Enterprise Dynamic Systems Control

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INTRODUCTION

The information Systems (IS) are designed, implemented and managed using abstractions layers to cope with the huge organizational complexity that is nowadays posed and also to facilitate the discussion between the different stakeholders of an organization (Laudon & Laudon, 2012) that have diverse perspectives and interpretations of it. Those discussions drive to the classical requirements elicitation stage that aims at identifying the best short-, mid- or long-term models to view, understand and operate the organization and to facilitate the forthcoming IS transformations. Abstraction is a powerful intellectual tool that, in a given instant in time and context, allows to leave some details for further analysis. In the subsequent instants of time and contexts, the abstraction level decreases and forces the stakeholders to further specify the models. Accordingly, Hoogervorst (2009) explains that business transaction models are abstractions, which prescribe the design freedom restrictions of a process-based organization and are useful to share a common understanding between the stakeholders regarding the business processes to be executed. In fact, in the IS domain, business processes models (OMG, 2013; Archimate, 2013) are frequently used to describe the way that operations are expected to happen while the actors perform their activities. However, the business transaction models *per si*, are not sufficient and do not guarantee that the business actors perform them accordingly during operation. This phenomenon occurs by many and diverse reasons, organizational actors perform workarounds at operation time that could be extremely different from the previous prescribed business transaction models. Operation is understood as the collective activity of all the elements within the organization and in the surrounding environment. It encompasses both the productions performed by the elements within the organization and the interactions with the organizational bounds (Dietz, 2006).

Hence, an actor is autonomous in deciding what to do next, and thus misalignments occur between the business transaction models and actor's operation. Moreover, business actors, individually and/or collectively, operate the organization and also administrate and steer it, by means of observing the state of the world and then acting with purpose to change its state. Moreover, an organizational actor is simultaneous a controller agent and a controlled agent within an enterprise. This reason is why steering the operation of business transactions, by the mean of the correct business rules, is strongly needed nowadays on organizations.

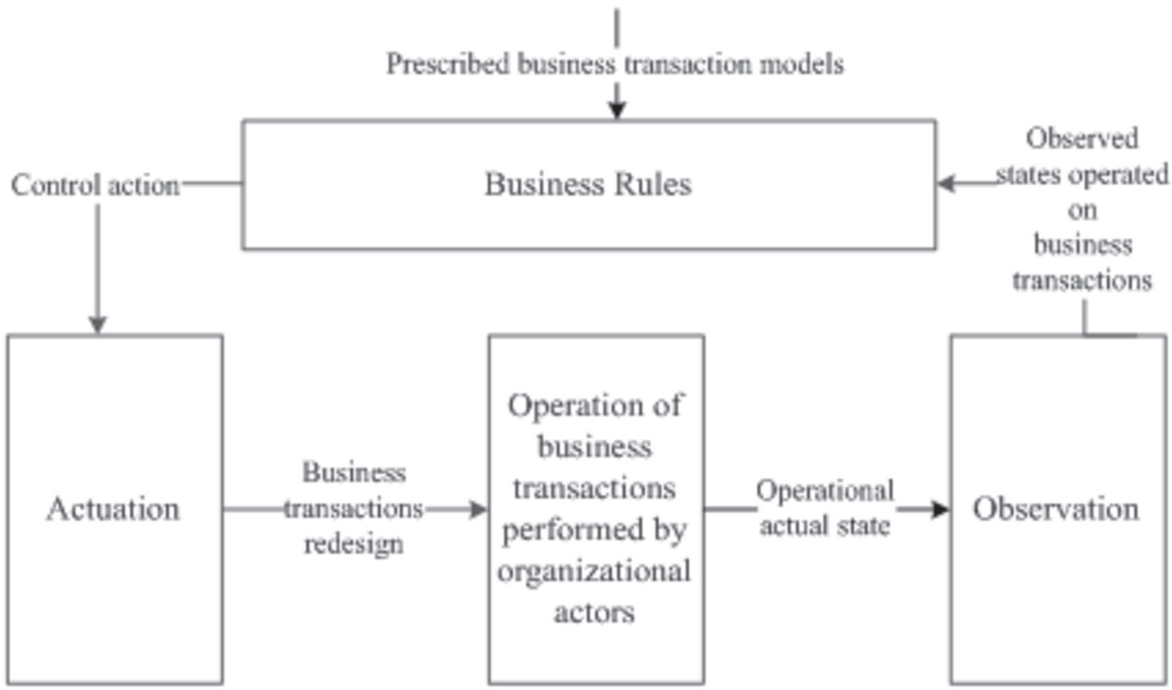
As depicted in Figure 1, organizations require steering for continuous verifying if the desired models are satisfied and then to take purposeful actions to correct them. In line, systems control area identifies the need to construct a classic cycle of observation, decision and control to guarantee that the operation of a system satisfies within the desired conditions (Franklin et al., 2009).

Moreover, organizational steering is most of the time considered as an independent and isolated organizational add-on component that reacts according with the behavior of the part of the organization that is supposed to control (COBIT, 2007). For instance, the General Systems Theory (Bertalanffy, 1969), the Viable System Model (Beer, 1981) and the recent Enterprise Governance proposals (Hoogervorst, 2009; Hoogervorst & Dietz, 2008).

In general, organizational steering is related with the ability to control, within a bounded effort, the operation of the enterprise towards a desired prescription whenever changes or perturbations occur. Steering the organizational operation from *a priori* prescribed models derives from the classical control engineering theories. These approaches are still valid for business information systems domain but require contextual adaptation for dealing with holistic concerns such as models change management

DOI: 10.4018/978-1-4666-5888-2.ch701

Figure 1. Steering cycle: the business transactions are the organizational objects to be controlled, the observed variables are its states and the control variables are the business transactions redesign initiatives



Following the proposals of (Guerreiro et al., 2012; Guerreiro & Tribolet, 2013), in these article we state that, due to the organizational complexity, behavior-based approaches are insufficient because it is impracticable to entire specify the dynamics of the system to be controlled without a constructional perspective of the business transaction models. To produce decisions about which action to enact, the understanding of the essential dynamic of the enterprise is crucial.

The proposed solution takes advantage of recent advances in the domain of IS ontology, in specific the Enterprise Engineering (Dietz et al., 2013) and the DEMO theory and methodology (Dietz, 2006), to present a steering solution. It triggers two different control actions whenever a misalignment between the business transactions models and operation are identified: (1) a change in the business transaction models to mitigate the misalignment or (2) a change in the business rules because deviation is considered innovative and thus it should be incorporated in the dynamic of the organization.

BACKGROUND

Classical Dynamic Systems Control

From the perspective of classic control concepts (Franklin et al., 2009) the system that we want to control is the execution of the business transactions. The purpose of a control system is to react whenever the disturbance affects the behavior of the system or whenever a new input is established. By other words, when the system is not producing the desired output for the imposed input. Control act in the input at the same time as the disturbance is affecting the system.

Figure 2 depicts classical design patterns for a control system. In the top, (A), it shows a system that is not controlled. The disturbance always affects the output delivered by the system. In this pattern, it is not possible to guarantee the behavior of the system output. In the middle, (B), a feed forward pattern that shows that the system input changes accordingly with the actual disturbance. Therefore, the system dynamics it not included in the control actuation. At the bottom of the Figure 2, (C), a feedback control pattern calculates the system input accordingly with the actual