

Fractal Enterprise Model in Intangible Resource Analysis: Double-Hierarchy Method

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Abstract. In global competition, tangible resources as a differentiating factor of competitive advantage are losing their power. The subject of intangibles and knowledge management is associated with high economic performance and, thereby, becomes increasingly significant in strategy implementation. This article explores how Enterprise Modeling (EM) can be used to mitigate the gap between the theoretical stands on the importance of the intangibles and their practical application. In particular, the study presents the application of the Fractal Enterprise Model (FEM) in strategic resource analysis. This research aims to propose a double-hierarchy resource modeling method using FEM and the patterns developed using this method. Additionally, this article presents an example of the method's application in a real case. The business situation concerns the structural change within the product development processes in pursuit of strategic leadership. The study deploys the Design Science Research (DSR) methodology and generates new knowledge about EM application in intangible resource management.

Keywords: Enterprise Modeling, Fractal Enterprise Modeling, FEM, Intangible Resource Building, Intangible Resource Analysis, Resource Hierarchy.

1 Introduction

The subject of intangibles and knowledge management is associated with high economic performance [1] and is becoming increasingly significant in the realms of strategy implementation [2]. The share of intangible assets in firms has shown to be rapidly increasing over the last years relative to tangible assets, which confirms the importance of accounting for intangibles in the analysis of performance and productivity determinants [3]. Therewith, the importance of physical or tangible resources as a differentiating factor of competitiveness is decreasing in relation to soft or intangible production assets, e.g., those related to knowledge, competencies, technology, research, and development [4]. Intangible assets contribute to productivity and growth within a

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firm through, e.g., human capital, organizational abilities, R&D activities, brand equity and through a broader community and economy, such as local externalities, innovation and entrepreneurship, institutional system, social capital, and trust, among others [4]. Thus, intangibles allow us to utilize resources more efficiently through the accumulation of knowledge and information via learning and innovation [5]. Hence, an understanding of a firm's intangible resource composition is critical for distinctive capability building and strategy implementation [6], [7]. However, the intangibles are often associated with the value that an organization can capture in either a balance sheet or economic performance report [8]–[11]. In fact, most of the intangibles modeling concerns evaluation models that are used to classify, theorize, and conceptualize the intangibles with the aim to make it possible to account on the balance sheet, e.g., in terms of different types of capitals: human, organizational, social, psychological, etc. [12], [13]. Consequently, the intangible resources are usually modeled using mathematical and/or statistical models, such as in [9], [14]–[17].

Therefore, the understanding of intangible resources' complexity, composition, and emergence is an under-covered area in the modeling discipline, perhaps, due to their invisibility and ambiguity. Enterprise Modeling (EM) may be a useful tool to address such a challenge to some extent. However, the main application of EM traditionally lies within the modeling of tangible resources and visible processes, such as Business Process Modeling (BPM) [18] or enterprise architecture in relation to information flow, e.g., ArchiMate [19], etc.

Previously, it has been demonstrated how EM, Fractal Enterprise Modeling (FEM) in particular, can be used to identify value capture processes through strategic resources management. Namely, it has been explained how mapping the firm-specific resources and the processes involved in their management, i.e., the strategically important value capture processes, can be tracked; see more details in [20].

The follow-up study provided deeper insights into the notion of intangible resources and their role in business processes [21]. In particular, the identification of the value capture processes has been extended with the notion of value conversion of intangibles based on their two roles as inputs and outputs in business processes.

Further investigation indicated the need to understand how intangible resources are used in the processes and how different activities contribute to the building of higher-level intangible resources. Thus, FEM has been used for modeling a generic resource development hierarchy, i.e., from assets to capabilities development [22]. The usage of this hierarchy helps to illustrate the scope of the intangible resources' building and their usage within the organizational structure.

In this article[†], the approach also accounts for the operant resource hierarchy, i.e., how basic operant resources (BORs) are organized to comprise either combined operant resources (CORs) and/or interconnected operant resources (IORs) in a particular business situation. Here, 'operant' stands for different types of intangibles [23]. The benefit of using both hierarchies in business analysis is perceived in a holistic approach, where the operant resource hierarchy complements the resources scope development perspective with the complexity of the intangible resources' configuration. Such a combination enhances the understanding of the higher-order resources and capabilities building in a given business situation.

The objective of this article is to extend the previously obtained method for intangible resource modeling, described in [22], by proposing a double-hierarchy modeling method using FEM and by introducing intangible resource patterns using this method. In particular, the proposed method and patterns combine two types of resource hierarchies: (a) the general resources development hierarchy [24], which was used previously in [22], [25]; and (b) the operant resource hierarchy [23]. This study also aims to apply this new method in a real business situation. The practical problem addressed is the lack of EM techniques to analyze intangible resource building, which considers the double resource hierarchy.

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The article is structured as follows: Section 2 describes the methodology used; Section 3 presents the knowledge base relevant to the modeling of intangible resources; Section 4 introduces FEM and gives more details on how the design to modeling intangibles has been approached; Section 5 presents a short re-cap of the business case and the research background; Section 6 presents the results of the practical application of the proposed method; in Section 7 the practical implications from the case analysis are discussed; Section 8 lists the lessons learned, outlines the limitations of this work and discusses future research; and in Section 9 the concluding remarks are given.

2 Research Methodology

This study aims to propose a double-hierarchy method for intangible resource analysis by combining the operant resource hierarchy model and the resource development hierarchy using EM, in particular, FEM. The presented research belongs to the design science research (DSR) methodology [26], where both the patterning method and the patterns can be considered as artifacts. The patterning method can be used to develop modeling patterns that capture particular combinations of the two resource hierarchies. Both the patterning method and the hierarchy patterns may be useful for (a) the modeling of intangible resources in a given business instance, and (b) the analysis of those resources through comparison between theoretical patterns and business instance situational patterns. Hence, it is expected that the modeling hierarchy patterns are representative of two types of business elements simultaneously: (1) the organizational scope, i.e., what business entities are involved in the usage of a given resource, where a larger scope indicates higher resource development (more details in [22]), and (2) the complexity of the resource, i.e., the resources' decomposition that shows what resources are involved in the creation of a higher-level resource (see more in [21]).

The process of the DSR consists of several iterative steps, such as (1) identify the problem, (2) define the solution, (3) design, (4) demonstrate, (5) evaluate, and (6) communicate/report [26]. This article presents the results of the EM design solution, i.e., a double-hierarchy method for modeling intangibles using patterning, as well as demonstration/evaluation by the practical application of the proposed design.

According to [26], the demonstration requires effective knowledge of how to use the tested artifact to solve a specific problem. The knowledge obtained in the preceding studies, where FEM has been applied in strategic analyses, is used as an input to the design solution [20], [25]. The demonstration step in this research aims to show how the proposed patterning method and modeling patterns can be used in strategic intangible resource analysis. The outcome of this step takes the form of the FEM models illustrating the relevance to the analyzed resources and processes of the enterprise. The models produced for the case have been analyzed from the perspective of the double-hierarchy patterns, where the business situation in intangible resource management has been diagnosed.

Furthermore, the demonstration and the evaluation steps, usually, are inseparable but the evaluation requires certain assumptions about the solution's performance [26]. From the modeling perspective, the proposed solution should be able to support the requests to represent different types of operant resources and their composition. From the DSR perspective, the knowledge obtained during the practical application of the new method can be fed back into the design phase. From the practical perspective, the application of the new method should provide useful insights about the business situation, i.e., the state of the strategy implementation taking a resource-based perspective. Hence, any outcome, positive and negative, generates valuable knowledge that can be used in developing a better solution for a given problem. For instance, by advancing the general knowledge about EM usage for this purpose, by providing more specific insights about how FEM can be used in the intangible resource analysis, and by helping to generate new ideas about future research directions.

Moreover, this article also presents an example of the method's application using a real business case. The practical question to answer is how someone using FEM, can understand the intangible resource composition and modify them through the changes in tangible resources, e.g., organizational structure. The question can be answered in two ways. The first way is top-down, i.e., to identify the key IORs necessary for reaching the strategic objectives and then decompose them into CORs and/or BORs. The second way is bottom-up, i.e., to map the key basic tangible and intangible resources (BORs) in the given process/s and analyze their usage to discover the combinations that may comprise CORs and IORs. The latter approach to resource analysis has been applied in the presented business example.

To illustrate the logic of such an analytical process, a very simple and generic example of operant resources' constructs has been used, i.e., one key organizational competence within R&D has been presented at a simplistic level. The process of explication of the relevant information in the case study is inherently subjective and a matter of biases [27]. Furthermore, considering the arguments that the perceived usefulness of modeling might be in the modeling process and not in the models themselves [28], the participation of a single junior researcher in the case analysis should be acknowledged as a limitation that may enhance such biases.

Further in this section the methodology used for modeling intangibles is described. Considering the ambiguity of intangible resources and the importance of hierarchy in resource development, there are three intangible resource frameworks combined in the design of the modeling method and the patterns. The deployment of these frameworks in the method's design contributes to a holistic approach to the intangible resource analysis in the following ways:

- the classification of intangible resources [29] is used to map different types of intangibles, e.g., knowledge-related, relational, cultural, etc.,
- the generic resource hierarchy or the value innovation resource hierarchy [24] is used to outline the position of a certain resource within the organizational structure, i.e., a scope perspective,
- the operant resource hierarchy [23] is used to denote the composition of a certain resource, i.e., the complexity perspective.

There are multiple ways to classify intangible resources, for instance [30]–[34]. In this work, the intangibles categorization proposed by [29] is adopted. The authors of [29] describe the tangible and intangible resources in terms of the operand and operant. The operand resources are typically physical (e.g., raw material). The operant resources are typically human (e.g., skills and knowledge of individual employees), organizational (e.g., competencies, routines, control mechanisms, cultural norms, and values), informational (e.g., knowledge about market, technologies, and competitors), and relational (e.g., relationships with customer, competitors, suppliers). Unlike informational resources, knowledge-related resources may take the form of explicit (visible and documented) and tacit (invisible that resides within an individual) [35]. Furthermore, [36] describes tacit knowledge in terms of the two comprising elements: cognitive and technical. The cognitive elements represent the individual's mental maps, beliefs, values, paradigms, viewpoints, etc., i.e., the culture-related intangible resources that may indirectly control the process execution [37]. The technical component represents the knowledge applied to a particular context such as skills, craft, know-how, etc., i.e., the knowledge-related intangible resources that may directly control the process execution [38].

Since both human and informational operant resources in the classification of [29] represent some type of knowledge, i.e., a technical tacit knowledge (e.g., skills, crafts, know-how, etc.) and/or an explicit type of knowledge (e.g., explicated from human heads and documented), they can be grouped into the same category knowledge resources. However, within the organizational category of operant resources, elements such as cultural norms, values, beliefs, attitudes, etc., represent the cognitive type of knowledge in the definition of [36]. Therefore, they can be grouped as cultural resources. Therewith, in this work, the intangible resources, or operant resources in the

terminology of [29], categorization has been adjusted forming the following three categories: knowledge-, culture-, and relation-related resources.

- *Knowledge-related intangible resources* represent the tacit type of knowledge that includes experiences, know-how, etc.
- *Culture-related intangible resources* represent personal and shared values, norms, beliefs, attitudes, etc.
- *Relation-related intangible resources* represent the relationships with internal individuals and groups, competitors, suppliers, customers, etc.

Furthermore, the *cognitive elements* of tacit knowledge represent individuals' mental maps, beliefs, values, paradigms, viewpoints, etc.; the *technical component of tacit knowledge* represents the knowledge applied to a particular context such as skills, craft, know-how, etc. [36]. In his conceptualization, these two elements may be undividable, i.e., usually, both are present in the unit of tacit knowledge, though they might be in different proportions. However, for analytical purposes, the modeling of these two elements is separated. From the EM perspective, technical knowledge might be associated with the input required to perform a certain process; whiles, the cognitive knowledge – with the mechanism that controls the process execution, i.e., sets the standards for the quality of the process outcome, making decisions on corrective actions, etc. Modeling cognitive elements and technical components of tacit knowledge separately provides a better overview and clearer structure for the representation of the tacit knowledge used in the process, i.e., acting upon the other resources to transform them, and for the representation of the tacit knowledge influencing the process run (or the process outcome), i.e., what intangibles control and coordinate this action. Such understanding benefits the resource strategic analysis because changes in processes, structure, and boundaries may be required to manage the technical tacit knowledge for strategic purposes. Since knowledge and skills are acquired by performing tasks, the new processes, structures, and boundaries may help to acquire, transfer, or combine knowledge to develop new competencies and capabilities [6]. In contrast, to manage the cognitive tacit knowledge for strategic purposes, a change in organizational policies and systems may be required to reinforce, promote, or shift personal (consequently organizational) values, beliefs, and norms to deliver/produce new value propositions [6].

In this work, as generic resource hierarchies, the value innovation resource hierarchy [24] is used to refer to an intangible resource in the organizational scope. The hierarchical schemata is important as many researchers argue that the resources can be arranged hierarchically [33], [39]–[42]. In particular, it has been suggested that competencies and/or capabilities belong to the higher-order resources since they represent the collection of routines and assets coordination that, together with other inputs, produce significant outputs of a particular type [42], [43]. This model suggests that developing a resource at a higher level requires actions such as knowledge exchange, handling relationships, and coordination where several parties can be involved. Thus, the modeling of intangibles in this dimension implies the members' capacity to interact and coordinate.

The classification of the intangibles applied in this work (i.e., knowledge-, culture-, and relation-related), is systematized following the analytical logic proposed by [24] and adapted in [25]. Namely, such resources are arranged according to the *context of their application and development within the organizational scope*:

- *Asset level* – the physical resources, such as the workforce, representing a repository for the intangible resources.
- *Resource level* – the personal skills, know-how, competencies, etc. to perform a task effectively and efficiently to contribute to the production of a valued market offer (strategic).
- *Competence level* – the combination, coordination, and management of the personal knowledge, skills, and competencies of the teams, the units, or function level to produce effectively and efficiently valued market offers.

- *Capability level* – the coordination of knowledge, skills, etc., within and between the multiple organizational functions and units (the organizational level) to produce effectively and efficiently valued market offers.

Assets are not considered in this research since they do not represent strategic intangible resources according to the presented classification approach.

The value innovation resource hierarchy [24] has been complemented by the *operant resource hierarchy* proposed by [23], which adds the complexity dimension to the intangible resource analysis. This hierarchy describes the intangible resources in terms of basic, composite, and interconnected (see Figure 1, right side):

- Basic operant resources (BORs). The basic operant resources might be viewed as the underlying, low-level resources that form the higher-order operant resources, e.g., skills and knowledge of individual employees. These resources only become the entities of such categorization if they only contribute to the production of an offering that has value for some market segment. Hence, BORs describe distinct or firm-specific operant resources. The typical BORs represent human-related, organizational, informational, and relational resources.
- Composite operant resources (CORs). The composite operant resources are a combination of two or more distinct BORs with low-level interactivity. At this level, they collectively enable the organization to produce effectively and efficiently valued market offerings. For instance, basic resource A + resource B + resource C = composite operant resource D. According to [23], the lower-order resources that are combined to become COR can be both tangible and intangible. However, the presented study is concerned only with the modeling of intangibles. The examples of CORs identified by [23], among others, are:
 - Market orientation. This category includes activities for acquiring information about buyers and competitors, as well as behavioral components, such as inter-functional coordination based on the customer and competitor information.
 - Alliance competence. This category comprises the ability to find, develop, and manage alliances. These CORs can assist in better understanding the drivers of alliances, e.g., partner identification propensity contributes to increasing competence in the above abilities.
 - Technological competence. These CORs have two facets: technological collaboration reasons and technological expertise. The technological competence is categorized as a firm's ability to understand, use, and exploit relevant state-of-the-art technology. Furthermore, there is a positive relationship between this COR and innovation success.
- Interconnected operant resources (IORs). The interconnected operant resources are similar to CORs but with a significant amount of interactivity among their constituents. Therefore, they reinforce each other to effectively and efficiently produce the valued market offerings. IORs may consist of both the basic (BORs) and the higher-order resources (CORs). The reinforcement can be identified by the resource's influence on each other as resources A x B, B x C, A x C, and/or A x B x C (where A, B, and C are resources). The examples of IORs identified by [23] are as follows:
 - Product innovation competence: a new product development requires organizational competence in linking the technology and the customer [40], [44]. This linkage has to be reciprocal to ensure innovation within the product development [40].
 - Knowledge creation capability: according to [45], the knowledge-creating capability is when the knowledge organization (1) has access to the people or the group of people with specialized information, (2) is able to absorb and (re)combine the exchanged information, and (3) can anticipate value from the exchanged and combined information.
 - Entrepreneurial proactivity: according to [46], entrepreneurial proactivity takes place when the firm may influence the market's responsiveness and its performance by developing a wide range of knowledge resources. This, in turn, requires acceptance by

the organization of risk-taking behavior, entrepreneurial processes, proactiveness, and competitive aggressiveness.

It is expected that as the firm goes up in the hierarchy, the competitive advantage from the resource becomes more sustainable because the resource becomes more inimitable and non-substitutable.

In this work, when approaching modeling and patterning intangibles, the concept of generic value innovation resource hierarchy is used to refer to an intangible resource to show its level of development, i.e., referencing the organizational scope. Whereas, the concept of the operant resource hierarchy is used to refer to an intangible resource complexity at any level of development, i.e., at any organizational scope. Figure 1 illustrates this logic.

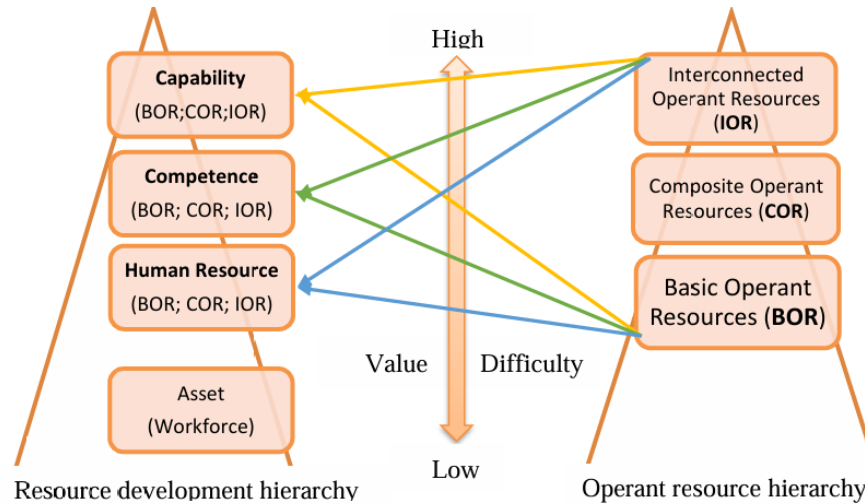


Figure 1. Combination of intangible resources' hierarchies (adapted from [23] and [24])

3 Background and Previous Work

There is relatively poor research about how EM can be used to mitigate the gap between theoretical stands on the importance of intangibles such as knowledge, competence, etc., and practical application. Those few studies that exist focus on separate intangible categories such as R&D and learning [47], human and social capital [48], or human, social, and technological capital [3]. While [47] notes that the single assets are the elements of the whole bundle of the intangibles, the integrative approach in measuring the overall effect of intangibles is needed. Hence, there is a limited choice of modeling techniques that can visualize the interconnections of the identified knowledge assets to the organizational routines, i.e., to show the activities in which a certain type of tacit knowledge is created and how and where it is used and/or transformed into other types of knowledge or other forms of value [49].

Therewith, several authors discuss the importance of hierarchy in intangible resource development [39], [40], [50], [51]. However, the currently suggested hierarchy of intangible resources is criticized for being elusive because there is no explicit or tangible patterning of activities governing such resources and their adjustments [51]. For instance, the value-added hierarchy/ladder model proposed by [24] describes the level of intangible resources by their position, accessibility, and application in relation to the organizational scope at a very generic level (i.e., from an individual to the team to the function and, ultimately, to the cross-functional level) without any explanation about the intangibles' composition or what activities may be responsible for the building of the intangible resources at a higher level.

One way to improve the understanding of how the intangibles evolve is to enrich the concept of the hierarchical ladder of [24] with the notion of the intangibles' complexity, as proposed in [23], [52]. The authors of these sources describe the intangibles in terms of operant resources, whereas

the operand resources are referred to as the physical. The operand resource classification includes three main categories: knowledge-, culture-, and relation-related as described in Section 2.

This article discusses the *approach to intangible resources analysis* using models and the remainder of this section explains how the chosen classification and hierarchies of intangible resources can be used in EM-based analysis. To direct the modeling process and the practical analyses, a closer look at how the intangible resources, in particular knowledge-related, generate value in an organization is needed. Therefore, some details relevant to the practical case analysis, such as value co-creation and value conversion aspects, are discussed.

The *value co-creation logic* is explained first. According to [44], a new product development process is a process of linking technology and customers, whereas innovation is a result of the reciprocal linkage between technological and customer competence [40]. Thus, the value co-creation logic is based on the specialist competencies (such as knowledge and skills) exchanged in the processes undertaken to the benefit of their own and other organizations [53], [54]. Therewith, the basic operand resources, such as knowledge and skills, become a foundation for the competitive advantage, i.e., being up-front with the customer through pre-empting the relationships with the strategic customers at the early stages of the product development [6]. In fact, early customer involvement reduces the costs, time, and energy for both parties while increasing satisfaction [55], [56]. Thus, the process of value co-creation through knowledge exchange occurs when the supplier applies its knowledge to the design and production of the product and/or service based on the customer's knowledge and capacities of its daily usage. In this perspective, the customers may be viewed as operand resources since their involvement leads to an integration of their knowledge and skills into a production process, which is essential for the company to ensure value co-creation through innovation and coordination [52].

Also, it is essential to note that organizations are self-responsible for facilitating the integration of customer's intangible resources in their value creation processes and should establish processes correspondingly [57]–[59]. Also, in the value co-creation logic, companies should not be limited to making customer proposals based on the customer's expectations but should actively assist a customer in their value creation [57]. Therefore, as pointed out by [45], knowledge-related resource building within the value co-creation exists when the employees have access to people with specialized information, and when the organization can absorb and combine the exchanged information.

Further in this section, value conversion within intangible resource building is explained. The intangible resources are considered intellectual capital, while the management of intellectual capital is considered to be a process of extracting the value of knowledge that can generate profit for the organization [10]. To understand how the value from tacit knowledge is created and how it becomes embedded in organizational routines, as well as how it can be converted into other forms of value, the value conversion and creation dimensions must be considered.

V. Allee [49] describes three important dimensions of intangibles in value creation:

- *Intangibles as negotiables* or direct exchanges for money, converting intangibles to economic tangibles in the form of a product or a service. In its simplest form, this dimension might be associated with the technical tacit knowledge and/or experience application classified as BOR. For instance, applying knowledge and experience to 'Developing solutions' for customers that might be sold for money (see Figure 4 in Section 6 for illustration).
- *Intangibles as deliverables* or value outputs, the intangibles exchanged where the value of intangible is negotiated, i.e., an intangible is a deliverable. This includes informal knowledge, information, and other benefits that can be transferred from person to person or group to group, i.e., unpaid activities that help the work run smoothly and help build relationships. This dimension might be associated with the combination of intangible resources (COR) such as knowledge and cultural values/norms. For instance, through the reuse of technical knowledge from different people within the 'Internal R&D' team and their experience in cooperation based on the given cultural norms, a new type of intangible, such as a COR 'Technological competence', can be developed. These resources can be associated with an

output of the operational process, where the value of a new type of knowledge, e.g., ‘Technological competencies’, can be assigned to the organizational level (see Figure 4 in Section 6).

- *Intangibles as economic exchange or value inputs*, where they are dynamically converted into other types of value in a business model or increase resource value as such (tangible or intangible). This dimension might be associated with the power of interconnections classified as IORs [23]. For instance, the knowledge exchange with the strategic customer during its early involvement in the product development process, enhances the trust between the parties. Moreover, the building of ‘trust’ in the knowledge exchange process is reinforced by the employees’ competence and shared culture (the firm’s and the customer’s). This is shown in Fig. 6 through the assets of ‘Participants’ in the process of ‘Product strategy development’. Hence, the value of trust as an IOR is increased, which is one of the most important intangible resources for sustaining economic value [6], [7].

Hence, the analysis of the utilization of intangibles in value conversion may proceed in two directions:

- converting value as inputs, i.e., using intangible as input in the process to build another tangible or intangible asset (financial or non-financial); and
- converting value as outputs, i.e., using other assets (tangible and intangible) to create some type of intangible assets.

To summarize, when converting value from intangibles, an employee or an organization utilizes their tangible and intangible assets. It happens upon the assumption that certain roles convert those assets into more negotiable forms of value that can be delivered to other roles through transaction or exchange where an exchange is two or more reciprocal transactions [49]. Therefore, the notion of roles in describing value conversion is particularly valuable in understanding value conversion. This is because the value transaction is only completed upon the acceptance of this value by another role in the network. Such acceptance is contextual and dependent, meaning that the intangible as a deliverable is considered valuable in one context but not in another. Value, therefore, is an emergent property of the entire system, and it is essential to understand why and how value is created [49].

Roles in value conversion may not be the same as the role of an employee or business unit in the organizational chart [49]. Any role possessed by an employee, group, or organization, controls a set of intangible inputs by processing them and using them either directly for themselves or accrue to the firm. In the case example in Section 6, in the process ‘Requirement analysis’ an employee uses the knowledge and experience acquired and reused in the process for himself increasing the value of his skills that he can sell to the organization for a higher reward, i.e., using them as negotiables, but also contributes into the accrued value of the organizational competences, or converting value output from the process into the input for the organizational competence building, such as shown in Figures 4 and 5 (COR) in Section 6. Then such inputs (accrued knowledge, experience, values, and beliefs), may be used in the process of ‘Product strategy development’, where they may be converted into a higher value of a more negotiable form of intangible resources, such as an asset ‘Trust’. This is illustrated in Figure 6 in Section 6.

4 Patterning in Modeling Intangibles Using FEM

FEM is a modeling technique based on the fractal view of an organization [60]. Graphically, FEM represents the system of interconnected processes and assets; whereas a process has an oval shape, an asset is rectangular, and the relationships are captured by the different types of arrows, as shown in Figure 2. Together, these elements construct different types of patterns: a *process-asset pattern* shows the assets used in the process (part (a) in Figure 2), an *asset-process pattern* shows what processes must be in place to manage a given asset (part (b) in Figure 2), and a *decomposition of*

a process which provides more details about the activities and assets in a given process (part (c) in Figure 2). These patterns represent the fractals, which can be alternated to create a directed graph relevant to a particular situation showing the chain of the relationships across the fractal levels.

The intangible resources in FEM can be notated by using dashed-bordered rectangles (i.e., ‘Assets’ in FEM language) as shown in case models in Figures 4, 5, and 6 in Section 6. Moreover, these types of resources can be connected to different levels of ‘Workforce’ assets (from individual to entire function) using dashed arrows with the notation ‘resides within’ (as shown in Figures 4, 5, and 6 in Section 6). This interdependency indicates where an intangible resource is located and, hence, used within the organizational structure. In addition, FEM notations allow to distinguish processes and assets belonging to different functions, units, actors, etc., by usage of colors. The ADOxx toolkit is used to implement the FEM software tool [42]. More about modeling with FEM can be found in [61] and on its dedicated website[‡].

Although other techniques may also be suitable for the purpose, FEM has been chosen because it covers the requirements for the presented study, such as the possibility to visualize the low-level intangible elements based on which the higher-level intangibles can be developed, such as competencies and capabilities. Besides, FEM advances other EMs by its recurring structure, helping to navigate the relevant chain of the relationships across the fractal hierarchy of the processes and assets, paying attention to their roles in the system.

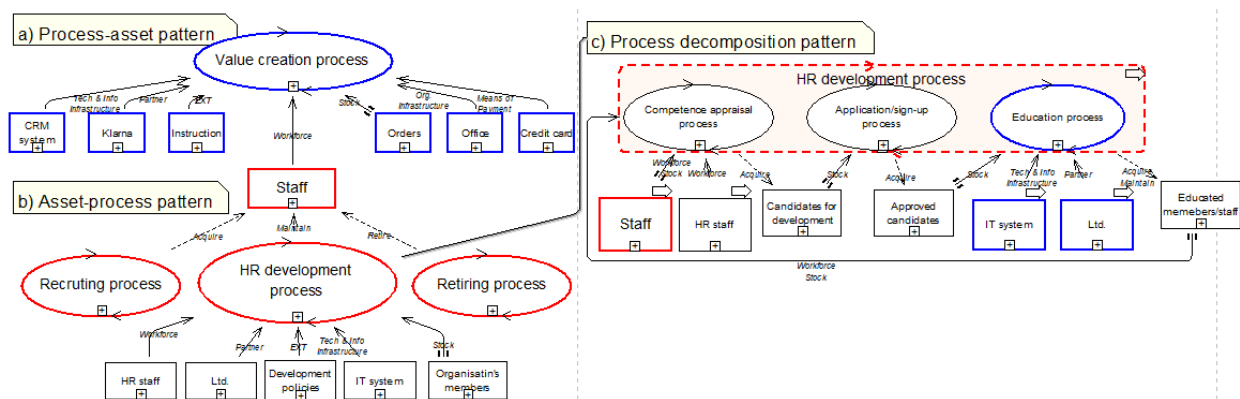


Figure 2. FEM generic patterns

The patterns for modeling a generic value innovation resource hierarchy using FEM has been described in [25]. In particular, through the connection of the knowledge and experience type of assets to the ‘Workforce’ asset at different hierarchical levels, it was possible to notate the owner of the intangibles within the organizational system. For instance, if the knowledge is possessed by a person, then such resource ‘resides within’ the lowest level of the organization. Hence, this knowledge is accessible only to a particular employee and might be lost by an organization when he/she leaves. In contrast, if such resource ‘resides within’ a ‘Workforce’ asset representing the team or inter-functional teams, then the resource is commonly shared and accessible among multiple people or functions respectively; therefore, it is an organizational resource.

In this work, the intangible resource development patterns have been created using FEM by combining the generic value innovation hierarchy with the operant resource hierarchy. The examples of the patterns are summarized in Table 1. To denote different types of operant resources, such as BORs, CORs, and IORs, the intangible assets (boxes with dashed borders) are used. These assets play the role of inputs in a business activity, which is denoted with the ‘EXT/Tech&Info Infrastructure’ connection. To show the level of resource staff development, the links ‘reside within’

[‡] www.fractalmodel.org

indicate which type of ‘Workforce’ asset possesses a given resource: an employee, a team, or a function, respectively.

The notion of intangible resource hierarchies is used in the following way. The concept of the operant resource hierarchy is used to denote the intangible resource complexity [23]. The resource complexity perspective provides more details about the intangibles’ construction at a different organizational scope (i.e., at the resource, competence, and capability levels). Hence, the fusion of the two perspectives enhances the analysis of intangible resources.

In FEM, an Asset represents a physical resource, i.e., a worker. However, according to [33], BOR is a distinct or firm-specific resource based on which a competitive advantage can be developed (which is difficult to imitate, acquire, and develop) [7]. Therewith, the BOR resources start with the human resource ladder in the model of [24] (see Figure 1). Consequently, in the presented method, a human resource is not viewed as a person, instead, a person is modeled as a depository of intangible resources, such as knowledge, skills, and abilities that an employee uses to perform organizational processes. Hence, these types of resources become unique and distinctive only when developed and appropriated in particular organizational settings. For instance, an employee is a person who performs a task, but only if he/she is skilled, knowledgeable, and experienced, does he/she become a strategic resource for the organization, i.e., relates to stage 2 of the resource ladder where intangibles emerge. From this stage, the resource building in both hierarchies is concerned with the combination of intangibles. Therefore, one may look at the bottom of the operant hierarchy (BOR) as stage 2 (resource) in the value-added model (see Figure 1). Hence, the three following stages generally represent the combination of intangibles. The difference, however, is that the value-added model emphasizes the resource combination referring to the scale: from personal to organizational. Whereas, the operant resource model emphasizes the way the basic resources are combined: as a composite or as a reinforcement.

Table 1 shows the following patterns:

BOR

- Resource level: at the resource level, an employee’s tacit knowledge, including technical and cognitive, e.g., experience and subject knowledge, and personal values and beliefs, represent the lowest level components of an organization’s intangible resources.
- Competence level: at the organizational competence level, the experience and knowledge obtained in a business activity is shared within the entire team. Hence, organizational cognitive tacit knowledge is transparent, which may lay the grounds for higher-level resource development.
- Capability level: at the highest basic resource development level, an organizational capability is obtained when cross-functional teams’ tacit knowledge is shared and accessible to all members of an organization. At this stage, the , the composition or interconnection is not yet considered; it is the possession of such is concerned).

COR

- Resource level: a basic example of COR at the resource level is a combination of BOR resources at the individual level, such as personal experience and knowledge, etc., of an employee that produces a COR ‘skilled employee’. This type of COR represents a valuable human resource that provides an organization with unique skills and know-how to make a process more efficient.
- Competence level: an example at the organizational competence level is the combination of different ‘know-how’s (based on tacit knowledge of different teams) from multiple units that together build the base for an innovation competence at a functional level.
- Capability level: an organizational capability that might be built upon intra-functional coordination, which includes a composition of the tacit knowledge (technical and cognitive) of employees from different functions. Another example is shared cultural values and beliefs that allow business activities to run smoother.

IOR

- Resource level: an example of BORs at the individual level is the knowledge and experience that are acquired and reused in a business activity, i.e., the acquired knowledge in a task changes the way the task is performed and vice versa. These individual assets reinforce each other to acquire a unique ability to perform a task in such a way that may produce different types of the process’s outcome, e.g., making it more effective.
- Competence level: an example of IOR at the competence level might be dynamic coordination. Such competence is based on the shared competencies between teams, the resource that is reinforced by the common cultural norms, views, beliefs, etc., possessed by employees within one function. Such reinforcement may change the processes’ outcome by better understanding, reaction, and nature of the response to the new information at a functional level.
- Capability level: at the capability level, the organization-wide dynamic coordination becomes a higher-order operant resource (capability). It emerges based on the common cultural values, norms of behaviors, etc., shared between different functions (note, the sub-cultural difference still may exist). Common cultural norms ease the knowledge exchange between different functions, i.e., reinforce the competence shared and the knowledge application throughout the organization. Thus, it improves the adjustments and responses to the new information, which may also change the process’s outcome.

Table 1. Intangible resource hierarchies with examples of FEM modeling patterns. (Legend: in blue – BORs, in green – CORs, in yellow – IORs)

	Resource	Competence	Capability
BOR	<p>Mapping Basic Operant Resources Resource</p>	<p>Mapping Basic Operant Resources Competence</p>	<p>Mapping Basic Operant Resources Capability</p>
COR	<p>Operant Composite Resource (COR) - organisational resource level</p>	<p>Operant Composite Resource (COR) - organisational competence level</p>	<p>Operant Composite Resource (COR) - organisational capability level</p>
IOR	<p>Operant interconnected resource - at resource level (human)</p>	<p>Operant interconnected resource - organisational competence level</p>	<p>Operant interconnected resource - organisational capability level</p>

The FEM is a modeling method based on a fractal view of an organization. FEM was originally constructed to solve a particular problem: finding all (or to the maximum extent) processes in the organization, including invisible ones. In this article, only a short overview of FEM is presented; more on the main principles of building FEM can be found in [61] and [62].

5 The Business Case

Previously, FEM had been used to model a single resource hierarchy that considers the organizational scope. That method was applied in a real-world example of the R&D analysis, where two patterns related to building organizational competence have been identified [22]. These patterns represent adaptive learning and generative learning. The organizational structure was pointed out as one of the main facets in distinguishing the patterns because the structural aspect ‘shapes the behavior of the members’ [33]. One of the prominent aspects related to the usage of the structure in resource development was the change in coordinating the asset controlling the R&D processes. The case example illustrated how the change in structure may enhance the organizational learning capability through better acquisition of knowledge-related intangible resources. It has been shown that the new structure has affected the intangible coordinating mechanism through the tangible assets shaping the coordination, such as instructions for product development from the product requirements at the operational level to the long-term product strategy at the strategic level (Figure 3).

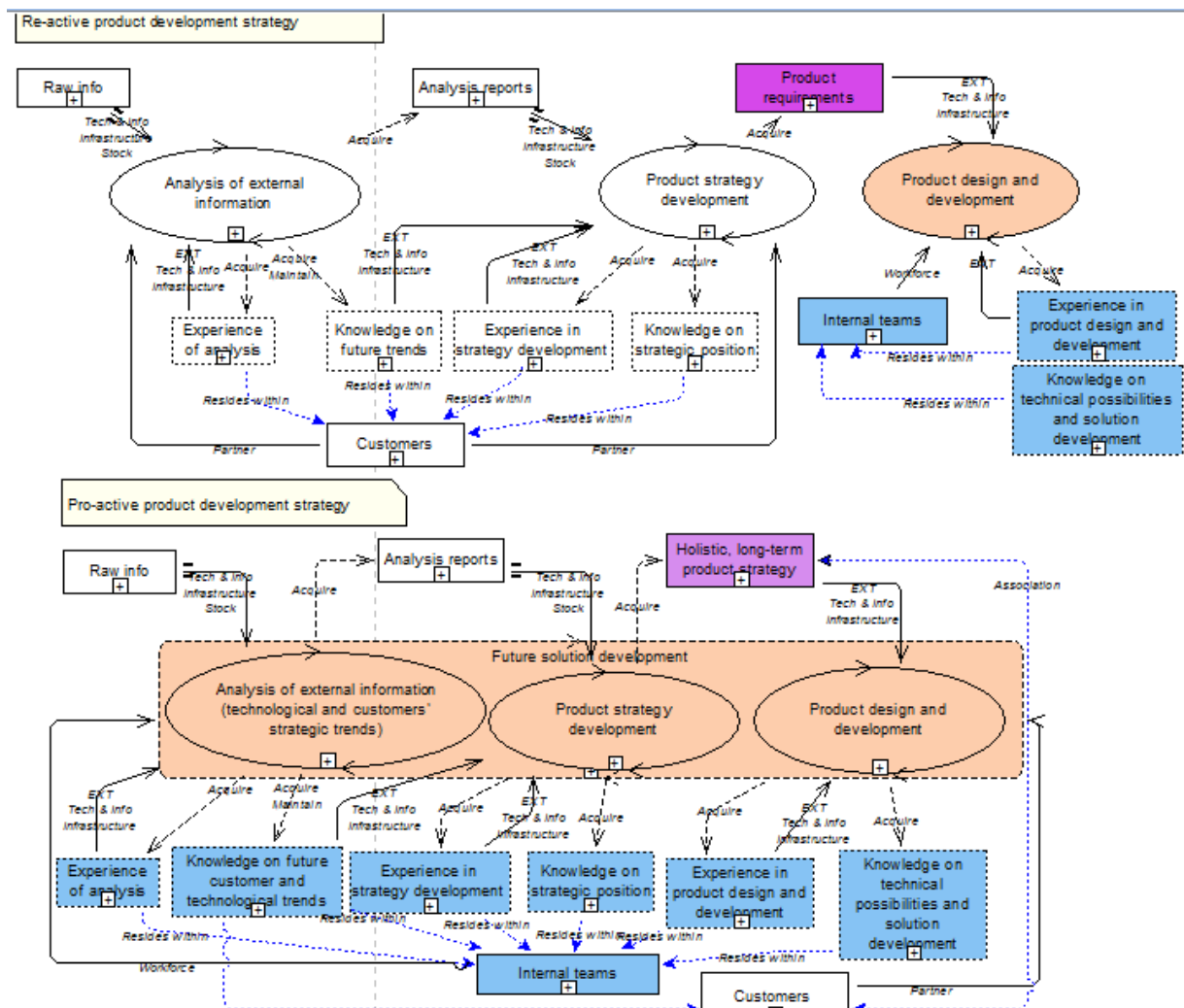


Figure 3. Case example models of reactive and pro-active ways of working in product development (adopted from [25]). Shapes: ovules – processes, rectangle – assets/resources, arrows – different types of relationships (see more in Section 6). Colors: in pink are shown the organizational processes; in blue – the organizational assets; in purple – the coordinating assets; and in black and white – the elements outside the organization).

The upper graph in Figure 3 illustrates the reactive approach, where the company is being directed by the ‘Customer product requirements’ at the operational level. In this situation, the R&D

team's coordination exhibits behavioral norms based on the assumption that the customers know exactly what they want. Such an assumption normalizes the expected employees' behavior of listening to the customers and matching their expectations, i.e., delivering the best quality solution rather than keeping up with the rapid industrial change and strategic innovation. For instance, it is unusual for R&D engineers to provide any feedback to the customer before the profound quality checks. This practice has been historically successful; therefore, there is a lot of confusion among members about why the profitability is declining. The lower graph in Figure 1 illustrates the proactive approach, where the company develops a 'Long-term holistic product strategy' together with the customer (see more in [22], [25]). To achieve the overarching coordination, the activities of a new department focus on early engagement with the external environment by 'actively hunting for the information'. Namely, by reaching out to the strategic customers before 'they know' what they want, by obtaining the technological information on the future products together with the customer, and by feeding this information back at the high organizational level to ensure strategic coordination. However, there are many intangibles behind each tangible resource, and acquiring such resources is a complex matter based on the development of a unique series of organizational activities [4]. Therefore, to improve resource management and sustain the proactive way of working, further investigation of the underlying intangibles is needed. More on the case description can be found in [22], [25].

6 Double-Hierarchy Resource Analysis Application in Case

Figure 4 represents the extended version of the process 'Product strategy development' presented in Figure 3.

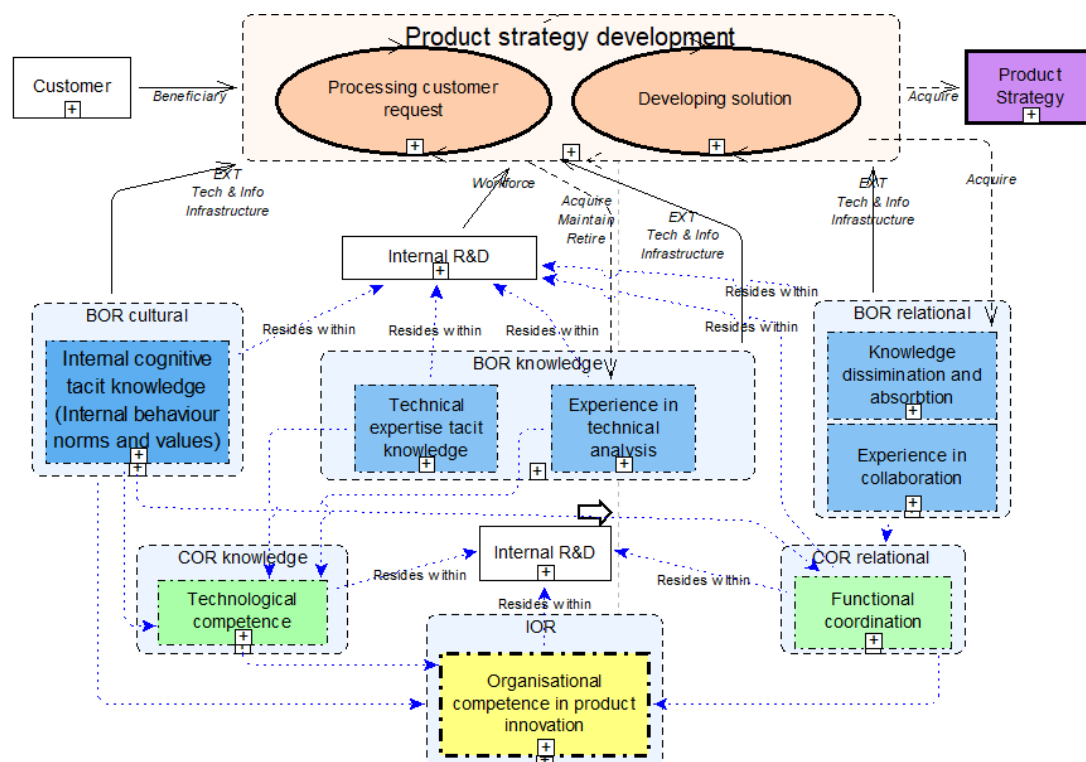


Figure 4. The example of the process decomposition from Figure 1 showing more details on the composition of the IOR before the structural change. (In blue – BORs, in green – CORs, in yellow – IORs)

In particular, Figure 4 provides more details on the usage of intangibles in its sub-processes, such as 'Processing customer requests' and 'Providing feedback on request'. For instance, the former sub-process uses the BOR knowledge 'Technical expertise tacit knowledge', which is resided within the internal R&D team. Also, the BOR tacit knowledge, such as 'Experience in

processing customer requests', is acquired and reused in this sub-process (blue rectangles in Figure 4). Hence, these two BORs (among others) composite the COR related to knowledge type of intangibles. The R&D unit members disseminate and/or absorb the new knowledge during the sub-process 'Developing a solution', where the customer request analysis is discussed. The experience of creating a product design together with other members leads to learning how to collaborate. Hence, in this sub-process, the two BORs are acquired and reused, which enhances the competence of collaboration within the R&D function, i.e., forms the relational COR resource 'Functional coordination'. The cultural BORs control the member' behavior organization-wide, i.e., are applicable in all processes, including the entire 'Product strategy development'. Thus, these BORs are a constituent part of all higher operant resources: directly, e.g., the COR relational and IOR; or indirectly, e.g., influencing the IOR through the COR knowledge. Hence, Figure 4 shows that the organization's IOR 'Organizational competence in product innovation' consists of the combination of at least two CORs ('Technical competence' and 'Functional coordination') and a BOR 'Internal cognitive tacit knowledge'. The reinforcement occurs through the influence of the internal cognitive tacit knowledge (the culture) on the way engineers collaborate; which, in turn, affects the organizational technological competence building.

Although it is argued that the possession of such IOR sustains the competitive advantage [23], a deeper case analysis suggests that this may not always reflect the truth. For instance, Figure 5 maps the difference in the combinations of BORs, CORs, and IORs used in the 'Product strategy development' process before and after the structural change. In Figure 5, the black-bordered assets (dashed and solid) capture the combination before the structural change; while the red-bordered elements (dashed and solid) capture the additional processes and assets introduced after the structural change. The difference is associated with the level of IORs development within the resource hierarchy described in [22] (as discussed in Section 3). In particular, it has been detected that the level of the IOR development in product innovation ('Organizational competence in product innovation') belongs to the competence rung within the general resource development hierarchy, i.e., lies within the scope of one function, such as R&D unit's (denoted as 'Workforce' in the process). After the change, the organization appropriated the IOR at the capability rung, i.e., the ultimate level in the resource hierarchy. Namely, the IOR 'Organizational Entrepreneurial proclivity capability' (Figure 5) has been developed on the basis of differentiated BORs and CORs. The acquisition of such differentiated intangible resources has been enabled through the establishment of the new team ('Tech advisory global team') and the sub-processes it performs, 'Hunting for industry technical knowledge' and 'Strategic customer identification and suggesting their future requirements'. There are two peculiarities with such a move. First, the new team plays the role of interconnector between the executive and operation levels, i.e., it works closely with the R&D function but, also, is directly involved in the long-term strategy development function. Second, the new processes it executes, require entrepreneurial cultural norms and behavior, i.e., different from existing ones, which are safety-oriented.

The sub-process 'Hunting for industry technical knowledge' introduces the acquisition of broader and deeper technological knowledge, e.g., BOR 'Industry technical tacit knowledge'. It also introduces the entrepreneurial cultural norms and behavior which are necessary to execute such tasks, i.e., BOR 'Cognitive tacit (Innovative, risk-taking, proactive behavior norms and values)'. All these BORs, including the experience in this new process, reside within the new team 'Tech advisory global team'. Together, they construct the COR 'Pro-active product innovation competence' and are included in the new IOR 'Organizational entrepreneurial proclivity capability'. Hence, by establishing a new team and processes, the organization bonds together different functions through the introduction of new cultural norms and behaviors. Note, that these new norms and behaviors are resided only within one part of the organization at the start. How this partial strategic-operational coordination enables adjustments in all other parts of the organization and its functions, is a matter of more complex schemata in knowledge resource management and organizational learning, which is a future research agenda.

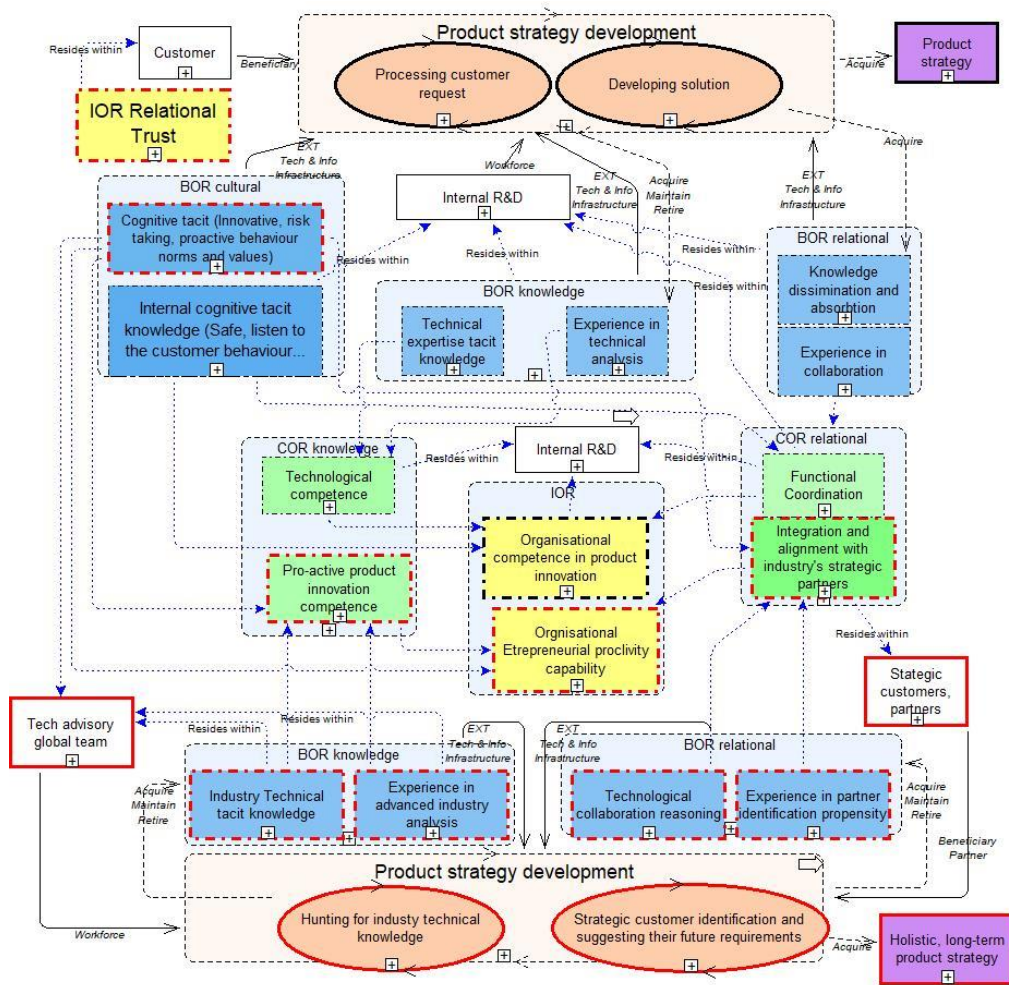


Figure 5. The example of the process decomposition from Figure 1 that shows more details on the composition of the IORs after the structural change. (In red boarders - assets and processes introduced after the structural change. In blue – BORs, in green – CORs, in yellow – IORs).

The sub-process ‘Strategic customer identification and suggesting their future requirements’ enables the acquisition of the BORs ‘Technological collaboration reasoning’ and the ‘Experience in partner identification propensity’. The ability of the firm to predict the industrial-technological path and, therewith, to identify the future customer requirements and to convince them of their future strategy, provides the grounds to both partners for differentiation, i.e., gives the reason to collaborate. Such collaboration secures the strategic relationships and alignment of partners’ businesses [7], [23]. The experience in performing such a task enhances the new team’s expertise, i.e., the resources necessary to gain organizational credibility [6], [7], [23]. Hence, these BORs together with the new cultural BOR, construct the COR ‘Integration and alignment with the industry’s strategic partners’. The new knowledge COR ‘Pro-active product innovation competence’ also influences the organization’s credibility in its strategic relationship building, i.e., the relational COR ‘Integration and alignment with industry’s strategic partners’. For instance, if the organization does not exhibit a profound knowledge of the industry and its technological trends, i.e., does not provide a credible reason for cooperation, the future strategic players may build partnerships/alliances with other players.

Hence, at least two CORs have been detected to form the IOR ‘Organizational entrepreneurial proclivity capability’. This IOR belongs to the capability level because its construction not only implies inter-functional cooperation but also requires the collaboration and alignment of activities of multiple parties, such as internal and external (e.g., customer) strategic teams. Thus, this IOR is critical for building isolating mechanisms to sustain a competitive advantage since the

relationships with the key players in the industry mean pre-emption of the relational resource base [7].

The analysis of FEM models with a focus on intangibles may be interpreted as follows: the introduction of the new department complements the existing product development competence with the processes, potentially, capable of advancing the intangible resources' base to sustain a competitive advantage. For instance, despite having IOR in place to ensure superior innovation competence, the company has been losing its strategic position and suffering financially. This discourse can be explained by the notion of double resource hierarchy. Namely, according to the general resource development hierarchy, the organization did not have the IORs at the organizational capability level, i.e., the most complex level of the resource application that is responsible for the coordination and knowledge exchange organization-wide and inter-organization-wide [22]. The lack of complexity and the ambiguity in resource building imply the vulnerability and/or unsustainability of the competitive advantage [30].

The application of the proposed modeling technique to describe the organization's situation enhances the analyses by providing better visual observation of the intangible resources' composition and, hence, how to better manage them. Namely, the visualization of intangible resource hierarchies' fusion may help the practitioners in the development of difficult-to-imitate resource and strategy implementation through a better understanding of the process-structure-resource relationships.

An example of intangible resource analysis is illustrated in Figure 6.

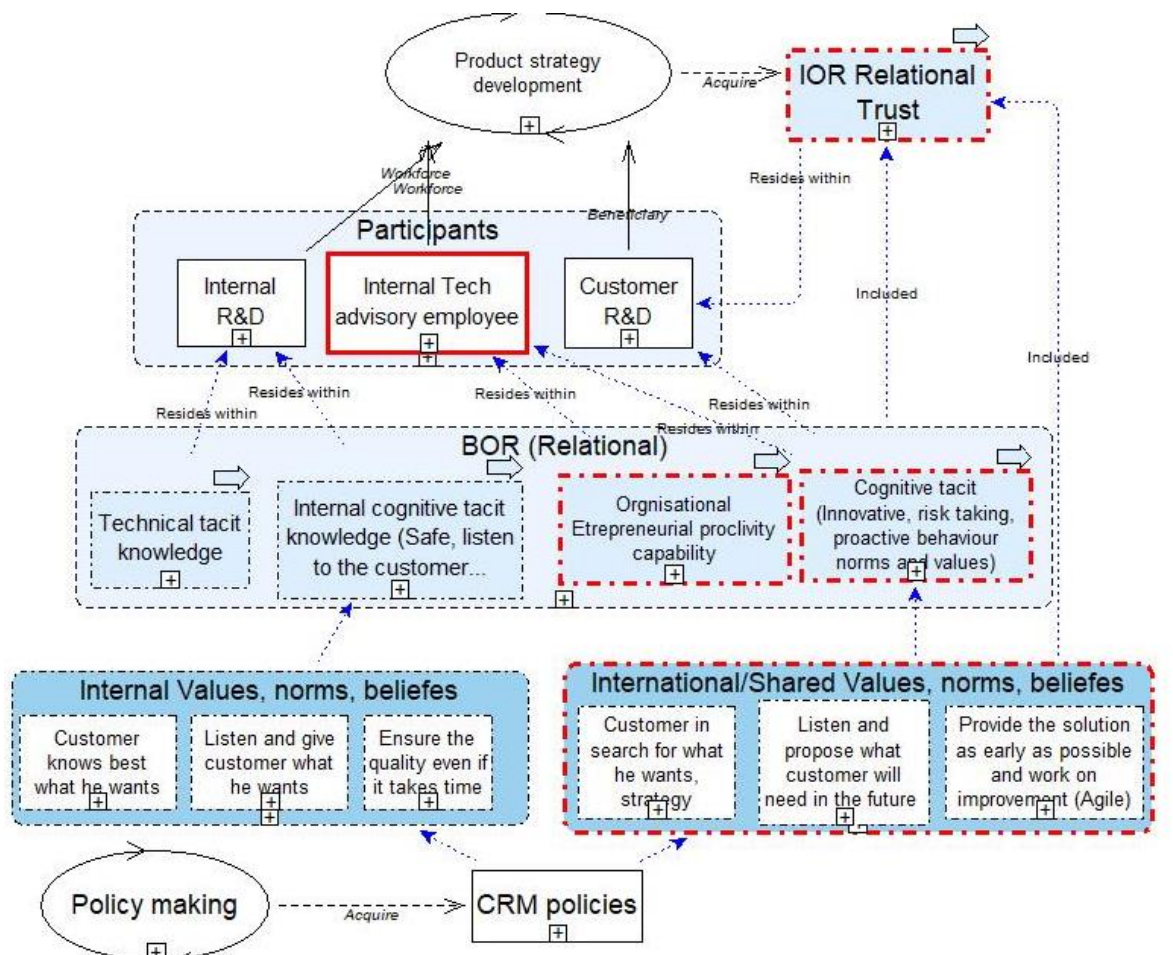


Figure 6. The decomposition of IOR ‘Trust’ from the case. Note that not all resources are considered in this very simplified version of analysis. (In red borders – assets introduced after the structural change).

In this case example the ‘Trust’ resource represents an intangible resource of a more negotiable value, i.e., the organization’s CORs and IORs are combined in the process of ‘Product strategy

development' (as shown in Figure 6) in such a way that elevates the relationships with the strategic customer to the level where a direct economic transaction may take place. In fact, trust is one of the most valuable resources in the modern business ecosystem and is a source of competitive advantage since it is difficult to imitate [7]. The model also shows that at the root of these valuable intangible resources are the organization's tangible resources and processes, such as CRM policies and the policy-making process. Thus, this is an example that illustrates how the tangible, routinized processes may affect the organization's strategic intangible resources building, i.e., influence the value conversion within the operational processes based on which the intangibles may be developed.

Figure 6 shows more details on the intangible resource-building complexity and explains why the implemented structural change has been taken as a measure to address the strategic position. To understand the issue, more details on the cultural elements and their control might be useful, particularly, how tangible elements, e.g., CRM, are interconnected with the development of intangibles such as trust and customer relationships.

Figure 6 also shows that shared behavioral norms and values between the firm and the customer lie at the bottom of strategic relationship building (apart from superior knowledge about the product's technical possibilities). The case example illustrates that to build trust between parties, the customer must believe that he will be served not only with quality products but also in a timely manner (given a dynamic environment). Before the structural change, the organizational values and behaviors in serving customers were tuned to listening to the customers and providing a solution, where the priority has been given to product quality. Such behavior suggests that R&D employees believe that the customer knows best what he wants and that the customer is the prime source of the strategic product requirements. However, for long-term strategic product development, i.e., the value co-creation, such an assumption may be deceiving. This is because value co-creation requires synergy with the customer from the very early stages in the process of future technological solutions development [23], [57]. Therefore, the cultural clash has been considered an impediment to achieving a desired strategic position. However, because the CRM policies that control the development of behavioral norms and values are strongly influenced by the historically developed culture, restructuring can be viewed as the means to tackle cultural issues.

7 Discussion

The evaluation of the presented artifacts, the modeling method for double resource hierarchy, and the patterns created using this method have proceeded simultaneously with the demonstration through application in the real case example. As outlined in Section 3, the acceptability of the method and the patterns relies on their possibility to model the scope and the complexity of the intangible resources, which together provide deeper and more holistic insights into a particular business situation. Hence, the quality of the proposed artifacts is discussed in this section through the lens of their contribution to the depth of the intangible resource analysis in a given business instance.

The presented study belongs to the first round of design and experimental usage of the solution to a given problem (i.e., the lack of EM methods for intangible resource analysis). Therewith, the methodology for modeling intangibles, which combines three frameworks proposed in this work (i.e., the choice of intangibles classification, resources development hierarchy, and operant resource hierarchy), may be questioned.

Moreover, considering the limited availability of the methods within EM for modeling and/or patterning intangibles, there are not many languages, methods, and techniques suitable for patterning intangible resources within this context. The first choice of the author was FEM due to its focus on modeling both the processes-resource and resource-process relationships in a recursive and hierarchical manner. This focus provided a strong possibility for this work's double-hierarchy resource modeling method.

Overall, it is important to note that the rigorous justification of the method and the EM used for the patterning may contradict the very core of DSR as a creativity-based methodology, i.e., the limitations that are imposed by the rigorous aspects may inhibit the development of new ideas. Some researchers argue that the key to DSR is additions to the knowledge base in the form of extensions to the theories and methods obtained during the experience, testing, and application of the artifact [63], [64]. Therefore, the new knowledge obtained in this study (positive or negative) may also be viewed as an artifact, i.e., the knowledge about method and patterns' development. Hence, it is too early to carry on the discussion on the 'best' choice or the positioning of the method, i.e., whether or not the business case's insights could be uncovered using other analyzing or modeling methods, at this stage of the research. This suggests the need for further exploration and evaluation to position the artifacts described in this article within the EM field.

Regarding outcomes of practical method application, the application of the presented method in the intangible resource building within product development in the case example has enriched business analysis by providing valuable insight. Namely, in the case study, the results indicated that a new department plays a mediating role within the organization, aiming at the following outcomes:

1. To elevate the capacity of the intangible resource building through the enrichment of the knowledge-related intangibles. This is achieved by complementing the existing R&D knowledge with deeper industry analysis as well as customer knowledge and involvement. Customer involvement at such an early stage of product development is beneficial for both parties due to strategically lowering cost, time, and effort [55], [56]. For instance, instead of listening to the customer, the new way of working is to suggest what requirements the customer may need in the future and work together to develop them. Such transactions are seen as beneficial since they help to build unique relational IORs, such as 'Trust', the most valuable resource in value co-creation logic [53], [54]. This resource gives the organization an instrument to actively assist and direct customer in their future strategy, which is the core of value co-creating logic [57]–[59]. For instance, the analysis indicated that organization resource development has reached the point of excellent competence in a new product development before the change but the element of the reciprocal linkage has been not adequately developed to enhance the strategic innovation within the product development process. This gap has been bridged by the introduction of a new structure and activities targeting to ensure the strategic linking between technology and customer [40], [44]. Since knowledge exchangeability hinges on the relevant processes being in place, and the value from the exchanged and combined information is understood and anticipated [45], [57], the old structure does not support the strategic knowledge exchange. The information exchange on the product requirements was happening mainly at the operational level (R&Ds from both parties). Hence, the specialized information, such as long-term strategic requirements with embedded value to serve the emergent market's needs, has been not accessible without the active involvement of the strategic group from both sides in the process of product development. The absorption and combination of such information was inhibited by the inadequate structure, i.e., lack of activities that enable access to strategic information and its spread throughout the entire product development process. This issue has been addressed by the introduction of the new department and the new processes.
2. To eliminate the cultural barrier. The relationships are built upon, among others, BOR resources representing cultures of both parties, which interact during the exchange process in such a way that influences the acquiring of common views and expectations, i.e., reinforcing each other to create trust through shared values and norms of behavior. On the basis of shared cultural norms and behaviors, the resource-building capacity has been elevated through the enhancement of the value conversion of the existing intangible resources to a more negotiable form. Thus, the new department's role is also to integrate the shared norms and values between parties to facilitate trust. This is achieved through the intangibles as deliverables (value outputs) [49], where the knowledge-related intangibles

based on shared cultural norms can be smoothly exchanged between parties to create a more effective form of trust.

3. To indicate the need for cultural adjustment. The relief from the traditional way of working with the customers may be viewed as a first sign of the emerging cultural shift that can reshape the employee's behavior. Even though the initiation of the policies' change is rather intuitive, the launch of new activities that institutionalize different cultural norms and behaviors confirms such intentions. The fact that cultural change is initiated in only one part of the operations indicates that the studied company has chosen to embrace a strategic need for change in an incremental manner. This is logical since such a transformational change is considered the most profound and difficult to implement, which often results in an organization's downfall [6].

These insights have been shared with the manager of the new department (the main interviewee). He expressed a genuine reaction to the unexpected twist within the modeling and the case analysis results, namely, by having a focus on the intangible resource perspective and not on the traditional process/architecture modeling. He agreed that the strategic discourse can be associated with the cultural issue, but nobody has yet 'put it that way' ('it' – the reason/need for structural change), and that the message should reach the top management.

8 Lessons Learned

The existing FEM modeling notations are sufficiently expressive to realize the conceptual methods to show the classification of the intangibles, the scope of the resource application, and the resources' complexity:

- **Classification:** although there is not an explicit notation in the FEM toolkit to classify the intangibles into knowledge, culture, and relation categories, the different colors can be effective for this purpose.
- **Scope:** The scope of the intangible resources application can be denoted by using the arrows, such as the 'resides within' connected to the tangible HR asset, e.g., the person, the team, or the entire function.
- **Complexity:** The complexity or the composition of the higher-level intangibles can be denoted by using the association links between multiple operant resources. However, determining whether a higher-level operant resource represents a combination type (i.e., COR) or a reinforcement type (i.e., IOR), might be confusing. In this work, the following interpretation is adopted: the composition (COR) occurs when BORs are visible and accounted for by different parties in their processes execution, which may change the value of the process outcome, while the reinforcement occurs when BORs and/or CORs may also influence the business process outcome in such a way that produces a different type of outcome.

Applying the method has also helped explain how the restructuring may have improved the sustainability of the competitive advantage through building more difficult-to-imitate operant resources.

This study provides an alternative perspective on intangible resource modeling for strategic analysis. However, it is limited to the application of the one EM technique (i.e., FEM), the relatively narrow scope of the intangibles' classification, and a single case of application. Future research should aim to mitigate such drawbacks.

The presented resource decomposition has been useful. However, it does not show how the combination occurs, i.e., what triggers the change in the pattern of the activities that acquire and combine those resources, such as organizational learning loops investigation.

Regarding the clearness of the concepts, a better understanding and definition of COR and IOR resources is needed.

9 Conclusion

This study aimed to propose and apply, in a real case scenario, a new double-hierarchy modeling method and patterns for the analysis of intangible resources. To reach the aim, enterprise modeling, particularly FEM, has been employed. The proposed method provides an alternative idea for how to approach patterning and analysis of intangible resources. The first evaluation and demonstration of the method has taken a practical perspective. The results of the method application in a real case indicate that the method has been useful in explaining the firms' strategic discourse from an intangible resource perspective. In particular, it has been shown how the intangible resources and their configuration contribute to the strategy implementation. Through modeling aspects, such as the operant resource acquisition, usage, parties of possession, and their composition, it has been possible to identify the intangible resources that may facilitate and/or inhibit the strategy implementation in practice. Also, it has been possible to illustrate how an organization may address strategic issues by adjusting its resource base through restructuring.

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