Reorganizing an Enterprise Thanks to its Information System

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Keywords: Information System Evolution, IS Evolution Steering, Enterprise Reorganization, IS Steering Model.

Abstract: Enterprise Information System (IS) is often reduced to a position to solve problems, most often administrative ones, by means of informatics. This paper considers another point of view of IS utility where it creates new opportunities and greatly expands the means to deal with complex change situations. The case studied in this paper is the enterprise reorganization. This exploratory research reveals the role of IS in such a critical situation. It unearths key IS modeling and architecture principles and discovers knowledge and methods of reasoning required to support IS evolution as an underlying way to the enterprise reorganization. It concludes with the emergence of a new research area: the Computer Aided Information Steering.

1 INTRODUCTION

Enterprise reorganization is a challenging transformation that has to take into account various modifications in human activities, business processes and areas of responsibility. It generally involves a large amount of people at different accountability, decision and operational levels. It has to deal with various risks like inconsistency of activities and responsibilities, non-compliance with the regulatory body and finally a total failure. It can even be considered as terrifying because of a high level of uncertainty that enterprise steering officers have to face (Opprecht et al., 2014) and the risks it implies (Sherer and Alter, 2004). However, today's enterprises are facing more and more frequent transformations (Rouse, 2005), which makes this topic particularly relevant.

There are many studies concerning enterprise reorganization, notably in the economy and management fields, like the one by Chandler (1962) recognized as fundamental. Other works investigate consequences of enterprise reorganization on its Information System (IS) (Huang and Gao, 2005), or in the contrary, Information Technology (IT) influence on organizational environments (Cruz-Cunha, 2010; Rouse, 2005). Many related works have been published in the domains of Business/IT alignment (e.g. Henderson and Venkatraman, 1993; Thevenet and Salinesi, 2007; Ullah and Lai, 2013), Business Process Reengineering (Barrios and Nurcan, 2004) and Enterprise Architecture (Aier et al., 2011; Greefhorst and Proper, 2011). They provide means for describing As-Is and To-Be states of enterprises and of their information systems. Besides, a few publications analyze the application of enterprise models for engineering enterprise transformation (e.g. Aier and Gleichauf, 2010; Aier et al., 2011; Buckl et al., 2009).

Enterprise reorganization is inevitably inter-related with the evolution of its IS. There are many works in the domain of IS evolution, most of them based on the usage of models (e.g. Aboulsamh and Davies, 2011; Pons and Kutsche, 1999; Ralyté et al., 2010), but, at the best of our knowledge, there is no study about the prominent role that IS can play in the enterprise reorganization process. This is the exploration topic of our paper. In particular, we introduce an approach for IS evolution steering as a means for addressing complex and often critical situations of enterprise reorganization. We argue that enterprise IS should be considered as a pivotal value to enterprise reorganization.

2 RESEARCH SITUATION

To present our research situation, we first consider a typical scenario of enterprise reorganization where an initial organization (AS-IS organization) has to be transformed into the targeted one (TO-BE organization). Then, we argue that this scenario

Ralyté, J., Opprecht, W. and Léonard, M.
Reorganizing an Enterprise Thanks to its Information System.
In *Proceedings of the 18th International Conference on Enterprise Information Systems (ICEIS 2016) - Volume 2*, pages 567-574
ISBN: 978-989-758-187-8

undervalues the role of enterprise IS in the reorganization process, and we claim that an approach for IS evolution steering would be a valuable support for this process.

2.1 A Simple Reorganization Scenario

A typical enterprise reorganization scenario can be summarized in six steps:

1. *Initiative,* which consists in identifying a myriad of situations revealing the inadequacies of the AS-IS organization.
2. *Motivation*, having as objectives to gather enough information demonstrating that local improvements are insufficient to efficiently face these situations, and to push to undertake a reorganization process.
3. *Design*, where objectives of the reorganization are specified and the TO-BE organization is designed.
4. *Impact Estimation*, that aims to assess the impact of the TO-BE organization on the enterprise, its pertinence and feasibility.
5. *Decision,* where three possibilities are considered: (1) to abandon the reorganization, (2) to modify reorganization intentions and re-design the TO-BE organization, which means to go back to the design step, or (3) to launch the reorganization process.
6. *Implementation,* which initiates the reorganization process, providing that such decision was taken in the fifth step. It includes the reorganization management and implementation inside the entire enterprise.

Generally the first five steps are under the strategic responsibility of the enterprise, while the sixth one is under the strategic control, which can be more or less effective and efficient. A major difference between the first five steps and the sixth one is very well known in the classical management culture – it represents the difference between the strategic level and the operational level. However, the success of the reorganization process depends on this sixth step. Any major failure happening during this step could create a disastrous situation with important strategic consequences for the enterprise.

2.2 Information System – A Pivotal Value to Enterprise Reorganization

Within the scenario presented above, the IS domain does not take part efficiently in any strategic discussion within the reorganization itself and even within the reorganization processes. Its role is recognized only in the sixth step, where it has to transform the initial information system, called ASIS-IS, into another information system, called TOBE-IS and whose design has to be deduced from the TO-BE organization. Given the importance of information systems for most of the enterprise activities, this scenario seems to be no more relevant to efficiently account for generic situations of reorganization. The following situations constitute evidences to support this claim.

2.2.1 Issues of ASIS-IS Transformation into TOBE-IS

All the IS specialists know that legacy IS transformation is very complex. In the case of reorganization, the TOBE-IS cannot be created from scratch. An important amount of data stored in the ASIS-IS must also belong to the TOBE-IS. The analysis of strategic TOBE-IS objectives (Pons and Kutsche, 1999) and continuous dialog between the enterprise steering actors and the IS steering actors appear to be essential, however not sufficient. Strategic objectives are not precise enough to work at the level of IS – to consider its data structure, processing and integrity rules. Furthermore, such a transformation usually induce a re-design of the IS architecture, and so open another important space of design and strategic decisions named enterprise architecture (Greefhorst and Proper, 2011). Therefore, IS transformation taken globally is a risky operation inside the reorganization process. It can lead to a major strategic failure, e.g. some enterprise actors in the TO-BE organization could have to face inefficient TOBE-IS interfaces and not be able to complete their tasks and responsibilities.

2.2.2 Transition from ASIS-IS to TOBE-IS

Once the strategic decision to move in the TO-BE organization is taken, all its actors must be able to work with the corresponding TOBE-IS. It means that this decision must be taken only with the agreement of the IS steering officers. Furthermore, there is always a period where ASIS-IS and TOBE-IS are both operational but only ASIS-IS is active. The consequence for the IS steering officers is to be able to maintain both systems. Once the decision to activate TOBE-IS is taken, ASIS-IS cannot be deactivated completely because it contains information (data) and data processing operations, which continue to be useful even if they belong to the AS-IS organization. So, the IS steering actors must be able to maintain active certain parts of the ASIS-IS, and a number of people in the enterprise should be able to work in both organizations: the AS-IS organization for former business activities and the TO-BE organization for the new ones. This overlap between ASIS-IS and TOBE-IS is crucial for the enterprise to ensure business continuity despite of the reorganization.

2.2.3 Exhaustive Strategic Information from Enterprise IS

While executing the first two strategic steps of the aforementioned reorganization scenario the enterprise reorganization steering actors have to deal with many uncertainties that can be reduced if the necessary and complete information is available for them. A large part of the necessary information can be found in the enterprise IS, which supports most of the enterprise activities within the AS-IS organization. Even if the informational field covered by the IS is not complete for taking decisions of reorganization, inside this field, the information is exhaustive and accurate. Notably, it includes: all the information about data, business processes and persons working with the IS; for each person, her informational space and processes she contributes; and the structure of the IS (its conceptual model).

The 3rd and 4th steps of the reorganization scenario can also be supported by the IS domain if the strategic discussions take into account IS potentialities. These steps are the good time to design the TOBE-IS, which must correspond to the intended TO-BE organization. Then, by comparing ASIS-IS and TOBE-IS it is possible to identify precisely the impact of the reorganization on the actors and their activities and responsibilities.

The IS domain can also support the 5th reorganization step. Once the direction of the reorganization is determined, actors responsible for its steering will have to pilot the reorganization management process. Based on the inputs given by the IS domain, this process can be decomposed into partial reorganizations. In this way, the enterprise reorganization steering actors would take decisions concerning only partial reorganization, which is much more manageable. Our suggestion for this step is to adopt an exploratory approach, which interweaves enterprise reorganization decisions with the IS evolution steering.

3 IS EVOLUTION STEERING

In order to understand the role of the IS domain inside the enterprise reorganization domain and to capitalize on, we need an *informational bedrock* containing all accurate and complete information on how enterprise IS supports its activities. Inspired by (Le Dinh, 2006), we build such a bedrock as an information system called ISIS – Informational Steering Information System. Enterprise IS and ISIS are not at the same level. IS is at the operational level, where actors (IS users) can query/create/ delete/modify objects of IS classes, and trigger/control/stop operations on these objects according to their access rights. ISIS is at the IS steering level, where actors (IS steering officers) can query/create/delete/modify the design of classes, operations on these classes, integrity rules, processes, and access rights. In the next sections we present the schema of ISIS and how it is used in IS evolution steering.

3.1 IS Steering Model (IS-SM)

The proposed ISIS model, called Information System Steering Model (IS-SM), is restricted to the information, which can be extracted from the enterprise IS in a generic way. Thus, it does not pretend to contain all the information that an enterprise can possess. But for the reorganizational purpose, it contains organizational information, such as organizational units, which may be decomposed into smaller ones in a vertical way or in a transversal way, positions in organizational units, persons' assignments to one or several positions, their responsibility over different information elements, etc. The (simplified) model of IS-SM is given in figure 1. It is composed of three main parts: activity, information, and regulatory.

The *activity part* considers, on the one hand, all relations between actors and the information system of the enterprise, and, on the other hand, actors' positions inside the organization. Its main element is *activity*, which can be composed of other activities, and participates in one or several *business processes*. *Persons* can perform an activity only if they are assigned to *positions*, which are in charge of it. Another important concept of IS-SM is *business rule* that controls the execution of activities and business processes and is dependent on the enterprise business model.

The IS-SM *information part* reflects the traditional IS concepts such as *class*, *operation*, *integrity rule*, and their interrelations.

The IS-SM *regulatory part* describes knowledge about laws, policies and regulations that are independent of the enterprise organization but

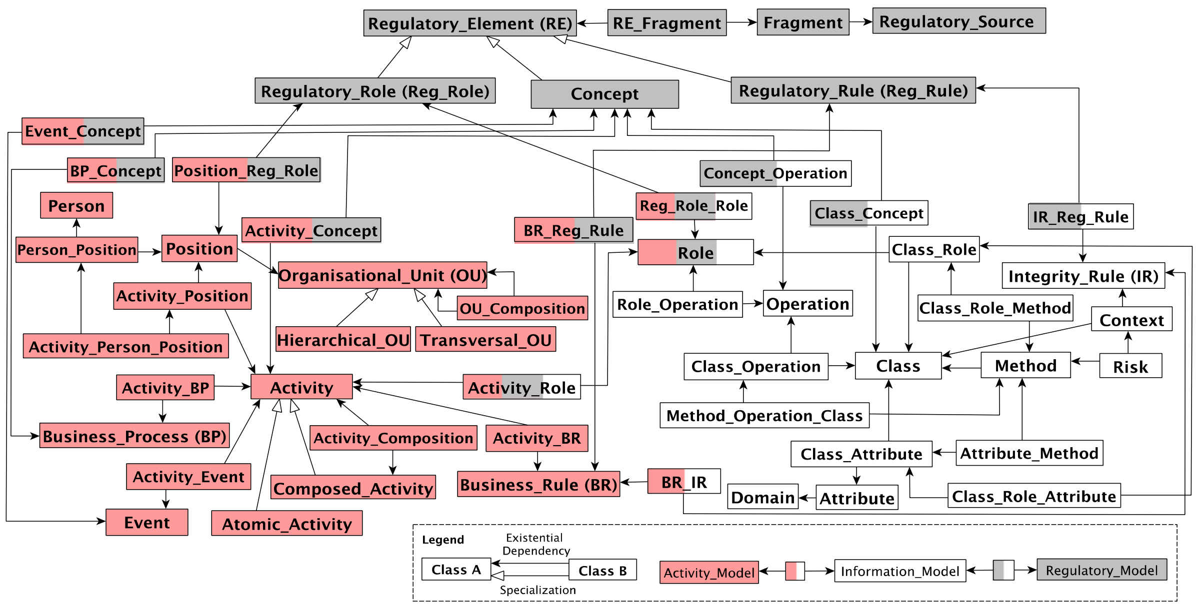

Figure 1: Simplified Information System Steering Model (IS-SM).

necessary to design its information system. This knowledge is described in terms of *regulatory elements* that can be a *regulatory concept, regulatory role* or *regulatory rule*. The elements of the two other parts of the model can be dependent on these regulatory elements. For instance, internal regulation policies, laws and international regulatory instruments impose the organization to have some positions, activities and business rules, and to store and process particular data, i.e. to contain appropriate classes, operations and integrity rules implemented in its IS. Generally, this regulatory part is not made explicit in the traditional IS. However, it is very important for the IS steering officers to trace every regulatory element inside the IS. In case of its change (e.g. a change of a law), a compliant IS evolution must be triggered, and so this trace is necessary for steering the evolution process with efficiency and assurance.

The main interrelations between the activity part and the information part are formed on the *role* concept. A role is associated, on one side, to one or several activities, and, on the other side, to one or more classes/operations. So, the activities related to a role have the right accesses to the classes and operations associated to this role, and, consequently, the persons, who may perform these activities, also. Other interrelations concern business rules (from the activity part) and integrity rules (from the information part). Association is established between a business rule and an integrity rule if the later was created from the former.

The interrelations between the activity and information parts on one hand and the regulatory part on the other hand are formed on the following elements: event, business process, position, business rule, role, class, operation, and integrity rule. An interrelation is made between those elements and the elements of the regulatory part, if they are created from the last ones.

The last difficulty to surmount is to consider that in general an enterprise has several information systems, more or less independent of each other. So, IS-SM must include the concept of IS, and all the elements of its informational part must be associated with the IS where they are present. Furthermore, a lot of services can be built upon an IS, and IS-SM must take them into account. Indeed, *IS* and *service* concepts are defined in IS-SM but are not shown in Figure 1 for readability purposes.

To conclude, we argue that such informational bedrock is feasible, because the system supporting enterprise IS contains all the required information.

3.2 Measuring IS Evolution Impacts

At each increment of ASIS-IS evolution towards TOBE-IS, the IS evolution steering officer has to take important decisions that could have more or less important impact on the TOBE-IS and therefore on the TO-BE organization. The uncertainty level, that she has to face, can be reduced by providing appropriate information to observe IS changes, to understand their impacts, and to identify potential risks. This information can be obtained from the IS-SM but has to be reduced to the only information space involved in the evolution at hand. For this purpose, we assume that responsibility is a key concept for the impact analysis of an evolution. Inspired by (Feltus et al., 2011; Khadraoui and Feltus, 2012), we define responsibility as a set of ISIS instances from IS-SM representing accountabilities and capabilities of an actor to perform a task – her impact on the information (Ispace) and the regulatory (Rspace) elements.

3.2.1 Information Space (Ispace)

The information space of an IS-SM activity part element *x (i.e.* role, person, position, and activity), retrieved from IS-SM and denoted *Ispace(x),* represents the space of information accountability and capability of *x*. It is formally defined as a powerset *Ispace(x)=<Cl(x), Op(x), IR(x)>* where the set of classes *Cl(x)*, the set of operations *Op(x)* and the set of integrity rules *IR(x)* are accessible from *x* in IS-SM (i.e. can be obtained by join, selection and projection operations). The part of IS-SM that allows to retrieve *Ispace(x)* is shown in figure 2.

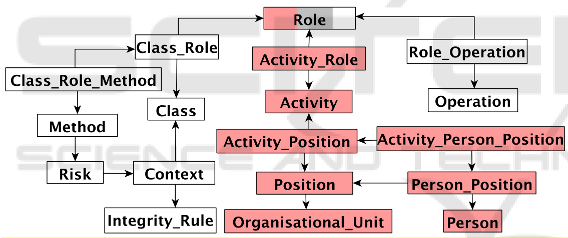

Figure 2: The part of IS-SM allowing to retrieve the Ispace of a role / activity / position / person.

For example, the Ispace of a role *r* is defined as *Ispace(r)=<Cl(r), Op(r), IR(r)>*. Here, *Cl(r)* represents the set of classes that *r* can access (with the primitive methods: *read*, *create*, *update*, *enable*, *disable*), and, therefore, for which *r* carries accountability (probably shared with other roles) and holds capability to execute methods on these classes. *Op(r)* represents the set of operations that can be executed by the role *r*, and for which *r* carries accountability and holds the necessary capability. Finally, *IR(r)* contains integrity rules accessible to *r* via the methods of the classes in *Cl(r)* of its *Ispace*. Therefore, *r* carries accountability to validate these rules when this validation is not completely automatized and holds capability for that.

The *Ispace* of a person *p*, *Ispace(p)*, represents the information elements (classes, operations and integrity rules) that *p* needs to access in order to perform the activities related to her position(s). In the course of evolution, when a person leaves the organization, her information knowledge should be identified and transferred. On the opposite, when a person enters the organization, she should be trained to use this information. It is defined by the union of the *Ispace* of each of its roles in the organization.

3.2.2 Regulatory Space (Rspace)

The regulatory space of an IS-SM activity part element *x* (i.e. role, person, position, and activity*)*, denoted *Rspace(x),* represents the space of regulatory accountability and capability of *x*, composed of concepts, regulatory rules and regulatory roles of the regulatory part of IS-SM (see Figure 1), which are accessible from *x*. For example, if the Rspace of a person *p, Rspace(p),* includes a regulatory role *rr*, then *p* has compliance responsibility with *rr*, and possesses the capability to play this role, i.e. the required knowledge and proficiencies.

3.2.3 Roles of Ispace and Rspace

The Ispace and Rspace defined systematically on the ISIS-IS and the TOBE-IS allow to measure the delta of the IS evolution from information and regulatory points of view respectively. They allow determining how the work environment will change for each actor of the organization. For example, some persons could be granted with new responsibilities (i.e. creating, deleting, modifying objects) over an existing or newly created information space, for which they did not have access before. This situation arises questions such as: "are these persons ready to assume these new responsibilities?" or "do they have appropriate capabilities?" Creation of a new information space could also require creation of new roles, positions and activities. All these changes at IS level must be decided at the enterprise steering level. However, the information necessary to support the decision taking is accessible at the IS level.

3.3 Principles of IS Evolution

The subject of IS evolution is to transform a schema IS_1 into another schema IS_2, and to transform IS_1 objects into IS_2 objects. We propose to approach it from the point of view of ISIS, whose schema is represented by IS-SM. For the sake of clarity, at the ISIS level we call a class, *element*, and its objects, *instances*, while, at the IS level, we keep the standard terminology of *class* and *object*.

3.3.1 IS Evolution Primitives

Since IS-SM, the ISIS schema, is built only by means of existentially dependencies, the starting point of the evolution domain is very simple. It is a list of atomic primitives: *create*, *enable*, *disable*, *abort* and *delete* an instance of any IS-SM element. Because of this simplicity, we consider that the schema of the IS steered by ISIS is also built by using only existential dependencies. Notice that an instance/object is existentially dependent on its element/class.

These primitives induce to the following states of an instance (and also object): *created*, *enabled*, *disabled*, and *deleted*. depicts the generic life cycle of an instance/object.

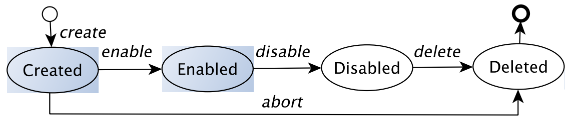

Figure 3: The lifecycle of an instance of any element from IS-SM.

A *created* instance/object exists but is not yet useful. For instance, a created integrity rule cannot yet be validated because some of its validation processes are not yet designed or implemented. A created instance/object can be aborted and so becomes *deleted*, or be *enabled* and so becomes useful, e.g. an enabled instance of an *Operation* can now be executed. A *disabled* instance/object is accessible only by other disabled instances/objects, except for query, where all instances/objects can access it. For example, a disabled instance of the element *Class*, which is a class at the IS level, means that it is always possible to query its objects, and it is possible to create and delete its objects only through disabled operations. A *deleted* instance disappears definitively. If a created/enabled instance/object is dependent on another instance/object, then this one is created/enabled. All the instances/objects, which are existentially dependent on a disabled/deleted instance/object are disabled/deleted.

3.3.2 Evolution Effects

An evolution primitive cannot be isolated only to its main concern, element or instance. It has effects on other parts in ISIS and IS, horizontally and vertically. *Horizontal effects* can be specified through patterns formally describing all the interrelations between elements or instances themselves. For example, if an instance *cl* of the element *Class* in ISIS is disabled, then all the instances *op* of the element *Operation* associated to *cl* must be disabled, because they cannot be performed in the corresponding IS without processing *cl* objects. *Vertical effects* are deduced from conformity rules between instances and objects. For example, if *cl* is disabled in ISIS, then all its objects must be disabled in any IS where *cl* is a class. Every primitive becomes robust if it implements all its horizontal and vertical effects. Indeed it depends on two main properties: (1) the whole IS schema (including static, dynamic and integrity rule perspectives) must be easily evolvable, (2) the IT system supporting the IS (e.g. a database management system) must provide an efficient set of evolution primitives (Andany et al., 1991).

3.3.3 Composite Evolution Primitives

The above-mentioned atomic primitives are actually *too primitive* and the evolution steering managers need to have more sophisticate operations to be efficient. They are built by composing atomic primitives; so they are called composite primitives. For example, a composite primitive *cp1* allowing to replace an activity of a person by a new one would include three atomic primitives: *p1* disables the affectation of the old activity to the person, *p2* affects a new activity to the person, and *p3* activates this affectation. Like atomic primitives, composite primitives induce horizontal and vertical effects caused by the atomic primitives they include. They are robust if they take into account all these effects. Below in this paper, all primitives are considered as robust.

3.3.4 Managerial Effects

The managerial effects consider the efficiency of IS at the human level. Most of them can be detected automatically, but the evolution managers have to decide if the proposed evolution has a harmful effect or not on the enterprise activities. If yes, they must decide to give up the evolution or to continue it nevertheless. If no, they are reassured in the validity of the evolution. Managerial patterns will bring out these managerial effects. Primitives, which take into account these managerial effects, are called smart primitives. Below, all primitives are smart.

For example, the change of a person's activity *a1* into *a2* has a managerial effect – the evolution managers must be sure that this person was not the last person to be in charge of *a1* and also if the workload of the remaining persons in charge of *a1* will not become too heavy. Another example would be the situation of a class without any role associated to it because its utility is no more obvious.

4 FROM IS EVOLUTION TO REORGANIZATION

The enterprise reorganization process is larger than an IS evolution because it implies changes at organizational level for several organizational units. For example, it can include the creation of new positions, new assignments of actors to positions and to activities, introduction of new business rules, etc. We explore now how to consider enterprise reorganization from the IS point of view. Even if it is not sufficient to encompass all the reorganization problems, it can offer not only accurate information but also a method to conduct this complex and delicate process. Pursuing this aim, we propose, in the *preparation* step, to decompose reorganization into several evolutions and to analyze the interactions between the management of reorganization and the management of these evolutions. It is sure that impacts and managerial effects have an important role to play in this decomposition process. Then, the *supervision* step plans processing of these evolutions. Some of them can be launched in parallel, while other in sequence. But this plan must be scalable depending on the results of evolutions in progress or finished. It is important that these results are communicated to the *supervision* as soon as possible to adjust the plan of evolution processing. Next, the *coordination* step decides the moment to launch evolutions, depending on the results achieved, or to abandon an evolution partially or totally. The supervision and coordination steps are continuously in alert because they must always choose the good path, especially taking into account information coming from evolution processing. Figure 4 depicts the lifecycles of processing enterprise reorganization and IS evolution with their coordination.

Inside the reorganization process, there is a critical situation, which can be hidden by the efforts to develop the TO-BE organization and its TOBE-IS, the legacy business processes. These processes are legitimate in the AS-IS organization, but due to the reorganization they become legacy, for instance, due to the introduction of new business or regulatory rules. In particular, their operations become outdated in the TO-BE organization and their instances in the ISIS become disabled. However, at the moment when they are disabled, some of them are still underway. Moreover, there are several situations, especially in public administration and contract management, where it is impossible to stop them. They must continue to deal with their current issues inside the AS-IS frame of rules. Our proposal contains intrinsically a response to surmount this situation of legacy processes, by means of disabling instances in ISIS and objects in TOBE-IS. In this way, these processes, their operations and the rules to validate become disabled ISIS instances. So, they do not belong to the TOBE-IS and consequently to

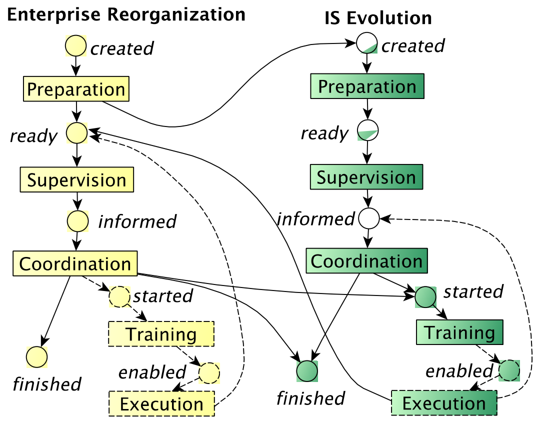

Figure 4: Coordination of the reorganization lifecycle with the IS evolution lifecycle.

the TO-BE organization. But, even after the reorganization, they can perform their current issues in the AS-IS organization until their end. It remains to manage actors who must be able to work again in the frame of AS-IS, while working every day in the frame of TO-BE.

The reorganization scenario presented in section 2 raises up crucial questions for the reorganization process. This intelligence must be kept in our approach centered on ISIS. Indeed, this scenario faces critical situations that are not dissolved due to ISIS, because enterprise reorganization is not only a question of IS. The deep change is in the method to manage the reorganization process at the enterprise level. The TO-BE organization must have its TOBE-IS as soon as it exists. The reorganization domain shows the necessity for an enterprise to have an accurate ISIS. It must be implemented in a complete environment, which we call Computer Aided Information Steering Environment (CAISE), to deal with strategic developments. Due to information, with its central place in any enterprise, due to IS, there in no more reason to separate business strategic and IS activities. They must be interwoven. In the case of enterprise reorganization, we observe that the sequential way of the typical scenario is not adequate with the use of ISIS.

5 CONCLUSIONS

In this exploratory paper, we argue that the IS domain, and in particular IS evolution steering, has to play an important role in any enterprise reorganization and at each step of the reorganization process. Indeed, reorganizing an enterprise inevitably implies more or less important changes in its IS, which have to be implemented to make this reorganization possible. Identifying and simulating these changes at IS level allows to understand how the organization itself will change and to assess its feasibility and risks. But, to take this responsibility, the IS domain must provide clear, complete, and rigorous information models that can evolve in a consistent way. For this purpose, we propose an IS evolution steering approach based on the construction of ISIS (i.e. informational steering IS) founded on IS-SM (i.e. IS steering model). For IS steering, IS-SM allows to specify a complete information model of ASIS-IS and to design the TOBE-IS. For the reorganization steering, it allows to have continuously a complete and accurate situation of the enterprise at the informational level. We complete our approach with the notion Ispace/Rspace that helps to measure the impact of IS evolution on the enterprise organization from informational and regulatory points of view, and facilitates the decision making at enterprise steering level knowing that most of the reorganization/evolution decisions cannot be reversed.

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