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Enhancing organizational self-awareness with enterprise modelling frameworks

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Introduction

In a time when technology has made the world smaller and important events take place at an incredibly high pace, organizations constantly need to adapt themselves in order to survive. The challenge of today's organizations is to develop capabilities of continuous sensing, learning and adjusting to the dynamics of their environments (Magalhães, 2004). An essential requirement of these capabilities entails developing organization's self-awareness. Human consciousness gives subjects the capacity of self-awareness. Self-aware beings know who they are, how they do things and what they (and others) are doing at any particular moment. Whereas this capacity is innate in individuals, organizational self-awareness must be built and maintained by continuous interactions among their members. From our point of view, the act of modelling enterprises and discussing enterprise models is an effective means of supporting organizational self-awareness.

The evolution of the Information Systems (IS) field has been marked by the emphasis given to models and modelling activities as a means of facilitating the communication among systems stakeholders. The high inter-dependence between IS and organization's structure, culture and processes, as well as the need of aligning IS and organizations, has lead to an expansion of the IS field that include organizational analysis and process (re)design activities as part of systems development efforts. From this expansion, emerged the Enterprise Modelling (EM) activity. EM research and practice has shown that enterprise models are effective communication tools in supporting systems development and process (re)design. A distinctive feature of EM frameworks is the representation of different enterprise concerns in terms of different but inter-related perspectives. The most commonly depicted enterprise perspectives are the process, information, application, and technology perspectives (Schekkerman,2004}. Whereas the former describes enterprise activities *i.e.* what organizations do, the remaining perspectives describe its resources *i.e.* the entities required for their operation. Another important feature of EM framework is the usage of languages with more formal syntax and semantics as well as graphical representations, which have shown to reduce ambiguous and inconsistent interpretations.

However, current EM frameworks are restricted to concerns relevant for participants and stakeholders of systems development. Moreover, most of these representations are based on static, mechanistic and deterministic views of the organization. Modelling the organization for its self-awareness is a more challenging task and entails conceptual and methodological implications. It requires integrating approaches coming from organizational and IS fields, to capture: (1) organization's structural and dynamic aspects, (2) routines and decision-making processes, and (3) its formal and informal sides. Moreover, it entails capturing organization's evolution. All these

aspects must be captured from different viewpoints and levels of details. Means for mapping between different aspects, viewpoints and levels of details must also be provided.

This paper discusses the conceptual and methodological implications of modelling enterprises to enhance organizational self-awareness, and illustrates the benefits of using EM for self-awareness purposes through a set of applications, tested with case studies in real organizational settings. The remainder of this paper is organized as follows; section 2 clarifies our notion of organizational self-awareness and summarizes ideas of the contemporary thinking of organizational science. Section 3 summarizes the state of the art in EM. Section 4 discusses the conceptual and methodological implications. Section 5 summarizes some practical applications.

Organizational Self-Awareness

Organizations as Resultant of the Agency-Structure Duality

The approach proposed in this chapter is based on a view of organization as a socio-technical entity, which self-realizes in the permanent action and interaction of its component parts. This view of organization is the outcome of a number of intellectual influences, namely *organizational constructionism* (Giddens, 1984), *autopoiesis* (Maturana and Varela, 1980), *organizational intelligence* (March, 1999), *organizational complexity* (Tsoukas, 2005) and *organizational evolution* (Aldrich and Ruef, 2006). These theories center on how organizational agents continually (re)create and change the organization. Constructivist theories argue that organizations exist largely in the minds of organization members in the form of cognitive maps, or images. In talking about organizations and designing maps of it, they are *reified*, that is, they are made real. Hence, the existence of shared maps requires social agreement and cooperation.

In the present work, we focus on the organization as the resultant of the actions of individual and social agents. Agency is an essential notion of social theory. Human action is more than a mere combination of acts. Human beings have the capacity to understand what they do (Giddens, 1984). These reflexive capacities are (a) largely carried tacitly and (b) embedded in the flow of day-to-day activities. A social actor is "an organizational entity" whose interactions are simultaneously enabled and constrained by the environments of the firm, its members and its industry (Lamb and Kling, 2003). Structure is another important notion emerged from social theory. According to Giddens (1984), it comprises rules and resources. Rules are generic procedures of action applied in reproduction of social practices. Resources are the media through which power is exercised. Resources may be *allocative* or authoritative. *Allocative* resources include information, objects, goods or material phenomena and capabilities to allocate or transform them. Authoritative resources include soft competencies and social resources such as power relationships.

The notions of agency and structure are the cornerstones of Structuration Theory (Giddens, 1984). This theory suggests a recurrent duality between agency and structure. For Giddens, social action makes up what he calls the system, that is, the observable patterns of events and behaviour. Social systems comprise the situated activities of human agents, reproduced across

time and space. Structure refers to the unobservable rules and resources used to generate the system. Structure is saved as memory traces and is recursively implicated in social systems. Structuration is the process of producing and reproducing social structures through the daily activity of social actors.

Refining Organizational Agency: a Complex, Adaptive Framework

Organizations are also currently regarded as *complex systems* (Magalhães, 2004). (Bohm, 1980) argues that in every complex system there are hidden processes below the surface of reality, which explain the world stage at any time. Complexity introduces notions such as self-organization and emergence (as opposed to deterministic motion), chaos and unpredictability (as opposed to command and control), or sensemaking and understanding (as opposed to rationalizing and predicting).

Another important concern of the constructivist paradigm is *organizational evolution*. Axelrod and Cohen (2000) have taken the principles of complexity and evolution and have put together an innovative framework for analysis and (re)design of social, political and organizational systems, which allows refining the notion of organizational agency. We summarize below the essential concepts of this framework:

- Agents are collections of properties that include location and capabilities. Agents interact with artefacts and other agents. Agents can respond to what happens around them and can do things more or less purposefully. Thus, agents have goals. Agents can be not only persons but also families, businesses, countries or computer programs.
- Artefacts are objects with properties such as location or capabilities. Agents interact with other agents and/or artefacts. An artefact has "affordances" (features evoking certain behaviour from agents). However, they do not have purposes of their own or reproduction capabilities.
- Strategies are ways of an agent of responding to its surroundings and pursuing its goals. A strategy is a conditional action pattern that indicates what to do in which circumstances.
- Success measures are "scores" used by an agent or by a designer to define how well an agent or strategy is doing.
- Populations are collection of agents, or, in some situations, collections of strategies.
- Systems are larger collections, including one or more populations of agents and possibly also artefacts.
- Designers are agents that introduce new agents, artefacts or strategies into the world.
- Adaptation takes place when a selection process leads to improvement according to some measure of success. Adaptations for some agents may not be for others. Moreover, adaptations of agents do not necessarily leads to an adaptation of the system
- Selection involves the change processes triggered by success measures.
- Variety defines the diversity of types within a population or system. Variety is driven by change processes. Variety is a central requirement to adaptation.
- Interactions address the question of who or what should interact with who or what and

when. Interactions make a complex adaptive system come alive. Interactions give rise to events and develop an unfolding history.

- Interaction patterns define the recurring regularities of contact among types within a system. These patterns are neither random nor completely structured. Interaction patterns are determined by two kinds of factors; proximity and activation. *Proximity* determines how agents become likely to interact. Activation determines the sequencing of their activities. *Activation* groups together many different processes that affect the timing of agent activity.

Human Activity and Consciousness

In order to be fully understood, agency must be regarded at collective and individual levels. Whereas Structuration Theory and Axelrod and Cohen's framework explain the formation and evolution of societies, Activity Theory (AT) is a psychological theory which analyzes the formation and evolution of individual and collective activities, and its relationship with human consciousness.

Leont'ev (1974) has described an activity as being composed of *subjects*, *object*, *actions*, and *operations*. Actions are conscious, goal-directed processes that must be undertaken to fulfill the object. Operations are actions, which become unconscious with practice. The subjects involved comprise multiple individuals and/or sub-groups who share the same general object of activity and who construct themselves as distinct from other groups. This model was later extended to include social rules *i.e.* regulations, norms and conventions constraining actions and interactions within the activity system; community *i.e.* activity stakeholders and division of labor *i.e.* horizontal division of tasks and vertical division of power and status (Engeström *et al.*, 2005).

Activity constituents may change in time according to a set of key principles. The first principle assumes that events should not be analyzed in isolation but as result of *developments* over time. Another key principle is *mediation* by tools and signs. Tools and signs are artifacts that shape the way human beings interact with reality. The principle of *object-orientation* (different from object-oriented programming) is one of the most important principles of AT. Every motive is an object, which drives activity execution and coordination. AT also differentiates between internal (mental) and external activities. *Internalization* is the transformation of external activities into internal ones. *Externalization* transforms internal activities into external ones.

According to Leont'ev (1977), consciousness is the basis of all human activity. Activity theorists argue that consciousness is not a mere set of discrete disembodied cognitive acts. For AT, having human consciousness means to be part of a web of social activities and to live and act in a culturally elaborated environment populated by a wealth of tools, including language (Nardi, 1998). In other words, consciousness is an individual and social phenomenon that both influences and is influenced by human activities.

Organizational Consciousness and Self-Awareness

The notion of consciousness of activity and structuration theories can be refined further in search of the intellectual foundations for a new construct that has been labeled as organizational consciousness (Magalhães & Tribolet, in press). Such a refinement can be found in the teaching of Weick (1995; 2001) about sense-making in organizations. Sense-making is defined as structuring unknown contexts and/or actions and assigning them with meaning. Sense-making is distinguished from other explanatory processes such as understanding or interpreting by the following characteristics; the process of sensemaking is (1) social, (2) grounded on identity construction, (3) retrospective, (4) focused on extracted cues, (5) ongoing, (6) driven by plausibility rather than accuracy and (7) enactive. The seven properties of sense-making affect the initial sense that a person develops of a situation and strongly influences how this perception is developed for future action. In other words, sense-making lies at the foundation of the consciousness that organizational agents develop of the organization as a whole and of their place in it. Sensemaking and organizational consciousness are closely related notions. However, these are rather abstract notions comprising several capacities including perception, memory, reasoning, association and awareness among others.

In this work, we narrow our focus and refer to a more specific and operational capacity given by consciousness; self-awareness. Organizational self-awareness has an individual and an organizational dimension. The individual dimension refers to the capacity that individual members of the organization have of answering questions such as; *who am I in this organization?, how are things done here? What is the organization -as a whole- doing now?*. The organizational dimension refers to the combination of human or automated agents, resources and procedures that provides organizations with the necessary intelligence for dealing with questions such as; *who are my members?, how do they do things?, what are they doing now?*. An organization is self-aware when these two dimensions are aligned. In practice, achieving this alignment has proved to be neither straightforward, nor easy. Despite the existence of several IS/IT providing already some degree of self-awareness, it is partial, frequently inconsistent or outdated. It is precisely in supporting a dynamic alignment between organizations and its agents, where we envision the value of enterprise representations and tools.

Enterprise Modelling Today

Structuration theory, AT and the Axelrod and Cohen's Framework provide approaches consistent with the complexity paradigm of organizations. Nonetheless, these approaches are described in natural language and with a high level of abstraction. Hence, they are limited to human use and lead to different interpretations.

Several EM frameworks, including languages, methodologies and supporting tools have been developed and are being increasingly used since their emergence more than 20 years ago in computer-related fields. EM has been addressed by two main areas; IS and Artificial Intelligence (AI). The frameworks developed in these fields are commonly referred as Enterprise Architectures

(EA) or Enterprise Ontologies (EO). In both fields, they have been mainly used to support the development of business applications (Schekkerman, 2004). Several EA frameworks of the IS field including languages, methodologies and supporting tools have been developed. Whereas some focus on specific sectors, others are applied to a wide range of organizations. Some well-known generic frameworks are the Integrated Framework Architecture (IAF) (IAF, 2007), the Open Group Architecture Framework (TOGAF) (TOGAF, 2003), and the Enterprise Unified Process (EUP) (Ambler *et al.*, 2005). Within this field, the Enterprise Ontology developed by J. Dietz (Dietz, 2006) for business process (re)design purposes, and the CEO EA framework (Sousa *et al.*, 2005) are two approaches relevant for our work. Within AI, two well known EO are the Enterprise Ontology proposed by (Uschold, 1998) and the ontologies of the TOVE project (Fox *et al.*, 1998).

Perspective	**EO (Uschold)**	**TOVE**	**EO (Dietz)**	**CEO EA**
Found./time	entity, relationship role, actor, state time point, interval time line	 time point, interval time line	 time unit, range requested time promised time actual time	entity, role
Activity	activity, event doer, owner pre-conditions, effects	activity, constraint state, state tree enabling/caused state	coordination act production act transaction process event, fact, state	goal, activity process
Resource	resource-entity	material labor tool		information-entity application-entity technology-entity
Agent/ Organization	organizational unit purpose corp., legal entity partner, partnership management link manage, delegate manage, delegate person, machine	organizational unit Org.-goal, role-goal agent, group, team speech act, protocol role, skill, policy authority, autho-link information link person, machine, sw.	 actor, role agenda action rule subject	organizational unit

Table 1 - Perspectives and concepts included in several EM frameworks

As mentioned in section 1, the distinguishing feature of EM frameworks is to model an enterprise from different viewpoints or perspectives. Table 1 shows the most relevant perspectives and concepts defined in four frameworks; (1) Uschold's EO, (2) the TOVE ontology, (3) Dietz's EO, and the (4) CEO EA framework. All frameworks -excepting Dietz's ontology- include organizational/ agent, activity, and resource-related perspectives. Organizational behaviour is modelled using activity hierarchies, where atomic activities are represented in terms of initial and final states, resources consumed and produced. Dietz's EO models organizational behaviour in terms of inter-agent transactions, and action rules that define when to activate a given role. Processes are modelled by describing the coordination mechanisms among activities or transactions. Resource-related perspectives describe the resources, and their relationships among them.

Most of the frameworks include a set of foundational concepts such as *entity*, *relationship* (among entities), *event*, *state*, and *time*-related concepts. Event, state and time-related concepts

are used to capture activity dynamics. Events are defined as facts or actions happening at a given point of time. State is typically conceptualized as 'states of affairs', and represented in terms of relationships among entities. In all these frameworks, agent and organizational concepts are put together within a single perspective (named as organizational). Roles represent expected behaviour and/or skills. Activities are associated to roles to indicate the behaviour and skills required to execute them. Agents (actors in some frameworks) are associated to a set of roles indicating the behaviour or skills provided by the agent.

Enhancing Organizational Self-Awareness: Implications for EM

Limitations of Current EM Frameworks

Section 2 states the type of questions that it is necessary to answer in order to achieve organizational self-awareness. The overview summarized in section 2 also shows that none single framework today allows answering all the stated questions. Moreover, maintaining such self-awareness also requires capturing individual and organizational changes, which means the capability of providing not only accurate but up-to-date answers. Due to their underlying assumptions and purpose, EM frameworks cannot model the actual behaviour of organizational agents and less, capture their evolution.

The EM frameworks illustrated in table 1 are created as a means for systems design and implementation. Their purpose is to facilitate the elaboration of systems specifications. Consequently, they mostly focus on organizational processes, and thus, organizational behaviour and dynamics is represented only from an activity perspective. Agent dynamics is not captured. Moreover, since agent behaviour can only be inferred from their assigned roles and associated activities, they model generic, expected behaviour rather than the actual behaviour of specific individuals. Hence, these models do not allow to answer questions such as *how/when a specific individual performs a given task?, or which resources a given individual provide/consume?*.

Including a separate agent-centric perspective is necessary to provide an additional layer to represent behaviour both at role and individual levels. Time-related information is also necessary in order to capture individual and organizational evolution.

Two interdisciplinary EM frameworks overcome some of the previous limitations. The OperA+ framework for the specification of multi-agent systems (MAS) (Dignum, 2004), allows a two-layered approach that separates organizational and social structures, allowing to model both organizational behaviour, as well as the behaviour of given agent populations. The PCANS model of the CASOS group (Carley, 2007) defines four separate perspectives; (1) agent, (2) organization, (3) activities, and (4) resources. The PCANS meta-model models interactions within and between all these perspectives, answering some questions about individuals such as *who interacts with whom?, with which organization/activity/resource a given agent interacts with?*. Time is an explicit variable in all PCANS perspectives, allowing the answer to questions such as *when does an agent perform an activity?*, or *when does an agent use/provide a resource?*. It also allows capturing changes in individual agents and organizations.

Nonetheless, no single framework fully captures the complexity, dynamics and situatedness of human behaviour, leaving several questions to be answered such as *how does a given individual execute a given task?, how does an individual coordinate his own work? Or how does an agent manages his personal resources?*.

Finally, due to their emphasis in modelling expected rather than actual behaviour, these models disregard the problem of associating and aligning the daily actions of individuals with organizational activities and resources.

Conceptual Implications

Overcoming the limitations described in the previous section entails addressing the following issues:

- The addition of an agent-centric perspective: The theoretical background and empirical evidence gathered in this research suggest that adding an agent-centric perspective to EM frameworks enriches currently available representations and enhances the scope of EM. The agent perspective allows capturing behavior of specific agents, whether individual or collective, as well as the interaction patterns among them, regardless of the activity being performed.
- The inclusion of the notion of context: Current EM frameworks do not include the notion of context. However, contemporary paradigms acknowledge that both individual and organization behavior is context-dependent. Hence, this notion is essential in understanding, representing, and analyzing human behavior. The notion of context we propose in our work integrates ideas from cognitive and social sciences. Cognitive and social contexts focus on the interactions among entities rather than the entities themselves. Contexts are thus defined as the network of entities (agents, resources, and rules) that are relevant for an agent in a given situation, created and continually updated by the interactions among them. Drawing on the notion of social contexts, our also acknowledges the existence of hidden rules governing agent interactions that characterize specific interaction settings.
- Separation of design and execution concepts: Constructivism highlights that activity and resource names and models are abstractions, *i.e.* creations of our minds that allow us to understand study, discuss or analyze the operation of enterprises. This assumption suggests the need of having two separate modelling layers, one representing expected behavior (design layer) and the other representing actual or enacted behavior (execution layer). In our work, we accomplish such separation by defining a set of design-related concepts (activities and resources) and execution-related concepts (agents, actions, tools, information-related items, and contexts). Hence, every activity or resource model represents one of several viewpoints that specific agents (individual or collective) may have of a particular context of execution. Since activities are merely abstractions, single actions or single interactions with activities is not straightforward because it depends on how activities have been defined by particular agents. The inclusion of the concept of context aims at facilitating this association. Arguably, actions and activities are analogous

concepts and as such, both are abstractions. This issue is solved by associating actions with smaller semantic units more easily associated with daily work operations (activity "buy book" *vs* "print book information").

- Time as an explicit variable: several EM frameworks include time as an explicit variable to represent activity dynamics. In order to capture and represent agent dynamics, it is essential to include time-related concepts within the agent perspective.

Addressing Conceptual Implications

Figure 1 illustrates how we propose to address conceptual limitations 1, 2 and 3 (for details see (Zacarias *et al.*, 2009)). The agent perspective added acknowledges different organizational levels, distinguishing between individual and collective agents. Individual agents are member of collective agents that in turn are agents within broader organizational units. Secondly, it decouples the concepts of actions and interactions from activities. Since activities are merely abstractions, single actions or single interactions with activities is not straightforward because it depends on the activity definition. According to the proposed model, actions and interaction sequences create and update respectively, action and interaction contexts. Relating actions to activities entails analyzing the whole action sequence, and other characteristics of the corresponding contexts.

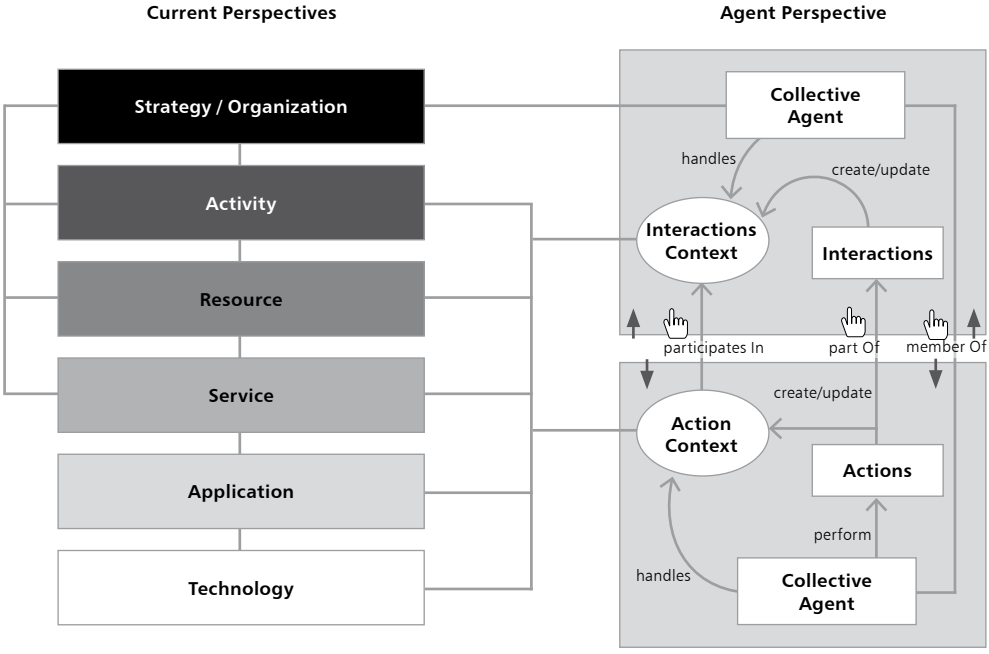

Figure 1 - Adding an agent perspective to current EM frameworks

Methodological Implications

Overcoming current EM limitations also entails addressing the following methodological issues:

- Capturing behavior from actual actions and interactions: In EM models are built using mostly techniques such as interviews, workshops, or questionnaires. However, complexity and constructivist ideas suggest that such approaches are limited since they only capture what subjects say and/or believe they do, rather what they actually do. These points to the need of building representations of human behavior from action repositories.
- Using Context as unit of analysis: The difficulty of universally associating actions with activities due to the context-dependent nature of human behavior suggests the usage context as unit of analysis rather than formally defined activities.
- Periodic Approach: Capturing agent and organizational evolution necessarily entails devising mechanisms to facilitate periodic data collection and analysis processes.

Addressing Methodological Implications

Figure 2 illustrates how we propose to address the previous methodological implications (see details in (Zacarias *et al.*, 2008)). A methodological approach to capture and depict model representations of agent behaviour at personal and inter-personal levels was developed as part of the framework. The method offers a bottom-up approach that captures individual and inter-personal behaviour of action and deliberation layers from action repositories, and makes an instrumental use of the notion of context. It encompasses six activities; (1) bootstrapping, (2) action capture, (3) context discovery, (4) context-based analysis and (5) context integration.

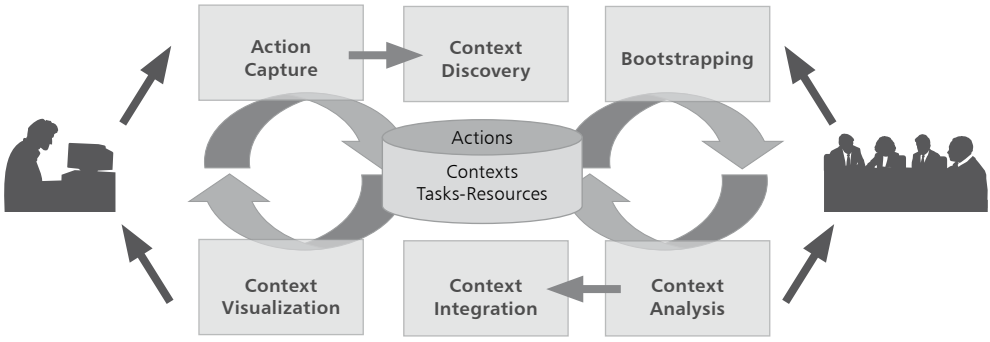

Figure 2 - Defining a bottom-up, context-based approach

In bootstrapping, the basic action types and resources to be registered are defined, and their meanings discussed. Ideally, action and resource definitions are registered. Action capture creates the action repositories. Actions are captured in natural language, using a structure <subject, verb, object>, where the subject represents the agent performing the action, the

verb represents the type of action performed, and the object the resources involved. Context discovery entails identifying, characterizing, and labelling contexts. Contexts are discovered by grouping action sequences involving the same agents, similar sets of tools, and information items, during specific time intervals. Once identified, contexts are characterized with the names of recurrent actions, tools, information items, participating agents, as well as time-related data.

Context visualization displays context main characteristics to their owners, for validation purposes. Action and patterns can then be found within particular contexts. In context-based analysis, contexts are used as units of analysis in representing individual and inter-personal patterns. Hence, such patterns are always associated to a given context. Context-based representations offer situated 'pictures' of the observed subjects and the interactions between them, and allow discussing which behaviour should be standardized or (re)designed. Context integration takes places when patterns are considered good practices, and they are standardized as formal organizational behaviour and consequently, update specific activity/ resource models.

Executing these activities creates three cycles. First, action capture, context discovery and visualization activities are performed by the observed subjects, and are repeated until they are satisfied with the contexts identified. The second cycle reflects the iterations involving observed agents and external observers. The bootstrapping activity produces an initial set of action and resource types, which can be extended throughout the process, according to the results of context analysis and integration activities. The third cycle is due to the evolution of agent behaviours, requiring new iterations of the whole process from time to time.

Using EM for Organizational-Self Awareness: Applications

Organizational self-awareness is exhibited through several capabilities. This section describes three different capabilities that that are provided by our approach and can be related to the notion organizational self-awareness (1) capturing and describing work practice, (2) capturing and measuring human multitasking at work and (2) assessing the alignment between organizational designs and actual work practices. Each capability (which have been validated in real organizational settings), illustrates a different usage scenario of our proposal.

Capturing and Modelling Work Practices

The importance of modelling work practice in developing information systems is acknowledged by (Sierhuis, 2002). Moreover, self-aware organizations know the actual work practices of its members. Current EM frameworks capture generic task, activity, and process model that define behaviour at a role level *i.e.* they only describe generic behaviour. Modelling work practices require the capability of answering the question; "How does Individual i perform Activity A? Which resource(s) use?". This compound question has been addressed by independent research in systems development and simulation, but not by EM frameworks.

Capturing and modelling work practices means building diagrams situated in particular contexts, reflecting the particular action types, action flows and resources employed by given individuals in performing given tasks. Since these resources can be human, diagrams reflecting inter-personal patterns must be built. This means the ability to answer questions such as (1) "Who (Individual i1) interact with who (Individual i2)?", and (2) "How does Individual i1 interact with Individual i2?" These questions must be addressed using a representation language and model acquisition approach better fitted for purposes of organization analysis.

Capturing and Modelling Multi-Tasking Behaviour at Work

Self-aware organizations should also be capable of measuring human multitasking at work. Several researchers have acknowledged the impact of human multitasking in individual productivity (Czerwinski, 2004; Wild, 2004). Multitasking behaviour does not reflect how work is accomplished. Rather, it reflects how agents manage themselves. It requires the capability to answer question such as "How does Individual I manage Resource R?", where Resource R is the individual him/herself. This behavioural concern has been addressed in research works of human-machine interaction, human resource management, cognitive sciences, but no EM framework has addressed it.

Our approach captures and models human multitasking using the notion of context to define work fragmentation, rather than tasks. Multitasking behaviour is modelled in terms of context interleaving, and context activation rules. Different tasks may require similar resources. Likewise, the same task may require different resources, at different stages. Since switching costs are caused by the need to 'pull' different set of physical and cognitive resources, and contexts reflect resource groupings, this criteria is more appropriate to measure work fragmentation than tasks.

Aligning Design with Execution

Self-awareness in organizations does not only entail answering questions about when and how its members execute or organize their work. It also entails assessing if actual behaviour responds to behaviour predefined in procedures or workflow models. The problem of aligning organization's design with actual execution using action logs has been acknowledged and addressed by the process mining research (van der Aalst, 2005). However, the focus of this field is restricted to the alignment of pre-defined application workflows, with workflows acquired from execution data collected from logs produced by workflow and enterprise applications. This work does not collect data from non-structured actions stored in message-based, groupware applications, where messages are not associated with tasks. It also disregards non-computer mediated actions and interactions, which require to be registered manually. Without unstructured, non-classified actions, it is not possible to get accurate definitions of actual organization workflows. The problem of alignment activity models with execution is completely disregarded by EM acquisition approaches, which depart from higher level of abstraction and collect data collection with manual techniques such as interviews or seminars rather than from action logs.

Conclusion

Organizational self-awareness is a pre-requisite for an effective action, decision-making and learning in organizations. Due to the dynamics of current environments, the development of this capacity entails a continuous communication effort among organizational agents. Current EM frameworks have proved to be effective communication means for system development ends. However, it is necessary to explore appropriate approaches in enhancing organizational self-awareness. This paper discusses the conceptual and methodological implications of extending EM for such purpose.

From a conceptual standpoint current EM frameworks need to be extended with agent-centric perspectives and concepts capable of capturing and representing specific human behaviour at personal, inter-personal, group and organizational levels. EM frameworks need also to be "context-aware" *i.e.* they need to include explicitly the notion of context in order to capture the particular situations in which the represented behaviour is displayed. Finally, it is important to acknowledge that activities and resources are abstractions, and as such they may have different meanings for different subjects making it necessary to separate such abstract descriptions from descriptions of concrete actions, tools and individuals in order to allow different representations (showing different viewpoints) of the same reality. The framework itself requires further development. More formal and detailed representations must be explored as an essential aspect of the automated support devised for our framework.

From a methodological standpoint it is essential develop ways of building representations from actual actions and interactions due to the limited introspective capabilities of human beings. In our work, we built representations from manually collected action logs. However, manual registers restrict the extension of case studies. In order enhance the volume of such logs it is necessary to draw on automatically collected logs. With the staggering amount of computer-mediated interactions, human interactions are increasingly leaving electronic "footprints". Developments in fields such as data mining (Witten and Frank, 2007) and semantic technologies (STC, 2007) are providing the analytical capabilities of discovering interaction patterns from both structured and non-structured information sources. The exploration of these technologies seems promising in providing automated support to methodologies aiming at enabling and/or enhancing organizational self-awareness.

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