HOW DO NEW PRODUCT DEVELOPMENT STARTUPS HANDLE MISSING EXPERTISE?

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ABSTRACT

This paper presents a framework for how new product development focused startup firms (NPDSFs) handle missing expertise. The dimensions of the framework are: strategies for handling missing expertise, channels used to acquire missing expertise, and a priori awareness, timing and nature of missing expertise. Each dimension was analyzed in the context of data collected through interviews with entrepreneurs at NPDSFs. Obtaining free advice from experts and attempting to develop the missing expertise internally were the most frequently used strategies. The product development team’s own social and professional network was the most frequently used channel. Moreover, the results suggest that if an NPDSF does not anticipate the missing expertise, it will most likely run into it unprepared during the development phase of the new product development process. On the other hand, if it anticipates the missing expertise, it will most likely handle it during the planning phase by making structural changes to its product vision and operations. Therefore, being able to anticipate missing expertise might increase NPDSF success. The framework that was developed in the study can be leveraged in guiding future research.

KEYWORDS

Expertise, new product development, product design, startup, entrepreneurship

1. INTRODUCTION

New venture creation has gained momentum during the last decade in The Netherlands [1]. That trend is paralleled with an increase in the number of educational programs in Dutch universities [2], which widen the breadth of knowledge and skills that may be utilized in new ventures. Efficient access to relevant expertise is of specific interest to new product development focused startup firms (NPDSF) because the scarcity of their resources gives them limited flexibility in dealing with knowledge gaps. On the other hand, their innovation-centric value proposition leads them to frequently face knowledge gaps. Thus, their approach to managing this inherent tension is critical to their survivability. This research aims to illuminate that process by describing how small NPDSFs handle missing expertise.

In order to answer this question, an informed grounded theory [3] approach was used to develop a framework based on the literature and field work. The data that substantiate the framework were collected during interviews with product development team members and leaders at NPDSFs, and consultants who had worked with NPDSFs.

The main contribution of this research is the resulting framework, which can be applied to structure future research. Moreover, a set of propositions were extracted from the dataset by using the framework as a coding scheme, which can serve as guidelines for NPDSFs.

2. BACKGROUND

In this study, expertise is conceptualized as an advanced understanding of new product development (NPD) in terms of knowledge and skills. Advanced understanding implies that specific aspects of NPD knowledge and skills are not treated as disjoint low
level entities, and that their interactions constitute higher level contextual, behavioral and problem oriented competencies [4].

2.1. Literature review

Several expertise-related success factors have been identified for technology based NPD ventures. The most relevant one to this study is that missing knowledge has adverse effects for ventures [5]. On the other hand, a balanced distribution of expertise among the startup team members can contribute to success [6]. Completeness of the founding team in terms of having dedicated staff in key roles related to engineering, operations, finance and marketing is also a correlate of success [7]. Venture capitalists use the founding teams’ level of experience with the market and product as key criteria to evaluate new venture proposals based on the expectation that they will be determinants of performance [8], [9]. That expectation is congruent with findings that indicate founders of successful high technology ventures had previous experience in firms that operated in the same industry as the startup [10], and similar results have been obtained in other industries as well [11].

Therefore, the literature provides an understanding of if and why expertise is relevant to the success of NPDSFs. However, it offers limited information on how they handle missing expertise. One of the empirical studies that tackles the latter question identifies social capital as a mechanism for accessing expertise [12]. The study emphasizes the importance of cultivating personal networks rich in bridging social capital for entrepreneurs. It also highlights the need for distinct networking strategies at different time points, industries, and countries. A related study focuses on the role of social capital within business incubators, and concludes that the diverse set of actors operating at an incubator can potentially act as advisers and mentors for a startup past the incubation phase [13].

On the other hand, there is extensive information on how more mature NPD organizations deal with needed expertise from a knowledge management perspective with a particular focus on: how product and process knowledge can be documented and reused internally within the organization; the implications of that process for managing human resources; and, how new knowledge can be acquired from external sources.

A pertinent research approach has been to investigate differences between how novice and experienced designers deal with missing knowledge in mature NPD organizations. A study within the UK aerospace industry showed that although novice designers often expressed the need to talk to experts, they did not immediately ask for advice [14]. Instead, they preferred to note and compile questions. Two potential explanations were organizing questions for time savings purposes, and the need to develop confidence about the questions before consulting an expert. Thus, inexperience itself might act as a barrier to seeking information from experts in professional practice. The study also reports that novices are more likely to use trial and error approaches when designing whereas experts use specific strategies, which is consistent with other reports of novice-expert designer differences [15].

It is possible that novices engaged in NPD do not use advanced strategies for accessing information because they are unaware of them. Therefore, novice designers might lack the necessary expertise for utilizing more systematic and effective approaches to accessing, structuring, and applying NPD knowledge, and might benefit from process and tool based interventions to adopt advanced practices [16], [17].

Recognition of missing expertise can prompt designers to consult with experts within their organization [18]. Deken et al. observed that novice designers not only acquire knowledge from experts during consultations, but that they also jointly generate new knowledge [18], [19]. Seeking contextual information was identified as a critical activity since in the absence of sufficient contextual information, novices risk asking questions that do not fit the experts’ knowledge base, and the solutions generated by experts are unlikely to fit the novices’ situation. This observation has also been made when studying the utilization of process experts to contextualize formalized process knowledge for NPD teams in the automobile industry [20]. For NPDSFs, leveraging internal expertise through such consultations is not always a viable option given their small size. Nevertheless, when engaging external experts, sufficient contextualization might be an issue.

It has been argued that entrepreneurs convert general knowledge into economically relevant knowledge, and that investing in human capital can create more entrepreneurial opportunities [21]. Thus, it can also be argued that for many NPDSFs, the generation of new knowledge through R&D activities is probably not a good strategy, and it is more important for them
to acquire available expertise instead. This view is supported by empirical findings which reveal that R&D intensity is negatively correlated with return on investment for firms with low market share [22], and by subjective evaluations of that relationship by entrepreneurs [23].

Thus, executing the right strategy for acquiring expertise that is available externally may be more relevant than trying to generate it internally. This is congruent with the findings of a study which compared corporate vs. independent ventures in terms of resource performance relationships and found that “success may be less a function of the different resources ventures have and more a function of what strategies the firms choose based upon their resources” [24, p. 48].

Moreover, documenting the expertise available internally within the organization is relevant. At the team level, systematic approaches to knowledge management can provide structure and stability. Although active knowledge management is currently not standard practice, it has been argued that it will become an integral part of project and team management because team and project work are increasingly adopted as the most effective approach to organizing knowledge work [25].

An example of active knowledge management in teams is cross-training. Cross-training increases productivity and transparency by reducing organizational silos—when business functions work independently without considering the shared goals—between departments [26]. Although it may seem natural for this to be more of an issue for large companies, it would be unsound to assume NPDSFs should not be concerned with it. Close working relationships among a small group of people does not necessarily guarantee a shared understanding of the organization on strategic or operational levels.

Finally, handling missing expertise can mean learning new skills. Skills are learned by a combination of gaining knowledge and experience. Skills often can only be mastered when experience is processed and given meaning [27], which once again turns the spotlight to the necessity of interacting with and utilizing experts.

2.2. Research questions

The literature review resulted in the decomposition of the primary research question—how do NPDSFs handle missing expertise—to the following research questions:

- Was the missing expertise anticipated?
  
  Rationale: Given there might be differences in information seeking behaviour between novices and experts in industry, it is relevant to consider if NPDSFs are proactive by anticipating missing expertise, or if they are reactive and run into it.

- In which phase of the NPD process was the missing expertise experienced?
  
  Rationale: Many of the referenced studies analyse if new venture characteristics prior to receiving external funding correlate with success, which highlights the significance of the timing of having access to relevant expertise in the growth cycle of a venture.

- Was the missing expertise NPD process or product related?
  
  Rationale: The literature reports a correlation between the founders’ experience in developing similar products and in working at other firms operating in the same market as the new venture and success. This implies the relevance of not only having an understanding of the product space, but also of the process of developing the product. Thus, understanding more about the nature of missing expertise in this regard is informative.

- What strategy was used to handle the missing expertise?
  
  Rationale: Although some potential strategies are discussed in the literature such as investing in social capital and not being overly R&D intensive, a more comprehensive discussion on the different strategies available to NPDSFs and the extent to which they are utilized is needed.

- Through what channels was the missing expertise acquired?
  
  Rationale: Although some channels for acquiring missing expertise are discussed in the literature such as consulting with experts within the organization and utilizing incubator networks, a more comprehensive discussion on the different channels available to NPDSFs and the extent to which they are utilized is needed. Moreover, it is relevant to analyse if certain strategies lead to the use of certain channels.
3. METHOD

An informed grounded theory [3] approach was used in responding to the research questions by developing a framework on how NPDSFs handle missing expertise, which is presented in section 4. Informed grounded theory counters the belief that literature review needs to postponed until the end of data analysis in grounded theory [28] driven research. A traditional grounded theory approach could have been followed given there is a knowledge gap in the literature on what the framework aims to describe. However, as presented in section 2.1, there is relevant information that should be taken into account. Thus, an informed grounded theory approach was utilized in order to leverage that information while allowing the salient points to emerge from the dataset.

That entailed considering the information identified in the literature in conjunction with the qualitative responses to the interviews conducted at NPDSFs. Thus, although no specific hypotheses were constructed based on the literature review, the research questions were based on it, and guided the iterative analysis of the qualitative dataset. Since this is an exploratory study, its primary purpose is to construct the framework as opposed to validate it. Therefore, having documented the research questions and their rationale in section 2.2, the purpose of this section is to provide information on how interviews were conducted in the field, and how the responses were analyzed.

3.1. Data collection

The data were collected through interviews with product development team members and leaders, who were working at NPDSFs at the time of data collection, or at more mature companies that had recently gone through the startup phase. Consultants who had provided expertise to NPDSFs were also interviewed in order to broaden the perspective within the dataset. Interviewees at the mature companies were asked to reflect on the experiences they have had during only the startup phase. Consultants were asked to reflect on the experiences they have had with NPDSFs. One person was interviewed at each firm.

The specific focus of this study was small NPDSFs in their formative stages with about five employees or less that had either recently started generating sales or were planning to do so in the near future. The firms were all based in The Netherlands. Detailed information on the NPDSFs and the interviewees is provided on Table 1.

The interview protocol aimed to initiate an exploratory discussion on the research questions in the context of the NPDSFs, and contained specific prompts on the following topics:

- Definition of expertise
• Knowledge management processes
• Description of products under development
• Description of team formation approaches
• Identification of missing expertise—when and if it was anticipated
• Approaches to handling missing expertise
• Engagement of external experts in handling missing expertise
• Training practices within the firm
• Outsourcing practices within the firm
• Barriers to handling missing expertise

This protocol was modified slightly depending on the role of the interviewee within the firm, and the type of firm.

3.2. Data analysis

All interviews were transcribed. The initial analysis entailed reviewing the transcripts in response to the research questions presented in section 2.2, and was conducted collaboratively between the authors. Potential answers to each research question were first listed, and then clustered. The resulting clusters were further discussed among the authors to minimize or eliminate conceptual overlap between them. The final set of clusters constitutes the majority of the categories listed under each dimension of the framework presented in section 4. Three categories were extrapolated from the clusters as theoretical possibilities, and did not directly manifest themselves in the data. They are the categories in Figures 4 and 5 for which no cases have been reported. The research questions constitute the five dimensions.

After the framework was established, the data were analysed again according to a case-based coding approach. A case consisted of a situation reported in an interview that was related to the identification of a specific instance of missing expertise, and how it was handled by the product development team. As such, a case can be construed as a specific interaction across the five dimensions of the framework. All transcript coding decisions individually made by the authors were reviewed as a group to ensure consistency and accuracy. 31 cases associated with missing expertise were identified. The cases were then used to determine the incidence of each category under each dimension, which are reported in section 5. Relationships between strategy and channel usage, and missing expertise anticipation and strategy usage were analysed and also reported in section 5.

Finally, other relevant issues that were brought up during the interviews that remained outside of the scope of the framework were identified and tagged for reporting in the discussion in sections 5 and 6.

One such issue was the outcome of the cases. For instance, questions in the following format could have been formulated: was anticipation of the missing expertise during a specific phase of the NPD process and handling it with a specific strategy and through a specific channel effective? However, given the number of permutations of the five dimensions that can possibly make up a case is high compared to the actual number of cases, a generalization from such specific interactions could not have been achieved and was not attempted. Regardless, the interviewee’s opinion of the consequences of a case was still explored. Also, an objective effectiveness measure such as financial performance was not utilized because the primary focus of this study was to understand the different mechanisms NPDSFs utilize to handle missing expertise as opposed to judging the effectiveness of those mechanisms. The latter is relevant topic for future research.

4. FRAMEWORK FOR HANDLING MISSING EXPERTISE IN NPDSFs

The framework for handling missing expertise in NPDSFs presented in this section was arrived through the process discussed in section 3.2. The framework has five dimensions, which map onto the research questions of the study, and each dimension has multiple categories associated with it (Figure 1). In this section, the categories are described in detail.

A priori awareness of missing expertise

Anticipated: Team realizes that it lacks the missing expertise before the project progresses to the point when it becomes necessary.

Not anticipated: Team does not realize that it lacks the missing expertise until the project progresses to the point when it becomes necessary.

Timing of missing expertise

Planning: Team experiences missing expertise in the front-end of the NPD process during which product vision and requirements are constructed.

Development: Team experiences missing expertise in the latter phases of the NPD process during which solutions that address the product vision and requirements are generated, evaluated, refined, and implemented.
Nature of missing expertise

Content-related: The missing expertise is related to the product under development. For example, understanding of the technology embedded in the product, and skills that enable the accomplishment of a development task fall under this category.

Process-related: The missing expertise is related to the process that is being followed to develop the product, and is product independent for the most part. For instance, working knowledge of project planning or decision-making tools fall under this category.

Strategy for coping with missing expertise

Ignore and proceed: Team ignores the missing expertise although it is aware of the issue, and attempts to advance the project without taking any specific action to address it.

Company acquires the missing expertise internally: A team member or members acquire the missing expertise.

Obtain free expert advice: Team informally obtains advice from an individual, stakeholder (e.g. supplier), or government or non-profit agency who has the missing expertise and is willing to share it for free.

Recruit a new team member: Team recruits a new team member who has the missing expertise into the team/company on a permanent basis. New team member might be someone with a professional consulting background.

Engage consultant as a contractor: Team recruits a consultant who has the missing expertise and history of professional consulting experience on a temporary basis as a paid contractor.

Outsource the task: Team outsources the task that depends on the missing expertise to another entity outside of the team on a professional basis. The milestone associated with that task is returned by the entity to the team.

Redefine product vision: Team decides that acquiring the missing expertise is not feasible based on its operational constraints, and reframes the project such that the redefined product vision does not require that expertise.

Strategic partnership with an external entity: Team shares (or applies) some of its expertise with another organization in exchange for the expertise it misses.

Channel for acquiring missing expertise

Team’s network: Team identifies the source for handling the missing expertise through its own social or professional network. (This should not be confused with the next four channels below. For instance, if the expertise was directly acquired from a supplier, the channel was the team’s own network since the supplier was already a part of that network. However, if the supplier acted as a gateway to a third party that provided the missing expertise, the channel would be the supplier’s network since the third party was not initially a part of the team’s network.)

Consultant’s network: Team identifies the source for handling the missing expertise through the social or professional network of a consultant it has professionally engaged.

Supplier’s network: Team identifies the source for handling the missing expertise through the social and
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Additional analysis was conducted to explore the relationship between timing and awareness of missing expertise. 90% of the anticipated missing expertise cases were experienced during the planning phase and 10% during the development case. Conversely, 6% of the unanticipated missing expertise cases were experienced during the planning phase and 94% during the development case.

5.3. Nature of missing expertise

The majority (87%) of the missing expertise cases were product-related whereas 13% were process-related (Figure 4). It should be noted that the interview protocol did not prompt the subjects to refer to specific types of missing expertise, and subjects’ conceptualizations of expertise might have affected their choice of which missing expertise cases to report in the interviews.

5.4. Strategies for handling missing expertise

The cases were analyzed to determine the strategies that were used to handle missing expertise according to the framework. The results are shown in Figure 5. Obtaining free expert advice and acquiring the missing expertise internally are the most frequently used strategies. Missing expertise was not ignored in any of the cases, and strategic partnership with another entity was used only once. Pertinent qualitative findings associated with each category are presented below.

**Obtain free expert advice**

This strategy was used not only when NPDSFs were missing expertise, but also when they wanted to validate the work produced at various points in the process and to reflect on progress.

The following excerpt from an interview illustrates a case in which the interviewee from firm A “drops
by” a laboratory in the university he studied to check if the electronics experts there would suggest the use of a different part than the one he was considering.

“Yesterday I went to the electronics lab. I told the employees of the lab about one of the problems we had with our bike and asked them how they would handle it. I am not an electrical engineer, so there might be an existing part that I don’t know about.”

The main affordance of this strategy is that it can quickly yield effective information that can be integrated into the workflow of the NPDSF. Thus, it is efficient, but requires a broad ubiquitous first-order social network.

**Acquire missing expertise internally**

In NPD, there is always expertise that needs to be acquired internally because NPD organizations not only consume but also create new knowledge - even if the creation of new knowledge is solely a product of adapting existing knowledge. Here, the analysis is concerned more with if the members of the NPD team are in a position to generate the new knowledge and acquire any necessary skills within the resource and time constraints of the NPDSF.

Acquiring the missing expertise internally was the preferred strategy for handling missing expertise in the study. However, in certain situations, it may actually be more cost effective to acquire it externally even if the team has the capacity to acquire it internally.

For instance, in one of the cases, the team at firm B was aware that there was advanced knowledge available in another organization that would address its missing expertise. However, it did not have the financial resources at the time to license the intellectual property. The team also knew that it was not positioned to fully develop it by itself. Ultimately, a hybrid strategy was used where the team generated the “minimum” knowledge to develop and launch the product. It used the resulting revenue to purchase the more advanced knowledge to incorporate into the next generation of the product.

In another case, firm E developed the basic expertise necessary to undertake the task internally just to be in a position to better interface with the external consultant they hired as a contractor to execute the task. This is congruent with research findings regarding the need to contextualize the expertise gap to the consultant [18], [20]

**Outsource the task**

This strategy meant that the missing expertise was not gained internally, or handled directly by the NPDSF. The task that depended on the missing expertise was executed by an external party. The external party acted on the input from the team, and provided the required output.

A generalizable case is related to manufacturing. The team at firm A was planning to produce its product in low volume for testing purposes by using its own manufacturing expertise and facilities. However, the team knew that the commercialization of the product would result in manufacturing expertise it did not possess, and was making plans to outsource the manufacturing operation.

“First we make everything ourselves but later on we are going to outsource more and more. The first prototypes we will build ourselves, the sight prototype, test models, all the way up to the 0-series. When that happens we are going to outsource, some parts will be ordered at factories, for instance in Taiwan. We do not plan to have our own factories.”

**Redefine project goal and product vision**

This strategy was used when an NPDSF identified missing expertise it was not in a position to handle due to time and resource constraints, but had enough flexibility in its business model to change its product vision. In other words, the issue of missing expertise was not handled, but evaded, and the team modified the product vision such that the new vision was better related to the expertise it did possess.

For instance, during the planning phase, firm A identified service design as a topic it lacked expertise in, and redefined its product vision to go around it.

“First we wanted to create a service system around the bike. Not just the product but also the service around the product.” The team then concluded: “It would cost too much effort. We are better at designing products, so let’s stick to that.”

**Recruit a new team member**

Importing the expertise into the team by way of recruiting a new team member who has the missing expertise resulted in the expansion of the startup team. It also made the expertise of the new team member available not only in the current situation, but also in potential future situations.
The analysis revealed that a new team member with the required expertise can even be a catalyst for the creation of the NPDSF. Before firm B was founded, two of its founders were considering starting a new venture, but they knew that they did not have the necessary expertise covered among them. They had an idea to develop audio products but lacked the expertise to build it. Bringing in someone with that expertise effectively launched the startup.

“The shop owner had the idea of upgrading the current (imported) products. But he did not know how to realize his idea. He already had a friend in electronics, but no one that could really build the products. So, the three of us started a company soon after he met me.”

Recruiting a new person into a startup can mean giving them ownership in the firm since it is common for the founders not to draw salary during the initial period (several interviewees in this study reported financially supporting themselves through part-time employment outside of the startup). Therefore, the significance of the missing expertise can drive this decision. This is supported by the rationale provided for using this strategy by firms B, D, and E in this study.

Engage consultant as a contractor

This strategy is similar to bringing in a new team member, but the team expansion and the gained expertise is mainly temporary and can significantly affect the wage bill during the engagement since experts charge high rates as contractors.

For instance, firm J was designing a machine to cut bread, and hired a specialist for a specific task that it did not have expertise in.

“The missing expertise was knowledge about saws. The teeth of the saw have a very big influence on how it cuts, residue, etc. Instead of trying to learn and to design the new perfect teeth, we simply asked an expert to design the best tooth.”

Strategic partnership

This strategy was used when the NPDSF and another party were working independently on similar topics, and lacked expertise in different areas.

More specifically, the team at Firm G was introduced to a team of graduate students in a university by a client, who suggested that the two teams collaborate in order to advance their projects. The tasks that relied on missing expertise were exchanged between the two teams.

“This Lowlab committee informed us about a team of TU Delft students who were working on a similar project. We got in contact with the students. Then the students focused on the fritting process and we focused on the extrusion process.”

This approach necessitates the end goals of the two parties to be non-conflicting so that the strategic collaboration is mutually beneficial.

5.5. Channels used to acquire missing expertise

It was not possible to conclusively determine the channel that was used to acquire the missing expertise in 8 of the cases. The remaining 23 cases were analyzed according to the framework. The results are shown in Figure 6.

The most frequently used channel for acquiring missing expertise is the team’s own professional and social network. Experimentation and research and the supplier’s network are also frequently used channels. Consultant’s network and human resources agencies were not utilized.

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<th>Channels used to acquire missing expertise</th>
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<td>Team’s network</td>
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<td>Experimentation and Research</td>
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Figure 6  Distribution of the channels that were used by the NPDSFs to deal with the 23 missing expertise cases in the study across the categories of the framework.

5.6. Mapping strategies and channels

Additional analysis was conducted to explore the relationship between the strategies and the channels
that were used to handle missing expertise. Three distinct patterns were observed. Out of the 8 cases that entailed the use of the acquiring missing expertise internally strategy, 5 led to the use of a channel that could be identified, and 4 of those cases used the experimentation and research channel. Thus, the acquiring missing expertise internally strategy was executed mainly through experimentation and research.

Out of the 8 cases that entailed the use of the obtain free expert advice strategy, 5 led to the use of the team’s network channel. Thus, the obtain free expert advice strategy was executed mainly through the team’s network. All 3 cases that entailed the use of the recruit new team member strategy entailed the use of the team’s network channel. Thus, the recruit new team member strategy was executed through the team’s network.

5.7. Strategy differences between anticipated and unanticipated cases

Additional analysis was conducted in order to determine if there are differences in strategy usage between anticipated and unanticipated cases of missing expertise. The proportion of each strategy in the 10 anticipated and 18 unanticipated cases were compared. When missing expertise was anticipated, the recruit new team member, redefine product vision, and outsource the task strategies were used more (18% vs 5%, 18% vs. 5%, and 27% vs. 10% respectively).

When missing expertise was not anticipated, the consultant as contractor and obtain free expert advice categories were used more (15% vs. none, 35% vs. 9% respectively). However, the statistical significance of these differences could not be tested since the number of categories (8) compared across the two conditions was large in relation to the number of cases (28).

6. DISCUSSION

The analysis highlighted a tension between the cofounders wanting to start the venture with people they know, and ensuring that the necessary basis for the required expertise is covered. The former restricts potential cofounders to one’s immediate social circle, and the necessary expertise might very well lie outside of it. Therefore, when composing a founding team that will maximize coverage in necessary expertise, it seems that one either needs to have a wide social circle, or be willing to trade-off the perceived benefits of starting the venture with people he/she knows personally. Although the literature reports the need to have a balanced team in terms of expertise [6], [7], and to invest in social capital to achieve it [12], it only indirectly addresses the need of the cofounders to trust the other cofounders [29], which may be why the entrepreneurs in this study expressed a sentiment toward starting the venture with people they knew fairly well.

The analysis also identified an interesting trend regarding the significance of having a priori awareness of missing expertise: if the NPDSFs does not anticipate the missing expertise, it will most likely “run into” it unprepared during the development phase of the NPD process. On the other hand, if it anticipates the missing expertise, it will most likely proactively handle it during the planning phase. These observations put an emphasis on successful strategic planning since “running into” missing expertise is highly likely to result in delays in the NPD process and cost overruns.

Moreover, the results suggest that anticipating the missing expertise might have consequences for the strategy used to handle it. Anticipation seems to increase the use of strategies that result in structural changes to team composition, product vision, and outsourcing. Failing to anticipate seems to increase the usage of ad-hoc strategies that do not result in structural changes.

It is somewhat surprising that an overwhelming majority of the missing expertise cases reported in the study were content-related. This could be an indication that either the entrepreneurs had advanced process expertise, or they did not fully comprehend the significance of process expertise in NPD. More qualitative research is necessary to put this finding in context.

The NPDSFs in the study relied heavily on gaining the expertise internally and obtaining free advice from experts as strategies. Although the latter is efficient, the former might not be. The former strategy might have been preferred because the majority of entrepreneurs in the study perceived a long-term benefit in it in terms of the potential to reuse the acquired expertise. However, some of them also thought that the strategy extended product development time, and were aware that they might be making trade-offs between expertise reutilization and development time and cost. The strategy might have also given them a stronger sense of control. However, heavy reliance on acquiring the expertise
internally can be problematic. As discussed in the literature review, there is a negative correlation between R&D intensity and startup success [22], [24]. A mediating variable might be how advanced the missing expertise an NPDSF is attempting to acquire.

Another commonly used strategy was outsourcing, and the NPDSFs that used that approach perceived improved feasibility of the product as the main benefit. In other words, they had more confidence in the task being successfully executed under the control of an external expert entity. On the other hand, engaging a consultant as a contractor and temporarily bringing him/her into the team was mainly perceived as an accelerator for the development process.

It is interesting that none of the interviewees reported ignoring missing expertise. Clearly, ignoring missing expertise can be detrimental. However, it can be justified in certain situations. More specifically, the NPDSF can decide to proceed without handling the missing expertise if the cost-benefit outcome is favourable. In other words, if the missing expertise is not critical, a sub-optimal solution that can be reached without the expertise might be satisficing enough to warrant proceeding with product development. However, it can be argued that making a plausible cost-benefit analysis in such a scenario is challenging, and that proceeding with a sub-optimal solution would not constitute informed risk management. This brings up the question of how NPDSFs perceive and manage risk in general, which is beyond the scope of this study. However, it is possible that the real reason the use of this strategy was not reported in the study might be the unwillingness of the interviewees to voice that they did not practice sound risk management.

None of the strategies were reported to be ineffective in handling the missing expertise from the perspective of product quality. In other words, all of the strategies that were used were reported to have “worked” in terms of handling the missing expertise and advancing the development of the product under the time and resource constraints.

The NPDSFs in the study overwhelmingly relied on their own networks as a channel for acquiring missing expertise, which is perhaps not surprising as that is the most immediately available mechanism. If an NPDSF’s own network is broad and diverse, then this can indeed be an effective channel for accessing the necessary expertise. However, going beyond one’s own network can have a multiplier effect, and it is somewhat surprising that the teams did not tap into remote networks more frequently to access even more diverse sources of expertise.

Finally, as discussed in the literature review, although it has been argued that active knowledge management techniques can effectively structure knowledge-intensive work, the NPDSFs in the study did not report using them with the exception of the team at Firm E, which used a logged chat room to document decision rationale. The rest of the teams did not perceive the benefit of active knowledge management because it was too time consuming to document the knowledge or to reuse it. This rationale is congruent with what has been observed at mature companies [25]. However, less experienced product designers might have limited information literacy and knowledge acquisition strategies [14], [15], and structure in the form of training and tools can facilitate NPD knowledge documentation and reuse [16], [17].

7. LIMITATIONS

The primary limitation of this study is the generalizability of its findings since the research was conducted by using a single data collection method with a relatively small set of NPDSFs (9) and consultants (2) in The Netherlands. Therefore, it is not clear if other NPDSFs—especially in other countries—would exhibit similar behaviours given research has shown that there are country specific differences in new venture success factors [12].

Another limitation is that the study did not attempt to objectively evaluate the efficacy of the observed interactions between the dimensions of the framework. That requires the utilization of more objective performance metrics such as return on investment as opposed to self-reports. However, that would have required longitudinal data collection to be meaningful given the study focused on small NPDSFs in their formative stages. This study was exploratory, and its main objective was to identify the relevant behaviours associated with handling missing expertise in NPDSFs, and to present them in the form of a framework.

8. FUTURE WORK

As mentioned in the introduction, the primary goal of this research was to develop a framework for how NPDSFs handle missing expertise, which was achieved. Although the framework was also used as
an analysis tool to identify specific mechanisms of handling missing expertise, its potential is in future deployment in order to systematically evaluate the efficacy of those mechanisms. In that context, the framework can be used to guide further qualitative work, or its differentiating principles and structure can be translated into a survey instrument. The authors plan to pursue the latter method since it would be lead to more generalizable findings.

There are several conditions that can be explored with a survey instrument that build on the framework presented in this study. One approach is to deploy the tool with NPDSFs in The Netherlands as well as other countries to see if the preliminary findings of this study are generalizable to not only The Netherlands, but also to other markets. Another approach is to systematically compare NPDSFs to mature NPD organizations within a specific market to understand if and how missing expertise handling practices change as ventures grow.

9. CONCLUSION

This study resulted in the development of a framework that describes how NPDSFs handle missing expertise. The framework identifies and articulates a set of strategies and channels that are used by NPDSFs to handle missing expertise.

The application of that framework as an analysis tool showed that being able to anticipate missing expertise might increase the success of an NPDSF because such awareness seems to lead to the handling of the missing expertise early on during the NPD process by resulting in structural changes to team composition, product vision, and outsourcing.

The analysis also showed that entrepreneurs in the study had a strong bias toward cofounding the NPDSF with people they personally knew, which set up a tension between the need to trust and the potential benefits of a more diverse expertise base. On a similar note, the NPDSFs in the study relied primarily on their own networks as a channel to access missing expertise. Although that behaviour is efficient, it fails to recognize the significance of going beyond one’s immediate network. Thus, expertise in networking (in order to access missing expertise) is as a critical developmental area for NPDSFs that may lack it.

The following guiding propositions are put forward based on the findings, which are particularly relevant to entrepreneurs who are interested in starting an NPD venture. Founding NPDSF teams should:

- Be composed not only to ensure coverage in the relevant areas of expertise, but also to avoid confusion around roles in cases of expertise overlap.

- Anticipate missing expertise, and consequently, be prepared to make structural changes to product vision, team composition, and outsourcing.

- Seek training on information literacy and knowledge acquisition processes and tools.

- Contextualize their expertise gaps to consultants and other external parties when engaging them.

- Invest in building relationships that go beyond their immediate social networks with parties that can serve as direct stakeholders in their NPD process in order to access potentially more diverse types of expertise.

- Exercise obtaining free advice from experts within their immediate social network as an efficient strategy, but should not view it as a substitute for the above proposition.

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