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BUSINESS AND INFORMATION SYSTEMS MISALIGNMENT: DIAGNOSIS, THERAPY AND PROPHYLAXIS TECHNIQUES BASED ON SYNDROMES

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ABSTRACT

Alignment is an intentional state organizations aim at. Misalignments are the factors that organizations as a whole and its organizational actor as enablers face in their routine business operations. This paper proposes a misalignment approach based on medical sciences, arguing that by observing organizations as systems and using an approach similar to that adopted by the medical sciences in the study of the human body system, the misalignment classification and management capabilities might be improved. We believe that the medical science concepts provide an interesting foundation to set the misalignment semantics and terminology, thus establishing the grounds of a misalignment classification schema and providing techniques to detect, correct and prevent the misalignments. Therefore, using a metaphor between disease and misalignment, a set of concepts defined by medical science, such as symptom, sign, syndrome, etiology, diagnosis, therapy and prophylaxis, are adapted to address the problem of misalignment between business and information systems.
Based on both academic research and years of professional consultancy, the authors propose an initial and possible instantiation to those concepts, establishing a misalignment classification scheme that links enterprise architecture views, misalignment symptoms and causes, and defining techniques to detect, correct and prevent misalignments.

KEYWORDS

Alignment, Misalignment, Classification Scheme, Enterprise Architecture, Medical Sciences.

1. INTRODUCTION

Understanding what business and information systems alignment is, how to obtain it and therefore maintain it, is a "problem" (Pereira et al. 2003). The challenges and importance of aligning business and information systems have been highlighted in several surveys, studies and researches. Since the first reference to the alignment concern in the late 1970s several definitions and approaches have been proposed to address this issue, especially since the 90 decade. The Society for Information Management published the key issues for IT executives, for almost a quarter of a century, reporting the alignment in the Top-10 of IT Management issues, as first or second major concern since 1980 (Luftman et al. 2006). Despite the universal acceptance of alignment importance and the efforts developed by practitioners, academics, consultants, and research organizations on this problem, it remains a persistent issue, although some improvements have been achieved over the years (Luftman 2007).

Traditional approaches addresses the alignment concern seeking an answer to how can organizations achieve alignment, but with little contribution on how to identify and correct misalignments. However, organizations, actually, "feel" and "suffer" on a daily basis the misalignments, those difficulties that compromise the alignment achievement. The misalignment concept has been mentioned within the scope of different alignment researches (Chan et al. 2007), especially when addressing the justification for alignment or when mentioning the impact to organizations that do not achieve alignment, but it was only recently that some authors focused on a misalignment approach. Recent studies introduced the subject of misalignments as a relevant research topic for the alignment problem, seeking answer to the questions *what are the typical symptoms of misalignment* and *how to detect, correct and prevent misalignments*.

The first explicit focus on misalignment research was sponsored by (Luftman 2003), when proposed to identify a set of symptoms of misalignment that organizations could suffer, symptoms that, when experienced, indicate that an organization is not optimized, not achieving all potential. Although this approach does not provide an explicit definition for the concept, it foresees two relevant intentions: (i) misalignments might be expressed by symptoms, and (ii) misalignments inhibit organizations to be optimized and achieve full potential.

Therefore, misalignment between business and information systems, likewise alignment, is a major issue and an unsolved problem in today's complex and dynamic organizational world, recognized as an interesting approach to understand and promote the alignment between business and information systems. This paper addresses the alignment concern, focusing on the problem of understanding and managing the misalignments, the factors that compromise the achievement of business and information systems alignment.

2. ALIGNMENT APPROACH CATEGORIES

(Chen 2007) argues that, on the one hand, research on alignment has taken different approaches due to distinct perspectives in separate research fields and, on the other, researchers from different fields address alignment issues from different perspectives. Therefore, (Chen 2007) proposes that research on alignment can be broadly categorized into three approaches: (i) Alignment via Communication in the business field, (ii) Alignment via

Architecture in software engineering field, and (iii) Alignment via Governance in the IT management field.

The Alignment via Communication approach works on the social dimension of alignment, which is the state in which business and IT executives/personnel within an organizational unit understand and are committed to the business and IT mission, objectives and plans. Under this approach, efforts are made to narrow the culture gaps between business and IT people, which has been a major cause for system development failure. It focuses on ways of marketing IT to business people, connecting IT planning with business strategic planning, and speaking a common language so that shared knowledge about the IT and business domain can be built, and organizational learning can be achieved. This category includes the Strategic Alignment Model (Henderson et al. 1993), the Social Dimension (Reich et al. 2000) and the Alignment Maturity (Luftman 2000).

The Alignment via Architecture approach uses architecture analysis and design techniques to assure the proper alignment. The scope for analysis under this approach can be as broad as an enterprise. In fact, the Enterprise Architecture is the main structural mechanism for enterprise design that based on a coherent description of enterprise architecture provides insight, enables communication among stakeholders and guides complicated change processes. Research on enterprise architecture focuses on describing the relationships between architecture descriptions at the organizational, business, information, application and technology levels for facilitating alignment. This category includes the Zachman framework (Zachman 1987) and the Business IT Alignment Method (Chen et al. 2005).

The Alignment via Governance approaches focuses on ensuring the linkage between the business and IT plans, on defining, maintaining and validating the IT value proposition, and on aligning IT operations with enterprise operations. Additionally, governance areas include value delivery, resource management, risk management and performance measurement. This category includes IT governance frameworks and best practices, such as the Control Objectives for Information and Related Technology (ITGI 2007), known as COBIT, and the IT Infrastructure Library (Rudd 2004), usually referred as ITIL.

3. STATE OF THE ART OF (MIS)ALIGNMENT APPROACHES

The Strategic Alignment Model (SAM), one of the most divulgated models, was proposed in 1993 to support the integration of information technology into business strategy by advocating alignment between and within four domains (Henderson et al. 1993): (i) Business Strategy, (ii) IT Strategy, (iii) Organizational Infrastructure and Process, and (iv) IT Infrastructure and Processes. The inter-domain alignment is pursued along two dimensions: (i) functional integration, between the business domain and the IT domain and (ii) strategic fit, between the external and internal domains, (Henderson et al. 1993).

Based on the Strategic Alignment Model, (Luftman et al. 1999) engaged on a research project with the objective to determine the enablers and inhibitors to align business and IT strategies. Therefore, a five-year study (from 1992 to 1997) was conducted and responses were analysed from around one thousand executives representing over 500 US Fortune 1000 organizations. The executives attended seminars on the alignment subject at IBM's Advanced Business Institute and were asked to fill out a questionnaire to identify the three top enablers and inhibitors concerning the alignment between business and information technology. The

option for open questions was selected to allow the participants to give a free expression of their opinions on factors from their own experience rather than being restricted to a limited set of alternatives (Luftman et al. 1999). The responses were analyzed for similar keywords or phrases in order to group on a set of alignment enabler and inhibitor categories.

Following his previous research (Luftman et al. 1999) proposed an approach to assess the organization's alignment maturity (Luftman 2000), supported by five levels of maturity, each one focused on a set of six components based on practice validated with an evaluation of 25 Fortune 500 organizations. The six components for assessing alignment maturity are Communications, Value, Governance, Partnership, Scope and Architecture, Skills (Luftman 2000, Luftman 2007). The five maturity levels are drawn on the core concepts of the Software Engineering Institute's Capability Maturity Metric (CMM), but under this model focused exclusively on alignment.

The concept of Enterprise Architecture (EA), which has been around from almost two decades supported by several frameworks and definitions (Zachman 1987, Sowa et al. 1992, Open Group 2003, Schekkerman 2004), is frequently related as an approach to promote business and information systems alignment. In fact, alignment is, for several years, the top answer to the question "*For what kind of issues do you plan an EA Program*" in the Trends in Enterprise Architecture Survey (IFEAD 2004, IFEAD 2005). Within the EA context, the Zachman Framework for Enterprise Architecture (Zachman 1987, Sowa et al. 1992), formally published in 1987, is the most widely known and used framework. The framework provides a view of the subjects and models needed for developing and documenting the enterprise architecture and is described in a matrix that provides on the vertical axis multiple perspectives of the overall architecture and on the horizontal axis a classification of the various artifacts of the architecture (Zachman 1987).

Based on a decomposed alignment supported in the concepts addressed by Enterprise Architecture, (Pereira et al. 2003, Sousa et al. 2004) propose to address the alignment based on the Business, Information and Application architectures, arguing that guarantee the alignment among the Business, Systems and Information is to guarantee the alignment between: (i) Business Architecture and Information Architecture, (ii) Business Architecture and Application Architecture, and (iii) Application Architecture and Information Architecture. To support this approach, Alignment Heuristic's were developed as common sense rule (or set of rules) to increase the probability of finding an easier way to achieve Business, Information and Application Architectures alignment. In order to evaluate the coherency level among the components it is requited that: (i) the architectures be correctly defined and contemplate all the relevant situations for the organization, and (ii) to those architectures the rules that guarantee the alignment be applied.

Luftman, the same researcher that concluded about the enablers and inhibitors of alignment (Luftman et al. 1999), some years later proposes a set of symptoms of misalignment that organizations could suffer (Luftman 2003), symptoms that, when experienced in any combination, indicate that an organization is not optimized, not achieving all potential. This research was, actually, the first initiative explicitly focused on misalignments to address the alignment concern. Furthermore, it introduced for the first time the expression symptoms of misalignment that would be referred and followed by other authors and research initiatives (in fact, this is a core concept under this paper proposal).

(Chen et al. 2005) argues that as rates of business and technological changes accelerate, misalignments between business and IT architectures are inevitable. Therefore, a research project is being conducted at the Software Engineering Institute aiming to develop a method

for detecting and correcting misalignments, trying to address the question *Can misalignment be prevented and, if so, how?* (Kazman et al. 2002). This research proposes the Business IT Alignment Method (BITAM), a process that describes a set of twelve steps for managing misalignments, supported on a three-level model (a similar structure to the Enterprise Architecture components) that defines the layers of Business Model, Business Architecture and IT Architecture and three alignments dimensions: (i) Business Models to Business Architectures, (ii) Business Architectures to IT Architectures, and (iii) Business Models to IT Architectures (Chen et al. 2005). The BITAM approach defines misalignments as the improper mappings between the layers and realignment activities as those activities that restore coherence to the mappings (Kazman et al. 2002, Chen et al. 2005). Furthermore, it suggests that there are three stages of maturity in an organization's ability to deal with misalignment, in increasing level of maturity: Detection, Correction and Prevention.

4. MEDICAL SCIENCES PERSPECTIVE TO DISEASE

Medical Sciences are the most ancient sciences with centuries of evolution in the study of a very complex system, the human body, and in the definition of common nomenclature and techniques that are used worldwide. Within the scope of this nomenclature, one key concept is that of disease (Kornai et al. 2004).

The classification of diseases is addressed by a specific discipline, the nosology. Nosology deals with the systematic classification of diseases and the naming of clinical concepts characterized by a disease. According to this discipline, diseases can be classified by symptom, etiology, pathogenesis, as well as by organ systems (Paterson et al. 2006, Pitchford 2002, Martin 1992).

Disease is a real life fact. The medical sciences provide techniques to deal with and manage diseases. Therefore, when some disease affects a patient, the nature of disease must be determined through a diagnosis process, performed by the physician, in order to define an adequate therapy that could solve or reduce that disease situation. Furthermore, in a preventive approach, diseases (at least some of them), can be prevented or the chance to be affected by it can be reduced, through prophylaxis procedures (Crawford 2007).

4.1 Disease

The term disease means a deviation, an abnormal condition of an organism that impairs bodily functions, characterized by symptoms and signs (Kornai et al. 2004, Jennings 1986, MedicineNet). The need for controlled medical vocabularies to classify disease into general groups and for detailed nomenclatures has been a hot topic over the centuries through the development of new and enhanced disease classification systems (Kornai et al. 2004). The Systematized Nomenclature of Medicine and the International Classification of Diseases are the most recognized disease classification system used by medical communities (Kornai et al. 2004). The approaches and focus on the classification systems have been evolving over the years, while the first efforts grouped diseases by their symptoms, modern systems focus on grouping diseases according to anatomy and causes.

4.2 Organ System

In the medical context, an organ is a relatively independent part of the body that carries out one or more special functions, e.g. the lungs, the heart. A group of related organs is an organ system, e.g. the respiratory system, the circulatory system. The organs within a system may relate in a number of ways, but functional relationships are most the commonly used (MedicineNet).

4.3 Symptom, Sign and Syndrome

A symptom is a sensation or change in health function experienced by a patient, such as headache, fatigue, tiredness, pain, or nausea. Symptom is therefore a subjective report or subjective evidence of disease, as opposed to a sign, which is objective evidence of the presence of disease or disorder. So, signs are observable whereas symptoms are not (Crawford 2007). For example, a patient may describe visible sores or invisible pain, which means that the visible complaints are signs (that can be measured) while the invisible ones are symptoms (that cannot be seen or measured). Despite the semantic differences, both symptoms and signs are indications of disease, meaning that the disease as a phenomenon needs to manifest itself through the symptoms and/or signs. A syndrome refers to the association of related signs and symptoms and, as such, the presence of one is an alert to the potential incidence of another.

4.4 Etiology

Pathologists study the causes of diseases within a discipline called etiology. Etiology is defined as the study of disease causes or the study of agents that cause disease, e.g. the etiology for some lip cancers is overexposure to sunlight, which means that sunlight is an etiologic agent of these cancers (Crawford 2007). However, the etiology is not always known and sometimes the answers to the cause and the causing agent might not be straightforward. (Green 1996) proposed the “three C's of etiology”, i.e. Cause, Contribute and Correlate, and explains that each term refers to factors that may have something to do with the appearance of the condition.

Cause, means that there is a proven cause-and-effect relationship between the two factors, e.g. boiling water on bare skin causes burns. The statement for cause is the following: when A happens, we observe that B happens too because A contributes all the ingredients necessary for B to occur.

Contribute, means that this factor, in the presence of other factors, can lead to the condition in question, e.g. stress along with a high-cholesterol diet as well as a genetic predisposition contributes to heart disease. The statement for contribute is the following: When A happens, B sometimes happens because A, when added to other factors in combination, may lead to B.

Correlate, means that for reasons we may not know, the condition and a particular factor appear to occur at the same time. One may not be casually related to the other at all, but rather they both may be related to a third factor, e.g. a cold virus may cause a runny nose and a sore throat, but the runny nose does not cause the sore throat, nor does it contribute to the sore throat, nor visa-versa, which means that they are both related (or correlated) to the same causal factor - the cold virus. The statement for correlate is the following: When A happens, B often happens because factor C is present and related to both A and B.

4.5 Diagnosis

In medicine, diagnosis (diagnostics) is the process of identifying a medical condition or disease by its signs, symptoms, and from the results of various diagnostic procedures. It is an act of discrimination and characterization. The diagnosis process begins with a description of symptoms, and then the doctor obtains further information from the patient himself about their symptoms, his previous state of health, living conditions, and other environmental and social conditions. Additionally, doctor conducts a physical examination to gather disease signs (Crawford 2007, Jennings 1986, MedicineNet).To support the diagnosis process, physicians have available useful tools, some of them based on the disease classification systems previously described. The ICD includes symptoms checklists that allows for quick preliminary diagnosis and the SNOMED includes diagnostic terms and diagnostic procedures.

4.6 Therapy

Therapy is the attempted remediation of a health problem. In medical field, the term treatment is used as synonymous for therapy. A treatment should not be undertaken until the nature of a patient's illness is known and it should be rational, based on scientific facts and planned carefully (Crawford 2007). A treatment can be complex as it may require several procedures to be undertaken and different specialists involved (Crawford 2007, MedicineNet).

4.7 Prophylaxis

Prophylaxis is any procedure whose purpose is to prevent, rather than treat or cure, disease. These may include technical procedures such as vaccination and antibiotics, but also simpler initiatives such as daily physical exercise. There are two groups of prophylactic measures, the primary prophylaxis whose objective is to prevent the development of a disease, and the secondary prophylaxis used when to prevent the further development of an existing disease (MedicineNet).

5. BUSINESS AND IS MISALIGNMENT NOMENCLATURE

As mentioned before, the medical science concepts provide an interesting foundation to set the misalignment nomenclature. Therefore, we revisited those concepts and proposed adapted definitions to the misalignment context:

Table 1. Misalignment concepts and semantic.

Concept	Definition
Misalignment	An abnormal condition that impairs organization components (architectures), characterized by typical symptoms and signs experienced by the organizational actors.
Organ System	The organization components, in other words, the architectures involved in the misalignment.
Symptom	Subjective evidence of misalignment that is experienced by organizational actors.
Sign	Objective evidence of misalignment experienced by the organization and observable

Concept	Definition
	both to internal and external organizational actors.
Syndrome	Set of symptoms and signs that typically occur together.
Etiology	The underlying factors that cause misalignment.
Diagnosis	Process of identifying a misalignment by its signs, symptoms, and from the results of procedures, such as questionnaire and tests.
Therapy	Actions whose purpose is to attempt to correct the misalignments identified by the symptoms/signs and confirmed through the diagnosis.
Prophylaxis	Principles, guidelines and common sense rules whose purpose is to prevent, rather than treat, the misalignment.

The following Concept Map (Novak et al. 2006) depicts the concepts described in the previous table, and their relationships. The misalignment concept is the core concept.

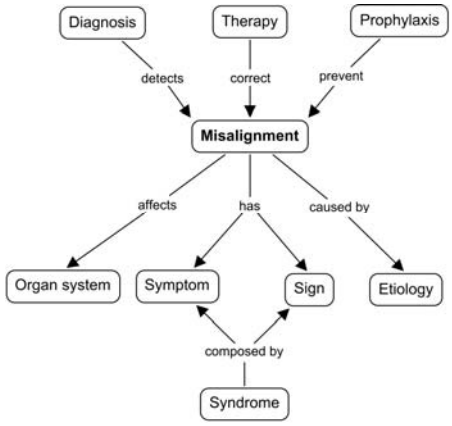

Figure 1. Misalignment concepts and relationships.

6. BUSINESS AND IS MISALIGNMENT CLASSIFICATION

Grounded on the medical sciences perspective, more specifically the nosology discipline, i.e. the branch of medicine that deals with the systematic classification of diseases, we suggest a misalignment classification scheme based on three dimensions: (i) organ system, (ii) symptom/sign and (iii) etiology.

6.1 Organ System Classification

The organ system axis is a structural classification dimension. Enterprise Architecture (EA) is related with the structure of the things of relevance in the organization, their components, and how these components fit and work together to fulfil a specific purpose (Sousa et al. 2004).

Therefore, it seems that EA might be a reasonable foundation for this structural dimension and their views or architectures the relevant classification scheme. These views often focus on four or five viewpoints, such as (ISO 1995, Maes et al. 2000, Pascal et al. 2004, Sousa et al.

2005): (i) Organizational architecture deals with the aspects related with the organization that are not related with the specific business nor with the mechanisms used to accomplish the creation of value. It includes concepts such as mission, vision, strategy, goals, and roles; (ii) Business architecture results from the implementation of business strategies and the definition of processes. It defines the functional requirements of business process support systems. The core concept within the business architecture is the business process; (iii) Information architecture describes what the organization needs to know to run its processes and operations. It defines a view on the business information that is system and technology independent and is structured as a collection of informational entities; (iv) Application architecture supports the business requirements and allows efficient management of the organization's entities. It defines the applications needed for data management and business support, regardless of the actual software used to implement systems; (v) Technological architecture represents the technologies behind application implementation as well as the infrastructure required for the deployment of the business process support systems.

Table 2. Organ System dimension in misalignment classification scheme.

Code	Description
OA	Organizational Architecture
BA	Business Architecture
IA	Information Architecture
AA	Application Architecture
TA	Technology Architecture

Under this classification dimension, a misalignment might be instantiated in two possible options: (i) selecting two architectures to classify a misalignment between architectures, or (ii) select only one to capture a misalignment within the architecture. This capability to deal with intra-architectural misalignments overcomes other approaches limitation, which assumes that each architecture is aligned with itself, as mentioned by (Sousa et al. 2004): "validate alignment among architectures but assume each architecture is aligned with itself". The following figure presents the relevant intra and inter-architectural dimensions.

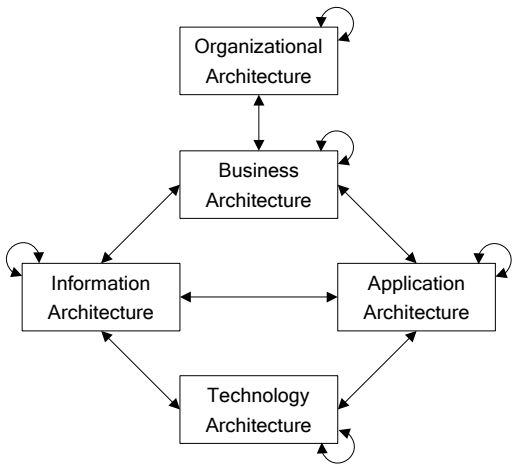

Figure 2. Misalignment concepts and relationships

6.2 Symptom/Sign Classification

The symptom/sign is a behavioural classification. Within disease classification scheme, this is one of the core classification dimensions and is particularly relevant when there is limited knowledge about the target system. To set this library, it was considered that misalignments symptoms/signs would be those evidences of unawareness and inefficiency, the inability to perform required tasks, the extra effort and extra costs. The following table presents a collection of symptoms/ signs that can be found in organizations, grouped as misalignment syndromes based on a perception of symptoms/signs that might occur together:

Table 3. Symptom/Sign dimension in misalignment classification scheme.

Code	Description
S.01	I am not aware of the organization's mission.
S.02	I am not aware of the organization's strategy and goals.
S.03	I do not know who the ultimate responsible for a business process is.
S.04	I do not know with whom I should speak to obtain knowledge about business processes.
S.05	I do not know what my responsibilities are.
S.06	I do not know what the expectations about my work are.
S.07	I do not know to whom I should report within the context of different activities.
S.08	I am not aware of the process contribution towards the organization goals.
S.09	I am not aware of my contribution towards the organization goals.
S.10	I do not know with whom I should speak to obtain the semantics informational entities.
S.11	I do not know who the ultimate responsible for a business informational entity is.
S.12	I find that same entity has different semantic according to the interlocutor.
S.13	I find that different concepts and names are used to refer to same entity.
S.14	I do not have the required information to support day-to-day activities.
S.15	I do not have the required information to support decision-making.
S.16	I have found information outdated.
S.17	I do not know with whom I should speak to obtain information and help about an application.
S.18	I do not know who the ultimate responsible for an application is.
S.19	I need to repeat the login in different applications.
S.20	I spend time configuring and updating users' profiles in several applications.
S.21	I need to develop and use end user computing applications.
S.22	I cannot develop/innovate certain types of business and products.
S.23	I spend time reintroducing the same information over different applications.
S.24	I need to use different applications during the day to perform my business activities.
S.25	I spend time executing manual validations that could be automatic.
S.26	I need to repeat the same application task several times to perform a business activity.
S.27	I do not understand how to use and interpret the same concept in different applications.
S.28	I need to run queries on different applications to get a full picture over an entity.
S.29	I find information consistency problems.
S.30	I find information integrity problems.
S.31	I have no confidence on application's information.
S.32	I find information entities with required fields not filled.
S.33	I spend time to correct data to ensure consistency between information replicas.
S.34	I spent time synchronizing data between applications.
S.35	I can't comply with the business level of service.
S.36	I have frequent periods where applications are unavailable.
S.37	I find that batch processes are not completed during the non-working period.
S.38	I spent extra resources and costs with new developments facing business volume increase.

Code	Description
S.39	I have found unprotected confidential information.
S.40	I have found that users have access to information not required for their activities.
S.41	I need to keep competencies on several different technology, operating systems and DBMS.
S.42	I spent time and resources to develop conversion layers between platforms.

6.3 Etiology Classification

Etiology was adopted as a disease classification axis after several years of usage and research since it requires deeper knowledge about the system and, even in current days, the factors causing a disease are not always straightforward. Nevertheless, we propose a set of preliminary etiological factors in the context of business and information systems misalignments, based on those factors that might cause or contribute to misalignments:

Table 4. Etiology dimension in misalignment classification scheme.

Code	Description
E.01	Undefined organizational strategy and organizational goals.
E.02	Undefined business process goals.
E.03	Lack of relation between process goals and organizational goals.
E.04	Undefined business roles.
E.05	Undefined responsibilities.
E.06	Undefined hierarchy or lines of reporting.
E.07	Multiple hierarchy or lines of reporting.
E.08	Insufficient business users training.
E.09	Lack of data ownership.
E.10	Poor IT planning and portfolio management.
E.11	Insufficient IT resources.
E.12	Lack of IT skills and competencies.
E.13	Lack of data quality controls.
E.14	Undefined business information requirements.
E.15	Multiple applications managing the same information.
E.16	Unavailable requirements at application level.
E.17	Wrong requirements implemented at application level
E.18	Users managed differently in different applications.
E.19	Lack of applications interfaces.
E.20	Undefined security requirements over the information entities.
E.21	Undefined capacity and performance requirements.
E.22	Under capacity infrastructure.
E.23	Insufficient involvement of business users in systems developments.
E.24	Undefined criteria to prioritize IT projects.
E.25	Undefined business service levels.
E.26	Lack of translation from business service levels to IT service levels.
E.27	Lack or poor systems performance monitoring.
E.28	Technological heterogeneity.
E.29	Obsolete technological infrastructure.
E.30	Incompatible platforms or technologies.

7. BUSINESS AND IS MISALIGNMENT SYNDROMES

Misalignment syndromes are a collection of symptoms and signs that usually occurs together. Therefore, we propose the following syndrome library derived from the aggregation of symptoms/signs. Additionally, through the interpretation and understanding of underlying symptoms/signs it is possible to combine this with the structural classification dimension and suggest the EA sub-architectures involved within the misalignment.

Table 5. Misalignment syndromes.

Code	Symptom and Sign		Organ System
SD.01	S.01	I am not aware of the organization's mission.	OA
	S.02	I am not aware of the organization's strategy and goals.	OA
SD.02	S.03	I do not know who the ultimate responsible for a business process is.	BA
	S.04	I do not know with whom I should speak to obtain knowledge about business processe	BA
SD.03	S.05	I do not know what my responsibilities are.	OA-BA
	S.06	I do not know what the expectations about my work are.	OA-BA
	S.07	I do not know to whom I should report within the context of different activities.	OA-BA
SD.04	S.08	I am not aware of the process contribution towards the organization goals.	OA-BA
	S.09	I am not aware of my contribution towards the organization goals.	OA-BA
SD.05	S.10	I do not know with whom I should speak to obtain the semantics informational entitie	IA
	S.11	I do not know who the ultimate responsible for a business informational entity is.	IA
SD.06	S.12	I find that same entity has different semantic according to the interlocutor.	IA
	S.13	I find that different concepts and names are used to refer to same entity.	IA
SD.07	S.14	I do not have the required information to support day-to-day activities.	BA-IA
	S.15	I do not have the required information to support decision-making.	BA-IA
	S.16	I have found information outdated.	BA-IA
SD.08	S.17	I do not know with whom I should speak to obtain information and help about an application.	AA
	S.18	I do not know who the ultimate responsible for an application is.	AA
SD.09	S.19	I need to repeat the login in different applications.	BA-AA
	S.20	I spend time configuring and updating users' profiles in several applications.	BA-AA
SD.10	S.21	I need to develop and use end user computing applications.	BA-AA
	S.22	I cannot develop/innovate certain types of business and products.	BA-AA
SD.11	S.23	I spend time reintroducing the same information over different applications.	BA-AA
	S.24	I need to use different applications during the day to perform my business activities.	BA-AA
SD.12	S.25	I spend time executing manual validations that could be automatic.	BA-AA
	S.26	I need to repeat the same application task several times to perform a business activity.	BA-AA
SD.13	S.27	I do not understand how to use and interpret the same concept in different applications	IA-AA
	S.28	I need to run queries on different applications to get a full picture over an entity.	IA-AA
SD.14	S.29	I find information consistency problems.	IA-AA
	S.30	I find information integrity problems.	IA-AA
	S.32	I have no confidence on application's information.	IA-AA
	S.33	I find information entities with required fields not filled.	IA-AA
SD.15	S.31	I spend time to correct data to ensure consistency between information replicas.	AA-TA
	S.34	I spent time synchronizing data between applications.	AA-TA
SD.16	S.35	I can't comply with the business level of service.	AA-TA
	S.36	I have frequent periods where applications are unavailable.	AA-TA
	S.37	I find that batch processes are not completed during the non-working period.	AA-TA
SD.17	S.38	I spent extra resources and costs with new developments facing business volume increase.	IA-TA
SD.18	S.39	I have found unprotected confidential information.	IA-TA

Code	Symptom and Sign		Organ System
	S.40	I have found that users have access to information not required for their activities.	IA-TA
SD.19	S.41	I need to keep competencies on several different technology, operating systems and DBMS.	TA
	S.42	I spent time and resources to develop conversion layers between platforms.	TA

8. BUSINESS AND IS MISALIGNMENT DIAGNOSIS

Misalignment Diagnosis was defined as the process of identifying a misalignment by its signs, symptoms, and from the results of procedures, such as questionnaire and tests. Therefore, the classification scheme, as proposed, is itself a relevant contribution for misalignment detection, since it allows the identification of misalignments in an organization by comparison with the symptoms and signs provided by the classification scheme. Nevertheless, more structured techniques should be defined to support the diagnosis process. We propose three techniques for misalignment detection: (i) misalignment self-diagnosis, (ii) misalignment diagnosis questionnaire, and (iii) misalignment diagnosis test.

The self-diagnosis is, under medical sciences, usually supported on symptoms checklists to which the patient assigns a qualification (Never, Sometimes, Often) according to symptom sensation frequency. Under this research, we propose a similar, but extended technique, supported on a matrix with symptoms/signs in rows and etiology in columns. This matrix allows organizations to quick assess and compare themselves in relation with typical misalignment symptoms and usual causal factors. Under this matrix, the Misalignment NSOC Matrix, symptoms/signs are assessed as *Never*, *Sometimes* or *Often*, and the intersection cells are marked with *Cause* if organization realises that the row symptom is caused by the column etiological factor.

	E.01	E.02	E.03	E.04	E.##	**Diagnosis**
S.01						**N**
S.02						
S.03						**S**
S.04						
S.05						**O**
S.##					**C**	

Figure 3. Misalignment NSOC Matrix: a Self-Diagnosis Tool.

The second technique, misalignment diagnosis questionnaire, is similar to the physician inquiring activity to detect and understand the symptoms and potential underlying causes for disease. This technique is much more detailed that the one used for self-diagnosis, and is based on a questionnaire with specific Diagnosis Questions (DG). Because organizations are very complex systems with several actors involved, the questionnaire should be oriented to different organizational roles, ensuring that all relevant participants are involved. This is, actually, the same argument used by Zachman to define the framework perspectives. Therefore, we propose to link the Diagnosis Questions to the different perspectives, in order to

address the participants view, i.e. Planner (Board), Owner (Business people), Designer (IT responsible) and Builder (IT staff). The following table presents an example of this technique for symptom S.21 (*I need to develop and use end user computing applications*).

Table 6. Misalignment diagnosis questionnaire example.

Code	Question	Planner	Owner	Designer	Builder
DQ.01	Do you think that current information systems support business requirements?	x	x		
DQ.02	Are there any end-user-computing (EUC) tools developed by business users to support business activities?		x		
DQ.03	The EUC tools are used to overcome inexistent or wrong implemented application functionalities?		x		
DQ.04	Are you aware of end-user-computing tools used to support business to overcome application functionalities?			x	
DQ.05	Are there requests under IT to develop those functionalities covered by EUC tools?		x	x	
DQ.06	Does business users request IT resources for their EUC tools development, e.g. server, development tools license?				x
DQ.07	Does business users request you support and help for their EUC tools development, e.g. query support, special backups?				x

The third and last diagnosis technique is focused on misalignment signs validation. As described in the misalignment nomenclature, signs are objective evidences of misalignment experienced by the organization and observable both to internal and external organizational actors. Therefore, similar to the physician that perform analysis and other tests, this technique supports the validation of misalignment signs, e.g. Perform a database integrity and consistency audit would be a diagnosis test (DT) for syndrome SD.14 which includes the symptoms *I find information consistency problems* and *I find information integrity problems*.

9. BUSINESS AND IS MISALIGNMENT THERAPY

Once misalignments are detected, organizations initiate realignment initiatives. This is the therapy to correct misalignments, which is a fundamental technique, as it alleviates the symptoms and corrects the misalignment factors addressing their etiology. The following table presents a library of therapies that might be considered for some described syndromes:

Table 7. Business and Information Systems Misalignment Therapy.

Code	Description	Syndrome	Organ System
T.01	Define and communicate organization's mission, strategy and goals.	SD.01	OA
T.02	Define and assign business processes ownership and responsibility.	SD.02	BA
T.03	Define and assign business roles, responsibilities and reporting lines.	SD.03	OA-BA
T.04	Define business process goals and link it to organizational goals.	SD.04	OA-BA
T.05	Define and assign information entities ownership and responsibility.	SD.05	IA
T.06	Define and assign application ownership and responsibility.	SD.08	AA
T.07	Develop a data dictionary and promote dictionary rules and standards.	SD.06	IA
T.09	Implement a management information system.	SD.07	BA-IA
T.09	Develop application interfaces.	SD.07,	BA-IA

Code	Description	Syndrome	Organ System
		SD.11	BA-AA
T.10	Implement a single-sign-on solution.	SD.09	BA-AA
T.11	Implement an identity and access management solution.	SD.09	BA-AA
T.12	Implement data integrity, data consistency and data quality controls.	SD.14	IA-AA
T.13	Perform database and application functionalities consolidation.	SD.13	IA-AA
T.14	Implement a workflow system.	SD.11	BA-AA
T.15	Implement a load balancing solution.	SD.16	AA-TA
T.16	Upgrade application and database server's capacity.	SD.17	IA-TA
T.17	Implement a failover solution.	SD.18	IA-TA
T.18	Reprioritize the project portfolio.	SD.10	BA-AA
T.19	Implement encryption mechanisms to secure confidential information	SD.18	IA-TA
T.20	Implement an enterprise information integration layer.	SD.15	AA-TA
T.21	Provide training on specific applications functionality.	SD.10	BA-AA
T.22	Review users' profiles and access rights.	SD.18	IA-TA
T.23	Consolidate and standardize platforms and technologies.	SD.19	TA

10. BUSINESS AND IS MISALIGNMENTS PROPHYLAXIS

Prevention is the ultimate goal for any non-desired situation or state. The ability of preventing a situation is directly proportional to the ability of detecting and correcting it in a timely and planned manner. In fact, BITAM describes prevention as the third, and last, maturity stage in the organization's ability to deal with misalignment (Kazman et al. 2002).The following table presents an initial list of prophylaxis techniques that aim preventing the occurrence of misalignments, promoting the alignment between business and IS.

Table 8. Business and Information Systems Misalignment Prophylaxis.

Code	Description	Syndrome	Organ System
P.01	Organization's mission, strategy and goals shall be defined and published.	SD.01	OA
P.02	Business processes shall have an owner responsible for process update, control, quality and improvement.	SD.02	BA
P.03	Business roles and responsibilities shall be defined and assigned, and lines of reporting shall be established to different roles.	SD.03	OA-BA
P.04	Business process goals shall be defined and linked to organizational goals, and roles operational goals shall be defined and linked to business process goals.	SD.04	OA-BA
P.05	Information entities shall have an owner responsible for ensuring quality and accuracy, and for defining security requirements.	SD.05 SD.06	IA IA
P.06	Information architecture with all relevant business information entities shall be identified, including concepts, semantic and alias.	SD.06 SD.07	IA BA-IA
P.07	Information shall have a means of being communicated to the appropriate audience using standard applications and tools.	SD.07	BA-IA
P.08	Applications shall have an owner responsible for ensuring documentation, new developments and maintenance prioritization, availability and performance requirements.	SD.08	AA
P.09	User identification, authentication and authorizations should be managed centrally.	SD.09	BA-AA
P.10	New business and new products launching shall be preceded by the identification of application's functionalities gaps and required developments shall be performed.	SD.10	BA-AA

Code	Description	Syndrome	Organ System
P.11	Each business process shall be supported by a minimum number of applications and each business activity shall be supported by one application.	SD.11 SD.12	BA-AA BA-AA
P.12	Applications shall support efficient automatism for repeated tasks and for sequential tasks without input required.	SD.12	BA-AA
P.13	Each information entity shall be managed by only one application that provide the services to access and update the entities it manages.	SD.13 SD.14 SD.15	IA-AA IA-AA AA-TA
P.14	Applications shall provide data quality controls.	SD.14	IA-AA
P.15	Technology standards shall be defined and followed by all projects.	SD.19	TA
P.16	IT service levels shall be defined, and availability/performance monitored.	SD.16	AA-TA
P.17	High availability infrastructure shall be provided for high critical processes with demanding performance and availability requirements,	SD.16	AA-TA
P.18	Applications shall be scalable to support business volume increase.	SD.17	IA-TA
P.19	Information security mechanisms shall be implemented according to sensitive information, according to security requirements.	SD.18	IA-TA
P.20	Information access shall be provided on a need-to-know basis, using least privilege rule.	SD.18	IA-TA

11. CONCLUSION

Based on a set of medical sciences concepts and techniques related with disease, we have proposed an approach to classify and manage business and information systems misalignments. Establishing an analogy between the human body and the organization, both complex systems, we propose to observe the organization by the architectures that must fit and function together, as the human body requires that a number of organ systems must function together.

This proposal contributes to information systems research and to the business and information systems alignment problem as it: (i) allows for established concepts and standard misalignment classification that can be used by all organizational actors within the organization, thus avoiding nomenclature clashes; (ii) supports the misalignment classification, not only, between the architectures but also within the architectures, considering the organizational, business, information, application and technology architectures; (iii) supports the identification and understanding of misalignments symptom and sign, subjective and objective indications of misalignment, not only by internal actors but also by external actors; (iv) supports the identification of possible causes of misalignment; (v) makes an initial contribution to the identification of possible realignment strategies; (vi)makes an initial contribution to misalignment prevention through guidelines; (vii) the techniques proposed comply with the three maturity stages to deal with misalignment.

To conclude, we believe that this proposal approach splits the complex alignment problem into more simple statements that are able to be understood and used by organizational actors, in such a way that it would be possible to have a worldwide community contributing to the misalignment classification library and management techniques, based on own experience and successes. The very next steps in this research would be to fill the NSOC matrix by several organizations in order to validate the classification scheme in real life environments and test the therapies and prophylaxis to assess their results.

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