Enterprise Adaptability Using a Capability-oriented Methodology and Tool Support

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Abstract. Complex, dynamically changing business environments impose great need for adaptability, where the enterprise modelling discipline ought to provide relevant support. To investigate how capability-oriented methodologies, aimed to integrate contextual enterprise modelling with system design and run-time adjustments facilitate enterprise adaptability in dynamic contexts, we are using a case of an international financial institution facing, through a timeline of several years, different adverse events. Our scenario follows planned transitions towards improvements, by considering how unplanned disturbing events influence the main enterprise elements - strategy, goals, rules, actors and resources, business processes, as well as technical components; and how context modelling and design of capabilities could be utilized to respond to undesired business situations, by providing an adaptation roadmap for managing planned and unplanned changes. By utilizing our previously defined multi-dimensional framework for enterprise adaptability, we have analyzed how Capability Driven Development methodology complementing an enterprise modelling approach such as 4EM, could be applied to support successful business transformations, as well as we outline the requirements for supporting tools, in our case - ADOxx.

Keywords: enterprise modelling, adaptability, context, capability

1. Introduction

Socio-technical systems are ‘assumed to evolve over time through a combination of planned and emergent (unplanned) change’ [1]. Abundance of triggers initiating changes exists because systems have complex internal states, and are situated and interconnected with their broader environment exposing dynamic and often unpredictable situations. Man-made structures (buildings, information systems, enterprises, countries, unions) need to be designed with certain mechanisms and principles, provided with ‘enabling infrastructure that can offer strategic flexibility and the capability to accommodate future’ [2]. Enterprises as ‘organized complexities’ [3], continuously experience order, design and re-design as ‘inter-action between understanding and creation’. Flexibility and the ability to change are continuous

challenges before the enterprise architecture and modelling [4] and represent stable foundation for challenging expanded managerial-IS view-point where the system is observed from multidisciplinary perspective that triangulates information systems, management and complexity.

Some approaches acknowledge non-planned, emerging character of a variety of enterprise developments that rest largely to the capacity of self-organization to respond to [5]. In order to facilitate that, mechanisms should enable enterprises to sense and respond to change [6]. The response means reconfiguration in order to survive (enacting business continuity) and return on right track of developments. In this study, we are investigating planned and unplanned changes and their implications to adaptability - resulting with the guidelines how to use a capability-oriented methodology that will help companies to adapt appropriately. To demonstrate, we are using business case of international financial institution with planned developments and facing unplanned events (significant fraud) as kind of 'thought experiment', i.e. what if the bank had a capability-based reaction mechanism in place? We are providing guidelines on adaptation roadmap both from managerial and IS perspective and outlining how the approach could be supported by AdoXX tool.

We are extending the work of [7] where CDD Methodology [8] was investigated for adaptability for complexity, through 3-dimensional framework (Table. 1). The focus of this study is dimension 3 and its components: adaptability transformations, variability support, modularity, positive and negative feedback and patterns.

Table 1. Dimensions for analysing and evaluating enterprise adaptability [7]

Dimension 1: Complexity of the environment (external & internal)	Dimension 2: Managerial (Strategic, Tactical, Operational) Profiling	*Dimension 3:* *Artifact-integrated components*
Probe-Sense-Respond strategy CAS characteristics Broad business ecology Multifaceted context capture SIDA & PDCA loops Top-down/bottom-up/lateral learning	Clarification and proper addressing of strategy, tactics, operations Purposeful/Purposive system Outcomes/Outputs Qualitative/Quantitative information	*Adaptability transformations* *Variability support* *Modularity* *Positive and negative feedback* *Patterns*

The paper is organized as follows: Section 2 introduces the main concepts relevant for our study, along with some approaches on how the adaptation is achieved. Section 3 elaborates the business case. Section 4 discusses the use of the CDD Methodology for adaptability with the reflections on the illustrated case. Section 5 concludes the work, by summarizing the efforts and future perspectives of this research.

2. Main Concepts and Related Work

Adaptability is degree to which adjustments in practices, processes or structures of an entity are possible, to projected or actual changes of its environment [9]. Those changes are incorporated by *context*, representing current situational environment of

an entity, such as an enterprise. Consequently, *capability* may be defined as the ability and capacity that enable an enterprise to achieve business goals in certain context [8].

There are various approaches of how enterprise adaptation may be supported. Some authors suggest adaptation via alterations in the IS elements directly, others rule-based adaptation, [10]; or through variability [11] achieved by capturing early and late requirements and effectuating through architectural design components; or by capturing and detecting change signals from broader ecosystem of internal and external environment [12] and by incorporating feedback/feed-forward controls [13].

Changing business conditions, broad business ecosystems and complexity in the internal and external environment constitute the contexts that need to be captured and responded to. capability-oriented approaches, such as CDD [8] reach out to context and assist dynamic reconfiguration – which make it a direction to look into when addressing planned and unplanned changes. The baseline of the CDD methodology is consisted of: a capability design process that describes how to design capabilities by using process models, goal models and other types of enterprise models, which origin from the 4EM framework [15]; context modelling describes the variations in the enterprise environment; and run-time adjustment for enabling adaptation by actualization of adequate capabilities.

Complementary to this, different software platforms and tools used to articulate both the modeler's and managerial understanding of the enterprise developments need to be able to respond to real-life scenarios. Few software tools and platforms facilitate holistic enterprise modelling, such as ADOxx [14]. We are therefore in this study outlining how the tool would be beneficial for supporting enterprise adaptability initiated by managerial decisions and viewpoint.

3. Management of Planned and Unplanned Events

Changes being introduced in time in the enterprises, can be distinguished whether they are being triggered by unplanned events or are planned - hence the time periods of planned change and periods of change for survival complementing them.

Planning initially takes static snapshot of the entity, its mechanisms and resources, is situated within certain context and aims in certain direction dynamism introduced by portraying the TO-BE state through a transitioning period and effectuated changes [15]. However, unplanned events occur at certain point on the path from AS-IS to TO-BE, and deliberate actions need to be undertaken so that the enterprise adapts properly, maintaining the trajectory towards goals accomplishment (a new AS-IS state). Due to the disruptive extent of the unplanned event that hinders enterprise's existence, the management and the enterprise (assisted by EM) need to resume the course and facilitate the transition towards a desired TO-BE state.

1. Business Case Elaboration

In the following, we briefly describe an International financial institution with the headquarters in a EU country – goals, business processes and other relevant elements [15] to mimic a 4EM implementation**.**

The company has been opening micro-finance banks in developing countries globally (23 in total). The strategic position is Microfinance bank, combining traditional banking principles to highly risky subprime clients through own human-intensive lending technology.

- Goals of the branches (AS-IS state). Each branch needs to achieve a set of *measurable, goals and qualitative goals* (referred in 3.2).
- Business processes (AS-IS state). *Bank level and branch level processes* exist for the core business and for the bank-specific technologies.
- Organizational structure (AS-IS state). General Managers, Management Board, Shareholders, Global Audit Committee, Head Office staff (Heads of Departments, Specialists), Branch staff (Managers, Supervisors, Officers)
- The 'to-be' state embodies a broad range of goals and improvements that should be achieved in the transitioning state.
- Future state (TO-BE state). To have opened 32 branches within the next 3 years, including trained staff, to acquire as much of the market as possible - preferably ranking in the first 5 banks in the country according high-quality loan portfolio.
- Need for planned change (TRANSITIONING state). These plans incorporate: managing logistical efficiency in further branch opening (from 20 to 32), providing mixture of existing and new staff in new branches in the first 3 years, raising flexibility of existing staff to temporary relocate, growing middle managers from internal staff, training staff for no mistakes in core software migration project.
- In the timeline of developments, an unplanned disturbing event happens.
- The unplanned disturbing event (in the AS-IS state). One of the branches has been established in the region shaken by pyramidal-savings scheme swindles and the population has lost significantly their savings. The branch represents an EU bank that can be trusted, appointing branch manager from and EU country. However, one year after the bank appointed local person as a manager, there are rumours for his fraudulent behaviour (corruption, refinancing of loans with new disbursements (prohibited), imaginary customers, imaginary businesses) spreading through the population and some of the branch employees. The communication channels in the bank are horizontal, vertical, but very few lateral (only to report harassments and money laundering). The Heads of departments communicate with the Branch Managers, senior with middle management; official meetings with clients are established on occasional level, upon recommendation of branch managers. There is little 'safe' space for a whistleblower or anonymous customer to push the information to Head Office and respective management. Any such attempt usually stops with the doubtful

branch manager. Branch goals are delivered according KPIs and eventually there come first external complaints from known customers (directed to HO) and another manager acting as whistleblower, to uncover the fraud. Customers withdraw deposits, do not repay or prematurely close loans, do not use payments services. New local highly reputable branch manager is appointed. Goals for the specific branch are reformulated in quantitative and qualitative terms. The extremely high reputation risk may cascade through all bank and endanger its existence as a whole.

– After this event, the new developments combine efforts to manage both activities for planned and handling of unplanned events, towards sustaining the enterprise in its existence, and developing it further more. The roadmap for coping with planned and especially unplanned disturbances if using capability-oriented methodology - in our case CDD [8] is presented in the next section.

2. Modelling Change Using Capability Driven Development Methodology

We are using the CDD meta-model [8] to model the subject (the bank) and its change management through the timeline of handling unplanned disturbing and planned change. For the purpose of clarifying a roadmap, we will be considering the main components of the CDD methodology only, and the main sub-models of 4EM [15], to be able to visualize the changes introduced in each of them (Figure 1)

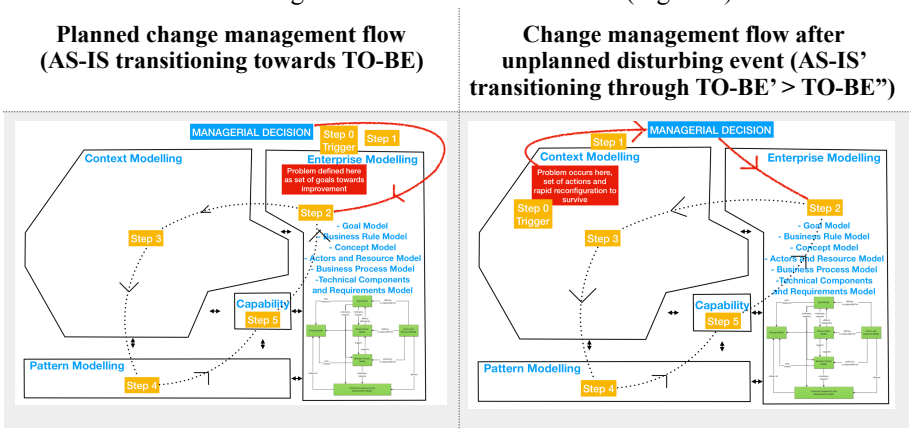

Fig. 1. Visualizing planned and unplanned change management flow

It is relevant to visualize that the triggers (Fig. 1, Step 0 – the Trigger) for enterprise adaptability can come both from management, as a managerial decision as set of goals and direct towards improvements, but also from diverse contextual developments that the entity needs to adapt to in order not to succumb and divert (extensively) from the upward direction of achieving the goals.

Figure 1 depicts the continuous communication between management and its EM&CDD at hand to facilitate the enterprise in dynamic conditions, tracing the relations for business-IT alignment. It visualizes the location of the triggers (Step 0):

for planned change in the hands of management, whereas the unplanned events are triggered and usually need to be captured in the Context (image on the right). As the first situation enacts the Plan-Do-Check-Act loop, the second enacts Sense-Interpret-Decide-Act loop. Step 1 is to reason what the events mean in relation to the main purpose of existence, reflect how the enterprise will react to the events, having in mind the goals, governing principles, structure (reaching of managerial decision) and then react appropriately by introducing changes, capabilities (Steps 2, 3, 4, 5).

In the reasoning stage, the management needs to investigate 'why' a disturbing event occurred and what could be done differently (and from the moment on, improved) in order to prevent in the future. The questions management asks are very diverse in nature, ranging from missing components, resources, infrastructure, support, principles, technology, structure, channels. While the first two stages can be categorized as managerial decisions that use inputs from all aspects of the enterprise and its context through its information system, the third stage can be treated as implementation of those decisions. Here, our case study has the following narrative - model where the changes need to be implemented. Namely, the 4EM sub-models serve as appropriate constellation because they match and map to point out where and how the managerial decisions resulted in changes in all sub-models.

The business case records the following developments related to this:
Alterations in the Goal Model of the respective branch and the bank as a whole have been as follows. This branch now needed to achieve the following measurable, quantitative goals: Monthly growth of outstanding deposit portfolio of 10.000 EUR per month (previously 100.000 EUR); Monthly growth of outstanding loan portfolio of 20.000 EUR per month (previously 200.000 EUR); Absolute amount of loan disbursements per month of 250.000 EUR (previously 1.500.000 EUR); Percentage of arrears in loan portfolio over 30 days of less than 5% (previously 2%); Newly attracted customers (private individuals and legal entities) of at least 2 per month (previously 20 per month); and additional one: Retaining of number of clients as-is (not drop towards loss of customers in numbers). This branch needed to achieve the following unmeasurable, qualitative goals: Corporate presence - to be minimized in the first 6 months after the fraud; Positive reputation - damaged to the extent that influence the bank as a whole - all efforts are in this direction to improve; Word of mouth referral (marketing activities for brand awareness are on HO level) - to pay personalised attention to each complaining customer; Corporate-social responsibility in the region - increase as much as possible; Motivated staff - from being highly demotivated because of bad reputation, firings, resignations.

Alterations in the Business Rule Model of the bank occurred. The governing principle stating: 'The bank accepts feedback from known persons (external or internal) (does not act upon anonymous complaints and reporting)' has been altered with: 'Anonymous complaints (internal and external) are to be considered'.

Alterations in the Concept Model on bank level were through introduction of the concepts of 'whistleblower', 'external information source regarding fraud', 'whistleblower protection'.

Alterations of the Actor and Resource Models on the bank and branch levels were in: the roles of Head office and Branch staff have been reconfigured in the relations

with the specific branch; and/or re-populated to address the new situation; some of these changes have later on expanded and been introduced to bank level, as result of the institutional learning towards fraud

Alterations of the Business Process Model have occurred both in bank and branch processes. New modelling and instantiations took place - 80% of the branch processes have been altered for this specific branch only and some have influenced the business processes for certain aspects in fraud recognition, management and prevention on bank level, even on international sister-bank level.

Alterations of the Technical Components and Requirements Model resulted in the very up-to-date own technology dependent information systems and components in place for the core banking business, as well as broad ecosystem of various components serving diverse non-core-banking needs. The situation had implications in redesigning the top-management information flows towards multimodal sensing and response for fraudulent activities. The requirements have been re-set in being stated as (1) managerial need and (2) outcome to be achieved first, and (3) information system design second. This helped clarify situations where due to IS limitations the management couldn't properly assess or react to prompt situations.

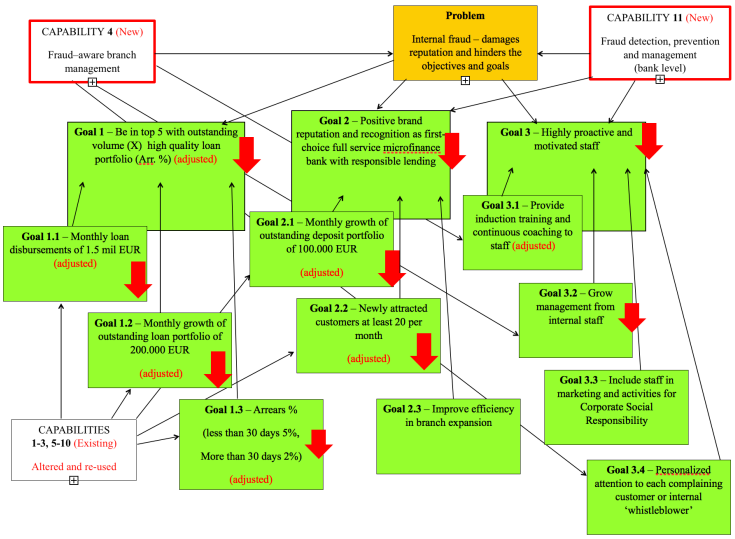

Fig. 2. Influence of the problem (adverse event) on objectives and goals – and use of capabilities (existing and new) to address the changed context

The main contextual changes that triggered managerial decisions of alterations of goals as well as cascaded to the other 4EM sub-models are visualised on Figure 2 with red arrows denoting drop in goal achievement in qualitative and quantitative terms as well as comment in red ('adjusted') whether that specific goal has been

modified due to the new circumstances. The changes were completed with *a broad set of capabilities being introduced or re-used after the unplanned trigger*.

Capabilities 1, 2, 3 as well as 5-10 (Fig. 2) have been re-used after alteration to the new context. They are as follows respectively: Capability for *loan disbursements* – lowered limits to be disbursed by the branch; Capability for *customer acquisition* – modified process to include HO staff; Capability for *deposit promotion* – modified process to hear out delicate customer feedback; Capability for *guerrilla marketing* (reuse/adapt from HO to Branch Staff) – to include and train branch staff; Capability for *loan decisions of all types* (reuse/adapt from Branch to HO Staff) – lowered limits; Capability for *arrears management* for loan clients of all types (reuse/adapt from Branch to HO Staff); Capability for *training/coaching of new staff* (reuse/adapt from this Branch to neighbouring Branches); Capability for *collaboration with top management* (reuse/adapt from Branch Managers to Supervisors); Capability for *Corporate Social Responsibility* (reuse/adapt from HO to Branch Staff). The adaptation process for alteration and re-use of existing capabilities went through some (not all) of the sub-models of the 4EM and dimension 3, according the pattern:

*Managerial Decision (New context) -> (**any** of the 4EM sub-models except Technical&Req.) – (**any** of the dimension 3 aspects) – Technical&Requirements –> Information System (in general) (processes with dotted black line on Fig. 3).*

Capabilities 4 and 11 have been newly introduced. Their names are: Capability for *fraud-aware branch management* as sub-system and Capability *for fraud detection, prevention and management on bank level* as a system. The adaptation process for the newly designed and implemented capabilities went through the pattern:

*Managerial Decision (New context) -> (**all** of the 4EM sub-models except Technical&Req.) – (**all** of the dimension 3 aspects) – Technical&Requirements –> Information System (in general) (process with red line on Fig 3.)*

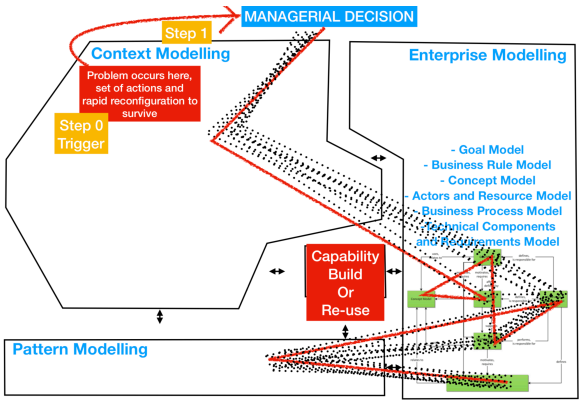

Fig. 3. Adaptation process flow for development of new and re-use of existing capabilities

The design and development of Capability 4 and Capability 11 (Figure 3, process flow shown with red line) have both touched upon all and each of the 4EM sub-models, and all dimension 3 elements, figuratively placed in the 'pattern modelling' block on the figure, for practicality of the process visualization. They are initiated by managerial decision (MD) as reaction to contextual trigger that fraudulent behaviour has been detected by the information system in place, on branch (Capability 4) and bank level (Capability 11). The other capabilities (1, 2, 3, 5 – 10) have been altered and re-used necessitating changes in one or few of the 4EM sub-models (process flow shown with black dotted line). The alteration and re-use of the existing capabilities helps the enterprise cope with the changed situation because of the lack of important capability that takes time and actions to develop and introduce.

4. Discussion on Roadmap, Mechanisms and Tool-support for Adaptability

The banking business case elaborated in the study serves as a realistic illustration for enterprise adaptability needs and transformations. The developments in the bank after the unplanned trigger (internal fraud event) describe how substantial efforts of the enterprise are focused towards building the capability for fraud prevention, detection and damage control, as well as adapting to new conditions of work, where context and internal mechanisms have changed. When analyzing the actual developments and timeline, the bank management had the role to decide on 'what next and how to proceed' after being triggered by unplanned events, that could have even been foreseen (such as number of events in the 'business continuity and disaster recovery planning'). After managerial decisions that introduce changes to many aspects of the company's way of doing business are made (governing rules, concepts, goals, actors, technology, …), CDD+4EM responds to effectuate them in the 4EM sub-models, use all mechanisms (context modelling, patterns, variability, transformations, …) to re-align and design, provide capabilities to the new needs and deliver. The adaptation roadmap these events traced has been visualised on figures 3 and 4, capturing:

- The *main participants* (Management, CDD+4EM artefact and team-in-place, Contextual participants and occurrences, the Information System on generic level)
- The *route* on how the enterprise behaves when introducing deliberate, planned change and when adapting to unplanned change, differentiating:
  - The *difference* between the two routes in *triggers* – planned change triggered by managerial decisions and carried out to dynamic completion by CDD+4EM; and unplanned change triggered in context, necessitating managerial decisions and being carried out to dynamic completion by CDD+4EM
  - The *difference* between the *adaptation process* flows when existing *capabilities* are *re-used/altered* for changing needs; with the situations when capabilities are *newly* designed, built and put in place, on two different levels (bank and branch)

We are deliberately *incorporating participation of management in the roadmap*, since there is little to no automatism when facilitating enterprises upwards. With this perspective, we can advise (i) managers on what happens when an entire IS mechanism of CDD+4EM is in place at their disposal for various planned/unplanned circumstances, what they can expect and do with it; and (ii) modelers, on the managerial entry-points to be considered (not omitted) to support enterprises in adaptability in dynamic environments using capability-oriented methodology.

With regards to the three-dimensional framework [7], capabilities needed and made use of all of aspects in dimension 3. Namely, *adaptability transformations* (dynamical, at run-time) would have been used in capability re-use (refactoring), through introduction/removal of roles/capabilities and introduction/removal of relations and (re)population of existing roles with different actors. *Variability* has been invoked in 80% of branch processes being altered for this specific branch only. *Modularity* has occurred in 5 capabilities (e.g. re-use of training capabilities with different content, marketing activities module implemented for branches). *Positive and negative feedback* has been incorporated in capabilities to open communication channels. Patterns(as reusable components) assisted re-use of capabilities but also in generation of new ones (especially for combining quantitative and qualitative indicators). Combining qualitative and quantitative indicators before assessing the state of a branch became pattern for future decision making across all branches.

Table 2. Necessary requirements for *software tool support* during the capability development, modification and re-use

Input from participants (socio-material) and their interrelatedness	Artefacts integration and their in terrelatedness	Adaptation roadmap (capability development/re-use depending on triggers)
Management Contextual participants Modeling team Information Systems team	4EM sub-models Context model Pattern model Managerial decisions	Capability development for planned/unplanned events Capabilty modification and re-use

With regards to how the metamodeling platform ADOxx supports the hollistic, multi-participant case developments and adaptation roadmap along with the managerial needs and enterprise evolution through planned and unplanned triggers we can have evaluated the followin: the tool provides support for the enterprise modelling(Goal Model, Business Rules Model, Concepts Model, Actors & Resources Model, Business Processes Model, Technical Components and Requirements Model), separately, as well as congruently using a recently developed 4EM AdoXX module.

However, to represent the roles of all the participants in the business case and facilitate their relations and communication, we would be unsupported with how the management conveys on continuous basis their decisions and generates new inputs, how the contextual participants' information is communicated and effectuated, and in general, how the overall ecosystem relations and communication are enabled. With regards to the artefacts used to address the business case, we have enlisted all 4EM

sub-models, but also all the CDD components, with specific mention of the role of continuous managerial decisions capture and effectuation. ADOxx can be enhanced with the modules that support *capability* and *context* components to help easier communication through unified modelling format, as well as with the method-templates for their elicitation [16]. The adaptation roadmap support as our main contribution in this case, ought to argue for future ADOxx modules towards designing process flows that capture triggers either in context or from management and effectuate into new capabilities developments; or trace capability modification and re-use regarding the triggers from management, context or automated ones (as prescribed in the CDD methodology). These notions should enable traceability and validation of a more holistic and encompassing nature.

5. Conclusions and Future Work

In this study, the focus was on how CDD+4EM can be used for supporting managerial decisions that need to be effectuated in the enterprise, due to adverse business events. The 3-dimensional framework served as foundation for assessing how a methodology that complies with adaptability requirements for complexity opens up space for investigating foreseen (planned/unplanned) and unforeseen events. For foreseen changes, CDD's ability to indicate missing capabilities comes in with a role to close gaps, align mismatches, re-use and introduce capabilities. For unforeseen changes, companies need to 'probe' the context as well as evaluate and receive suggestions for the internal capabilities; both broader and (not just) immediate context (framework dimension 1), along with what is needed at which managerial level – strategy, tactics, operations (framework dimension 2). However, here we were working out dimension 3, and with that restriction, we are able to discuss the common business case, the CDD+4EM roadmap for managing change and artefact-incorporated components that support adaptability. We show *what* of all relevant information from the banking case is possible to model with CDD+4EM (planned and unplanned change triggered by different participants and in different environments), *how* (through the adaptation roadmap steps of business-IT alignment to the new reality that tracks the capability design, development and (re-use). This research contributes to the application of CDD methodology to dynamically changing businesses; and by tracing adaptation roadmap on capability-oriented methodology using broad business-IT perspective and participants. *CDD methodology with 4EM address the main needs*: *translating the managerial decisions* into proper reconfiguration of the enterprise model and its sub-models (Goal, Business Rules, Concepts, Actors and Resources, Business Processes, Technical Components and Requirements) (in cases of planned and unplanned change); *context modelling* complements to capture events and address unplanned change (that may result in small adjustments or might compromise goal achievement); and *set new and/or re-used capabilities* that embody the capacity and ability to deliver the business value needed by the stakeholders using *diverse internal mechanisms (patterns, modularity, variability, adaptability transformations, positive and negative feedback)*. CDD parallels businesses' big-picture viewpoint and complex

internal mechanisms with the information system bridging and integrating components to enable and facilitate adaptability in dynamic environments. ADOxx as metamodeling platform integrates the 4EM and its sub-models, extending with various modules to operationalize the business needs. However, the capability development/modification/re-use as described in this study, as well as the modelling of the context need further development. In addition, we pointed out the diverse participants whose input is necessary but not dynamically captured with the current modules, the artefact communication and integration to respond to the big-picture real case scenarios as well as the adaptation roadmap as process flow conveyed to introduce and/or re-use capabilities as possibilities for the platform improvement.

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