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The development of zero-energy transformation concepts in The Netherlands. A comparative case study analysis of two transformation concepts

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Abstract

In a new product development project numerous decisions are made that influence the course and the outcome of the project. Remarkably, little research is done on how decisions in new product developments are actually made and how the decision making affects the performance. This research contributes to closing this gap of knowledge by comparing the decision making of two new product development projects. This study provides insight in the importance of various decisions and how successful decisions should be made. The study contributes to the new product development literature through extensively studying the use of decision making styles in two product development projects of transformation concepts. The empirical findings emphasize the importance of understanding the context of projects and the way decision should be made to be successful.

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1. Introduction

The social housing sector in the Netherlands has set itself the challenging task to transform 100,000 social houses in a timespan of seven years to zero-energy-usage homes. Six social housing associations and four construction companies are involved in this transformation process. The six social housing associations have taken

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responsibility to provide the required houses, whereas each construction company has committed to develop its own zero-energy-usage transformation concept.

The challenge is to come up with an integral zero-based energy concept that can be implemented on a large scale and assembled in a very short time frame. Special attention therefore needs to be paid to large scale production and assembly of the concepts on location. Since the tenants will stay in their homes while assembly takes place on location, the actual assembly not only needs to be fine-tuned with the respective social housing association, but also with the tenants.

To realize the agreed transformation target, the construction companies will need to take various strategic decisions. This varies from decisions on their concept proposition and consequently the design, the production and the assembly of the concept to the selection of their innovation partners. It is important for the companies to make the right decisions, in the right way, because a great deal is at stake.

In the past few years there is a growing interest on decision making in the new product development literature. Initially the scholars were focused on the decisions in an innovation context, particularly the stage-gate-decisions, i.e. go/no-go-decisions. In the more recent years, the focus is on the process of decision making [1,2]. Various scholars discussed the decision making regarding the innovation portfolio [3-5], whereas others studied the decision making in new product development projects [6,7].

In spite of the increase of studies on decision making in an innovation context, there is still little known how decisions are actually made in innovation projects. The aim in this study is to determine what the important decisions are in a new product development projects and which decisions have a large effect – either positive or negative – on the eventual intended outcome. The corresponding research questions are: “What are important decisions in a new product development project and how does the decision making affect the project outcome?”

In order to answer the research question a multiple-embedded case study is conducted. The studied cases represent two of the four transformation projects. The most important decisions in this case were identified and the decision making styles of these decisions were compared to the decision making of the less important decisions. The paper is structured as follows: First, the literature on decision-making in new product development projects is reviewed. Then, the research methodology is introduced and the collected data is analysed. The paper concludes with the contributions to the literature; the managerial implications; the research limitations; and, proposes directions for future research.

2. Theoretical background

2.1. Renovation in the housing sector

Although the research on renovation in the housing sector is limited, three main streams can be distinguished. The first stream is focusing on the policies that are applied to promote the use of energy-saving renovations [8-10]. These studies described the policy instruments that are used by national and European governments and what the effects are of these policies. The second stream focuses on the performance of energy-saving renovations [11,12]. The performance is for example determined through evaluating the energy effectiveness of the concepts or their payback time [13]. The third stream studies the adoption and implementation of energy renovations in the housing sector. These studies focus on the context in which the renovation concepts are proposed and which aspects play a part in a successful renovation [14,15].

2.2. Decision performance

Mintzberg, Raisinghani and Theoret [16] define decision making as “a set of actions and dynamic factors that begins with the identification of a stimulus for action and ends with the specific commitment to action” [16p. 246]. In this definition as well as the process of decision making as the outcome of decision making are incorporated [16,17]. Both are items of which the performance is widely discussed in the literature [18-21]. The process of decision making is frequently measured through comprehensiveness of the decision making and the speed of the decision process [18,20,22,23], whereas the outcome is measured via e.g. effectiveness and acceptance [17,19,21,24].

Decision comprehensiveness can be defined as the extent to which a decision maker attempts to be exhaustive or inclusive in making and integrating decisions as it considers multiple approaches, courses of action, and decision criteria in its decision making [22,23]. Decision speed on the other hand is about the pace a decision is made. Most

of the few empirical studies that examined the association between decision speed and firm performance found a positive association [18,25,26].

Decision effectiveness is defined as “the extent to which a decision achieves the objectives established by management at the time it is made” [19, p. 372]. Whereas the decision effectiveness measures the degree in which the objectives are achieved, affective acceptance is a by-product of the decision making process and is defined as the degree to which team members maintain interpersonal relationships that allow them to work together effectively in the future [17,24].

2.3. *Styles of decision making*

In the decision making literature three dominant style are distinguished: the rational, the political and the intuitive style [3,27,28]. The rational style is based on the concept of rationality which is the logical or sensible behaviour of pursuing goals [29]. In economics, rationality in decision making is equalled to utility maximization, which is the individual behaviour to seek for the maximization of one’s expected pay-off [3]. However, various studies showed that the assumptions of economic models are unrealistic [29,30]. As a contradiction to the normative models, the concept of bounded rationality was used to describe decision making from a rational perspective. In the concept of bounded rationality decision makers are limited through their own capabilities and environmental constraints [27,29]. Given the limitations, decision makers tend to search for the information that is necessary to make decision that satisfies the decision maker’s interests [27,31].

The political style holds the view that a decision is the outcome of a political process in which the preferences of the most powerful coalition of decision makers triumphs [19,27]. The traditional view on political behaviour in decision making states that politics arise from conflicts over objectives and beliefs, while a more recent view argues that political behaviour results from power imbalances [19,27]. The concept of the political model is based upon these two key insights [19]. First, decision makers may have different interests that are the result from functional, hierarchical, professional, and personal factors. Second, decision makers try to serve their own interests by influencing the decision outcome with a wide variety of power resources [3,27,28,32]. Power resources that are identified in the literature are the ability to manipulate resources, deal with uncertainty, expertise, authority, control over information and being irreplaceable [32,33].

In the intuitive style decisions are made with the help of intuition, which is defined by Dane and Pratt [34] as “our inborn ability to synthesize information quickly and effectively” [34, p. 33]. The ability of decision makers to synthesize the information and make a decision is based on the deep and intimate knowledge of the decision situation [27,28]. Khatri and Ng [35] argue that intuition is subconscious, complex, quick, not emotional, not essentially biased and part of all decisions. The latter means that even in decision-making process in which only rational-analytic methods are used, there is always a trace of intuition present [35]. Three operational indicators of intuitive decision making are widely addressed in previous studies [28,35]. The first indicator is the reliance on judgment, which is used in decision situation where decisions should be made quickly, adequate information is absent and there is no precedent. The second indicator is the reliance on prior experiences. Decision makers tend to use the knowledge of past experiences to make a cognitive conclusion of a decision situation [28,34]. The third indicator is the use of ‘gut-feeling’. Decision makers can have a strong feeling about the situation, but are not able to articulate the reasoning on which the decision making was based [28,35].

2.4. *Decisions in new product development projects*

Various scholars have attempted to categorize the decisions in a new product development project. Krishnan and Ulrich [36] distinguished four categories, based on the functional aspects of the development process: engineering design; marketing; organisation; and, operations management. Brun, Saetre and Gjelsvik [37] identified similar categories, but used other terminology to categorize the decisions: product; market; organisational resources; and, process. Finally, the categorization proposed by Yahaya and Abu-Bakar [38] shows an overlap with the previous two, but they added two new categories, which are related to the project strategy and the structural aspects of the project. Based on these categorizations a new categorization is proposed that incorporates all the categories.

Within new product development projects a broad range of decisions can be identified [36,39]. These decisions vary from the design of the concept that are linked to the various phases of the development process [40-42], to the integration of the supply chain in the process [43-45] and from the launching strategy of innovations [46,47] to the

organizational structure of the project [38,48]. The list of decisions in the review of Krishnan and Ulrich [36] serve as a basis for filling in the proposed categorization and is extended with decisions from other studies [37,38,40,42,45,46]. The categorized decisions can be shown in Table 1.

Table 1. Categorized decisions in a new product development project

| Category | Decision |
|---|--|
| Strategy | Which innovation project will be pursued? |
| | What is the business model of the innovation? |
| | What are the project objectives? |
| | What are the major project milestones? |
| Product | What is the core product concept? |
| | What is the product architecture? |
| | What variants of the product will be offered? |
| | Which components will be shared across which variant of the product? |
| | What will be the overall physical form and industrial design of the product? |
| | What are the values of the key design parameters? |
| Process | What is the design of the component(s)? |
| | What is the configuration of the physical supply chain? |
| | How will the product be designed? |
| | How will the product be produced? |
| | How will the product be assembled? |
| Organization | What type of development process will be employed? |
| | What is the plan for production ramp-up? |
| | Who will design the components? |
| | Who will produce the components? |
| | Who will assembly the components? |
| | Who has the power of decision? |
| | How will the project organization / team look like? |
| | Who will be part of the project organization? |
| What will be the physical arrangement and location of the team? | |
| Structural | How will be the communication among team members? |
| | Which organizations will be involved in the project? |
| | How will the project be positioned in the firm? |
| | What is the prototype plan? |
| Marketing | How will project performance be measured? |
| | How will the project be monitored and measured? |
| | How will the information and knowledge be stored? |
| | What is the plan for market testing and launch? |
| | What will be the market of the product? |
| | How will the product be distributed? |
| | Who are the customers of the product? |
| Who are the end-users of the product? | |
| Finance | What are the needs of the customers / end user? |
| | How will the product be priced? |
| | What investments will be made for this project? |
| | How will the profit and losses be distributed? |
| | How will the cash flow of the project be? |

3. Research methodology

Case studies are well suited to studying phenomena in their natural setting, especially when the boundaries between phenomena and their context are not clearly evident [49]. The design of this research is a multiple embedded case study. A multiple case design allows us to use the literal replication logic for which two to three cases are sufficient for literal replication [49]. The embedded design of the research denotes to the use of several units of analysis.

The in-depth case studies are two development projects. Case 1 represents a non-successful project which was

terminated in January, 2016, while Case 2 represents a successful project. In both projects a zero-energy-usage transformation concept is developed.

3.1. Data collection

The data in this study is mainly collected through documents and extensive interviews with persons that were highly involved in the project. The data was collected while both projects were still on-going.

The interviews in this research had a semi-structured character. An interview guide was used in the interviews. First to determine the important decisions in the project and second to recover the way these decisions were made. During the interviews the distinction was made between the decisions in which the interviewee was involved and in which not. Only the former were discussed with the interviewee. This way it was possible to reconstruct decisions based on first-hand experiences. An overview of the used data sources is given in Table 2.

The interviews in both cases were not limited to persons of the lead firm, also persons from the partner firms were interviewed. Firstly, the interviewees were asked what they considered as important decisions in this project. After a first series of decisions was obtained, a list of decisions based on earlier research was presented to the interviewees. The interviewees were asked if the first series could be complemented with decisions of the presented list. Secondly, based on the final series of decisions, a selection was made between the important decisions in which he or she was involved and in which not. Thirdly, the important decisions in which the interviewee was involved were discussed with the interviewee focusing on the process of decision making, the style of decision making and the outcome of the decision.

Table 2. Overview of data sources per case

| | Sources of evidence | Details |
|--------|---------------------|---|
| Case 1 | Interviews | 21 interviews with 18 persons (average interview length was 87 minutes) |
| | Documentation | Project reports, presentations, agendas, minutes, professional articles, and newspaper articles |
| Case 2 | Interviews | 16 interviews with 16 persons (average interview length was 90 minutes) |
| | Documentation | Project reports, presentations, agendas, minutes, professional articles, and newspaper articles |

3.2. Data analysis

The first step in the data analysis was to create an overview of the project and to develop a provisional timeline of the project and its decisions. The overviews were used to create a better understanding of the project and its decisions, which made it possible to ask supplementary questions.

The second step was to process and to classify the decisions that were discussed during the interviewees. The classification was partly based on earlier research on this topic, however for some decisions a new classification was introduced. The decision types are presented in Table 1.

The third step was to process the decisions that were discussed in depth with the interviewees. Some decisions were described by multiple persons. These descriptions were merged into one single description. As a final check the final list of decisions was compared with the provisional timeline.

The fourth step in the data analysis was to quantify the decision making processes based on the degree of rationality, intuition and politics on a scale from 1 (very low) to 7 (very high). Also the decision performance, i.e. speed, comprehensiveness, effectiveness and acceptance was quantified in a same way. Only in case of speed the scale is from very slow (1) to very fast (7).

The final step was to compare the decisions in both cases. The first step in this comparison was to determine the performance within and between cases. The second step was to determine the decision making processes based on the decision performance.

4. Cases

4.1. Case descriptions

The descriptions of both cases are shown in Table 3. The cases are characterized based on the product that is developed, the design process and realization processes that are applied and how customer contact is organized.

Both products show similarities in the design. In both projects a new shell is placed to isolate the houses and installations are used to generate and regulate the energy. However, in the product of Case 2 there is a bit more attention towards the presence of the tenants. In Case 2 the installations are placed outside the houses to avoid nuisance in case of maintenance and also the tenants are involved in the choices regarding the bathroom, kitchen and toilet. The importance of the tenants comes back in the contact with the customer, which is quite important to the construction company. Further, both the design process and the realisation process are more structured in Case 2 than in Case 1. In Case 1 there is freedom to implement new ideas to own insights, but this interferes with

Table 3. Characteristics of concepts in both cases.

| | Case 1 | Case 2 |
|------------------------------------|--|--|
| Product | The product consists of a new shell to isolate the houses and installations to generate sustainable energy. The new shell is made of prefab outer walls that are placed in front of the original wall and a new isolated roof containing solar panels. The installations are placed in the attic, and the pipes and wires are tucked away in the prefab outer walls. Further, if necessary, kitchen, toilet and bathroom are replaced. | The product contains a new shell, consisting of a prefab outer wall, and a prefab roof elements with solar panels, and installation unit to generate and regulate energy. This installation unit is positioned in the backyard to reduce the nuisance during the renovation and afterwards. Also a direct current system is applied instead of the general alternating current system. Further, the tenants have the opportunity to choice a new kitchen, toilet and bathroom. |
| Design process | There is no tight design process in use; the process has an ad hoc structure. New ideas are implemented before the previous ideas are properly tested and evaluated. As a consequence there is no real basic design that can be structurally improved in various renovation projects. | A structured process is in use to improve the concept over time. New ideas are first externally tested before implemented in the concept and also the renovation of the projects occurs in steps to be able to evaluate and assess the performance of the product. |
| Realisation process | The different parts of the product are prepared in advance, mainly the larger modules like the outer wall, the roof and the installation. Other aspects of the renovation, like renovating the inside of the houses, are done on location by different specialists. Tight control and coordination is necessary to have a smooth process and to avoid nuisance. | The houses are renovated according to the assembly principle. The modules, both inside and outside the house, are prepared in advance as much as possible so that they can be assembled in a short period of time. On location a small assembly team is used to assemble the different modules. This way of renovating reduces both the time and the nuisance during the renovation. |
| Customer contact | The construction company is responsible for the renovation of the houses and prepares the renovation in close collaboration with the social housing association. Further, the social housing association has the lead in the communication with the tenants. Although this occurs in collaboration with the construction company, the housing association is the first point of call. | The construction company renovates the houses in close collaboration with the social housing association. The construction company is responsible for the renovation and considers the communication with the tenants as vital to be successful. Therefore, also the communication with the tenants occurs in close collaboration. |
| Project status (February, 2016) | In total 42 houses are renovated divided among three realization projects. In the beginning the concept was changed various time. The concept meets the requirements regarding net-zero usage, but the customer satisfaction is low and the concept is still above budget. In January, 2016 the decision was made by the Board of Directors to terminate the project. | In total 138 houses are renovated divided among three realization projects. The concept meets the functional requirements and there is in general a high degree of customer satisfaction, both with the housing association and with the tenants. However, the price of the concept is still above budget. The Board of Directors has still confidence in the project. |

structurally improving the concept, which is the case in Case 2.

Subsequently, the organizational characteristics of both cases are presented in Table 4. These characteristics show that the construction company in Case 2 had more experience in New Product Development (NPD) projects than the firm in Case 1. This is seen in logically in the NPD experience, both in the team and in the rest of the organization, but also in the way the project team is formed and organized. In Case 1 a combination of a lightweight and a heavyweight structure is used which makes it hard to act autonomously. Also the involvement of various directors makes it harder to work independently. This in contrast with the team in Case 2 that has the characteristics of an autonomous team and has to report to a single director.

Table 4. Organizational characteristics in both cases

| | Case 1 | Case 2 |
|----------------------------|---|--|
| Team formation | The project team was, to a large extent, the successor of a previous project. The addition of new people to the team was done based on personal insights of the responsible person. Later in the project people were added based on availability. | Before the team was composed, profiles were made by the responsible persons. Next, the profiles were compared with the employees' competences, which were stored in a database. Based on these comparisons the most appropriate persons for this project were selected. This method was also applied in a later stadium. |
| Team structure | The team structure shows characteristics of both a lightweight team and a heavyweight team. The core of team, a small group, is full-time assigned to this project, but these persons still report to their functional manager. The rest of the team is part-time assigned to the project and act as members of a lightweight team. | The project team is a combination of a heavyweight team and an autonomous team. Some team members are still reporting to their functional managers, but in practise they are working full-time on the project. The other team members were released and full-time assigned to the project and the responsible project manager. |
| NPD experience | The NPD experience in the team was limited, although the team members had some experience with more conceptual projects. The organization had in the past some experience with NPD projects but that knowledge was drained away over the years. | Various team members had experience with NPD projects and also in the organization there were other NPD projects in development. |
| Decision authority | In a large part of the decisions a steering group, consisting of involved directors, had the authority to make decisions. Only in the more operational decisions the project team was authorized to make decisions. | In most decisions the project manager or the project team were able to make the decisions. Only in the more strategic or radical decisions regarding the project course the responsible director was in charge, but generally in consultation with the project team. |
| Top management involvement | Within this project various directors were involved to which the project team was accountable. Further, over the time different directors become involved due to organizational changes. | The project team was accountable to one single director. This director was involved from the beginning of the project. |
| Involvement other firms | Three other firms were actively involved in the development of the product. These firms were considered as equal partners and therefore also were involved in the making of various decisions. | Various firms were involved in this project, but mainly in the actual product development. The involvement of these firms can be described as actively involved suppliers. |

4.2. Important decisions

In determining the important decisions in a new product development project, the interviewees were asked what the important decisions were in their project. These answers were then classified and categorized according to the classification presented in the theoretical section. In Table 5 the number of mentioning for each case are shown.

As can be seen from the table, in Case 1 organizational decisions count for more than a third of the important decisions. Most of the decisions in this category are related to the organizational structure, the staffing of the project team and the collaboration with external partners. The latter can be explained due to the involvement of three external

partners that have a large interest in this project. Further, also decisions related to the strategy and the product are considered to be important. The mentioned decisions are about the decision to start the project, the applied business model and the concept design. All three refer to basic elements of a projects, namely the motive of the project, the way to generate value and the offered solution.

In Case 2 also the organizational decisions count for a large share, but less dominant than in Case 1. In contrast to Case 1, the decision to select partners is less important, since a lot of the product development occurs in-house. Decisions that are mentioned in this category are related to assigning responsibilities. Two other categories that stand out in comparison with Case 1 are the decisions about the marketing and the context. In Case 2 the interviewees mentioned the importance of determining the clients’ demands and the contact with the customer. The contextual decisions count for a minor part of the mentioned decisions, but it can be seen as a sign that the project team also considered the context in which it operates and how to respond on changes in the environment.

Table 5. Mentioning of important decisions per case

| Decision category | Case 1 (n = 123) | Case 2 (n = 137) |
|-------------------|------------------|------------------|
| Strategy | 20 (16%) | 21 (15%) |
| Product | 18 (15%) | 16 (12%) |
| Process | 13 (11%) | 19 (14%) |
| Organization | 47 (38%) | 37 (27%) |
| Structural | 9 (7%) | 16 (12%) |
| Marketing | 9 (7%) | 19 (14%) |
| Financial | 7 (6%) | 6 (4%) |
| Context | 0 (0%) | 3 (2%) |

4.3. Decision performance

The decision performance is measured on a process level and on an outcome level. The performance on a process level is measured through decision speed and decision comprehensiveness, while the outcome is measured through decision effectiveness and decision acceptance. The decision performance on the four items for both cases is presented in box plots (shown in Figure 1).

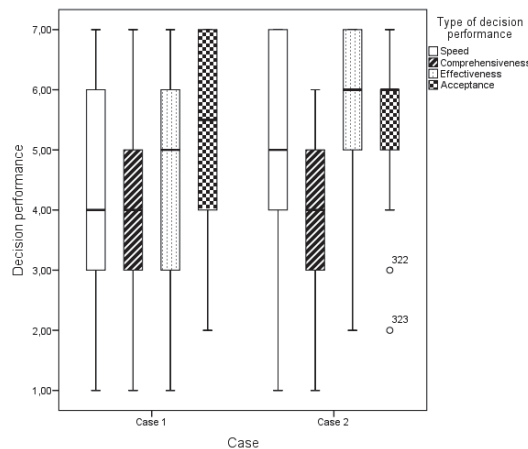


Figure 1. Decision performance for both cases on 7-point scale

The decision speed in Case 2 is considerably high; a large majority of the decisions are made in a pace that can be

labelled as quick to fast. In only one decision process the speed is considered to be very slow. The decision speed in Case 1 is slightly slower, but nevertheless the speed is above average. The comprehensiveness is in both cases average, although in Case 1 there is one decision process characterized as extremely comprehensive. Regarding the decision effectiveness larger difference are seen. The effectiveness of decision making in Case 2 is very high, while the effectiveness stay behind in Case 1. Also in the decision acceptance there are differences. In both cases the acceptance is in general relatively high, but in Case 1 a wider range is seen. This means that there is more variance in the acceptance in this case.

4.4. Styles of decision making

Three styles are distinguished in decision making: rationality, intuition and politics. To determine the effect of the styles on the decision on the decision performance, the variable decision effectiveness is used. The reason to use this variable is that it is a decision maker’s intention to make the right choice with the desired result, considering the circumstances. Figure 2 shows the decision making styles in decision with a low, medium and high degree of effectiveness. To classify the decision effectiveness the decision with a score of 1 or 2 on effectiveness are scored as low, with a score of 3, 4 or 5 as medium and with a score of 6 or 7 with high.

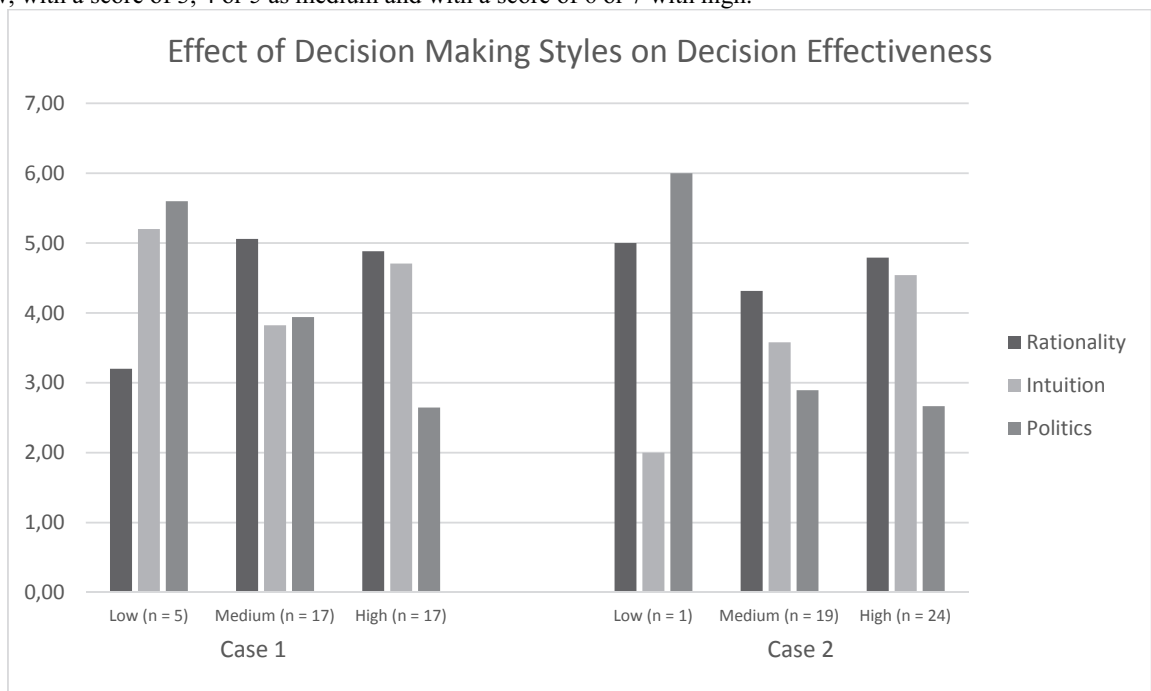


Figure 2. Effect of decision making styles on decision effectiveness

The figure shows that in Case 1 only five decisions are labelled with a low degree of effectiveness. The remaining 34 decisions are equally labelled as medium or high. However, in Case 2 a majority of the decisions is labelled as highly effective. Further, 19 decisions have a label ‘medium effective’. Only 1 decisions is label with a low degree of effectiveness.

In both cases it is striking that the more effective a decision is, the less political the decision has to be. In the decisions that are labelled with a low degree of effectiveness the political decision making is dominant, this in contrast with the decisions with a medium or high degree of effectiveness.

Regarding the effect of rationality and intuition on decision effectiveness it is harder to identify a pattern. In general the degree of rationality in both cases is quite stable; only the decisions in Case 1 that have a low degree of effectiveness show a slightly below average degree of rationality. In Case 2 it seems that the more intuitive the decision making becomes, the more effective the decision making is. However, in this case there is only one decision that is labelled as

not effective. In Case 1 the most intuitive decisions are labelled as the decisions with the lowest degree of effectiveness.

However, if rationality and intuition are considered as a combination of styles, the results show that the more the two decision making styles are in balance, the higher the degree of effectiveness. In the decisions with a high degree of decision effectiveness neither of the two styles are dominant, but together they dominant the decision making.

5. Discussion

5.1. Research results

The research shows that the way decision are made affects the decision performance and ultimately the project performance. Both cases show that political decision making has a negative effect on the decision performance. However, it is difficult in a project that involve multiple persons and organizations to completely eliminate the political forces. Therefore, either the number of involved persons or organizations had to be limited or different interests had to be aligned. The former was the case in Case 2. In this case the construction firm had the lead and internally the project team was able to act autonomous. This was in contrast with Case 1. Here there were multiple firms involved and also internally different interests had to be taken into account. Further, the results show that to be effective in the decision making the rationality and the intuition in the decision making have to be in balance. In Case 2 this was solved by selecting persons that had experience in NPD and were able to act and think intuitively, while tools and techniques were used to structure the decision making.

Further, the research demonstrates that in the successful case (i.e. Case 2) the degree of decision effectiveness is higher compared to the decision in Case 1. A logical explanation for this relationship is that if decisions are executed as intended, the desired overall result is obtained. A remark has to be made that the decision makers cannot be completely held accountable to the result of the decision making. External mechanism can interrupt or even disrupt the decision making and this way affect the outcome. Further, the speed of decision making is higher in Case 2 than in Case 1. A reason for quick decision making is that a new product development project is characterized by uncertainty and it is therefore important to anticipate on (external) changes.

Finally, the results demonstrates that it is important to have a holistic view in the decision making. This means that various aspects of the project have to be considered in the decision making. This is in contrast with Case 1 in which the decision making is mainly focused on the project organization, the product and the way to generate value. In Case 2 there is also attention for other aspects of the project, like the structural aspects of the project, but also the external environment. For example, importance is attached to the marketing decisions: they project team would like to understand their clients and users before making other decisions regarding the project. Also aspects in the project context are taken into account, something which is not the case in Case 1.

5.2. Contributions

This study contributes to the literature on decision making in new product development projects by demonstrating the effect of decision making on the decision performance and ultimately on the project performance. In particular the combination of the three decision making styles (rationality, intuition and politics) on the decision performance. In the recent innovation literature Kester [5] and Kolbe [6] studied the three dimensions combined. However, Kester [5] focuses on the decision making on a portfolio level, while Kolbe [6] describes a conceptual model to come up with new ideas.

Further, this research contributes to the earlier research on decisions in new product development project [36-39]. These studies describe different typologies and categorization of decisions. In this research the important of the various decisions and decision categories is determined. The previous categorizations are extended with two new categories: financial and contextual decisions. The former involves not only the (financial) resources that are invested, but also how profit and losses are shared and how the cash flow is set up. Further, this new categorization also incorporates decisions about the project context; factors in the project context can influence the project progress and decisions have to be made how to anticipate on (future) events.

Finally, the study contributes to the research on renovation in the housing sector. In the literature the focus is mainly on the effectiveness of renovations and the policies to stimulate renovation. However, in this research two development projects of zero-energy usage concepts are extensively studied. The study supports the results of the previous research

on the (successful) adoption of sustainable renovations [14,15], but also shows the importance of the internal organization to be successful.

5.3. Limitations and future research

This research is not without limitations. The study has an experimental character. Therefore, the results cannot be generalized. However, this study can act as an initial impetus for future research on decision making within innovation projects. First, more case studies have to be conducted to obtain greater insight into decision making in innovation projects. We suggest that future research examines decision making in multiple industries, rather than in a single sector. Through conducting studies in various industries the industrial characteristics influence the decision making.

Second, it was only possible in our study to collect data about the decisions through interviews with involved persons after the decisions were completed. For future research it is suggested to combine this approach with longitudinal studies as well. This approach will give scholars the opportunity to study and assess these processes from the frontline.

Third, the selected cases were executed in a similar context. This enhances the internal validity of the research, but at the same time the external validity is questionable. Through studying similar projects in different contexts the external validity can be enhanced.

6. Conclusion

This study shows that the effectiveness and speed of decision making has a positive effect on the project performance. The degree of effectiveness and speed is the result of the way decisions are made. It is important to combine the three styles of decision making (rationality, intuition and politics) in a way that the desired result is achieved. The study has implications regard to the management and decision making in new product development project. Although this study shows some preliminary results of how decision making affects the project performance, more research is necessary to understand decision making in innovation projects and its effect.

References

- [1] Hauser, J.R., G.J. Tellis, and A. Griffin, Research on innovation: A review and agenda for Marketing Science. *Marketing Science*, 2006. **25**(6): p. 687-717.
- [2] McNally, R.C. and J.B. Schmidt, From the Special Issue Editors: An Introduction to the Special Issue on Decision Making in New Product Development and Innovation. *Journal of Product Innovation Management*, 2011. **28**(5): p. 619-622.
- [3] Kester, L., A. Griffin, E.J. Hultink, and K. Lauche, Exploring Portfolio Decision-Making Processes. *Journal of Product Innovation Management*, 2011. **28**(5): p. 641-661.
- [4] Kang, W. and M. Montoya, The Impact of Product Portfolio Strategy on Financial Performance: The Roles of Product Development and Market Entry Decisions. *Journal of Product Innovation Management*, 2014. **31**(3): p. 516-534.
- [5] Kester, L., *New Product Development Portfolios: Identifying the antecedents and consequences of decision-making processes*. 2011: TU Delft, Delft University of Technology.
- [6] Kolbe, L.M., *The mindset of the R&D professional: Decision making in innovative contexts*. 2015, Amsterdam: Vrije Universiteit.
- [7] Eling, K., A. Griffin, and F. Langerak, Using Intuition in Fuzzy Front - end Decision - making: A Conceptual Framework. *Journal of Product Innovation Management*, 2013.
- [8] Winston, N., *Regeneration for Sustainable Communities? Barriers to Implementing Sustainable Housing in Urban Areas*. *Sustainable Development*, 2010. **18**(6): p. 319-330.
- [9] Tommerup, H. and S. Svendsen, Energy savings in Danish residential building stock. *Energy and Buildings*, 2006. **38**(6): p. 618-626.
- [10] Amstalden, R.W., M. Kost, C. Nathani, and D.M. Imboden, Economic potential of energy-efficient retrofitting in the Swiss residential building sector: The effects of policy instruments and energy price expectations. *Energy Policy*, 2007. **35**(3): p. 1819-1829.
- [11] Harvey, L.D.D., Reducing energy use in the buildings sector: measures, costs, and examples. *Energy Efficiency*, 2009. **2**(2): p. 139-163.
- [12] Judson, E.P. and C. Maller, Housing renovations and energy efficiency: insights from homeowners' practices. *Building Research and Information*, 2014. **42**(4): p. 501-511.
- [13] Salcedo Rahola, T., *Integrated project delivery methods for energy renovation of social housing*. 2015, TU Delft, Delft University of Technology.
- [14] Hauge, A.L., J. Thomsen, and E. Lofstrom, How to get residents/owners in housing cooperatives to agree on sustainable renovation. *Energy Efficiency*, 2013. **6**(2): p. 315-328.
- [15] Hoppe, T., Adoption of innovative energy systems in social housing: Lessons from eight large-scale renovation projects in The Netherlands. *Energy Policy*, 2012. **51**: p. 791-801.

- [16] Mintzberg, H., D. Raisinghani, and A. Theoret, Structure of Unstructured Decision-Processes. *Administrative Science Quarterly*, 1976. **21**(2): p. 246-275.
- [17] Janssen, O., E. Van de Vliert, and C. Veenstra, How task and person conflict shape the role of positive interdependence in management teams. *Journal of Management*, 1999. **25**(2): p. 117-141.
- [18] Eisenhardt, K.M., Making Fast Strategic Decisions in High-Velocity Environments. *Academy of Management Journal*, 1989. **32**(3): p. 543-576.
- [19] Dean, J.W. and M.P. Sharfman, Does decision process matter? A study of strategic decisionmaking effectiveness. *Academy of Management Journal*, 1996. **39**(2): p. 368-396.
- [20] Atuahene-Gima, K. and H.Y. Li, Strategic decision comprehensiveness and new product development outcomes in new technology ventures. *Academy of Management Journal*, 2004. **47**(4): p. 583-597.
- [21] Hough, J.R. and M.A. White, Environmental dynamism and strategic decision-making rationality: An examination at the decision-level. *Strategic Management Journal*, 2003. **24**(5): p. 481-489.
- [22] Fredrickson, J.W., The Comprehensiveness of Strategic Decision-Processes - Extension, Observations, Future-Directions. *Academy of Management Journal*, 1984. **27**(3): p. 445-466.
- [23] Slotegraaf, R.J. and K. Atuahene-Gima, Product Development Team Stability and New Product Advantage: The Role of Decision-Making Processes. *Journal of Marketing*, 2011. **75**(1): p. 96-108.
- [24] Amason, A.C., Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams. *Academy of Management Journal*, 1996. **39**(1): p. 123-148.
- [25] Baum, J.R. and S. Wally, Strategic decision speed and firm performance. *Strategic Management Journal*, 2003. **24**(11): p. 1107-1129.
- [26] Judge, W.Q. and A. Miller, Antecedents and Outcomes of Decision Speed in Different Environmental Contexts. *Academy of Management Journal*, 1991. **34**(2): p. 449-463.
- [27] Eisenhardt, K.M. and M.J. Zbaracki, Strategic Decision-Making. *Strategic Management Journal*, 1992. **13**: p. 17-37.
- [28] Elbanna, S., Strategic decision-making: Process perspectives. *International Journal of Management Reviews*, 2006. **8**(1): p. 1-20.
- [29] Dean, J.W. and M.P. Sharfman, Procedural Rationality in the Strategic Decision-Making Process. *Journal of Management Studies*, 1993. **30**(4): p. 587-610.
- [30] Simon, H.A., Theories of Decision-Making in Economics and Behavioral-Science. *American Economic Review*, 1959. **49**(3): p. 253-283.
- [31] Simon, H.A., Rational Decision-Making in Business Organizations. *American Economic Review*, 1979. **69**(4): p. 493-513.
- [32] Dean, J.W. and M.P. Sharfman, The Relationship between Procedural Rationality and Political-Behavior in Strategic Decision-Making. *Decision Sciences*, 1993. **24**(6): p. 1069-1083.
- [33] Hickson, D.J., C.R. Hinings, C.A. Lee, R.E. Schneck, and J.M. Pennings, Strategic Contingencies Theory of Intraorganizational Power. *Administrative Science Quarterly*, 1971. **16**(2): p. 216-229.
- [34] Dane, E. and M.G. Pratt, Exploring intuition and its role in managerial decision making. *Academy of Management Review*, 2007. **32**(1): p. 33-54.
- [35] Khatri, N. and H.A. Ng, The role of intuition in strategic decision making. *Human Relations*, 2000. **53**(1): p. 57-86.
- [36] Krishnan, V. and K.T. Ulrich, Product development decisions: A review of the literature. *Management Science*, 2001. **47**(1): p. 1-21.
- [37] Brun, E., A.S. Saetre, and M. Gjelsvik, Classification of ambiguity in new product development projects. *European Journal of Innovation Management*, 2009. **12**(1): p. 62-85.
- [38] Yahaya, S.Y. and N. Abu-Bakar, New product development management issues and decision-making approaches. *Management Decision*, 2007. **45**(7): p. 1123-1142.
- [39] Brown, S.L. and K.M. Eisenhardt, Product Development - Past Research, Present Findings, and Future-Directions. *Academy of Management Review*, 1995. **20**(2): p. 343-378.
- [40] Fixson, S.K., Product architecture assessment: a tool to link product, process, and supply chain design decisions. *Journal of Operations Management*, 2005. **23**(3-4): p. 345-369.
- [41] Sanchez, R. and J.T. Mahoney, Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal*, 1996. **17**: p. 63-76.
- [42] Ulrich, K.T. and D.J. Ellison, Holistic customer requirements and the design-select decision. *Management Science*, 1999. **45**(5): p. 641-658.
- [43] Hofman, E., H. Voordijk, and J. Halman, Matching supply networks to a modular product architecture in the house-building industry. *Building Research and Information*, 2009. **37**(1): p. 31-42.
- [44] Petersen, K.J., R.B. Handfield, and G.L. Ragatz, Supplier integration into new product development: coordinating product, process and supply chain design. *Journal of Operations Management*, 2005. **23**(3-4): p. 371-388.
- [45] Sobrero, M. and E.B. Roberts, Strategic management of supplier-manufacturer relations in new product development. *Research Policy*, 2002. **31**(1): p. 159-182.
- [46] Hultink, E.J., A. Griffin, S. Hart, and H.S.J. Robben, Industrial new product launch strategies and product development performance. *Journal of Product Innovation Management*, 1997. **14**(4): p. 243-257.
- [47] Di Benedetto, C.A., Identifying the key success factors in new product launch. *Journal of Product Innovation Management*, 1999. **16**(6): p. 530-544.
- [48] Sosa, M.E., S.D. Eppinger, and C.M. Rowles, The misalignment of product architecture and organizational structure in complex product development. *Management Science*, 2004. **50**(12): p. 1674-1689.
- [49] Yin, R.K., *Case Study Research: Design and Methods*. 2003, Thousand Oaks, California: Sage Publications, Inc.