Modeling the Dichotomies of Organizational Change: a State-based Capability Typology

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Abstract. Modern digital businesses are facing a constant challenge in adapting to dynamic environments. Therefore, change has become a significant element of business analysis. Capability thinking, when applied to business management, is associated to design and analysis of supporting information systems and is inextricably linked to strategy and change. This results in the need to monitor and analyze how and when the organization's capabilities need to change. Capability and change dimensions have been explored in the literature in order to identify dimensions relevant to organizational change. The identified capability dimensions are purpose, potentiality and ownership while the relevant change dimensions are control, scope, stride, frequency, desire and tempo. The two sets of dimensions have been combined forming a typology and visualized in a StateMachine diagram. The contribution of this task lies in the conceptualization of the dimensions, including the negative aspect of capabilities, which can provide a starting point for an Enterprise Modeling method optimized for identifying the need for capability change and guiding the transition.

Keywords: Capability management, Digital business, Business transformation

1 Introduction

Organizations have always been struggling to survive in dynamic environments, since the external business environments have always been a factor triggering dynamic change in enterprises. Being flexible and adaptive is a necessity for every modern organization's continuity and for this reason, change has been a significant factor affecting business strategy. Change and strategy are inextricably linked. Change drives strategy and strategy drives change [1]. Strategy involves planning, decisions and actions that are necessary for achieving business goals [2]. Analysis of change, being a part of strategy, has been a valuable business activity, especially since the rise of digital businesses. Digitalization of modern enterprises is an inevitable response to the digitalization of the environment, yet, it also facilitates the analysis of change.

Capability thinking is at the core of capability management. It improves the productivity and flexibility, especially of digital enterprises [3]. The concept of enterprise capability is in focus, not only of the actual business activities, but also of the development of information systems (IS) in order to support the business through design and

analysis of capabilities, using Enterprise Modeling (EM). Capability thinking also allows an organization to be perceived as a set of capabilities. Typically, capabilities are associated to strategy. The given capabilities an organization currently owns dictate its strategy and its strategy dictates the capabilities it develops [1]. As far as change is concerned, capability thinking dictates that any change and improvement to an organization is associated to capability change and improvement [1]. Capability change refers to introduction of new capabilities and modification or retirement of existing ones.

As a result, within capability thinking, the importance of change analysis is specialized to capability change analysis. A plethora of capability management methods exist, and the majority of them include capability modeling notations. There is a common theme among all the methods. The positive aspect of capabilities is the only one addressed. However, while employed to analyze capability change, a method should include the chance that an organization's capability is outdated to a point that it has become harmful, or an actual harmful capability exists in the form of a problem that the organization is unaware of. In addition, an organization may possess the potential for producing value in the form of resources that remain unexploited. These are possible organizational states that a change analysis method should consider and capability analysis should not be an exception. Not only advantageous and disadvantageous capabilities need to be analyzed, but also the transition from disadvantages to advantages needs to be facilitated by a method. This will provide the opportunity to identify the need for a change, not just manage a required change that the organization is aware of.

In this regard, the objective of this paper is to examine and describe the states a capability goes through when it changes, also incorporating several dichotomies to describe the change process. The result is a conceptualization of the related states of a capability evolution lifecycle.

This conceptual study is part of a Design Science Research [4] project that aims to develop a method and tool support, optimized for modeling enterprise capability change. In particular, EM will be employed to guide the transition of capabilities including the identification of the need for change. Analyzing change can be significantly benefited by a predefined conceptualization of a set of possible states of a capability. For this reason, a typology of capability states that includes the absence and the negative aspect of capability change is analyzed in this study.

The rest of the paper is structured as follows. Section 2 provides a brief overview of the related concepts and research. Section 3 briefly states the methods used in this study. Sections 4 and 5 present the dimensions of capabilities and change respectively, as elaborated using literature sources and reflection. Section 6 introduces and describes the capability typology, which is visualized as a model. Section 7 discusses the results and section 8 provides concluding remarks.

2 Background and Related Research

In this study, a capability is defined as a set of resources, whose configuration bears the ability and capacity to enable the potential to create value by fulfilling a specific goal

within a specific context. This definition is a composition of the definitions provided in [3] and [5].

In the literature, there exist several capability typologies, the majority of which concern the concept of hierarchical or domain-specific typologies. Regarding the hierarchical typologies, a brief summary is presented in Table 1, which has been published in [5]. A hierarchy of capability types suggests that there are different levels of capabilities. In other words, a higher level capability's purpose is to affect lower levels of capabilities and the hierarchical typologies aim to classify capabilities based on their purpose.

Table 1. A summary of hierarchical capability typologies from [5].

[6]	First Category	Second and third categories	Meta-capabilities	Ad infinitum meta capabilities
[7]	First-order Capabilities	Second-order capabilities		
[8]	Zero-level Capabilities	First-order capabilities	Higher order capabilities	
[9]	Substantive Capabilities	Dynamic capabilities		
[10]	Classical Capabilities	Radical/Integrated/Routinized dynamic capabilities		
[11]	Resource base	Incremental/ Renewing capabilities	Regenerative capabilities	

The domain-specific capability typologies that exist in the literature bear relevance for capability thinking in general, but the majority do not address change specific concepts. A few examples are discussed below.

A literature review of organizational IT capability typologies has been presented in [12]. The two perspectives that have been used as dimensions were the Functional Technology level and the Information Systems Strategy level. The focus of the Functional Technology level typologies and their components were:

- *IT Capabilities for Process Redesign:* Transactional, geographical, automational, analytical, informational, sequential, knowledge management, tracking, disintermediation
- *Technological Capability:* Application development, communication technology, database and security, technical support services, Web technology
- *IT Infusion in New Product Development*: Process Management, project management, information/knowledge management, collaboration and communication
- *Capability-based IT Classification:* Integration, scale, technology focus, accessibility

The focus and components of the Information Systems Strategy typologies [12] are:

- *Business Design:* Competitive positioning, geographic positioning, redesigning organization, redeploying human capital
- *IT Business Value*: Customer relations, Supplier relations, sales and marketing support, production and operations, product and service enhancement, process planning and support
- *Digital Options*: Digitized Process Capital, Digitized Knowledge Capital
- *IT for Organizational Design:* Value innovation, knowledge work leverage, IT-enabled business platform, operational excellence, value-chain extension, solutions delivery

In [13], another domain-specific capability typology for multi-agent systems was developed using complexity and locality as overlapping dimensions. Based on complexity, capabilities are classified as primitive or composite while the classification of capabilities according to locality includes external and internal capabilities. Domain-specific rules are also defining the dual nature of capabilities according to this typology, for example, an external capability is always primitive.

In [14], a study related to risk management and capabilities has been conducted and a typology of macro-capabilities has been presented that bear relevance for change. Four types have been identified. Initially, there is the Delivery type, which refer to an enterprise's capabilities that concern the execution of tasks, ranging from services and the production of goods, to scheduling, controlling and monitoring the production. The second identified type, namely Integration and Coordination, aims to support the delivery capabilities by the management and coordination of the dependences among resources so as to find new ways to perform activities. The third identified type is Learning capabilities that concern the generation of new knowledge in order to improve the efficiency and effectiveness of existing resources. Finally, Reconfiguration capabilities are about reconfiguring existing resources to potentially lead the organization to change.

There is also a variety of change typologies based on sets of dimensions. These are presented and discussed in Section 5 since they have been used for the development of the suggested capability and change typology.

3 Methodology

The aim of this paper is to examine and describe the states a capability goes through when it changes, also incorporating several dichotomies to describe the change process. Literature sources related to change dimensions and attributes have been identified and used to facilitate the development of a set of dimensions and their associated attributes that have been applied to the concept of capability and expressed as states. The process of capability change has been addressed as a separate system for modeling purposes. Therefore, the change dimensions have been depicted as a juxtaposition of opposing states in a UML StateMachine diagram [15]. The selection of the specific notation is the result of the semantic association between change and state transitions, as used in StateMachine diagrams. Every state transition is a change and the model allows the

inclusion, not only of a multiplicity of parallel states, but also the triggering factors that initiate the state transition and change.

4 Dimensions of Capabilities

The primary dichotomy that needs to be addressed regarding capability change is the attribute of being adaptive in the configuration of a capability or the absence thereof. This is reflected as the dichotomy between a static and a dynamic capability. Initially, it should be noted that by characterizing a capability as dynamic, the authors do not refer to the term "dynamic capability" [16] which has been widely used in management literature. Within the context of this study, the term is deliberately eschewed, since it is considered confusing [5], and the term "strategic capability" is used instead. Any capabilities with adaptive attributes are considered dynamic regardless of them being strategic or operational. Therefore, any capability whose configuration includes any degree of adaptability is considered dynamic, while any capability that lacks adaptability is considered static. That is, the term static refers to capabilities that cannot change. From a realistic perspective, that would result in an organization with a complete lack of adaptability and the capability to respond to change, which in return would limit its survivability. While it may be an unrealistic concept, it cannot be excluded as a possibility and, therefore, it is still necessary to include in a model focused on the conceptual level.

On a more detailed level of analysis, it is important to depict the existence of a change process or lack of it. A capability, even while being dynamic, is stable unless a change process is actively taking place.

– Purpose: Fulfilling goal vs Avoiding problem

The classification of dynamic, yet stable, capabilities that is proposed in this study has originally been introduced in [5] and is inspired by the direct association between capabilities and goals [3] and the discussion about goals in [17]. According to [17], goals, as desirable states that an enterprise aims to achieve, are also associated to problems, in the form of undesirable states that an organization aims to avoid. This classification has also been inspired by Higgins' Regulatory Focus Theory, according to which, there are two goal orientations, promotion and prevention. The former focuses on advancement, gains and pursuing ideals while the latter focuses on security, non-losses and fulfilling obligations, a fact which results in a dichotomy of strategic preferences in goal pursuit, eagerness versus vigilance [18]. Therefore, capabilities can be classified according to their scope, achieving goals, or avoiding problems. However, according to the definition used in an earlier section, a capability creates value when fulfilling a goal. Therefore, the ability and capacity to avoid a problem only contribute to sustaining the enterprise while having a supporting role. As a result, this type can be referred to as sustainability. Capability and sustainability are both advantages for an enterprise.

– Potentiality: Enabled vs Disabled

Both value-producing and sustaining capabilities require that the needed resources exist, are properly configured and are operationally active. Adopting a pragmatic perspective on organizations indicates that this is not what actually occurs on every occasion. A common phenomenon is that resources are missing, are not configured properly, or the abilities and capacities are not operationalized. This final case is the one that is addressed as an idle potential, which results in a disabled capability. Enabled potentials result in advantages, however, if the potential remains idle, then the enterprise is missing the ability to achieve a goal or avoid a problem. In the case where a capability is missing, the enterprise is incapable of achieving a goal, therefore it possesses an incapability. The second case is more severe. Lacking the ability to avoid a problem implies that the enterprise possesses a harmful or outdated capability that may lead to it harming itself. This enabled potential for self-harm is a negative capability that may be associated to outdates practices or practices that seem attractive but in fact are harmful when applied. The latter is similar to the concept of anti-patterns [19] that captures potentially attractive solutions that backfire when applied. However, the concept of documenting anti-solutions has not been applied to the capability approach, therefore, this type of negative capabilities is referred to as anti-capabilities. Table 2 depicts this classification.

Table 2. The initial capability classification (adapted from [5]).

	Achieve Goal	Avoid Problem
Enabled (Advantages)	Capability	Sustainability
Disabled (Disadvantages)	Incapability	Anti-capability

– Ownership: Single organization vs Inter-organizational

Finally, a stable dynamic capability can be classified according to being owned by a single organization or being inter-organizational. Within the extended context of the project to which this study belongs to, it has been identified that analyzing changes on an inter-organizational level requires focusing on different attributes [20]. The literature also supports the significant differences in the capabilities of an organization which are affected by collaborations, for example, the collaborating organizations may be co-evolving [1].

5 Dimensions of Change

The existing literature has been characterized by a dichotomist perspective and most of the studies have been focused on one or at least a few of the dimensions of change and their opposing states [21]. The dichotomies and attributes of change have been a topic

of research during the last decades, therefore, a variety of change dimensions and attributes have been identified and presented. The vast existing literature has been summarized in [21] and the result is a homogenous set of *eight dimensions* and their opposing attributes describing change in a dynamic way. Most of them have been included in the suggested typology. The set that Maes and Van Hootegem [21] presented consists of the following dimensions, starting from the included ones:

— Control: Planned vs Unplanned or Emergent change [21, 22] in association with intention and desire

This dimension concerns the degree of control the enterprise has over a change. On the one hand, a planned change occurs due to deliberate and conscious actions and requires clear objectives and systematic scheduling. It also requires the change to be intentional since it aims for particular results. On the other hand, unplanned change does not involve intention. It emerges due to the dynamics of the enterprise's environment. However, it is possible for a change to be anticipated, even if it is unplanned. This concept provides an opportunity for decomposition. Anticipation is also a relevant change dimension and has been included in the typology and model. The concept of plan implies the existence of anticipation and prediction of a change. However, anticipating a change does not automatically imply planning. Therefore, anticipation should be considered as a separate dimension that precedes the planning factor. Anticipation has been addressed as a change dimension in domain-specific approaches, for example, while analyzing self-adapting systems [23]. Source and type are also mentioned as change dimensions in that study, however, the suggested attributes are domain-specific, so they are not included in the typology. In addition, the intention dimension is associated to control, therefore it is not considered a separate category, even though it is included.

In addition, the existence of both goals and problems in this approach also requires the inclusion of desire as a dimension of change since the negative side of change needs to be addressed as well. This is in line with other business analysis methods which are not associated to capabilities, for example the SWOT analysis [24].

— Scope of change: Adaptation vs Transformation [21]

Scope addresses how intense the change is. What essentially differentiates adaptation and transformation is the degree of change and the impact that the change inflicts on the enterprise. Adaptation refers to readjustments based on context observation, while transformation refers to radical change that often involves abandoning of the original orientation of the enterprise. This attribute is considered important for the suggested typology.

— Frequency: Continuous vs Discontinuous [21, 23] or Discrete

This dimension addresses the number of times a change is happening. A change that is characterized as discontinuous happens occasionally and episodically. They are usu-

ally required after the enterprise has failed to respond in time to a change in its environment. On the opposite side, a change that is continuous when the enterprise's internal logic is gradually adapting to the dynamic conditions of the environment.

– Stride: Incremental or Gradual vs Revolutionary [21]

The stride dimension is associated to the quantity of steps or stages that are required before a change has been realized. The term incremental describes a change that is delivered as small the accumulation of consecutive adjustments. It is focused on individual parts of an enterprise. On the contrary, revolutionary change refers to major shifts where the deep structure of the enterprise is usually dismantled. Stride should not be confused with control. Control is about the end state while stride is about the pace of change.

– Tempo: Slow vs Quick [21]

Tempo is the second time-related dimension. It concerns the pace of change. However, this one is not linear since the pace can change from slow to quick and vice versa, thus it is relevant to the analysis of capability dynamics. For this reason, it is included in the typology.

The following dimensions have not been included in the typology. The reasons have been explained separately.

– Time: Long vs Short [21]

This dimension concerns the duration of a change. It is the only dimension whose state change is linear, since a change is starting with a short duration, it may become long, but cannot go back to short, in other words, not long. For this specific reason it is not taken into consideration for the suggested capability typology because it does not affect change analysis. It is only considered a boundary defining task.

– Goal: Open vs Strict [21]

A goal is defined as a desired state to be achieved, therefore it is associated to change analysis in terms of evaluating it once it is implemented. As an identified change dimension, it is associated to the attributes open, strict and the entire spectrum between them. The inclusion of goals in the typology has been discussed in the previous section. In addition, as mentioned earlier, this study adopts the definition of goals from [17] that also associates the concept with avoiding problems. The goal of a capability change is to transition from one capability state to another and this is driven by the goal of the capability. The goal of the change can be decomposed using the included dimensions and its inclusion as a separate dimension can invoke confusion. In order to avoid any possible confusion in the typology and model, this dimension has been excluded.

– Style: Participative vs Coercive [21]

The style dimension refers to style of leadership and decision making. The attributes associated to it are on one hand participative and coercive along with any states in between and, on the other hand, self-governing and directive. Self-governing change is performed by any involved parties but a directive change is enforced by the authorities. This dimension and its associated attributes have been excluded from the suggested capability typology and model due to the fact that, especially, the second dichotomy, overlaps with the intention dimension which has already been included in association to the control dimension.

6 A StateMachine Diagram for Capability and Change

The typology is visualized as a UML StateMachine diagram, as shown in Fig. 1. Its initial pseudostate leads to the Static state, to which any addition of adaptability triggers the transition to being Dynamic. If the adaptability is removed from the capability's configuration, it returns to being Static. Taking into consideration that the point of focus of the model is capability change, there will be no insight provided from any attempt to decompose the Static state. Therefore, Static has been modeled as a simple state, while Dynamic is a composite state which includes a plethora of sub-states. The capability can also transition to a Retired state in case the enterprise retires it. This is the only state that may also lead to the final state in the model. Note that the dashed lines in the model separate parallel states. For example, a capability change can be both Incremental and Slow at the same time.

Within the Dynamic composite state, the two main states are Changing and Stable to reflect a change in progress or the lack of it, respectively. The Stable state includes two parallel sub-states. The first one concerns if the capability is inter-organizational or not, belonging to a Single-organization as a default state after the initial pseudostate and a starting collaboration event triggers the transition to the Inter-organizational state, while any event stopping the collaboration returns the state to Single organization. The second parallel sub-state concerns the scope and enabling of capabilities. Therefore, the initial pseudostate leads to the Potential state leading to a choice pseudostate to distinguish between an idle and enabled potential. The enabled potential leads to a succeeding choice pseudostate which in return leads to a Capability state and a Sustainability state, triggered by their scope, fulfilling a goal or avoiding a problem. In order to avoid any possible confusion, it should be clarified that in this diagram the Capability state refers to the default state of a normal value-generating capability. On the other side of the spectrum, an idle potential is succeeded by a choice pseudostate that leads to a scope-based state transition to Incapability or Anti-capability. If the given goal or problem is removed, all four states transition back to Potential. Possible transitions exist within both scopes. If the ability and capacity to fulfill a goal is gained, Incapability transitions to Capability and vice versa in case it is lost. Similarly, if the ability to avoid a goal is gained, Anti-capability transitions to Sustainability and vice versa.

Initiating any change triggers the transition to a Changing state. If the change is stopped or implemented, the state transitions back to Stable. In addition, any state change within the composite Changing state, is a recursive transition that results in the

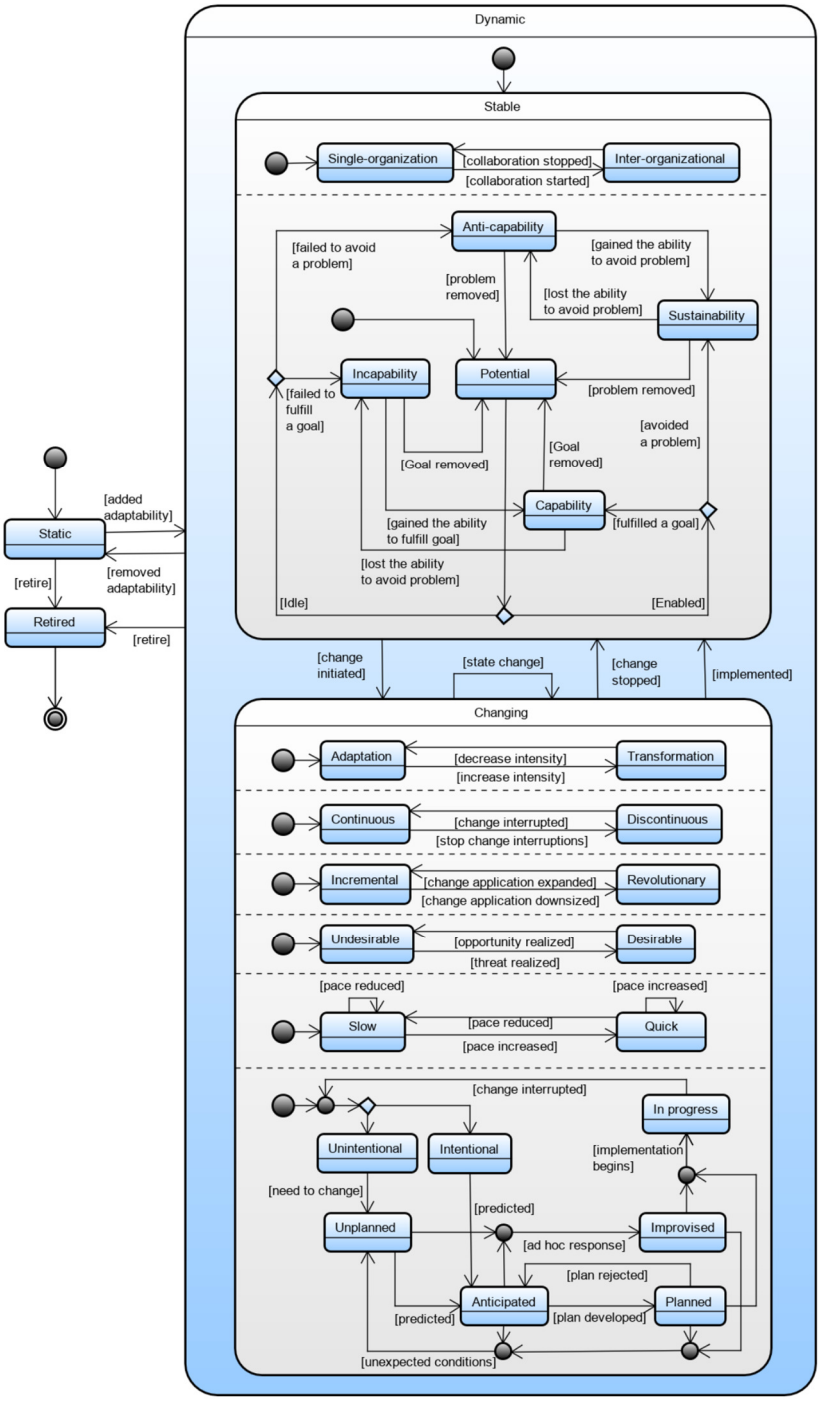

Fig. 1. The capability and change typology visualized as a StateMachine diagram.

state remaining Changing. Within the composite state, there exist six initial pseudostates that lead to parallel sub-states that reflect the dimensions discussed earlier. The five first depict dichotomies. The first one concerns Adaptation and Transformation and the events of increasing or decreasing the intensity result in the transition from the former to the latter and vice versa respectively. The second state is about frequency and includes the Continuous and Discontinuous states and the events that cause them to transition to each other, in particular, interrupting and stopping to interrupt the change. The third state represents the stride dimension, and as a result, includes the Incremental and Revolutionary states. Expanding or downsizing the application of change triggers the transitions between the two states. The fourth state includes the dimension of desire, with the states Desirable and Undesirable transitions triggered when any opportunities or threats are perceived. The fifth state depicts the states associated to the tempo dimension, Slow and Quick. Increasing or reducing the pace of change may provoke transitions from one state to another. It depends on the boundaries set and the definitions of Slow and Fast, as decided by the enterprise.

The sixth parallel state is more complex, since it combines several dichotomies. The initial pseudostate is succeeded by a choice pseudostate to reflect the intention factor with the states Intentional and Unintentional. A "need to change" event triggers the transition of Unintentional to Unplanned. Any prediction of the capability change transitions it to the Anticipated state. The same rule applies to the Intentional state. The Unplanned state can also transition to the Improvised state in case an ad hoc response is applied. Anticipated transitions to Planned if a plan is developed and returns to Anticipated when triggered by a plan rejection. Both Planned and Improvised states transition to In progress state if a capability change implementation is commenced. In progress returns to the intention factor if an interruption event triggers it.

7 Discussion

The dichotomies used for the development of this typology do not imply that the attributes are supposed to be exclusive extremes. On the contrary, every dichotomy represents a spectrum of states. From the low level dichotomies of capability change, to the highest level of continuity and change, an organization should aim to embrace the duality thinking, recognizing the merits of both sides [25] on different occasions and under different circumstances. Even the negative aspect of capabilities is a missing concept in capability thinking and this is the gap that this paper aims to address.

The main contribution of this work is the conceptualization of the negative aspect of capabilities and its combination with the dimensions of change for which, up to date, there was no research effort devoted to. Conceptualizing the absence and the negative aspect of a capability will provide the opportunity and support to identify missing opportunities or problems that an organization is unaware of, since the inclusion of the associated concepts will serve as a starting point for an improved monitoring function in a capability-based system.

This analysis is in line with the earlier work conducted within this project, where a framework was developed to provide structure on capability change by identifying the

phases, functions and information elements required for a system supporting adaptive capability architectures [26]. The three main change functions in the framework are observation, decision and delivery of capability change. The capability and change states presented in the typology in this paper can be combined with the framework elements towards the development of a detailed meta-model optimized for supporting capability change. For example, the control-related states can be valuable for improving the observation and decision functions. Any emergent, unintentional or improvised change is directly indicating a run-time adjustment which would lead the system to respond by selecting a proper capability variation, if one can efficiently address the emergent need, or by suggesting the development of a new variation. In other words, any change that is identified as unplanned, unintentional or improvised should be associated to the run-time phase of capability development, while a change that is planned or intentional can also be associated to the design phase of the system. In another example, identifying the tempo of change as slow or quick can affect the allocation of resources for the change activities based on the identified state.

The question still remains of how the capability and change typology can be integrated during the development of a meta-model. Before the development of a meta-model, there should be an association between specific attributes of a capability that is in a specific state. The dimensions will need to be included as super-classes describing a capability and any instantiation of a dimension class will trigger the instantiation of specific sub-classes based on context-related observation. This will act as a restriction of the possible courses of action by directing the capability transition according to the state transitions of the typology. For example, emergent change does not involve intention [21], therefore, all the possible associated attributes of a capability that is emergent, can automatically exclude all the possible associated attributes of an intentional or planned capability change.

8 Conclusion

In this study, a conceptual exploration of the concepts of capability and change has been performed in order to prepare a predefined set of states and their transition rules. Literature sources concerning change and capability, along with reflection from the authors resulted in a set of dimensions relevant to capability change. The most relevant capability dimensions its purpose, potentiality and ownership, while the relevant change dimensions are control, scope, frequency, stride, tempo and desire. Combining the two sets of dimensions resulted in a typology. The suggested typology has been developed and visualized as a UML StateMachine diagram.

During the next steps of this research project, the typology will be combined with the change function framework that was introduced in [26] and empirical research in order to provide the input for the development of a capability change meta-model, that will, in return, be part of a method supporting capability change, with an emphasis on digital organizations.

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