Conceptual Dependencies between two connected IT domains: Business/IS alignment and IT governance

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Abstract— **Mastering the complexity of IS engineering processes which are more and more constrained with the rapid market change became an essential requirement. IS engineers are challenged to develop systems that can meet the requirements of modern organisations in a continuously evolving environment. As far as IS engineering is concerned, IT governance has also the responsibility to master the change process and the evolution of the IS. We argue that Business/IS alignment and decision making mechanisms serve each other: strategic alignment is well performed when leaders make adequate decisions in time and strategic alignment facilitates the decision making process related to the information system (IS) and business processes (BP). We argue that it is essential to understand the dependencies and implications between ITG and alignment in order to improve both as a whole and to enhance the sustainability of ISs we engineer. This work provides a first stage in the understanding of Business/IS alignment and IT governance requirements and of their dependencies. It also offers a comparison framework for IS development approaches with respect to their ability to support Business/IS alignment and IT governance requirements.**

Index Terms— **Business/IS Alignment, Enterprise Architecture, IS engineering, IT governance.**

I. Introduction

Companies need to evolve in adequacy with their environment and to adapt quickly their way of providing services and products when change occurs. Each company has also to face challenges for engineering its information system which operates as networks of communicating and co-operating software components that deliver IT services to the actors, customers and partners of the company. On one hand, an information system shall be aligned with enterprise objectives. In this way, strategic alignment has to be performed to design adequate business processes and information systems. On the other hand, managers have to make strategic and tactical decisions in order to handle their information system services.

Even if the necessity of the alignment is widely recognised [1], [2], the operationalisation of this alignment remains too often limited. Moreover, few leaders consider that the IS and the processes of their organisation are aligned [3]. Luftman and Maclean [4] identifies two main causes: (i) the actors of the organisation do not know what the alignment is and (ii) there is an absence of communication and understanding between the world of the business and that of information technologies (IT).

Information systems (IS) have the responsibility of information processing and service providing for business activities (and actors). Because business activities are performed in an evolving environment, it becomes crucial to measure the effectiveness and the efficiency of the IS as a support of the enterprise activities and strategies. The purpose of the information technology governance (ITG) is to achieve IT related goals resulting from corporate governance[1] and to facilitate the anticipation of the required evolutions of the IS. ITG is a set of organised activities to control (i) if the decisions related to the IT management are linked to the strategic goals of the enterprise and (ii) if the decisions related to IT are properly applied leading thus to appropriate services, software architectures, IT infrastructures and business/IS alignment. Effects of the decisions should be measured in order to evaluate their applicativeness and appropriativeness in the implementation of the change.

The literature does not explicitly develop the link between business/IS alignment and IT governance although some attempts to highlight this relationship are worth being reminded. [5] suggests determining the value of "Business Process - IT Process" Alignment. IT governance is defined in [6] as the structures and processes that ensure that IT supports the organisation's mission. The purpose is to align IT with the enterprise, maximise the benefits of IT, use IT resources responsibly and manage IT risks. In [7] the necessity for enterprises to manage and pilot their information systems by anticipation of their strategic objectives has been identified. In [8], a research orientation which concerns the measurement of the implication of IT governance on strategic alignment was proposed.

The *enterprise knowledge* modelling activities and research [9], [10], [11] we developed during the last decade recognise that it is advantageous to examine an organisation from multiple and inter-connected perspectives: Enterprise Goals, Enterprise Processes and Enterprise Information System(s). The first two layers focus on intentional and organisational aspects of the enterprise, i.e. the organisational objectives and how these are achieved through the co-operation of enterprise actors manipulating such enterprise objects. The third layer allows to define the requirements for the IS supporting the

enterprise. One of those perspectives can not change without impacting one or the two others. The three layers modelling framework and the associated way of working (development process model) allow us to understand, to analyse and finally to model the enterprise according to its multiple perspectives, i.e. its strategy, its structure, and its IT strategy and support systems, in a global, interrelated and guided manner.

We argue that it is essential to understand the dependencies and implications between IT governance and strategic alignment in order to improve both as a whole and to enhance the sustainability of information systems we engineer. In this paper, we propose to develop a comprehensive framework by identifying relationships between Business/IS alignment and IT governance mechanisms. We propose to study the relationships between them, based on two comprehensive frameworks on Business/IS alignment [13] and IT governance [14]. Our aim is to identify the coherence and the cohesion between these two frameworks.

Our objective is to provide a framework to benchmark IS engineering approaches dealing with alignment and IT governance purposes. This work provides a stage in the understanding and characterisation of Business/IS alignment and IT governance requirements. The comprehension of these contributions anticipates our on going research whose objective is to work out methodological guidelines allowing us to build IS easier to maintain (the functional fit with business requirements) and to govern during change and evolution. Section 2 presents the context and motivations of the work. Section 3 presents the two frameworks. Section 4 presents the research methodology and the concepts used to identify relationships between the two frameworks, provides a first analysis and exposes our results.

II. How mastering the complexity of IS engineering constrained with rapid market change

A. Change

Companies change to better satisfy customer requirements, address increasingly tough competition, improve internal processes, modify the range of products and services they offer [15]. At the same time, organisations also experience the effects of the IT integration and evolution. While ISs continue to serve traditional business needs such as co-ordination of production and enhancements of services offered, a new and important role has emerged, namely the potential for such systems to adopt a strategic support role. IT was thus positioned as a strategic resource that enables automation, monitoring, analysis and coordination to support the transformation of business processes [16]. The paradigms of Business Process Reengineering and Business Process Improvement contrast with traditional IS development that focused on automating and supporting existing business processes [17]. Now, enterprises should create new ways of working to survive in a competitive environment. As stated in [18], organisational transformation depends of the creation of a powerful vision of what future should be like.

IS engineers were thus challenged to develop systems that can meet the requirements of modern organisations in a continuously evolving environment. The need for change is typically stated in a simple manner as a change vision. A classical example is John F. Kennedy´s statement: '*to send a man to the moon before the end of the decade*'. Thus, the change process is the process of transforming the vision into a new model. Within the world in which the vision has to be realised, many habits (legacies) exist. Some are based on formally stated goals, policies, or competing visions. Others are just regularly observable phenomena for which no predefined structure or reasons are known a priori. The task is therefore twofold. First, relevant habits must be analysed and the goals, policies and visions behind them must be made explicit. This leads to the 'As-Is' model that defines the functionality and history of the existing organisation. Second, the new vision must be established in this context leading to the 'To-Be' model that defines the requirements for the envisioned organisation. The quality of the As-Is and To-Be models depends on the knowledge elicited from the stakeholders and their involvement in the change process. Mastering the change in an organisation requires four major steps: reverse analysis, change definition, legacy integration and change implementation [19], [20].

B. Alignment

The Strategic Alignment Model (SAM) developed by Henderson and Venkatraman (1989) makes a distinction between the external perspective of IT (IT strategy) and its internal focus (IT infrastructure and processes), recognising thus the potential of IT to both support and shape business policy. The model is based on two types of alignment: *strategic fit* and *functional integration*.

Strategic fit recognises that the IT strategy should be articulated in terms of an external domain, i.e. the way the firm is positioned in the IT marketplace, and an internal domain, i.e. the way the IT infrastructure should be configured and managed. In fact, the IT Portfolio of an organisation not only has the potential to support existing business strategies, but also to shape new strategies [21]. Thus, IT becomes not only a success factor for prosperity, but also an opportunity to achieve competitive advantage. IT also offers a means for increasing productivity. Leveraging IT successfully to create products and services with added value has become a universal business competency [22]. By the way, the IT department moves from a commodity service provider to a strategic partner [23]. *IT strategy* involves three decisions: technology scope, systemic competencies and IT governance. IT governance is under the responsibility of the Board of Directors and executive management. It is an integral part of enterprise governance and consists of the leadership and organisational structures and processes that ensure that the organisation's IT sustains and extends the organisation's

[1] The purpose of the corporate governance is to ensure that enterprise strategy is properly implemented.

strategy and objectives [24]. The *internal IT domain* should also address three fields: IT architecture, IT processes and IT skills. Strategic fit is equally relevant for the business domain; the involved fields are similar but focussed to business. Business strategy, i.e. the external domain, involves business scope, distinctive competencies and business governance while organisational infrastructure and processes -the internal domain- articulates administrative infrastructure, business processes and business skills. *The change cannot occur in a field without influencing the others.*

Functional integration represents the alignment between business and technology domains. *Strategic integration* is the link between business strategy and IT strategy reflecting the external components. *Operational integration*, covers the internal domain and deals with the link between organisational infrastructure and processes, and IT infrastructure and process. This emphasises the importance of internal coherence between the requirements and expectations of the business and the capability of IT to deliver against it.

C. IT governance

[25] proposed the following definition for business-IT alignment: "the continuous process, involving management and design sub-processes, of consciously and coherently interrelating all components of the business – IT relationship in order to contribute to the organisation's performance over time.[…] At the strategy level, "strategic" alignment basically concerns decisions concerning perspectives like missions, scope (boundaries and granularity), governance and core capabilities". The link between IT-business alignment as a process deals with the IT governance as a strategic activity. In this way, IT governance is defined in [26] as "the organisational capacity exercised by the Board, Executive Management and IT management to control the formulation and implementation of IT strategy and in this way ensure the fusion of business and IT".

From manager's point of view, the governance is about *decision making support*. Decision-making is an intellectual activity which consists of identifying a problem in a particular context, often in a changing situation, and to find a solution if possible by selecting among several choices. For instance, the synthesis of governance practices in companies provided in [27] leads to a typology of decisions that IT managers make. The purpose of the decisions is often to improve the added value of the business. An IS well aligned with business activities can improve the performance of the company and generate more added value. For this purpose, we rather want to talk about an *agile alignment* which seems to us to be a prerequisite for the sustainability of information systems. Today another challenge is to develop an IT governance structure in coherence with the standards and laws.

An essential aspect of IT Governance is the alignment of IT with the business, often referred to as strategic alignment (see § II.C). As introduced below, various perspectives of the strategic alignment have been identified in [28] between external and internal domains on one hand, and between business and IT domains on the other hand. Thus, both for business and IT purposes, IT governance and business governance have been identified as parts of the external domain involved in the strategic alignment process. Henderson and Venkatraman [21] incorporate cross-domain perspectives, arguing that neither strategic nor functional integration alone is sufficient to align an organisation effectively. Cross-domain perspectives work on the premise that strategic alignment at an organisational level can only occur when three of the four corporate domains are in alignment. The underlying premise is that change cannot happen in one domain without impacting on at least two of the remaining three domains in some way. This leads to the four alignment perspectives defined according to the anchor domain (often initiator of change), the pivot domain, and the impacted domain: *strategy execution, technology transformation, competitive potential* and *service level*. The direction of the perspective runs from the anchor domain to the impacted domain, via the pivot domain.

We argue that the choice of the appropriate alignment perspective is the affair of the IT governance. Moreover, as far as IS development is concerned, IT governance has also the responsibility to master the change process and the underlying evolution of the information system as illustrated in Figure 1.

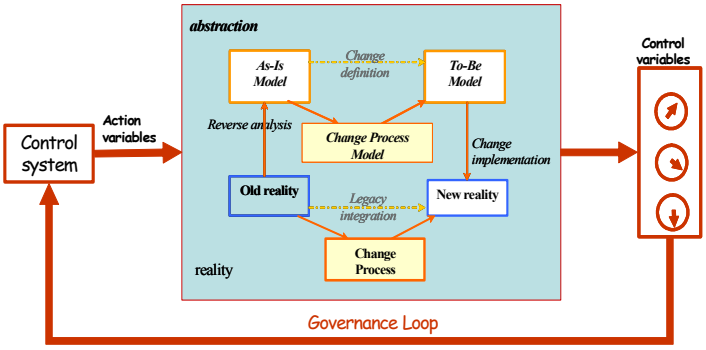

Fig. 1. Change and Governance Framework

D. Power of modeling

In the context of Business/IS alignment and IT governance, *enterprise knowledge modelling* can help understanding the current business situation [29] and establishing a vision of what the future should be like. Modelling of enterprise knowledge is a pre-requisite for system requirements elicitation and system development. A great amount of work was performed on enterprise knowledge modelling and enterprise architecture [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42]. All provide a collection of conceptual modelling techniques for describing different facets of the *organisational domain* including operational (information systems), organisational (business processes, actors, roles, flow of information etc), and teleological (purposes) considerations. Existing enterprise knowledge modelling frameworks stress the need to represent and structure enterprise knowledge. However, still few approaches investigate the dynamic aspect of knowledge modelling. The enterprise modelling process in an evolving environment is a decision making process i.e. a non-deterministic process. Accordingly, process guidance should allow selecting dynamically the next activity to be performed depending on the situation at hand [43], [44], [45], [46].

Moreover, as argued in [47], models facilitate understanding and communicating about the business and its support systems only if the objective of the model is well understood. For instance, if the objective is to understand the business well enough to specify supporting systems, it is not useful to model the entire business in detail. Contrary, if the aim is business innovation, it is necessary to provide more effort to define and/or redefine the entire business and to find improved ways of conducting it [9], [10]. These models are useful because they allow (i) to improve the knowledge (understanding) about the enterprise, (ii) to reason on alternative solutions and diverging points of view, and (iii) to reach an agreement. They proved their efficiency as well as for improving communication than making easier the organisational learning.

III. Presentation of the Two Domains and an Attempt of Conceptual Modeling

For a comprehensive study of the alignment and IT governance requirements, we developed two frameworks based on four perspectives -called also worlds- related to information systems. Each world is characterised using facets which are composed of attributes. The 4-World framework has been used for understanding several engineering disciplines: information systems engineering [48], process engineering [49], change engineering [21], etc.

The four worlds are interlinked: (*i*) the subject world generates some objectives for the usage world, (*ii*) the system world is a way to represent the reality or the subject world, (*iii*) the system world is built by the engineering processes described in the development world, (*iv*) the development world is a way to attain objectives for the usage world, finally (*v*) the system world is used to support the stakeholders objectives specified in the usage world, (vi) our hypothesis is that the system world may also support the requirements of the development world in an evolving context.

Nevertheless, we point out that only the four perspectives (worlds) and the structure of those frameworks are generic. Facets and attributes are specific to the universe of discourse. Thus, the two "4-World" frameworks were developed using the same meta-model (see figure 2).

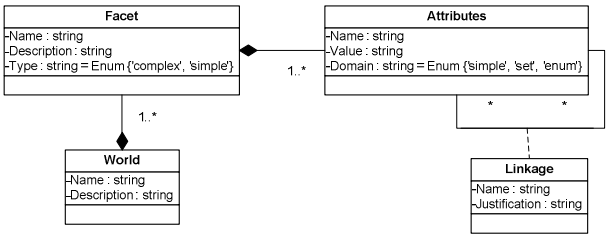

Fig. 2. Meta-model used in [14]

A facet is representative of particular characteristics of the domain of interest related to information systems. A simple facet holds a unique attribute and a complex facet holds a set of attributes. An attribute is defined on a domain of value. A domain can be a predefined one (integer, real, boolean...), an enumerated one (ENUM {a, b, c}), or a set (SET (a; b; c)). In the following, we only present the attributes organised in worlds. We represent ATTRIBUTES using capital letters and *values* in italics. The four worlds are structurally interlinked. Attributes can be interrelated in a world or between worlds. We identified three types of *dependency* relationships between attributes. (i) *existence* ('E'): the validity of a given attribute - with a known value or not-, implies the validity of target attributes. It is expressed as a function EXIST(Attr_src, Attr_tg). Attr_src and Attr_tg respectively represent source and target attributes. (ii) *support*: a source attribute, when defined, promotes the satisfaction of the target attribute. It is expressed as a function SUPPORT(Attr_src, Attr_tg). (iii) *implication* ('=>') : the value of a source attribute defines values for target attributes.

A. IS/Business Alignment framework

This framework aims to structure the understanding on Business/IS alignment requirements in an evolving environment and to analyse abilities of IS engineering methods and frameworks to deal with the alignment. The *subject world* concerns the Business/IS alignment. The objectives assigned to the alignment and the goals of the stakeholders which have the responsibility to deal with the alignment, are the purpose of the *usage world*. The *system world* is related to the representation of the IS supporting the BPs and the organisation strategy as well as the representation of the alignment between them. The *development world* handles IS engineering processes and integrates the requirements related to the alignment for creating and maintaining the fit between business and IS. The interrelated worlds and their attributes are summarised in Table 1.

TABLE 1
ATTRIBUTES RELATED TO THE IS/BUSINESS ALIGNMENT FRAMEWORK

ATTRIBUTE	*Value*
Subject World	
1 NATURE OF ALIGNMENT	SET (Enum { *business/IS, business strategy/ business, business strategy/IT strategy, IT strategy/IS*})
2 NATURE OF CHANGE	Set (Enum *{business, IT})*
3 ORIGIN OF CHANGE	Enum {*internal*, *external*}
4 TYPE OF CHANGE	Enum {*ad hoc*, *evolutionary*, *corrective*}
5 NATURE OF THE IMPACT OF THE CHANGE	Set (Enum *{strategic, operational})*
6 LIFE CYCLE OF THE CHANGE PROCESS	Set (*Enum {definition, implementation, consolidation*})
Usage World	
7 REQUIREMENTS FOR ORGANISATION ADAPTABILITY	Set (Enum {*structure, process, skills*})
8 REQUIREMENTS FOR IS ADAPTABILITY	Enum *{to adapt, to extend, to innovate}*
9 PERSPECTIVE OF ALIGNMENT	Enum {*strategy execution, technology transformation, competitive potential, service level*}
10 COMMUNICATION BETWEEN ACTORS	Set (Enum *{business → IT, business → business, IT→ IT, IT → business })*
11 COMMUNICATION BETWEEN HIERARCHY LEVELS	Set (Enum {*top-down, bottom-up, same level*})
12 COMPREHENSION OF THE USER	$n \in [0 .. 5]$
Development World	
13 NATURE OF THE DEVELOPMENT PROCESS	Enum {*ad hoc, systematic*}
14 MODELLING PARADIGM	Set (Enum {*context, decision, intention, activity, product*})
15 KNOWLEDGE CAPITALISATION	Set (Enum {*Product Knowledge, Process knowledge*})
16 RE-USE OF KNOWLEDGE	Set (Enum {*Product chunk, Process chunk* })
17 CAPTURE OF THE NEED OF CHANGE	Enum {*trigger, other*}
18 SOFTWARE SUPPORT	Enum {*automatic, mixed*}
19 EXISTENCE OF GUIDANCE	*Boolean*
20 GRANULARITY OF GUIDANCE	Enum {*micro, macro*}
System World	
21 COVER	Set (*Enum {activity, product, context, decision, intention, link*})
22 EA LEVEL REPRESENTATION	Set (*Enum {intentional, organisational, IS, technological*})
23 RE-USABLE COMPONENTS	*Boolean*
24 FORM	Enum {*diagram, text, ontology*}
25 NOTATION	Enum {*formal*, *semi-formal*, *informal*}
26 ABSTRACT LEVEL	Set (Enum {*meta-model*, *model*, *instance*})
27 INTENTIONAL ALI MEASURES	Set (Enum{*goal coverage, actor coverage*})
28 FUNCTIONAL ALI MEASURES	Set (Enum{*activity coverage, process coverage*})
29 INFORMATIONAL ALI MEASURES	*Information coverage*
30 TRACEABILITY	$n \in [0 .. 5]$
31 MODULARITY	Set (Enum {*functional, applicative, technical*})
32 IS FLEXIBILITY DEGREE	$n \in [0 .. 5]$
33 SOFTWARE SUPPORT	Enum {*automated, manual, mixed*}
34 TECHNICAL INFRASTRUCTURE	Enum {*interoperable, proprietary*}

Figure 3 provides a global view of the dependencies identified between the attributes of the business/IS alignment framework. We can notice that the change and the severity of the impact it can generate in the organisation force the stakeholders to formulate their requirements related to the IS and/or the organisation in order to absorb the constraints imposed by this change (A). Several intrinsic and structural characteristics of the system should provide it the capability to support those requirements. This is observed by the number of "Exist" relationships between subject and system worlds (A'). These requirements have to be taken into account by the development processes as well as by the system produced by this process (B). The consideration of these requirements is reflected in the support provided by the development world to the usage world to satisfy the requirements for IS adaptability (C). The same characteristics of the development world aim also to support and to improve the modularity and the flexibility of the system (D). Then, the implemented system will be maintained, integrated with others, during its life cycle. Some of its wished characteristics will particularly facilitate further development processes. For instance, knowledge capitalisation during the development processes is facilitated by an architecturally well structured IS. Indeed, the wished characteristics of the system under construction aim to better serve the organisation and to satisfy the stakeholders' requirements (E). The strategic alignment has not only technical (related to the IS) but also social purposes. Some characteristics of the usage world, as the COMMUNICATION BETWEEN ACTORS and BETWEEN HIERARCHY LEVELS and the COMPREHENSION OF THE USER, support the implementation of the change in the organisation as well as the stakeholders' requirements for the IS or organisation adaptability (F).

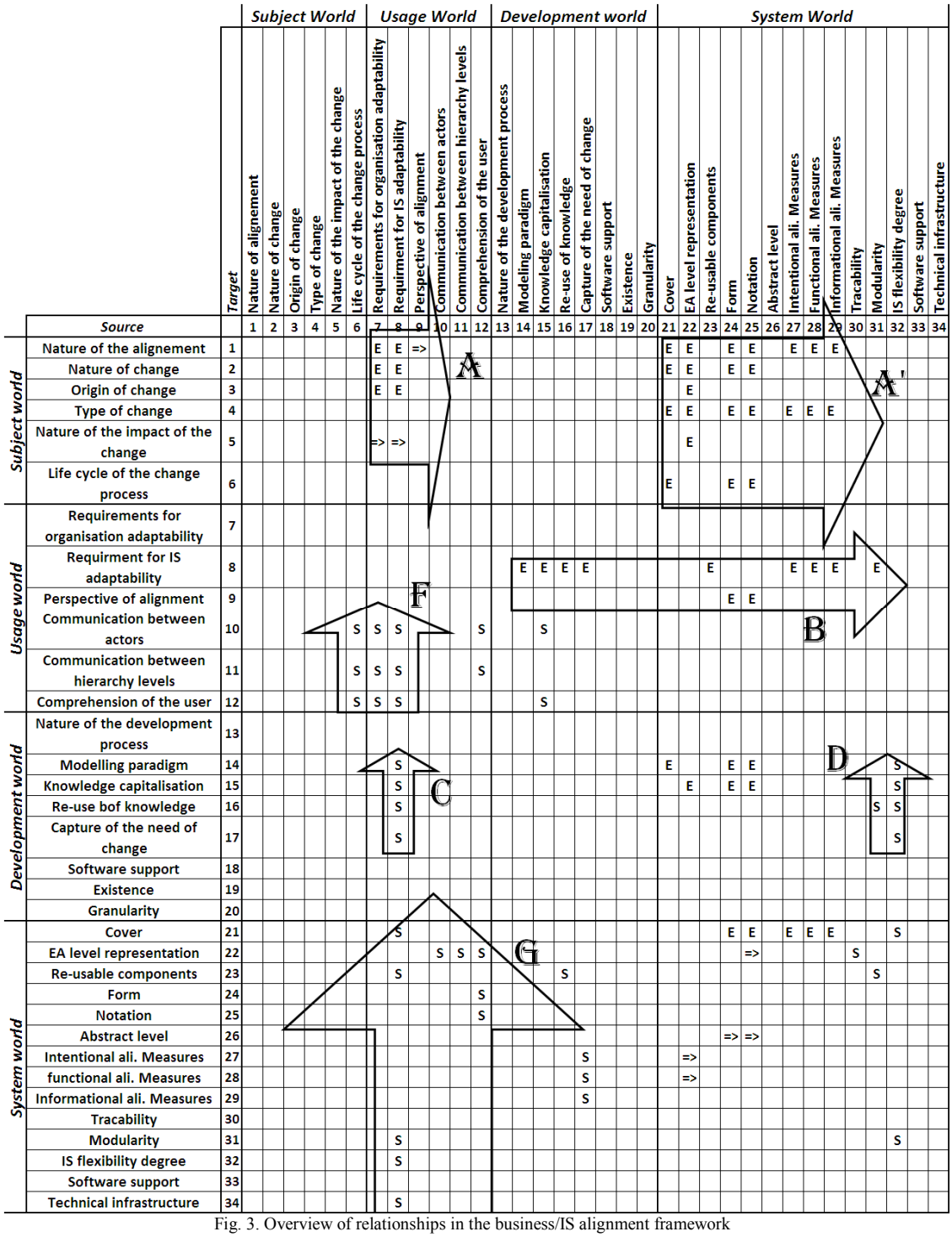

Fig. 3. Overview of relationships in the business/IS alignment framework

B. *IT governance framework*

We developed a conceptual framework for analysing engineering/ management approaches on pertinent aspects linked with the IT governance. This framework aims to highlight the strengths and weaknesses of the IT governance approaches. (a) the *subject world* is related to the definition of IT governance "What is IT-G for us?"; (b) the *usage world* situates the role assigned to the IS in the business context and justifies "Why performing ITG?"; (c) the *development world* suits the characteristics of the IS development processes; (d) the *system world* defines a particular structure of the information system to build in order to integrate alignment and governance requirements and their measures. The four interrelated worlds and their attributes are summarised in Table 2.

TABLE 2
ATTRIBUTES RELATED TO THE IT GOVERNANCE FRAMEWORK

ATTRIBUTE	*Value*
Subject World	
1 ORGANISATION OF THE GOVERNANCE	Enum {*centralised*, *decentralised*, *hybrid*}
2 DECISION	Enum {*IT architecture*, *IT infrastructure*, *requirement*, *finance*, *project scheduling*}
3 COVERAGE	Enum {*internal*, *external*}
4 NATURE OF THE ALIGNMENT	SET (Enum { *business/IS*, *business strategy/ business*, *business strategy/IT strategy*, *IT strategy/IS*})
5 TYPE OF THE CHANGE	Enum {*ad hoc*, *evolutionary*, *corrective*}
6 CHANGE CYCLE	Enum {*radical*,*continuous*}
Usage World	
7 RISK MANAGEMENT	Enum {*accepted*, *transferred*, *refused*}
8 QUALITY	Enum {*usability*, *efficiency*, *efficacy*, *degree of goal completion*}
9 VALUE	Enum {*organisation*, *external actors*}
10 ITG MATURITY LEVEL	$\forall n, (n \in \mathrm{N} \Rightarrow n \geq 0)$
11 ITG MATURITY OBJECTIVE	For each level L_i iϵ[0;n]: Enum $\{O_1, ..., O_m\}$
12 PERSPECTIVE OF ALIGNMENT	Enum {*strategy execution*, *technology transformation*, *competitive potential*, *service level*}
Development World	
13 ARCHITECTURE APPROACH	SET(Enum {*deployment*, *strategic modelling*, *cartography*, *target* IS})
14 QUALITY APPROACH	Enum {*continuous*, *factual*}
15 MATURITY LEVEL	$\forall n, (n \in \mathrm{N} \Rightarrow n \geq 0)$
16 MATURITY OBJECTIVE	For each level L_i iϵ[0;n]: Enum $\{O_1, ..., O_m\}$
17 DVPT PROCESS NATURE	Enum {*ad hoc*, *systematic*}
18 MODELING PARADIGM	SET(Enum{*process*, *decision*, *intention*, *context*})
19 LEARNING CAPACITY	Enum {*socialisation*, *externalisation*, *internalisation*, *combination*}
System World	
20 TOPOGRAPHY	Enum{*centralised*, *distributed*, *hybrid*}
21 ABSTRACT LEVEL	Set (Enum {*meta-model*, *model*, *instance*})
22 CONTENT	Set (Enum {*goal*, *indicator*, *service*, *IT process*})
23 FORM	Enum {*diagram*, *text*, *ontology*}
24 NOTATION	Enum {*formal*, *semi-formal*, *informal*}

Figure 4 provides a global view of the dependencies identified between the attributes of the ITG framework. (A) DECISION is a central concept to IT governance and leads to the creation of an IS which purpose is also to satisfy the requirement of supporting ITG related activities in a context of change. (B) The IS has to provide a support to decision-making and provide dashboard for change tracking. (C) A wished characteristic of the IS is the ability to support ARCHITECTURE and QUALITY APPROACHES, and the improvement of the development process maturity. The IS - through its support to the quality approach (C)- contributes also indirectly to the achievement of the QUALITY in the usage world and (D) contributes directly to the ITG QUALITY by the means of its CONTENT related to the supported business activities. We note also (D) the contribution of the development process to quality objectives.

Moreover, alignment is a founding for performing IT governance activities. The development activities which are related to ITG allow building a system of *indicators* for Business/IS alignment measures. The development processes and the underlying knowledge capitalisation and learning capabilities provide a support for creating and maintaining business/IS alignment.

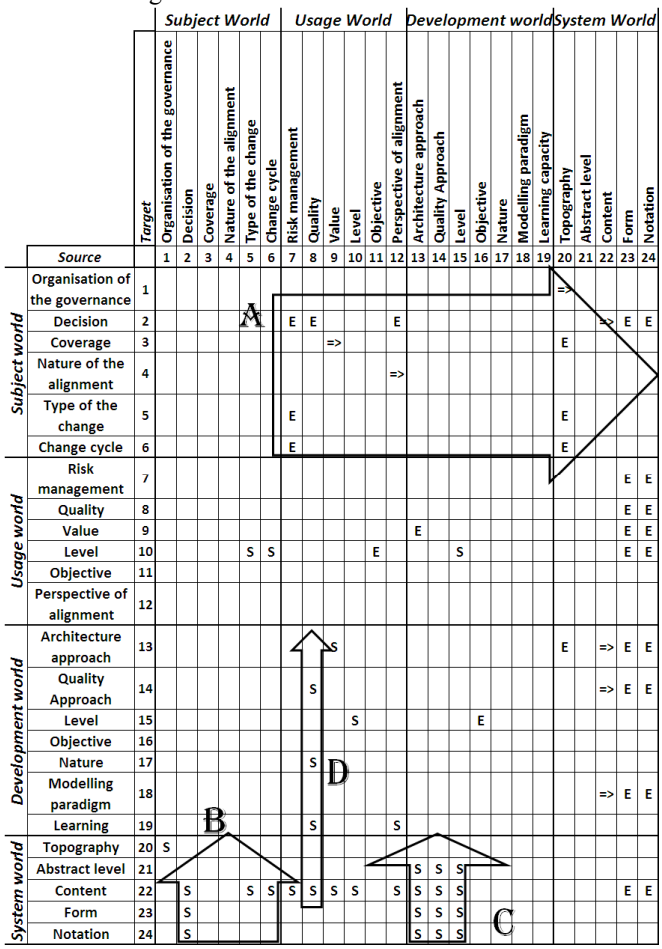

Fig. 4. Overview of relationships in the IT governance framework

IV. FRAMEWORKS RELATIONSHIPS

In this section we present the relationships between attributes of the two frameworks (see section III). To obtain the results presented in this section, we used two main approaches: (i) a top-down approach which consists in identifying the set of relationships and then the related attributes through out a deductive strategy; (ii) a bottom-up approach which consists in identifying the set of attributes first, then the relationships between these attributes.

To the three intra framework dependencies introduced in section III, we add the equivalence ('=' in figure 5, 7, 9, 10) which represents the fact that two attributes describe the same concept in the two frameworks. Each attribute is represented by its affiliation to a framework. We use the formal notation as shown bellow:

Attribute: <**FRAMEWORK_NAME**>.<World_Name>.

<ATTRIBUTE_NAME>

For instance, we represent the attribute PERSPECTIVE OF THE ALIGNEMENT in the usage world (UW) of the **IT GOVERNANCE** (**ITG**) framework by the following expression: "**ITG**.UW.[12 PERSPECTIVE OF ALIGNMENT]". An equivalence relationship can be described as follows:

ALI.UW.[9 PERSPECTIVE OF ALIGNMENT]=**ITG**.UW.[12 PERSPECTIVE OF ALIGNMENT]

Table 3 presents the used abbreviations.

TABLE 3
ABBREVIATION USED

Description	*Abbreviation used*
IT governance framework	ITG
IS alignment framework	ALI
Subject world	SubW
Usage world	UW
Development world	DW
System world	SysW

In order to present impacts of ITG and alignment frameworks on each other, we present relationships organised in four clusters of interest: (i) the change as a context of IT governance and Business/IS alignment, (ii) the alignment as an enabler for value creation, (iii) IT governance system as a support to alignment measures, and (iv) Enterprise modelling as an enabler for IS alignment and a facilitator for IT governance. We also observe several virtuous wheel of improvement between Business/IS alignment and ITG (see figures 6, 8, 9, 11 and 12)

A. Change: a context of the two domains

The NATURE OF ALIGNMENT is used in the same way in both frameworks describing domains (see section II) involved in the alignment process [21]. The TYPE OF CHANGE provides a privileged link between alignment and IT governance. On the business/IS alignment framework, it describes the way that change is performed on business processes and alignment models. On the ITG framework this attribute describes the way that change is performed on IT processes and IT governance models.

The change affects the alignment relationship and creates an IS operationally and/or strategically misaligned. The role of IT governance is to detect this misalignment before triggering a realignment process. To this end, we need (i) *indicators* the CONTENT attribute of the ITG system, (ii) the capability to detect change (CAPTURE OF THE NEED OF CHANGE) as soon as possible in order to reduce the harm caused by the realignment process. Indeed, this process requires additional human and financial resources. Thus, the more the detection of the need of change is late, more the time to recover alignment is long and therefore more expenses for the company are important. Once the misalignment is detected, IT governance has the responsibility to plan the realignment process. Depending on the impact caused by this misalignment, *strategic* or *operational*, (NATURE OF THE IMPACT OF THE CHANGE), a PERSPECTIVE OF ALIGNMENT (*strategy execution, technology transformation, competitive potential, service level*) should be adopted to maintain the alignment. Choosing the appropriate perspective is the purpose of IT governance.

ALI.SubW.[4 TYPE OF CHANGE]=**ITG**.SubW.[5 TYPE OF THE CHANGE]
ALI.SubW.[1 NATURE OF THE ALIGNMENT]=**ITG**.SubW.[4 NATURE OF THE ALIGNMENT]
ALI.DevW.[17 CAPTURE OF THE NEED OF CHANGE]= *trigger* v *other* => **ITG**.SysW.[22 CONTENT] = *indicator*
EXIST(**ALI**.SubW.[5 NATURE OF THE IMPACT OF THE CHANGE], **ITG**.UW.[12 PERSPECTIVE OF ALIGNMENT]

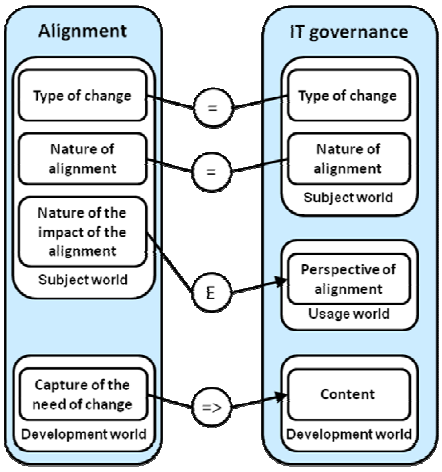

Fig. 5. Change: an invariant for the two domains

The CONTENT of the system -by the means of *indicators* which allows capturing the need of the change- triggers the first virtuous wheel of improvement. These *indicators* support the alignment measures that inform about a possible misalignment and consequently the necessity of change to restore alignment, what we call CAPTURE OF THE NEED OF CHANGE that itself requires the existence of indicators (see figure 6).

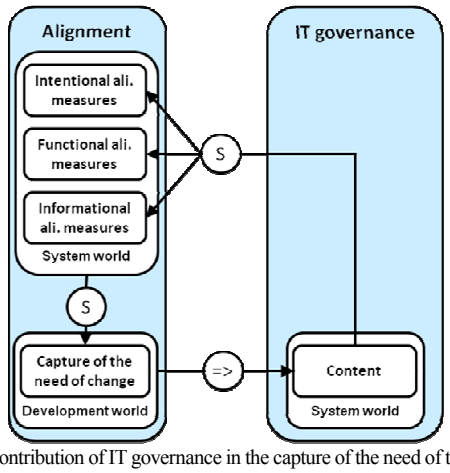

Fig. 6. Contribution of IT governance in the capture of the need of the change

B. Alignment as an enabler for value creation

We notice an equivalence link between the strategic alignment framework and that of the IT governance concerning the attribute PERSPECTIVE OF ALIGNMENT of the usage worlds (see figure 7). Moreover, when a perspective of alignment exists, IT managers should enact a risk management process. According to the fact that the alignment is lead by the business domain (REQUIREMENT FOR ORGANISATION ADAPTABILITY) or the IT

domain owners (REQUIREMENT FOR IS ADAPTABILITY), the IT governance has to provide adapted risk management methods.

Business/IS alignment throughout the requirements of USER COMPREHENSION, COMMUNICATION BETWEEN ACTORS and HIERARCHY LEVEL provides a support to VALUE creation. In our case, the value creation is oriented by the user and the utility of the system components. User shares their experiences on the usage of the IS components and create knowledge. This knowledge is a VALUE for the organisation if it is reused for future usage of the system. Mainly, the COMMUNICATION and the COMPREHENSION OF THE USER, as a support for knowledge exchange, is a support to a VALUE creation for the *organisation*. The IS FLEXIBILITY DEGREE and MODULARITY characteristics of the IS facilitate also the VALUE creation: the flexibility and the modularity contribute to the adaptability of the IS over the business processes. The value is related to the usage of the IS by the stakeholders.

The framework of alignment provides a set of measures in the system world. INTENTIONAL, FUNCTIONAL and INFORMATIONAL "alignment measures" aim to measure the support of the IS to the business using several ratios. The three lists of values are only indicative and not exhaustive. *Goal coverage* is the ratio of the business goals supported by the IS. *Process coverage* is the ratio of BPs completely enacted by the system (BP support system). *Activity coverage* is the ratio of activities supported by the system. *Actor coverage* is the ratio of actors present in the enterprise BPs modelled in the system. This measure verifies that the change of an object state in both the BPs and the system are triggered by the same actions. *Information coverage* sets, for each activity supported by the system, the ratio of the informational objects provided by the latter. One of the IT governance objectives is to ensure, through a control process, an adequate alignment between business and IT. In this way, the INTENTIONAL and FUNCTIONAL measures can be seen as a facilitator for DECISION making and RISK MANAGEMENT: the alignment measures capture the status of the alignment as it is currently. Decision and risk management have the responsibility to deal with the evolution decisions in order to improve the quality of the alignment or to accept the misalignment is some situations.

The KNOWLEDGE CAPITALISATION is dealt with in the development world of each framework. If the attribute is valid in the strategic alignment framework, it takes at least one value in the list of values defined by the attribute LEARNING CAPACITY of the ITG framework.

ALI.UW.[9 PERSPECTIVE OF ALIGNMENT]=**ITG**.UW.[12 PERSPECTIVE OF ALIGNMENT]
EXIST(**ALI**.UW.[9 PERSPECTIVE OF ALIGNMENT], **ITG**.UW.[7 RISK MANAGEMENT])
EXIST(**ALI**.UW.[8 REQUIREMENTS FOR IS ADAPTABILITY], **ITG**.UW.[7 RISK MANAGEMENT])
EXIST(**ALI**.UW.[7 REQUIREMENTS FOR ORGANISATION ADAPTABILITY], **ITG**.UW.[7 RISK MANAGEMENT])
SUPPORT(**ALI**.UW.[12 COMPREHENSION OF THE USER], **ITG**.UW.[9 VALUE])
SUPPORT(**ALI**.UW.[10 COMMUNICATION BETWEEN ACTORS], **ITG**.UW.[9 VALUE])
SUPPORT(**ALI**.UW.[10 COMMUNICATION BETWEEN HIERARCHY LEVEL], **ITG**.UW.[9 VALUE])
SUPPORT(**ALI**.SysW.[31 IS FLEXIBILITY DEGREE], **ITG**.UW.[9 VALUE])
SUPPORT(**ALI**.SysW.[30 MODULARITY], **ITG**.UW.[9 VALUE])
SUPPORT(**ALI**.SysW.[27 INTENTIONAL], **ITG**.SubW.[2 DECISION])
SUPPORT(**ALI**.SysW.[28 FUNCTIONAL], **ITG**. UW.[7 RISK MANAGEMENT])
EXIST (**ALI**.DW.[15 KNOWLEDGE CAPITALISATION], **ITG**.DW.[19 LEARNING CAPACITY])
ALI.UW.[9 PERSPECTIVE OF ALIGNMENT]=**ITG**.UW.[12 PERSPECTIVE OF ALIGNMENT]

EXIST(**ALI**.UW. [9 PERSPECTIVE OF ALIGNMENT], **ITG**.UW.[7 RISK MANAGEMENT])
EXIST(**ALI**.UW.[8 REQUIREMENTS FOR IS ADAPTABILITY], **ITG**.UW.[7 RISK MANAGEMENT])
EXIST(**ALI**.UW.[7 REQUIREMENTS FOR ORGANISATION ADAPTABILITY], **ITG**.UW.[7 RISK MANAGEMENT])
SUPPORT(**ALI**.UW.[12 COMPREHENSION OF THE USER], **ITG**.UW.[9 VALUE])
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EXIST (**ALI**.DW.[15 KNOWLEDGE CAPITALISATION], **ITG**.DW.[19 LEARNING CAPACITY])

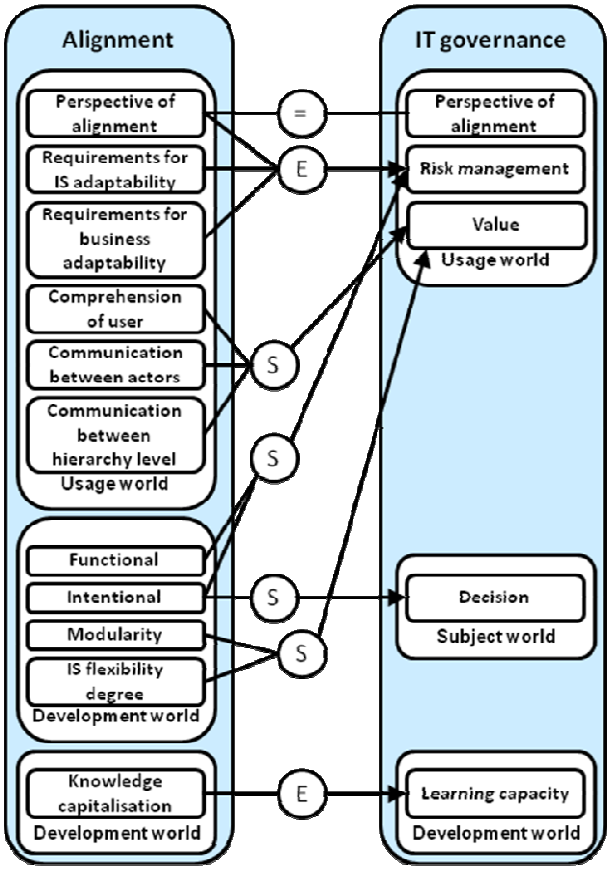

Fig. 7. Alignment as a context for value creation

Figure 7 shows us that the alignment empowers the value creation by the means of the modularity and the flexibility of the IS. Moreover there is also another dependency in ITG framework (see figure 4) between value and architecture approach as shown in figure 7. We identified a dependency between the architecture approach used in the ITG development world and the IS flexibility degree. The lower triangle drawn in figure 7 by the arrows representing these three dependencies describes a virtuous wheel of improvement between the strategic alignment and the ITG.

Figure 8 reminds us that the modularity of the IS improves its flexibility degree. In summary the modularity and IS flexibility empowers the value creation.

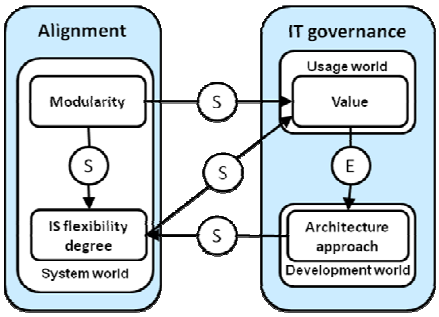

Fig. 8. Alignment as a context for value creation

C. *IT governance system as a support to IS alignment measures*

The alignment measures are expressed in the alignment framework and appear in the IT governance framework using the attribute CONTENT (see figure 9). CONTENT describes concepts that the system offers in order to support ITG (*goal, indicator, service, IT process*).

INTENTIONAL, FUNCTIONAL and INFORMATIONAL measures lead to formalise *indicators* which need to be stored and traced in the ITG system. It is also a pre requisite to represent those concepts throughout FORM and NOTATION: the two frameworks use the attribute FORM and NOTATION in a equivalent way.

ALI.SysW.[27 INTENTIONAL]=* => **ITG**.SysW.[22 CONTENT]=*indicator*
ALI.SysW.[28 FUNCTIONAL]=* =>**ITG**.SysW.[22 CONTENT]=*indicator*
ALI.SysW.[29 INFORMATIONAL]=* =>**ITG**.SysW.[22 CONTENT]=*indicator*
ALI.SysW.[24 FORM]=**ITG**.SysW.[23 FORM]
ALI.SysW.[25 NOTATION]=**ITG**.SysW.[24 NOTATION]

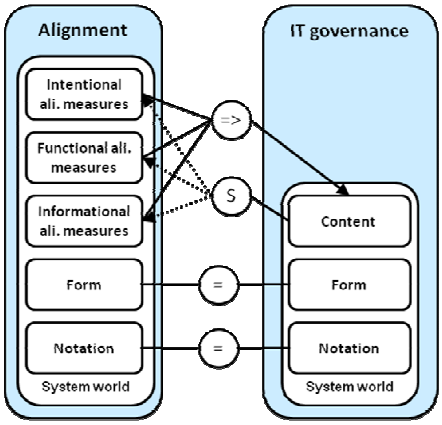

Fig. 9. Contribution of IT governance to alignment measure

We identify directly on the figure 9 a virtuous wheel of improvement between the alignment and the IT governance: the content of the system of ITG allows representing the alignment measures and reciprocally it supports the performance of the measures.

D. *Enterprise modelling: an enabler for IS alignment and a facilitator for IT governance*

The ARCHITECTURE APPROACH provides a way to obtain FLEXIBILITY and MODULARITY (see figure 10). Indeed, if there is an IS *cartography*, we will have a clear vision of the system and we can act to reach a more modular and consequently more flexible *target IS*. MODELLING PARADIGM was used in the same way in the IS/Business alignment and IT governance frameworks.

The modelling is an essential means to conceptualise alignment relationship. It is also a pertinent support to control and govern IS. A general vision of the enterprise with different levels of detail (EA REPRESENTATION LEVEL) is needed. This kind of models supports the managers to make the right DECISION, at the right level of the enterprise structure, during the business performance. This representation supports also the RISK MANAGEMENT. Indeed, we need such representations to be able to delineate the risk and its effects on the company in order to be able to master it. If the COVER is *intention*, *decision* or *context* oriented, it supports the DECISION making. In the same way, the MODELLING PARADIGM facilitates and supports the RISK MANAGEMENT if it is *context* or *decision* oriented.

SUPPORT (**ITG**.DW.[13 ARCHITECTURE APPROACH] = cartography v IS target , **ALI**.SysW.[31 IS FLEXIBILITY DEGREE])
SUPPORT (**ITG**.DW.[13 ARCHITECTURE APPROACH] = cartography v IS target, **ALI**.SysW.[30 MODULARITY])
ALI.SysW.[14 MODELING PARADIGM] = **ITG**.DW.[18 MODELING PARADIGM]
SUPPORT (**ALI**.sysW.[22 EA LEVEL REPRESENTATION], **ITG**.SubW.[2 DECISION])
SUPPORT (**ALI**.sysW.[22 EA LEVEL REPRESENTATION], **ITG**.UW.[7 RISK MANAGEMENT])
SUPPORT (**ALI**.sysW.[21 COVER] = intention v decision v context, **ITG**.SubW.[2 DECISION])
SUPPORT (**ALI**.DW.[14 MODELLING PARADIGM] = decision v context, **ITG**.UW.[7 RISK MANAGEMENT])

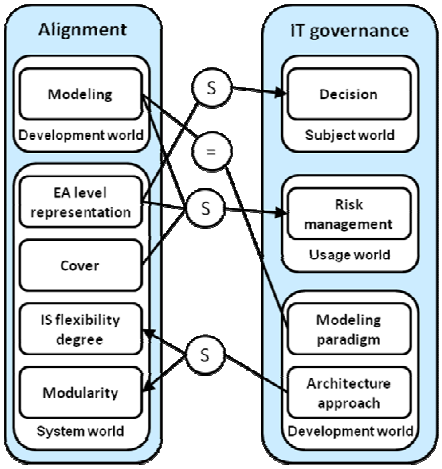

Fig. 10. Contribution of enterprise modeling

As described in the figure 8, IS flexibility empowers the value creation. Now, as shows the figure 11, the MODELLING PARADIGM enhances IS FLEXIBILITY DEGREE which supports the VALUE generated by the IS. Therefore, we can say that the MODELLING PARADIGM is an indirect source of value generation.

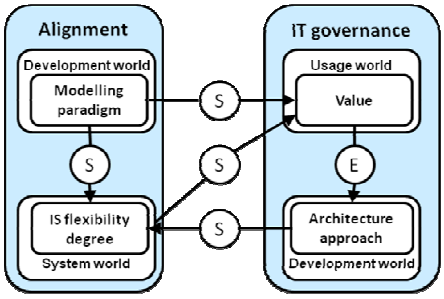

Fig. 11. Modelling paradigm as a source of value generation

EA LEVEL REPRESENTATION triggers the last virtuous wheel of

improvement. Indeed, it supports DECISION which requires indicators to make those decisions. These *indicators* support alignment measures. These measures require the existence of a representation of the enterprise in an architecturally structured form (EA LEVEL REPRESENTATION) (see figure 12).

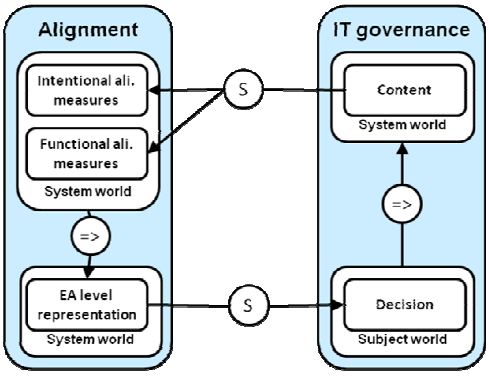

Fig. 12. Alignment measures in the IT governance and alignment domains

V. CONCLUSION

The purpose of this study is to provide a global and coherent vision of IT governance and strategic alignment mechanisms. We developed two comprehensive frameworks for these two IT related domains. Our research objective is to understand and to demonstrate the complementarities and dependencies between business/IS alignment and IT governance mechanisms. When we initiated this work, we made the hypothesis that the intersection between Business/IT alignment and IT governance mechanisms and requirements is not empty.

Relationships which were identified separately in the two frameworks let us to a first result: (i) the support of the IT governance to the strategic alignment is the capability to measure and control the completeness of the alignment and (ii) the alignment, as a mechanism to develop a more adaptable, more flexible IS, constitutes a support for organisational value creation.

We improved our first understanding (see section III) by identifying dependency relationships between the two frameworks on ITG and business/IS alignment. Our finding at this stage is that IT governance and Business/IS alignment are performed in the context of change and are focused on the value creation. Decision makers have to analyse indicators in order to deal with the orientation of the change process. The ITG as a set of control processes is a way to support the measurement of the degree of alignment between business and IT support. Moreover, the architecture approach, the modeling paradigm and the enterprise modeling as characteristics of the IS development processes are enablers and facilitators for Business/IS alignment and ITG. We are applying the results of this study in an industrial project in order to validate the correctness of the identified relationships in and between the two frameworks.

Our underlying research objective is focused on IS engineering methods. As a matter of fact, information systems are not enough flexible in order to be easily maintained "aligned on the business" in an environment which is in a perpetual evolution. Moreover, they do not support -well- the activities related to their own control. The comprehension of the contributions of Business/IS alignment and IT governance approaches anticipates our research in progress whose objective is to provide methodological guidelines allowing us to build ISs more easy to maintain (the functional fit with business requirements) and to govern during change and evolution. We aim to enhance IS engineering methods in order to provide some solutions -on the form of method chunks- to these weaknesses.

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