to the emerging body of knowledge on NPD within the startup context, providing practical insights into the application of established NPD models. Furthermore, the study offers valuable insights into technology startups' unique challenges during the NPD process.

Keywords New product development (NPD), Entrepreneurship, Technology startups, Design thinking, Stage gate process, Electric cars Ireland

1. Introduction

New Product Development (NPD) has long been recognized as one of the most challenging yet critical aspects of business development and success. This process typically involves a series of stages that require a range of skills, such as strategic planning, creative thinking, and effective execution (Holmstrom & Roberts, 1998). Despite the abundance of research papers and proposed models aimed at assisting entrepreneurs and businesses in managing the NPD process, (for example, Cooper, R. G., & Kleinschmidt, E. J. (2017), Montoya-Weiss, M. M., & Calantone, R. J. (1994)), there is a noticeable gap in the literature when it comes to the practical application of these models within the context of startups (Lüthje & Franke, 2004).

Startups face unique challenges when implementing an effective New Product Development (NPD) process. Indeed, an emerging area of research, studies widely recognize that startups encounter several distinct challenges in NPD. These include challenges in terms of limited resources, high risk and uncertainty, and the constant need for rapid adaptation to changing market conditions. For instance, Tung and Lin (2020) argue that in comparison to larger firms, startups have "limited resources and R&D scale" (p. 322), which ultimately hinders their innovation capacity and leads to high failure rates. The Failure rate among new products or services is reportedly in the region of 40%, as per the findings from Lee and Markham (2016). However, in the case of start-ups, research suggests that the failure rate among start-ups globally can be as high as 90%.

By way of adding to the current research, this paper aims to contribute to the existing body of research by presenting a snapshot of a single case study, tracing the journey of a new technology business as they navigate the New Product Development (NPD) process. The subject of this study is a new product, Plugable, which is working on creating an Airbnb for private EV chargers.

The primary objective of this study is to understand how a technology-based startup navigates the NPD process within the context of existing NPD literature. Within this aim, the paper seeks to address several specific research questions:

1. Review the literature to Assess the applicability of existing NPD models, such as design thinking, stage-gate, and agile approach, to startup situations.

2. Map and trace the NPD process adopted by the startup technology company, and glean insights from understanding this process, along with the challenges it presents.
3. Evaluate to what extent the various NPD processes proposed within the literature are appropriate in a real-life situation.

The findings of this study will contribute to the academic literature on NPD in technology startups, providing valuable insights to inform the practices of startups, policymakers, and other stakeholders involved in innovation and entrepreneurship in Ireland.

2. Literature review

2.1 Innovation, NPD and Entrepreneurship and Firm Success

The premise that innovation and new product development (NPD) is a key driver of economic growth and firm competitiveness was initially established by Schumpeter as far back 1934. In his work, "The Theory of Economic Development", published in 1934. Schumpeter introduced the concept of "creative destruction," in which he argued that entrepreneurship and the process of industrial mutation revolutionizes economic structures from within. In many respects, this theory has been foundational in explaining the role of innovation and new product development in driving economic growth and firm competitiveness.

Built on this foundation, other scholars such as Porter, M.E. and van der Linde, C., (1995), Foyolle (2007) and Saberi and Hamdan (2019) firmly placed the creation of new products and ideas as central to the creation of economic and social development. Indeed, the most recent Global Entrepreneurship Monitor Report (2022) argues that "starting and running new businesses is a vital process in any dynamic economy" and discusses how carefully crafted environmental standards can trigger innovation, allowing companies to improve their resource productivity.

In the NPD literature's context, scholars such as Romer (1990) and more recently Bricken et al (2014) put forward the economic and business case for NPD. In these study, successful NPD can lead to higher firm revenues (Bocken et al., 2014), increased market share (Spigel, 2017), and higher profits (Jacobides, Cennamo, & Gawer, 2018), thereby supporting job creation and economic growth (Doherty, Haugh, & Lyon, 2014).

2.2 A review of the NPD literature in the context of a start-up situation






A review of the existing literature, it is clear that the study of new product development (NPD) in the context of startups is both crucial and challenging for several reasons. Firstly, startups and new firm development are critical in modern economic and business ecosystems. In many developed and developing economies, small and medium-sized businesses form a significant portion of the economy, often accounting for 80-90% of businesses within the European Union (European Commission, 2020). As such, SMEs are often recognized at the forefront of innovation, frequently seen as the driving force behind introducing new products and ideas to markets (Audretsch, 2001) and in emerging economies like Sri Lanka, The SME sector is recognized as the largest business establishment sector which accelerates economic growth by managing unemployment, mitigating inequities of the income distribution and underpinning regional imbalance. (HMJCB Heenkenda, 2022).

Secondly, studies consistently show that the application of the NPD models proposed within the existing literature, in the context of startups, is problematic. Table 1 presents a brief overview of six of the main NPD models proposed within the literature. One of the main critiques of many of these models, suggests that for the most part, many of the early models were developed in the context of medium to large organizations. For example, in both its original and revised versions, the Stage-Gate model, often considered the industry standard, is a highly "structured, sequential approach to new product development, which typically encompasses a series of discrete stages" (Cooper, 2017). While alternative approaches such as Agile and Lean NPD have been proposed that prioritize flexibility and responsiveness, making them more suitable for startups. However, there may be challenges, in terms of intellectual property issues and the ability to manage relationships with external partners, which can be complex and time-consuming for start-ups (Chesbrough & Brunswicker, 2013).

The second concern centers on the application of these models given the lack of resources in a start-up situation, Croll and Yoskovitz (2013) for example, suggest that entrepreneurs in a start-up situation rarely have access to vital research reports and data on market potential to assess feasibility, critical to stage gate. Keir (2019) highlight the problems in accessing the necessary human and personnel resources, as such start-up are unable to adopt many of

the structures proposed by traditional NPD models (Giardino et al., 2017) and particularly in retaining and accessing high skilled employees needed (Mukul and Saini 2021). There is also the issue of accessing the necessary financial funding to successfully bring a new product or idea to market (Hendratmi, Ryandono and Sukmaningrum 2020). There is also the enduring problem of the high failure rates among NPD.

In summary, the existing discussion underscores the complexities and challenges of NPD in the context of startups. By way of bridging this gap, this case study aims to add to the existing literature by examining the process of NPD in a real-life application of NPD in a technology startup.

NPD Model	Description	Companies who used them	Year created	Reference
Stage-gate	A process model that describes the development process as a sequence of stages separated by decision points (gates).		Proposed by Robert G. Cooper in the 1980s.	Cooper (1988)
Agile	A flexible and interactive system of product development that emphasizes interaction, customer collaboration, and ability to respond to change.		Emerged in the 1990s and formalized in the Agile Manifesto in 2001.	Highsmith and Cockburn (2001)
Lean NPD	An approach that focuses on eliminating waste in the product development process, improving speed and efficiency.		Originated from Lean Manufacturing principles, applied to NPD in the late 1990s.	Womack and Jones (1996)
Design Thinking	A human-centered approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success.			Brown (2008)
Open Innovation model	A paradigm that assumes that firms can and should use external ideas as well as internal ideas to advance their technology.		Proposed by Henry Chesbrough in 2003.	Chesbrough (2003)

3. Research Methodology

A qualitative case study approach involving in-depth interviews and journal logs was adopted for data collection for this study. A qualitative approach was deemed appropriate given the aim of this study which was to explore and understand how a start-up entrepreneur and business undertook and approached NPD. In this paper, a number of interviews with the founders and a review of journal logs were the primary sources of data collection, which was supplemented with non-participant observation of the company documentation and information from website and online platforms. However, the in-depth interviews formed the primary data collection method.

As noted by Kumar (2014) interviews are among the most flexible and widely used methods for gaining qualitative information in social science research. The justification for interviews is well-proven and is particularly useful for exploring a subject in considerable depth with selected participants (Zihmund et al 2013). As noted by Norton (2009) interviews give the researcher a first order perspective by allowing interviewees to provide their experiences, views and feelings. A such as noted by Kumar (2014), “interviewing is a commonly used method of collecting information” (p. 176). Over a series of several months, interviews were conducted to explore the decision-making process and the learning. In addition to interviews, journal logs were kept by the founders at key stages, and these were also used to provide a record of relevant events. Interviews were conducted both face-to-face and online.

3.1 About the business

Plugable is a technology startup in the mobility space based in Ireland. It started as a college project by Dundalk Institute of Technology and Queens University Belfast students. Currently in its prototype stage, the business has two founders who spent more than 12 months taking the business from an idea to the prototype stage. One of the

entrepreneurs was introduced to the concepts of NPD during his Master's course, which was put into practice during the journey of this business venture.

Plugable looks to create a community powered EV charging network by connecting private EV chargers into a peer-to-peer network. By doing this it aims to become the largest EV charger network that the world has seen.

3.2 IDEA #1: EV Switcher.com – a DESIGN THINKING APPROACH

Earlier models of NPD have increasingly emphasized the use of Design Thinking as a process for startups to successfully manage NPD. In discussing the NPD process with the founders of Plugable, they mentioned their first product launch, EV Switcher, and the process they adopted. One of the founders, an EV driver himself, was passionate about EV adoption and the global movement that was happening. He acknowledged that he empathized with this new segment of people switching to electric cars and was keen to contribute or play a pivotal role in the global rollout of electric mobility. He said, 'I was very aware of the challenges faced by potential EV adopters. The buying experience to the level of awareness was exceptionally low, and finding information was a broken process.' At the time of the idea's conception, the founder was a student at Dundalk Institute of Technology (DKIT) and having studied NPD and Innovation; he knew that he needed to see if this was a real problem and that Design Thinking and being user-centric was critical. Looking to identify the problem statement, he decided to speak with the end user - existing and potential EV drivers - to try and understand their circumstances and challenges to identify opportunities. He said, 'From one-to-one discussions, I joined the Irish EV owners' group on Facebook, spoke 1:1 to potential buyers in my social network and also spoke to new EV owners when hunkering down to charge in a public charger point' These initial discussions with the users clearly identified a problem. 'After having many interactions with EV users, I identified a problem around the way electric cars were sold in the market and the level of information and education a prospective EV buyer has available in the market'.

From this initial discussion, he decided to venture into space by offering a unique service to consumers considering buying an electric car. This service, an 'extended test drive service for electric cars' coupled with education about electric cars, was designed to fill a gap in the market. With a background in digital marketing, he took the plunge, bought a domain, and used a no-code platform to build a prototype, which he named 'EV Switcher'. After building the prototype, he decided to get the website up and running. However, upon consulting with industry experts, the founder realized that the concept was not viable due to insurance-related issues. "We build an incredibly good product, and automobile dealers were ready to bite the bullet, but the tricky question that kept hitting us with no possible solution was, who or how will we cover the insurance for this service? There were no solutions available, and insurance brokers weren't willing to even start a conversation to create a product for this activity. I realized how not bringing customers and industry at my early research stages was a mistake." quoted the founder. Key learnings from this stage were the importance of bringing customer and industry validation at the initial stages of NPD.

3.3 IDEA #2: Plugable: Stage-gate approach

Around May 2022, the founder realized that the business model had viability issues around securing an adequate legal framework. The team concluded that while the problem was "essential and sizeable, it could not be solved now". So, the team moved on to another problem within the space - the lack of EV charging infrastructure. "With EV Switcher, we only got the customer and industry involved towards the last stage, which was a mistake. If we are going to spend time and resources in building something, we need to get the business validated by people who are going to pay for the service.", the founder quoted.

The first step was identifying the problem statement. The team recognized that this problem was too wide and deep to solve, so the team decided to narrow it down to the problem of not having access to a home charger, which incidentally was a problem faced by the founder himself. "As someone living in a rented house, I did not have access to a home charger which meant he had to use a granny charger which would take 1-2 days to charge an electric car Vs 4-10 hours using a home charger".

3.4 Customer engagement and understanding the market

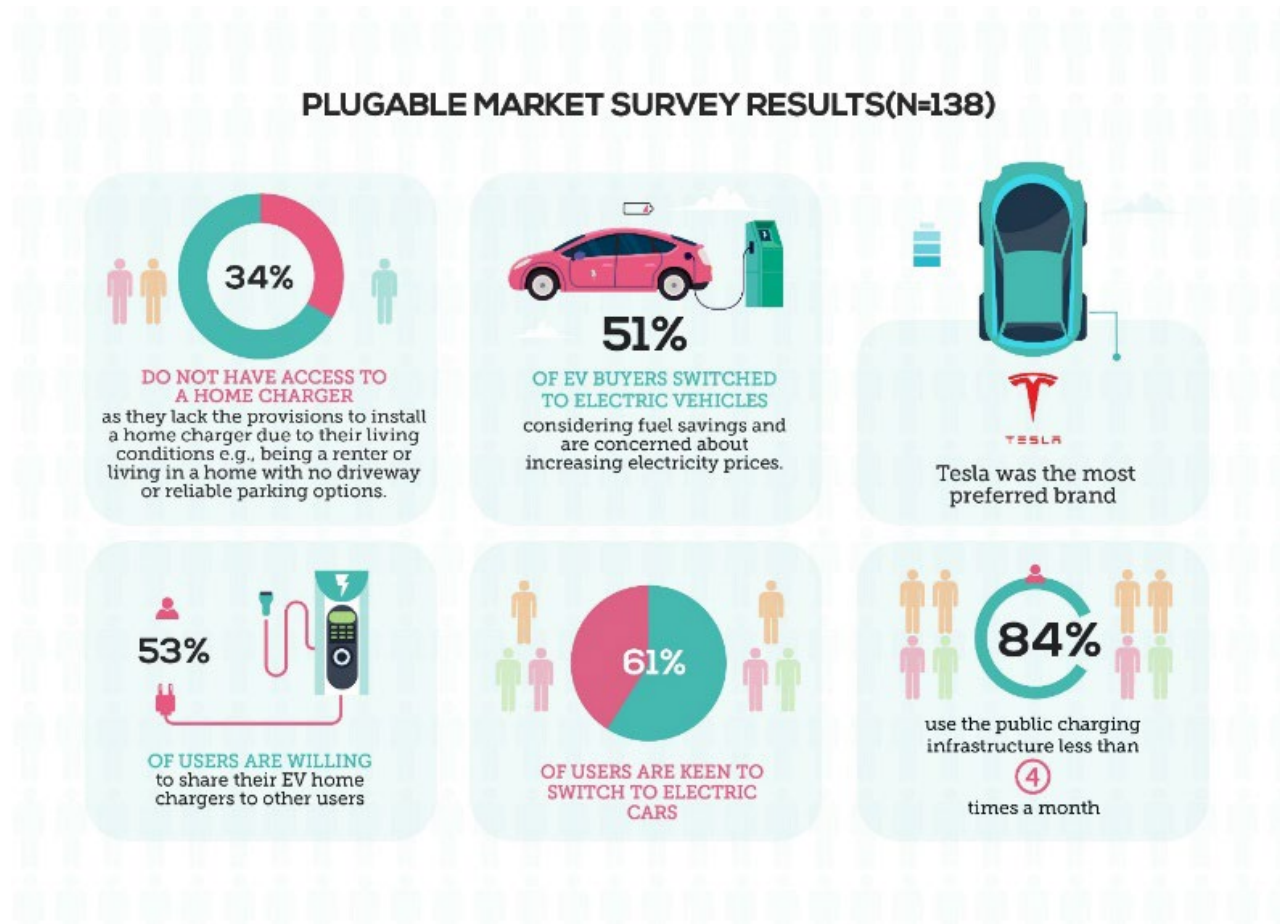
At early stage, the founder engaged with customers and market experts by testing the concept's viability. Number of stages in customer and stakeholder engagement process. He went on to interview other EV users who had similar problems. The first set of research showed that this problem called for an urgency and was a sizeable problem, but this time the founder decided to validate the opportunity as much as possible before getting into prototyping. At

first, he conducted 1:1 interview with EV users and spoke to industry members key agencies that regulate and monitor the sector including Zero emissions vehicles Ireland (ZEVl), the Sustainable energy authority of Ireland (SEAI), and EV owners' associations in Ireland and Northern Ireland. Everyone gave constructive feedback and supported to the idea, "This gave me the confidence to apply for grants and business plan competitions further to validate the viability and commercial potential of the idea. I applied for the feasibility grant from the Local enterprise office in Louth. While we had high expectations, we got rejected the first time but went back the following month with answers to their questions and finally landed our first grant". Realizing that "The idea started to grow hands and legs". At this stage, a second member soon joined as a co-founder.

After winning the first grant from Local enterprise, the team had started working on building a prototype or a minimal viable product (MVP) and hoping to get live by late August.

The duo team went on to win Queens University Dragons Den competition, New Frontiers @ Dkit by Enterprise Ireland, Student Entrepreneur awards, FIA startup competition, and Invent 23 by Catalyst. The team also conducted a survey(n=138) (table 2.0), sent this survey out on Facebook groups, and LinkedIn users, wherein 35% of new EV owners were found to not have access to a home charger and 51% of the existing EV owners were willing to share or rent their home chargers to others. So, by this stage, the team had done early market research, had a first-level business plan ready and secured money for funding the concept via grants that helped the team raise €50,000 towards building a Minimal viable product (MVP). The team has set a target of raising €100,000 via grants and government funding alone which will help them launch the MVP, acquire initial customers and validate the business idea before scaling it up to whole of EU.

Table 2.0: Plugable survey



4. Key learnings

Key learnings

The infographic consists of six pink rounded rectangular boxes arranged in a 2x3 grid. Each box contains an illustration at the top and a text box below. The illustrations are: 1. A person standing at a crossroads with a signpost. 2. A person sitting at a desk with a laptop and a person standing next to them. 3. A person sitting at a desk with a laptop and a clock on the wall. 4. A group of people sitting around a table, some with laptops. 5. A person standing with a hand on their hip, looking at a group of people. 6. A group of diverse people standing together.

- Importance of Problem Identification:**
The founders identified two problems during the NPD process but focussed on narrowing the problem statement and identifying a problem area that requires solving now.
- Importance of early customer Validation:**
Before moving to the prototyping stage, validating the business idea as thoroughly as possible is crucial. This involves both customer and industry validation. For Plugable, early validation led to funding and awards, which helped the team build a Minimal Viable Product (MVP).
- Flexibility and Adaptability:**
The journey of Plugable underscores the importance of being flexible and adaptable. When the founders encountered roadblocks with EVSwitcher.com, they did not give up. Instead, they identified a new problem to solve and pivoted their business model accordingly.
- Building the Right Team:**
Finding the right co-founder or team members is crucial for the success of a startup. In the case of Plugable, adding a second member willing to commit to a full-time position and lead the company was a crucial factor in their success.
- Leveraging Opportunities:**
The founders of Plugable could leverage various opportunities, such as grants and business plan competitions, to validate their idea and secure funding. This highlights the importance of proactively seeking and taking advantage of such opportunities.
- Community Engagement:**
Engaging with the community (EV users, industry members) played a significant role in the development of Plugable. It helped in problem identification and validation and in gaining support for the idea.

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5. Interpretation of Findings in the context of existing literature

The case study findings provide valuable insights into the New Product Development (NPD) process in the context of a technology startup.

5.1 Iterative Nature of NPD

The iterative nature of the NPD process, as demonstrated in the case study, aligns with the principles of Design Thinking (Brown, 2008). This is consistent with the broader literature on entrepreneurship, which emphasizes the importance of flexibility, experimentation, and learning from failures (Zahra & Wright, 2016).

The initial idea, EVSwitcher.com, was prototyped but later found non-viable after market research. This led the team to pivot to a new solution, Plugable, which was validated through market research before progressing to the prototyping stage. "The secret is one of a fail fast approach; there is no value in having an idea. It all comes down to execution and the only way to get there is by constantly iterating your idea.", said the founder in this context. This iterative process, where ideas are tested, refined, or discarded based on market research and feedback, aligns with the principles of Design Thinking (Brown, 2008).

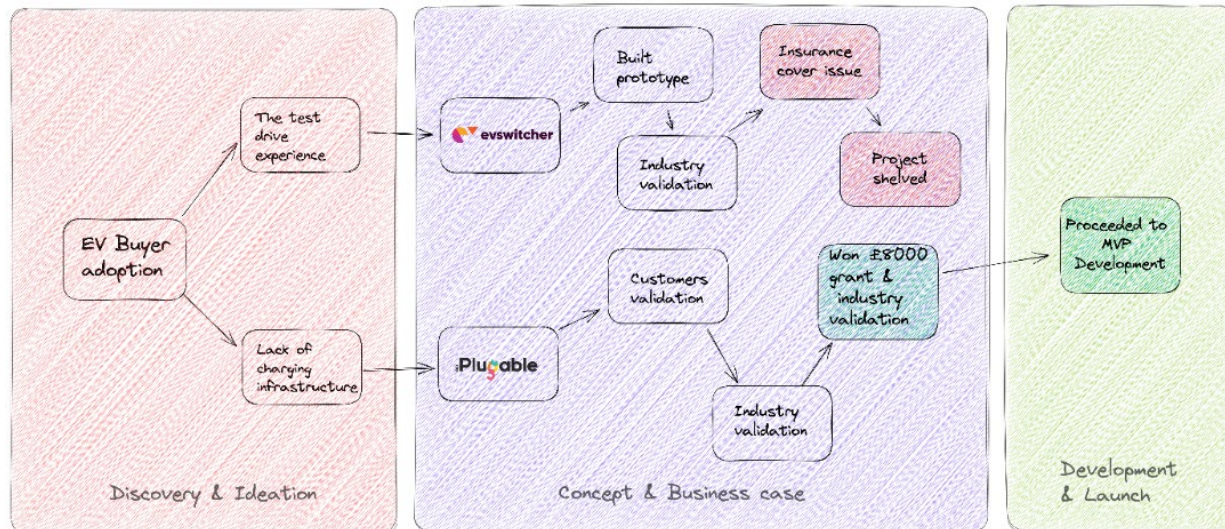
5.2 Importance of Market Research and User Feedback

The importance of market research and user feedback in the NPD process is a well-established theme in the literature on both Design Thinking and the Stage-Gate model (Cooper, 1990). This research provides further empirical evidence of the value of these practices in the context of a technology startup.

"The first thing we did was to validate the idea with customers and industry. From 1-to-1 interviews to mass surveys to winning business plan competitions, we bought in the customer inputs at the initial stages of NPD", quoted the founder. The survey findings further validate the importance of market research and user feedback in the NPD process. The fact that a considerable proportion of respondents did not have access to an EV home charger and were

willing to share access to their home chargers supports the market need for a solution like Plugable. This demonstrates the value of market research in validating product ideas and ensuring they meet user needs, as emphasized in both Design Thinking and the Stage-Gate model (Cooper, 1990).

5.3 Hybrid Approach to NPD



Hybrid NPD Process: Design thinking+ Stage gate

The effectiveness of a hybrid approach to NPD, combining elements of Design Thinking and the Stage-Gate model, contributes to the emerging literature on hybrid NPD approaches. While the existing literature has begun to explore the potential benefits of such approaches (Zahra & Wright, 2016), this research provides a concrete example of how a hybrid approach can be implemented in practice. Various models have been proposed throughout the literature to guide businesses through the New Product Development (NPD) process. These models are often presented as standalone solutions. However, evidence from this case study suggests that a more practical approach for startups might be to combine elements from several models.

The findings from the case study indicate that a hybrid approach to NPD, integrating elements of Design Thinking and the Stage-Gate model, can be practical within the context of a technology startup. This suggests that flexibility and adaptability in applying established NPD models may be crucial for startups navigating the complex and dynamic process of new product development.

In conclusion, the findings from this research provide valuable insights into the NPD process in the context of a technology startup. They highlight the importance of an iterative approach, market research, user feedback, and a hybrid NPD approach. These insights can inform future research and practice in entrepreneurship and NPD.

6. Limitations

While this research provides valuable insights into the New Product Development (NPD) process in the context of a technology startup, it is essential to acknowledge its limitations.

Single Case Study: The research is based on a single case study of one start-up entrepreneur's journey in the EV market in Ireland. While this provides a detailed and in-depth view of the NPD process in this context, the findings may need to be more generalizable to other contexts or industries. Further research involving multiple case studies across different industries and geographical locations would be beneficial to validate and extend the findings.

Self-Reported Data: The case study findings are based on the entrepreneur's self-reported experiences and perceptions. While this provides a unique and personal perspective on the NPD process, it may also introduce biases or subjectivity to the findings. Future research could incorporate multiple perspectives, such as those of team members, investors, or customers, to provide a more comprehensive view of the NPD process.

Survey Limitations: The survey findings are based on a relatively small sample of 137 respondents from the Republic of Ireland and Northern Ireland. While the survey provides valuable insights into the potential market for the Plugable service, the findings may represent something other than the broader population of EV users or potential users. Additionally, the survey relied on self-reported data, which may be subject to response biases.

Hybrid NPD Approach: The research explores a hybrid approach to NPD, combining elements of Design Thinking and the Stage-Gate model. While the findings suggest that this approach was effective in this context, further research is needed to understand the conditions under which such a hybrid approach is most beneficial and how it can be best implemented in practice.

7. Conclusion

This research explored the New Product Development (NPD) process in the context of a technology startup, focusing on the journey of Plugable, a technology startup based in Ireland from ideation to product launch. The findings provide valuable insights into the iterative and dynamic nature of the NPD process, highlighting the importance of flexibility, market research, and user feedback.

The case study demonstrated how an initial idea was tested, refined, and ultimately discarded based on market research, leading to the development of a new solution. This iterative process aligns with the principles of Design Thinking, emphasizing the importance of empathy, experimentation, and learning from failures.

The survey findings further validated the approach to developing the new solution, Plugable, demonstrating a clear market need and potential user acceptance of the proposed service. This underscores the value of market research and user feedback in the NPD process, as emphasized in both Design Thinking and the Stage-Gate model.

The hybrid approach to NPD, combining elements of Design Thinking and the Stage-Gate model, can be effective in the context of a technology startup. This contributes to the emerging literature on hybrid NPD approaches, suggesting that such approaches may offer a promising way forward for entrepreneurs and startups.

While the research has limitations, including the reliance on a single case study and self-reported data, it contributes valuable insights to the current understanding of the NPD process in the context of a technology startup. It provides a foundation for future research, with potential implications for entrepreneurs, researchers, and policymakers.

In conclusion, the journey of Plugable and its team in navigating the NPD process from ideation to product launch underscores the complexities and challenges involved in entrepreneurship. It highlights the importance of a clear problem statement, thorough market research, and an effective NPD process in the successful development and launch of a new product. It also emphasizes the potential benefits of a hybrid approach to NPD, combining the flexibility and user-centered focus of Design Thinking with the structured, stage-based approach of the Stage-Gate model.

Appendix

Exhibit A



Exhibit B

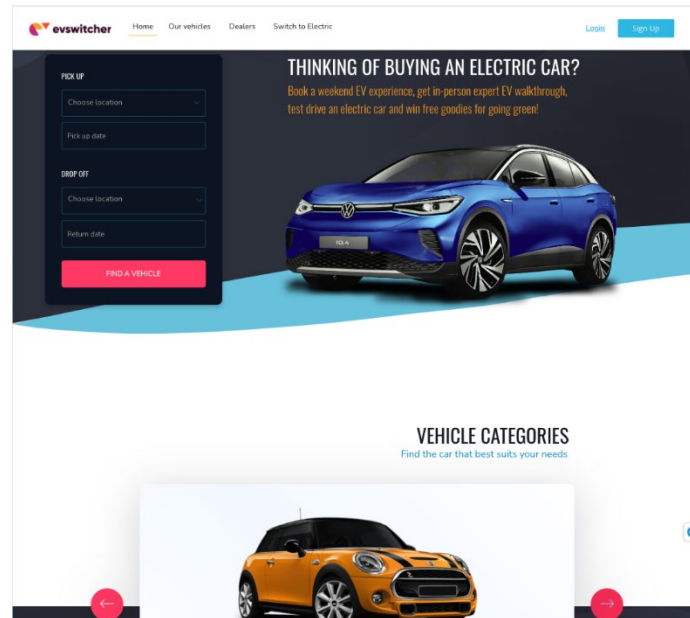


Exhibit c

V1



Reference

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