Approaches to sustainability decision making in product development projects and portfolios

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Abstract

Decisions in product development deal with finding the products and services that have the best potential to succeed on the market. Companies themselves, their customers, and the society in general are increasingly pursuing environmental sustainability, so there is a need to understand how sustainability can be taken into account in the decision making of product development projects. This chapter explores sustainability-related decision-making concerning product development projects and portfolios in a study of three companies that have a strategic interest to increase environmental sustainability in their business. The findings reveal two main approaches, here written into vignettes of strategy and compliance guiding sustainability decision making. Since all companies explicated both approaches, they were combined and together cover four decision domains of sustainability decision making in product development projects: direction, scope, content, and changes. The findings show that sustainability needs to be treated holistically in all phases of the decision-making process and adds a powerful external and regulatory connection to managing product development projects and portfolios. The institutional embeddedness of product development generates a need to integrate regulatory issues and aggregate customer and stakeholder voices as part of the decision-making processes.

Keywords: Product development, Decision making, Sustainability decisions, Context

1. Introduction

When firms invest in developing their products, they decide on many issues simultaneously. Which markets shall we serve? Which product ideas have the best market potential and can be developed efficiently? How should we allocate resources, to ensure the best possible business potential? And how could we serve the sustainability goals of this firm, the customer, the industry, and the society in general? Sustainability decision making relates to the initiation and selection of new product development (NPD) projects in the firm, as well as any possible details and changes during project implementation, as sustainability has to be considered both from the perspective of the product and the process by which it is designed and delivered (Silvius & Schipper, 2015). This chapter explores decision making on

sustainability, specifically concerning product development projects that are planned and carried out as part of firms' project portfolios and, therefore, implement the firms' strategies.

Sustainability is considered as a very strategic issue in industrial firms, and it is explicated increasingly in firms' strategies. Earlier research has differentiated between sustainability strategies of project organizations and project hosts separately and jointly (Aarseth et al., 2017). For product development projects, sustainability orientation in strategy is reflected into the projects that are planned and implemented, and this orientation is also associated positively with product development performance (Claudy et al., 2016). Sustainability objectives, however, may conflict with other objectives and each other in multi-stakeholder situations, creating tensions to whether and how such objectives can be reached (Sabini & Alderman, 2021; Shu, 2022). Firms have discovered various ways to manage such tensions and tradeoffs (Claudy et al., 2016; Sabini & Alderman, 2021).

Sustainability is considered as a core issue to be taken into account in project decision making (Silvius et al., 2017) and project assessments (Keeble et al., 2003) and, thereby, it is often used as a certain criterion or set of criteria for evaluating and selecting projects. However, the traditional iron triangle criteria tend to dominate and leave sustainability criteria as secondary (Silvius et al., 2017). Ways to address sustainability issues in projects depends on the stimuli, abilities, and behavioral profiles of project managers (Silvius & De Graaf, 2019; Silvius & Schipper, 2020). Sustainability is implemented also into various other project practices, tools and techniques in the project phases, over the entire lifecycle, and in managing stakeholders (Sabini et al., 2019).

The problem guiding this chapter is the need for companies to consider sustainability better in their product development projects, acknowledging the pressures and requirements of the institutional and societal context. The above-mentioned assessment and criterion-centric decision making dominantly addresses only an intra-organizational perspective to product development. However, there is a need to understand project decisions and portfolios as part of the broader business context (Martinsuo & Geraldi, 2020), and integrate also stakeholders' perspectives to sustainability decisions (Juntunen et al., 2019; Watson et al., 2018). As sustainability is institutionally and societally regulated and constrained, sustainability decision making in projects needs to be considered in a context-aware manner.

The purpose of this chapter is to explore companies' sustainability-related decision-making concerning product development projects as part of project portfolios. The objective is

increased understanding on the alternative ways in which companies can embed sustainability into their decision making. The focus is on one research question: *How, through which alternative approaches, do firms include sustainability into their decision making of product development projects?* The study reveals two main patterns of sustainability decision making and their co-existence and interplay across four decision domains and, thereby, complements the assessment and criterion-centric view that often neglects the external stakeholder view.

This research is explorative and qualitative in nature: the focus is on environmentally oriented companies that had a strategic interest to enhance environmental sustainability in their product development. Thereby, social and economic aspects of sustainability are purposely excluded, although the identified approaches might apply to them, too. The term product development is used in its broad sense: it features the development of (tangible) goods, (intangible) services as well as more complex product-service systems. The attention is *not* on the official product development evaluation or decision-making criteria as such, but rather the pattern of practices in sustainability-related decision making, as experienced by company personnel. This chapter acknowledges that product development project portfolios are managed in their broader business contexts (Martinsuo & Geraldi, 2020) with relevant external stakeholders that need to be taken into account (Juntunen et al., 2019; Watson et al., 2018).

The next sub-chapter offers an overview to previous research on sustainability, decision making and their joint treatment in product development projects. Then, the empirical study of three firms promoting environmental sustainability in their product development is introduced. The findings reveal two main patterns: *strategy* guiding sustainability decision making aligns with and details the currently dominant view in the literature, whereas *compliance* guiding sustainability decision making embeds the firms into their broader regulatory and institutional environments and offers a complementary perspective to decision making. The discussion section merges these two viewpoints, as the findings show a parallel use of both approaches in the firms. As a key contribution, the chapter reports four decision domains that integrate strategy and compliance and, thereby, adds novel viewpoints to managing product development project portfolios in a sustainable manner.

2. Literature review

2.1 Sustainability and product development

In product development, sustainability is an interest of companies and their customers particularly in terms of the products being developed. While environmental sustainability may have been considered previously as a source of costs, it is now also seen as a way to differentiate from competitors and create new kind of business value through sustainable products and services (Metz et al., 2016). Including sustainability into the new products has been discussed in terms of sustainability-led (Seebode et al., 2012) and sustainability-driven innovation (Metz et al., 2016). When new products are developed, companies' concern is not just achieving market potential and commercial value, but sustainability has potential positive impacts on the wider social and environmental systems, consumers' behaviors (Seebode et al., 2012), overall sustainability performance, completely new sustainability-oriented products and services, and process efficiency (Metz et al., 2016).

Besides the products, the processes by which products are developed and delivered need to become sustainable (following Silvius & Schipper, 2015). Companies may establish sustainability orientation (Claudy et al., 2016) and mindset (Metz et al., 2016) that will affect any of their processes and practices. Sustainability orientation is embedded in the values, norms and ideology as well as operational plans and practices in the firm (Claudy et al., 2016, Kalish et al., 2018). Sustainability mindset in an organization implies the management's full commitment toward sustainability results, reflected in sustainability-related objectives, structural arrangements, deliberate search for such opportunities, goal-driven sustainability initiatives, and related progress monitoring (Metz et al., 2016). According to Metz et al. (2016), the sustainability practices need to be integrated into existing product development practices, so that they are adhered to and become company-wide routines. While sustainability commitment does not necessarily alter the business models of the firm directly, its implications on strategic market, technology and entrepreneurial orientations may have implications on the business models indirectly (Klein et al., 2021).

It is clear that firms do not become sustainable at once, but the development of sustainability as part of product development may be a lengthy learning process, evolving over time. Various tools and models have been suggested, to assist companies in their efforts to include sustainability as part of product development. The survey by Kalish et al. (2018) summarizes new product sustainability checklists, life cycle assessment tools, materials screening tools, the EcoDesign Strategy Wheel, and supplier scorecards as commonly used tools for

embedding sustainability into product development. Yang et al. (2017) perceive sustainability as an important part of business model innovations and propose a sustainable value analysis tool to turn sustainability into opportunities (Yang et al., 2017). It acknowledges the lifecycle of the product, different stakeholders, different dimensions of sustainability value, and both created, captured and uncaptured value and helps firms in developing new opportunities by considering sustainability systematically (Yang et al, 2017). Hynds et al. (2014) propose a maturity model for sustainability in product development, to allow firms to assess their own situation and benchmark their development over time. The maturity model covers both strategic aspects and tools that feature sustainability issues into product development (Hynds et al., 2014).

Product development does not occur in isolation, but it usually requires customer interaction and also other forms of stakeholder engagement with the focal firm. Stakeholders may be particularly useful as sources of ideas, knowledge, and expertise, and they will need to be integrated into product development processes (Juntunen et al., 2019). They may also be helpful in solving problems and enhancing the social legitimacy of the firm (Watson et al., 2018). Some of the sustainability tools acknowledge that there are multiple stakeholders involved, when sustainability is considered as part of product development (Yang et al. 2017). While stakeholder integration is generally seen as positive to product development performance, the degree of openness and the product development phase of stakeholder inclusion varies across firms (Juntunen et al., 2019). Benefiting from stakeholder involvement in sustainability-oriented product development requires capabilities at operative, engagement management, and co-creative and learning levels (Watson et al., 2018).

2.2 Decisions in product development

Product development processes include many decisions that may or may not include sustainability considerations. Some of the decisions occur on the project portfolio level, whereas some of the decisions are more oriented at single projects and may consequently be reflected on the project portfolio level, too. Figure 1 summarizes the key decision domains in product development.

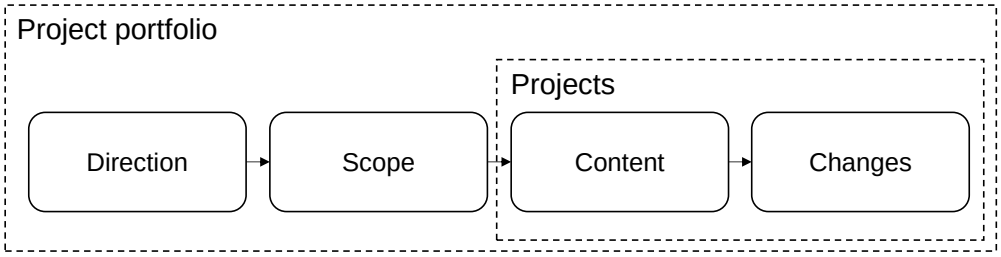

Figure 1. Key decisions in product development projects and project portfolios.

Strategy generally covers what types of product development projects to pursue (Wheelwright & Clark, 1992), so the general guidance of strategy represents one of the core decisions and sets the *direction* for the project portfolio and its projects. However, it is well known that companies may cherish various pet projects and under-the-table projects outside of the strategy and official product development processes (Loch, 2000). Thereby, the strategic guidance of product development decisions is by no means rational only. Various political and social processes are an inherent part of product development decision making (Kester et al., 2009, 2011; Röth et al., 2019).

Strategy is very typically reflected into such scoring models and related evaluation and selection criteria that enable the company to choose product development projects to the portfolio (Cooper et al., 1997). Evaluation criteria may be used in different ways, to assess and screen the project ideas, compare them with each other, and verify their alignment with strategy. Use of such criteria determines the *scope* of the project portfolio to be implemented, and it usually specifies not just the size of the project portfolio, but also the types of projects, chosen markets and businesses, and invested resources. Previous research has shown that the evaluation criteria evolve over the course of the product development process (Carbonell-Foulquie et al., 2004; Hart et al., 2003; Schmidt et al., 2009): in an earlier phase, the criteria may be general and vague, assessed in qualitative and even subjective terms, whereas later in the process they tend to be treated in a numeric form and through more or less exact measures.

The above project portfolio decisions eventually lead to choosing (or abandoning) projects within the project portfolio. The choice of projects requires that individual projects have been proposed and screened earlier, and then evaluated and selected based on their suitability to the strategy and other criteria as part of the project portfolio (Archer & Ghasemzadeh, 1999). The overall planning of projects and comparison within the portfolio yields a decision of the

content to be implemented in the projects, representing both the product (or service or product-service system) and any work effort it requires. While this content is expected to be covered in the project, it at the same time represents the practical ways to implement the strategy and proceed toward the direction intended in the project portfolio.

Besides the major selection and decision events, product development decisions deal with any plans and *changes* that may alter the course of the project during its implementation (Steffens et al., 2007), or the project's positioning in the portfolio. For example, changes that alter the resourcing of the project may be very strategic as they might have an impact on multiple projects simultaneously. Supplier choices and changes may be quite significant, as different suppliers may have different strategies, capabilities, and interests with regards to the project. Some changes may even open up completely new direction, in terms of a new emergent strategy (Kopmann et al., 2017). Re-prioritizing the projects because of a customer request, external pressure, or a major problem during development may imply significant change decisions for a certain project and even change the direction of the portfolio.

A key issue concerning product development decision making relates to the decision makers. Even if official evaluation and decision criteria and processes were in use, decision makers are individuals, they may have their unique preferences, traits, skills, and tendencies (Ozer, 2005; Kester et al., 2009, 2011; McNally et al., 2009). The negotiation between the decision makers causes a need to consider multiple perspectives for each decision (Christiansen & Varnes, 2008; Mosavi, 2014). Some research has indicated that individuals might have different profiles and orientations toward sustainability, clearly impacting related project decision making (Silvius & Schipper, 2020).

2.3 Sustainability in product development decision making

Much of the previous research concerning sustainability in product development concentrates on the organizational conditions that enable (or restrain) the inclusion of sustainability into product development. At the level of the firm, explication of sustainability strategies and setting sustainability-oriented goals and roadmaps offers guidance (Seebode et al., 2012), also to sustainability-related decision making. Consequently, sustainability could be included into the business performance monitoring systems such as balanced scorecard, either by building it into all the scorecard dimensions, covering it as a separate dimension on its own, or developing even a completely separate sustainability scorecard (Figge et al., 2002). This

study draws attention specifically to product development decision making: how is sustainability considered, when deciding on product development projects?

Martinsuo and Killen (2014) have treated sustainability as one potential dimension of projects' strategic value that needs to be identified and considered as part of the evaluation and decision making on product development projects, both as part of project portfolio evaluation and management and at the single project level. For single projects this might mean including sustainability into the product development or design brief that summarizes the pursued features of the developed product (Petala et al., 2010), enforcing sustainability through sustainability-oriented design processes or tools (Fargnoli et al., 2014), using selected environmental issues as one or more evaluation and selection criteria when selecting projects (Meade & Presley, 2002), and using sustainability-related performance indicators also later to assess projects (Keeble et al., 2003). At the level of project portfolios, sustainability can be included both in the evaluation and selection criteria and prioritization matrices and frameworks that compare projects (Brook & Pagnanelli, 2014). These examples suggest that sustainability can be embedded into design routines and tools, product development processes, and project and portfolio evaluation criteria and systems.

Sustainability, however, is more than a concern of a focal firm. Due to its industrial, societal and ecological implications, sustainability in a firm is always connected to a broader institutional frame, especially the legal and regulatory systems surrounding the firms as well as their customer and supply markets. While regulations may trigger sustainability innovations and provide guidelines and constraints that need to be adhered to in product development (Wagner et al., 2014), their role in sustainability-related product development decision making has remained unclear. This chapter, therefore, attempts to acknowledge both intra-organizational and external (regulatory) aspects of sustainability-oriented product development decision making.

3. Empirical study

As part of a research project *StraSus* (Strategic business models and governance for sustainable solutions), we encountered three industrial companies that wanted to embed environmental sustainability better into their product development projects. The companies are here referred to as Company A, Company B, and Company C. They all represent an environmentally conscious approach to their business and, thereby, they can be considered as

illustrative cases. The companies are based in Finland, operate in Northern Europe and are among the leading companies of their respective industries. They are big corporations with several business lines and annual revenues of hundreds of millions of euros. One of them is in energy, one operates in business-to-business services, and one focuses on raw material conversion. The companies' anonymity is retained at their own request.

The research teams of the participating universities conducted semi-structured individual interviews, informal discussions, and group interviews to collect data. The interview outline included background questions about the company and the interviewee; the role of sustainable development in the company; cooperation with stakeholders and in business networks; process of new product and service development; decision making on sustainability; value of sustainable development; asset management; and future aspirations. The interviewees included key informants from sales, R&D, operations, environmental management, and general management. The focus in this paper is on the issues concerning NPD and decision making, and some tentative findings have been reported in unpublished publications (Arvio, 2014; Martinsuo & Arvio, 2015).

For the data analysis, we originally coded and analyzed the data using ordinary content analysis techniques, resulting in case descriptions and cross-case analyses concerning the coverage of sustainability in the NPD decision making (partly reported in Arvio, 2014; Martinsuo & Arvio, 2015). For this paper, the analyses were further elaborated, revealing two main patterns concerning how sustainability-related decision making took shape in and across the studied companies' product development projects and portfolios. These two patterns are reported as the main findings. As both patterns appeared as valid in all the three companies, albeit in somewhat different ways, there is a need to consider how the two decision patterns interacted and competed in the firms.

The first pattern is directly aligned with the extant project selection and project portfolio management literature and builds on the idea of strategic direction and alignment. The *strategy* vignette reported in the results reveals how the companies infuse sustainability into their decision making through its strategic centrality, use of sustainability as an evaluation and decision criterion, selecting and funding projects that match with strategy, and making changes to them.

The second pattern links product development decision making with the changes of the institutional environment, reflected in regulatory guidelines and requirements and concerns of

the public (i.e., consumers). This *compliance* vignette portrays sustainability-related decision making as companies' reactive compliance to institutional rules, regulations, customer requirements, and public opinions, occasionally also indicates a proactive intent to anticipate future changes in them. It also demonstrates the power of the external institutional environment (i.e., industry, customers and public) in designing certain sustainability features into the product development projects and related design and manufacturing processes. We will seek support for this pattern from the discussions of project-environment interactions and institutional field embeddedness of projects.

The integration of the strategy and compliance vignettes are structured around the four decision domains described in the literature review (direction, scope, content, and change). The inclusion of sustainability in decision making is introduced and discussed across these decision domains as a key contribution of this study. The complementarity of the strategy and compliance vignettes brings novel nuances to managing NPD project portfolios, especially through acknowledging external societal, customer, and stakeholder requirements in the decision making.

4. Findings

The companies had their unique strategy for product development, guiding the selection of product development projects and the consequent project portfolio. They differed from each other in how the portfolio emphasized long-term vs. short-term development and strategic emphases vs. rapid responses to changes. The two vignettes below differentiate sustainability-related decision making on the basis of strategic direction vs. compliance to regulations and public opinion, and these both were present to some extent in all three companies.

4.1 Strategy guiding sustainability decision making

In all the three companies, environmental sustainability was included in the core of the companies' *strategic direction*, but in somewhat different ways: material and energy efficiency, carbon neutrality and emission reductions, and sustainability over the entire value chain; and as an overarching strategic intent and related goals or as a stepwise roadmap. One company was focused on a very specialized, environmentally conscious niche market, which enabled it to occasionally avoid competition, whereas the two others were more sensitive to competition and also flexible toward customer needs. One director, in particular, emphasized the strategic nature of sustainability in product development: *"Just like in any business, at the*

top is the strategy that guides all activities. The first thing to look at is if the decisions and actions support the strategy. Afterwards of course decisions are made according to how they support the strategy, what is the time frame and how close to the cores of current businesses the activities are. If you are at the core [here, environmental sustainability], on the fringes or developing something completely new, that is the question."

The strategic direction was manifested in investments made into NPD projects and, thereby, *the scope of the NPD portfolio*. All companies have their own product development processes for ideating, selecting, and implementing the projects. Interviewees emphasized somewhat different issues in the projects in the different companies. For example, one company's interviewees emphasized the centrality of the idea phase of the NPD process as a way to embed sustainability into the projects, as the company had developed tools and practices for it. It had also organized an idea campaign among their employees, to put their strategy into action by innovating ways to improve the environmental efficiency in their main operations. They harnessed an idea management tool and encouraged participation throughout the organization in the campaign. Another company put more emphasis on the official project management system, with sustainability included into the evaluation and decision-making criteria for selecting the projects and defining the portfolio. Employees in another company had put particular effort into how the steering of the projects was conducted.

As the companies followed fairly ordinary NPD processes, they also had included different evaluation criteria into the process and related decision making. The sustainability-related criteria dealt with strategic fit, risks, customer and stakeholder needs, and ecological effects of the products and processes. The interviewees emphasized the necessity of available information and analysis efforts in preparing for sustainability decisions. One director emphasized the need for in-depth analysis required for sustainability decisions, by contrasting to some errors in the past: *"Let's just say that the investment in the past have not all been so carefully considered. In a way the risk assessment has not been on a level that it should have been."* While the formality of project and product design assessments differed across the firms, actual decision making on *project contents* was based on discussion and dialogue in them all. The dialogical approach enabled the explication of different responsibilities and preferences concerning environment, social matters and profitability, and negotiation priorities concerning these topics. The dialogue occasionally took different paths, especially if external organizations were asked for input necessary for the decision making.

However, many interviewees emphasized that sustainability is directly linked with costs and income, too, and thereby also the financial evaluation criteria were experienced as relevant to sustainability decisions. Costs and financial issues were evident, as motives and rationale for sustainability in the companies' operations. According to one manager at the customer interface: *"In the end the thing that matters is money. Our production could be CO_2-free for a year and then we would go bankrupt. Someone else would always do the dirty work. You always need a financial foundation. It forces us to define things clearly, why it should be done, what is the benefit and who gets the benefit. Okay, emissions are cut, or do we get more credibility and more customers, a more positive image. If you can't show the reason why, it is not worth it."*

Besides NPD project assessment and selection, sustainability decision making took place when the processes of the companies were being assessed and improved, implying *changes* as part of the projects. The use of sustainability measurement information was identified as important in continuous improvements of the company's own operations. One manager emphasized: *"They are kind of quantitative measurements mostly. [Tells an example of measurement and consequent improvement in the company's business.] Quality management is also important and what goals are set. These are followed… Okay, then we need to make a distinction to goal setting. There's a process for that and a management system, KPI's [Key Performance Indicators] and so forth. Continuous improvement is the word."*

4.2 Compliance guiding sustainability decision making

Due to their strong ecological orientation, all three companies followed carefully how environmental requirements emerged and evolved in legislation as well as in customers' expectations and public opinion more generally. Some interviewees explicated that their firms were responsible toward the society for delivering environmentally friendly solutions in an efficient way. While the compliance to legal requirements was seen as a strong driver and *source of direction* for decision making regarding sustainability, it also enabled renewal. One manager particularly saw regulations and laws as an opportunity to create new business: *"Tightening legislation brings new business opportunities. A good example is the [a certain change in regulations]. Instantaneously there are X number of new business opportunities, because of [a consequence of the regulation]. Somebody has to take care of them."* Due to the companies' prioritization of environmental issues and their business scope, they were also in a position where they sometimes had the possibility to influence the future development of

laws and regulations, by lobbying together with other firms and associations and by getting involved in the early-phase preparations.

Customer expectations concerning sustainability were expressed in terms of both direct customer requests for environmentally friendly solutions and processes, and the firms' role in helping customers to comply with environmental regulations, and they together influenced the *scope of the NPD project portfolios*. One company responded very actively to any customer needs and focused all development activities on projected new customer needs. Also long-term development was focused on such customer needs that forthcoming regulations, technology changes and raw materials would enable serving. Another organization wanted to anticipate the long lifecycles of solutions in the customers' use and target efforts to support a sustainable solution lifecycle. The product development manager explained: "*I could give an example of our lifecycle-oriented product development, where we strive to create a concept to holistically serve the customers contractually as long as [the delivered solution] is in use. This is our ambition, but not a reality yet."* The company was eager to commit resources to testing solutions rapidly at an early stage of the product development and consequently learn and improve their products through a probe-and-learn process, to ensure sustainability in the delivered solutions and customers' processes. One of the companies was undergoing a transformation from following its own specific strategy toward an increased customer orientation, thereby also changing the approach to prioritizing and assessing sustainability aspects for decision making.

Due to their large scope and visible presence in the public, all the three companies were sensitive to public opinions and concerns regarding sustainability as part of *project contents*, but they differed in terms of the pressure concerning environmental issues. One firm, in particular, faced the public pressures from many directions, not only in terms of public environmental concerns, negative media visibility, and their own reputation on the market, but also investment priorities and political agendas in national governments. According to one manager, public opinion may drive investments into sustainability: *"It differs, but the biggest investments to sustainability are certainly in [a certain business area with political agendas]. Public opinion plays a role here… We have seen positive results, after a lot of communication and true actions. Additionally, I have seen a change in the attitude of certain employee groups. But of course that takes a long time."* The company has considered it important to involve actively in such networks where it can meet its loudest critics and,

potentially, influence the opinions of public agencies and non-profit organizations operating in the field.

The interviewees characterized a need to cross the boundaries between organizational departments as well as to cooperate with customers, regulatory bodies and other influential organizations, to aggregate different opinions when *defining contents for and changing NPD projects*. They effectively used their existing systems such as idea management tools, evaluation criteria, project control and reporting systems for this purpose, supplemented with various events organized for enabling dialogue with selected stakeholders. According to one manager, for example, decisions may take place in in-depth cooperation with the customers: *"Yeah, decision making… it is a multifaceted issue. I would like to clarify that these kinds of issues are delicate when it comes to cooperation. Still there are many areas where joint decision making is natural [in this business]. Also is it then decision making if you develop something together or agree on practices? If a customer proposes sub-contractors, that is in a way taking part in decision making. Of course we seek long-term partners, but conflicts of interest are rare."* Another interviewed manager emphasized the customer perspective specifically in monitoring and control: *"A customer finally admitted that safety and environment are really important. The thing is that we have been forerunners, but the customers are starting to notice these sustainability issues. We do see that because we can show that we are really good, that we have measurable results, we will do well in the future. And everything is not about money, but if have good statistics, it is easy to operate."*

5. Discussion: Strategy and compliance combined in sustainability decision making

The above vignettes brought in examples concerning how sustainability is covered in product development decision making in the four different decision domains. Strategy and compliance together contribute to product development decision making. Figure 2 ties these perspectives together, primarily concerning the product development project portfolio as a whole, but also indicating how strategy and compliance will convert to project requirements (including content and changes).

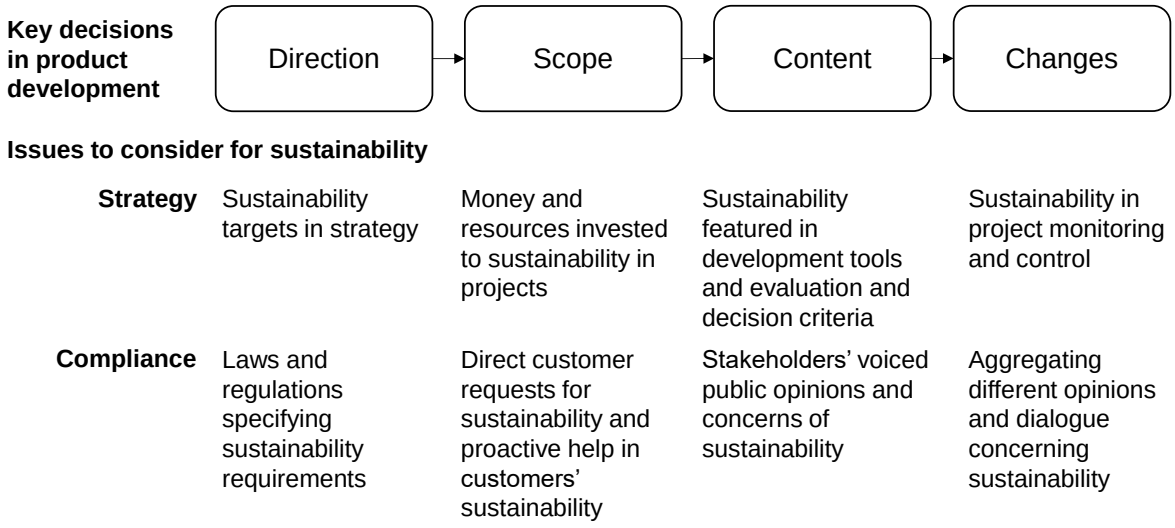

Figure 2. Four decision domains in sustainability decision making in product development projects.

Decision on setting the direction for product development portfolios and projects. In support of previous literature (Metz et al., 2016; Seebode et al., 2012), this study has offered evidence of how the firms emphasize sustainability in their strategies. The studied firms are good examples of sustainability-led and driven organizations that have chosen to guide their product development through roadmaps and plans that pursue increased sustainability both in products, services, and processes. At the same time, however, the second vignette showed that the companies were extremely sensitive to laws and regulations that stated ambitious environmental requirements to the products being developed as well as the companies' own environmental footprint. While the regulatory drive and pressure toward sustainability-oriented innovations has been acknowledged (Wagner et al., 2014), this study brings it as an important ingredient of product development decision making. There is a clear need to ensure consistency and mutual support, when choosing the direction that guides project portfolio creation and the ideation and selection of forthcoming product development projects.

Decision on the pursued scope of product development portfolios and projects. The aspect of scope concerning the investment into product development is quite implicitly covered in general project portfolio management research. Funding is considered as a key constraint, and the project portfolio is expected to be designed and implemented with the given funding. This study explicates the portfolio scope as a crucial decision in product development and highlights customers' requests and their sustainability potential as key factors specifying the portfolio scope.

Decisions concerning content and priorities, when selecting product development projects. The company experiences revealed the inclusion of sustainability both in tools and templates (Fargnoli et al., 2014; Petala et al., 2010) and evaluation and selection criteria (Brook & Pagnanelli, 2014; Meade & Presley, 2002) used during the product development processes in the firms. Where the previous research on project and portfolio selection often emphasizes strategy alignment, value, and balance in prioritization (Cooper et al., 1997), sustainability-orientation draws attention also to the contents being developed in product development projects. The compliance vignette revealed that during prioritization and content decisions, the concerns and voices of the stakeholders and the company's reputation in the public have to be taken into account. Prioritization of product development projects, thereby, does not take place in isolation within the firm only, but in tight connection with the societal context of the firm. Thereby, the findings lend support to the conceptual proposal of considering the product development portfolios as part of their broad business contexts (Martinsuo & Geraldi, 2020).

Decisions concerning changes and evolving aspects of implementation, when overseeing the projects' progress. Including sustainability into project performance assessments both during and after the projects is a logical step after its inclusion also in the selection phase. This study, however, revealed that sustainability brings in a necessity for process assessments, besides product and performance assessments. The strategy vignette drew attention to assessing and improving the processes with which products are designed and delivered, which is in line with previous research (Silvius & Schipper, 2015) but at the same time represents a new aspect of managing product development project portfolios. When sustainability of processes is developed and implemented in single product development projects, the same processes may be useful in other projects or their sustainability impact may occur immediately at the organizational level, thereby revealing process synergy potential. The compliance vignette emphasized the perspective of integrating stakeholder views to implementation decision and as guidance for changes, thereby making the monitoring, control and changes of product development project portfolios much more open and context-bound issue than indicated in previous research concentrating on intra-organizational views to product development projects and portfolios.

6. Conclusions

6.1 Contributions

Environmental sustainability is a global challenge that companies face both in terms of being a regulated constraint and representing their own strategic priority. This chapter has emphasized that sustainability is not merely something that appears in evaluation and selection criteria, when companies select product development projects into their portfolios. Instead, sustainability penetrates through product development and portfolio decision making processes much more holistically. The starting point for this chapter was the question: How, through which alternative approaches, do firms include sustainability into their decision making of product development projects?

The findings complemented the prevailing strategy and criterion-centric decision-making discourse with an additional emphasis on external compliance as guidance for sustainability decision making in product development. As a strategy and decision criterion, sustainability may be included in any of the existing project and portfolio decision systems, tools, routines, and performance measures. Additionally, sustainability is portrayed as an exemplary theme that ties projects and portfolios with a broader institutional context (as suggested by Martinsuo & Geraldi, 2020) and its regulations, norms and public expectations, thereby complementing the dominating view of project and portfolio decision making as an intra-organizational effort. The decisions of sustainability are challenged by the diverse voices and expectations of customers, stakeholders, regulators, and the public more broadly, and the company's reputation on the market. The findings, therefore, encourage considering the compliance perspective to sustainability decision making through including these external voices to all the key decision domains.

Four decision domains were used in structuring the empirical study, combining the strategy and compliance aspects and adding to current understanding of product development project decision making. The findings lend support to the general centrality of setting strategic direction and assessing the priorities among the proposed product development projects. Two novel findings relate to setting the resource and budget scope for the product development portfolio and aggregating different views when deciding about the details of project changes and evolution during implementation. In particular, sustainability necessitates an assessment of the scope of sustainability investments, either in all projects, or in a specific section of the project portfolio, or in both. As customer requests and customer-related business opportunities may create optimal conditions for enlarging the budgetary and resource scope

of product development investments, deciding on the portfolio scope will become a separate decision issue, after the strategy. Changes, in turn, relate to the continuity of sustainability dialogue both within the organization and with customers and stakeholders. Where changes are often taken negatively and considered as necessary reactions to new demands or external risks, the aggregated sustainability-oriented opinions may open up completely new business opportunities during the product development processes and, thereby, drive positive changes. In this way, hearing and aggregating external information for sustainability decision making is an important possibility for creating and implementing new emergent strategies.

6.2 Limitations and ideas for future research

The exploratory study has some validity limitations, through the choices of the target companies, certain choices in the research design phase, data collection frame, and analysis. The companies were chosen due to their explicit environmental orientation and interests on purpose, which restricts the transferability of the findings to such an environment. The data collection was arranged slightly differently among the companies, and the data collection occurred on a fairly general level, thereby causing some validity limitations. For example, the interview outlines did not go to much detail regarding laws and regulations, implementing the product development projects, or in distinguishing project-level, portfolio-level, and organizational-level issues in sustainability decision making. Therefore, also the data analysis has its limitations, due to slightly different accuracy and availability of source data.

Future research could develop and build on the decision-making framework (Figures 1 and 2) reported in this chapter. The research could be extended to cover also social and economical aspects of sustainability, besides the environmental aspects. Also, the focus could be directed at the managerial work regarding decision making on sustainability more specifically: where are these decisions made, who are involved in the decision making, what are the decision makers' personal preferences and tendencies, and how do people collaborate in decision making? The project and context information needed for the decisions could be mapped with detail, to update existing project portfolio management frameworks, adding specifically sustainability-related content. The portfolio scope decision could be investigated further, not just concerning sustainability, but concerning the management of product development portfolios in general. How do companies decide on investments into product development portfolios generally? How do they decide on the scope of sustainability-related projects, as part of the portfolio?

This study has revealed the centrality of the regulatory and legal context of product development project portfolios that pursue improved sustainability both in processes, products, and customers' business. This opens up completely new research avenues, not just concerning the integration of stakeholders into sustainability-oriented product development (as in Juntunen et al., 2019, Watson et al., 2018), but concerning the institutional embeddedness of product development project portfolios (Martinsuo & Geraldi, 2020). As compliance with institutional norms and environmental requirements can become a competitive advantage and differentiating factor (Metz et al., 2016), recognizing the societal and institutional potentials of sustainability needs to be tightly ingrained within the firms' strategies. The question then is: how will institutional forces shape the project management processes and project portfolio management routines that have, so far, been considered as highly intra-organizational?

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