

Assessing a complex, uncertain and disruptive technology environment for better IT alignment

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Abstract: Business and Information Systems (IS) alignment is a key management issue and has been largely investigated. Yet, little research shows companies how a fit between these "two worlds" can be achieved. The assumption of this paper is that making explicit the business model can contribute to improving the business/IT alignment. Moreover information systems supporting environmental scanning, strategic or competitive intelligence, and technology assessment, which are of prime importance for organizations, are much less investigated. This paper also aims at deriving a theoretical framework for assessing a technology environment from its properties such as complexity, uncertainty and disruptiveness.

Keywords: actor/issue analysis, environment scanning, scenario planning, strategic intelligence

1. Introduction

Business and Information Systems (IS) alignment has been largely investigated [HENDERSON&93] [HIRSCHHEIM&01], mainly at the level of internal management.

The necessity of aligning information systems with the external environment is much less explored and formalized. We recommend consideration of three levels in the business/IT alignment. The first level corresponds to the nowadays-classical alignment of information systems with the - internal - strategy, organization and technology. The second level takes into consideration the - external - environment and assumes that the information system has to integrate features for assessing this environment. Finally, the third level copes with evolution over time and emphasises the necessity to design information systems able to evolve according to the future changes.

In the next section, the internal alignment is considered and the role of a formally defined business model is outlined. We propose a *Business Model Ontology* to formulate, understand, analyse and share a company's business model. The third section deals with the second level of alignment and aims at suggesting a framework and its associated tools for assessing technology environments. The fourth section sketches a scenario approach for integrating assumptions for the future, impacts on business models and possible changes when designing information systems.

2. Business model

Whereas the early work on strategic IS alignment focused on aligning IS strategy to business strategy, the strategic potential of IS later led to the recognition that IS strategy can also affect business strategy [HENDERSON&93] [HIRSCHHEIM&01]. In simpler terms, business people have to be able to clearly formulate their vision and what they expect from IS people, and IS staff has to be able to point out how Information and Communication Technology (ICT) can improve a company's business goals. However, these two worlds, the one of business and the one of technology, sometimes seem quite distant. On the one hand every manager and entrepreneur has an intuitive understanding of how his business works, but in many cases she or he is rarely able to communicate it in a clear and simple way [LINDER&01] On the other hand, IS people have a clear idea of what information technology are able to accomplish in IS management, but they struggle to achieve a strategic fit with the big (business) picture.

We think that the understanding and use of business models is essential in an increasingly complex and uncertain business environment for the following reasons:

- The process of modelling social systems or an ontology – such as a business model – helps to identify and understand the relevant elements in a specific domain and the relationships between them [MORECROFT94].
- The use of a formal approach to business models (e.g. our ontology) helps managers and IS staff to easily communicate and share their understanding of the business logic between each other [FENSEL01].
- Business models facilitate change because of their building-block-like approach to formulating the business logic of a company [PETROVIC&01].
- A formalized e-business model can help to identify the relevant indicators of a *Balanced Scorecard*. (NORTON&92).
- Business models can help managers simulate e-businesses and learn about them. This is a method of doing risk free experiments, without endangering an organization [CONSTANCE&01].

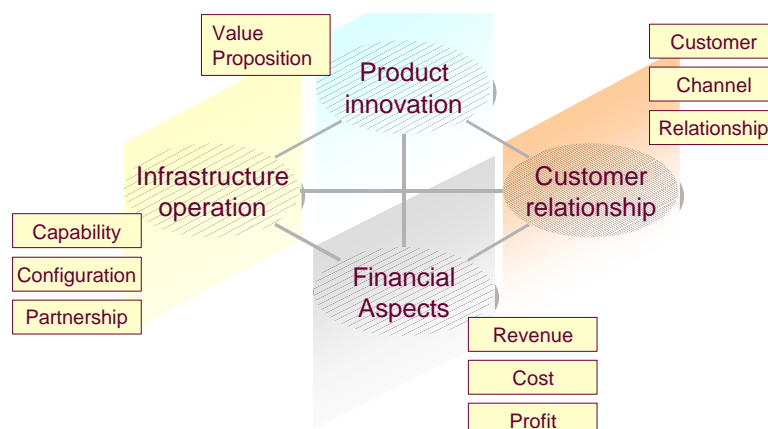


Exhibit 1. Business model framework

The *Business Model Ontology* presented in [OSTERWALDER&02], and visualized in Exhibit 1, is the conceptualisation and formalization into elements, relationships, vocabulary and semantics of the essential subjects in the business model domain. The ontology is structured into several levels of increasing depth and complexity. The first level of decomposition of our ontology contains the four main pillars of a business model, which are the products and services a firm offers, the relationship it maintains with its customers, the infrastructure necessary in order to provide this and finally, the financials, which are the expression of business success or failure.

The *product innovation* element covers all aspects related to what the firm offers. This comprises not only its products and services but also the manner in which it differentiates itself from its competitors. The element product innovation is mainly based on the value proposition, the offers and the benefices the firm proposes to its customers.

The *customer relationship* element describes who are the customers and the way a firm goes to market and gets in touch with its customers. This element consists of (a) the target customers, (b) the distribution channels in order to feel & serve customers, and (c) the customer relationship or equity in order to get & keep customers. The latter justifies some personalization and trust mechanisms that are becoming essential in an increasingly "virtual" business world.

The *infrastructure management* describes the value configuration that is necessary in order to deliver what the firms offer and to maintain a customer relationship. It is composed of (a) the capabilities, the competencies and the resources needed for delivering the value proposition, (b) the activity configuration (value chain, shop or network), and (c) the firm's partner network to access these resources and fulfil these activities.

The *financial aspect* is the culmination of an e-business model. The best products and services and the finest customer relationship are only valuable to a firm if it guarantees long-term financial success. The financial aspects element is composed of the company's revenue model and its cost structure, which subsequently define the profit & loss of a firm.

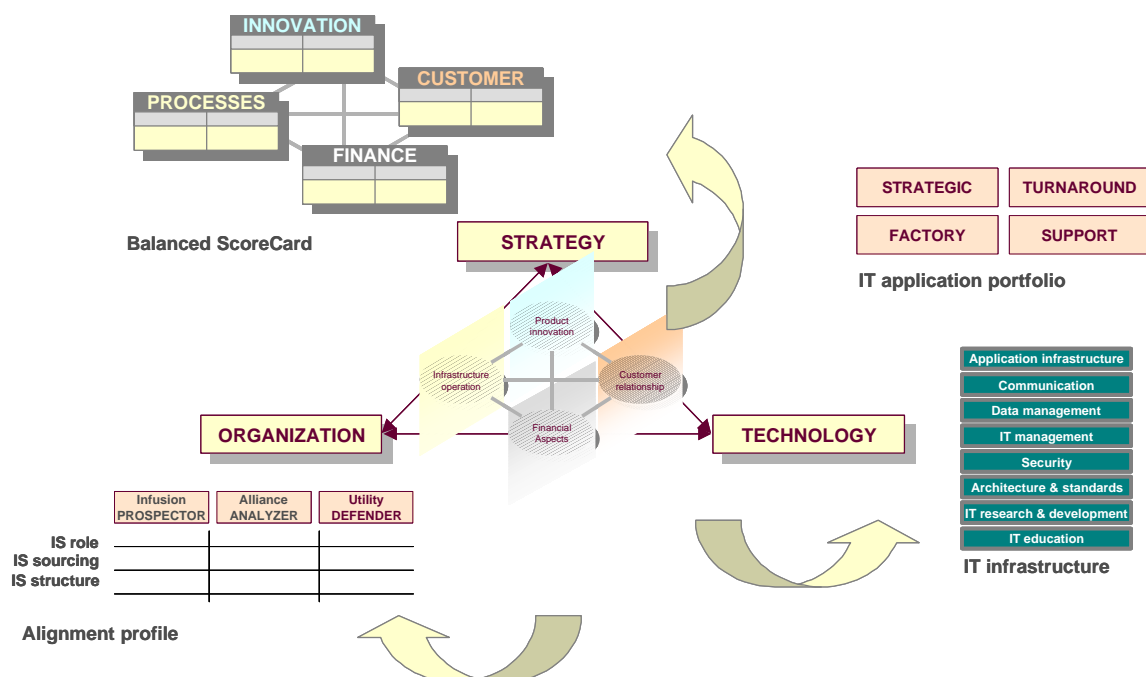


Exhibit 2. Alignment based on the business model

From an alignment standpoint, if the business model has been precisely defined using such ontology, it should help to improve the following decisions, visualized in the Exhibit 2.

Strategy. - What are the indicators of the executive information system for monitoring the strategy, using for example a *Balanced scorecard* approach [NORTON&92] with its financial, customer, internal business, and innovation and learning perspectives?

Organization. - What is the alignment profile with its IS role (opportunistic, comprehensive or efficient), IS sourcing arrangement (in-sourcing, selective or outsourcing) and IS structure (decentralized, shared or centralized), using for example the "defender, prospector, analyser" framework adopted by [HIRSCHHEIM&01]?

Technology. - What is the application portfolio with its turnaround, strategic, factory and support applications [WARD88]? What is the IT infrastructure [WEILL&02] with its different components: application management, communication management, data management, IT management, security, architecture and standards, channel management, IT research and development, and training and education in the use of IT?

3. Environment assessment

Assessing or scanning the environment of an organization can be defined as a search for information about events and relationships in a company's outside environment, the knowledge of which can help its top management to plan the company's future course of action [AGUILAR67]. Organizations scan their environment in order to understand the external forces of change that may affect their future position so that they can develop effective responses and strategies. The alignment between the organization's strategy and its environment is seen as essential for performance.

This section aims at deriving an integrated framework from the properties of a technology-intensive landscape. Many models have been proposed for monitoring the environment and achieving alignment with organizational strategy, structure, and performance such as the *SWOT analysis*, *the 5 forces model*, *the disruptive technology framework*, and so on. Moreover, a few empirical studies support the importance of environmental scanning and suggest a positive relationship with organizational performance [CHOO01]. Unfortunately, while the development of knowledge has produced many techniques to deal with parts of the problem, there is no easy methodology allowing for a systematic assessment of technology-intensive environments.

3.1. Complexity, uncertainty and disruptiveness

Research has shown that environmental analysis becomes even more essential in industries, which are characterized by complex, uncertain and disruptive environments.

Complexity is mainly due to a large body of self-organized stakeholders. Uncertainty is due to unpredictable dynamic futures with many open issues. Disruptiveness means non-continuous development and use of technology, with inflection points (or substitute technology).

These are commonly considered as the major drivers of environmental scanning [BOYD96]. Ironically, the characteristics that increase the value of scanning also make it more difficult and costly. Such environments usually characterize technologically intensive industries such as the mobile business, e-business and software industries.

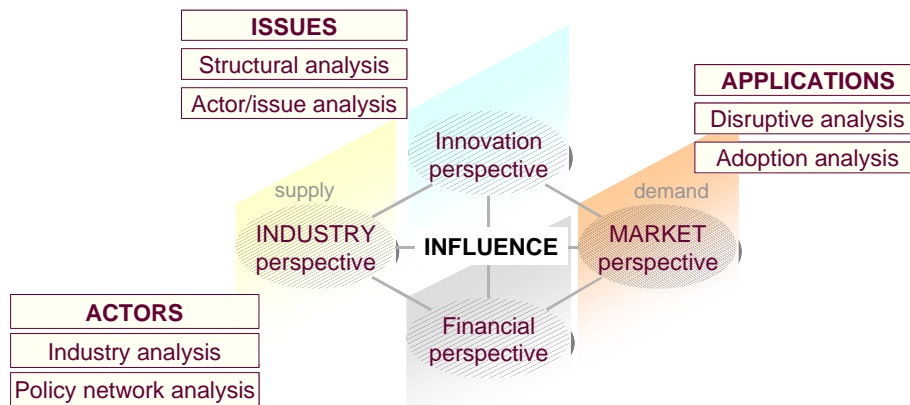


Exhibit 3. Information system for assessment an outside environment

3.2. Environment model

From a conceptual modelling or ontology point of view, based on these three characteristics, we suggest, as illustrated in Exhibit 3 four main concepts and perspectives for modelling an information system dedicated to assessing such technological environments, with their properties and relationships.

Actors

For dealing with complexity, “actors” are keys, with their stakeholder positioning, networks of actors, and business models. The “actors” perspective represents the supply side of the environment. The relevant actors are those, which have the power to directly or indirectly influence the organization's performance.

Among these actors, the different players that contribute to satisfy the same end-user needs take a prominent place. As illustrated by [PORTER85], these players principally include not only the organization's existing direct competitors, but also they players in adjacent industries along the value system such as suppliers, distributors, new entrants and substitute product producers.

However, other influential players in diverse environmental areas must be taken into account. It is indeed recommended to consider all the actors which can influence the evolution of the environment [GODET01]. In particular, it is worth considering players in the less immediate environment such as regulatory authorities and technology suppliers.

Uses

For dealing with disruptiveness, “use”, application and adoption, by the users, of the monitored technology have also to be assessed.

The use or usage perspective represents the demand side of the organization's environment. Assessing the uses and the market basically implies investigating the end user needs and how they are translated into demands (capacity and willingness to pay for these products). It is important to understand how customers adopt and value the technologies and the value propositions offered by the different actors.

Research in marketing has shown that the market is not a homogeneous group, but that buyers tend to have individual needs, behaviours and preferences. A process of segmentation is commonly used to identify groups of customers with similar purchase behaviour. It is vital to gather information about the customers (i.e. in terms of socio-demographic, psychological and behavioural variables) that represent each segment.

Knowledge of customers' needs, wants, demands and marketing segments allows firms to conceive more attractive value propositions and to gain substantial competitive advantage. Actually, some firms try to integrate their customers in the design of their value propositions (i.e. through mass customisation).

Issues

For integrating uncertainty, many kinds of "issues" should be taken into consideration. The actors will try to influence the issues to their advantage, and the evolution of these issues will dictate the possible futures. Issues can be defined as open and debatable questions, events or other forthcoming developments whose realization can significantly influence the future conditions of the environment and, consequently, the ability of the organization to achieve its objectives [ANSOFF80]. Issues can arise in different environmental areas such as the market, technology, regulatory, economic and social areas.

Issues are an important element of environmental analysis. While the two other elements provide a good picture of the current conditions, they are not a sufficient basis for guiding decisions which deploy their effect in a relatively distant future. In changing environments, companies must continually look beyond the current environmental state and assess its future prospects. Due to the high uncertainty of future developments, this often leads to establishing a number of scenarios rather than a single forecast (see below section 4). With this in mind, issues are a good mechanism to reflect on possible disruption of current conditions and trends, allowing the development of a broader set of scenarios. Particularly interesting issues are those that are open to dispute and upon which actors have diverging positions and means of influence.

The proposed elements cover the mentioned uncertainties: the market deals with demand uncertainties, actors cope with supply and its related strategic uncertainties, and issues cover environmental factors which include technology.

Influence relationships

In the technology assessment context, "influence" - preference, pressure, or power - is the pertinent relationship between the 3 types of concepts. Different kinds of influences can be modelled: actors can influence other actors; actors try to influence issues' evolution, defending or promoting position with a lesser or stronger commitment; issues' evolution influences use and adoption of technology, and vice versa, and so on.

While this concept is generic, relationships between a particular pairs of elements have an adapted meaning.

The uses and actors are linked by a "*market*" relationship: by adopting certain value propositions as an expression of their needs, end users influence the type of products that are offered by the different actors and determine their relative power; conversely actors can often shape and even create user needs by offering innovative value propositions.

Uses and issues are linked by an "*adoption*" relationship in the sense that the realization of issues can affect end user needs and, consequently, the solutions they adopt. Conversely, the adoption of certain solutions may positively or negatively affect certain issues in the future.

Actors and issues are linked by a “*position*” relationship. Actors can influence the evolution of certain issues by strategically positioning themselves on them. On the other hand, the realization of issues limits the strategic positioning of actors.

Finally, influence relationships also exist between the examples of issues, actors and uses. Actors are linked by “*pressure*” relationships [PORTER&85], issues by “*dependency*” relationships [GODET01], and uses by “*contribution*” relationships.

These relationships create a complex network of (in-) direct relationships between elements. For instance, the pressure relationships between actors can potentially change as a result of the evolution of certain issues or shifts in user needs. Decision support systems can help to assess these influence networks.

3.3. Assessment tools

For assessing these three main perspectives, our research tries to integrate in the same framework different already existing decision or analysis tools.

Actor analysis

At the actor level, we distinguish the industrial organisation inspired analysis (i.e. five forces and the value chain models), and the family of social or policy network analysis.

Based on the business model of the different actors, it is possible to assess the exchange of value and the interactions among them using the value system model. There are important indirect relationships between actors that must be taken into account, such as the pressure of existing competitors, suppliers, buyers, new entrants and substitute products producers [PORTER&80].

Policy network analysis [BRANDES&99] is another approach used in policymaking to study structures, processes, and outcomes, thereby concentrating on relations between policy actors.

Issue analysis

For assessing the strategic issues of a given environment, the structural analysis and the actor-issue analysis can be integrated in the application portfolio for eliciting the issues, assess the convergences and divergences, and anticipating coalitions and conflicts.

Identification of the relevant issues is a difficult task and is mostly a matter of judgment. It often must rely on the opinion of a group of experts. A number of methods can help by fostering creativity (e.g. brainstorming, assumption reversal, analogies), consensus (e.g. Delphi, nominal groups) and collaboration (e.g. group support systems).

[GODET01] proposes a systematic and formal method for identifying, classifying and prioritising issues. This structural analysis model, called *MICMAC*, is based on the concept of influence and dependence between issues and classifies issues as dominant, relay, dominated and autonomous.

An interesting category of tools consists of actor-issues methods. These basically consider the environment as a game between multiple actors that try to influence the issues that govern its evolution, either by mobilizing their resources to directly influence the issues outcome or indirectly by influencing (i.e. negotiating with) other actors.

There are a few actor-issue methods which stem from various disciplines and provide different information. The *MACTOR* method [GODET01] originates from a systemic perspective and provides an aggregate overview of the system under study through a number of computations on several input matrices.

[ALLAS&02] developed a simpler model to support negotiators, which essentially consists in a set of graphs that provide strategic information. Other methods tackle the same problem based on game theory using expected utility calculations [BUENODEMESQUITA&94]. Our prototype tool *MASAM* is built on these methods by combining their advantages and correcting some of their shortcomings [BENDAHAN&03].

Use analysis

Data warehouses, data mining and the so-called business intelligence tools for gathering, storing, analysing, and providing access to data should help analysts to explore the “*use*” perspective [LESCA&03].

There are also a variety of quantitative and qualitative methods including surveys, interviews, customer visits and focus groups [McQUARRIE96]. Alas, they are better suited for descriptive research than to discover actual or anticipate user needs. Reasons for this are that users are hardly conscious of their real needs and are prone to outside influence.

An alternative solution consists of focusing on the user's behaviour. There is a multitude of methodologies from different research disciplines such as diffusion studies (studying the link between the characteristics of an innovation and its diffusion process), adoption studies (focusing on the individual user's decision to adopt a particular service), uses and gratification studies (studying the gratifications sought in adopting a new service), domestication studies (studying the effect on society of domestication of everyday life technology), observational research (ethnography, participant, indirect observation, usability studies) and experimental methodologies (e.g. simulated shopping experience in a controlled environment) [PEDERSEN&03].

Companies must also understand the possible market evolution. There are several forecasting methods, such as various extrapolation techniques, probabilistic forecast, scenarios, expert opinion, Delphi, buyers' intentions survey, etc [MARTINO03].

Finally, we favoured a disruption analysis for detecting potential disruption in technology use and assessing the disruptiveness of emerging value propositions by comparing them to the more established ones on a number of dimensions [RAFII&02].

4. Evolution scenario

The ontology and the associated analysis models we suggest for this kind of emergent information systems should help to formulate a response to control the complexity, the uncertainty and the disruptiveness of most technology-intensive environments. They can be used not only for assessing the actors, the issues, the use of more or less disruptive technologies, and their mutual influences but also for forecasting, elaborating scenarios, and in so doing, nurturing decision-makers.

Since the future in a technology landscape is so uncertain and the pace of development so fast [COURTNEY&01], a scenario-based forecasting approach could be helpful before defining a strategy of adoption, deployment, and management of business solutions.

Traditional strategic planning methods are not suitable, because they are based on the assumption that the future can be predicted accurately enough to choose a clear strategic direction.

A suitable alternative is a scenario-planning approach [GODET&00], [SCHWARTZ91] [VANDERHEIDEN96], which is well suited to address the high levels of complexity and uncertainty observed in this industry.

Scenarios are descriptions of possible or probable futures, detecting and understanding the weak signals and the emerging lack of continuity on the way to the foreseen future. Scenario planning follows a systematic, interactive, and imaginative process. The exercise ends with three or four scenarios presenting plausible and surprising alternative future, instead of extrapolating current trends from the present like traditional forecasting. Scenario planning should facilitate strategy and decision in uncertainty.

There are a variety of different methods for designing scenarios. Developed in the so-called *French School* [GODET&00], the structural scenario method aims at constructing representations of probable futures as well as the formal rules and routes that lead there, using a mixture of facilitated group interaction and formal quantitative techniques (prospective workshop, structural analysis, analysis of actor's strategies, morphological analysis, expert inquiries).

On the other way, the *Global Business Network* approach, popularised by *Shell* in the 70's [SCHWARTZ91] [VANDERHEIDEN96], is much more informal and based on the key factors, the driving forces, and the alternative visions gathered by a team of experts during scenario workshops.

To prepare and analyse scenarios, a simulation modelling approach [CONSTANCE&01] is sometimes adopted. The simulated models should reveal what could happen if actors adopt different strategies under different market and competitive conditions.

5. Conclusion

We have suggested extending the traditional view of business/IT alignment with a more explicit consideration of the outside environment and the time evolution.

We end this position paper with three propositions, which have not been validated but could be the basis for more experiential studies:

Proposition 1 (Business alignment). – An explicit and formalized business model contributes to improve the IT alignment with internal business.

Since the business model conveys a more operational view of the strategy and the ontology we suggest allows a precise definition of its components, its formalisation and its exploitation should make easier the alignment of the executive scorecard (strategy), the application portfolio and the IT infrastructure (technology), and the IS profile (organisation).

Proposition 2 (Environment alignment). – An explicit and formalized environment assessment contributes to improve the IT alignment for a better business adaptation with its outside environment.

A well-defined influence model representing actors, uses and issues of the external environment, with the appropriate decision support system, should make easier and more accurate the assessment of an outside technology-intensive environment, which in turn should improve the adequacy of the business model.

Proposition 3 (Evolution alignment). – An explicit and formalized scenario approach contributes to improve the IT alignment for a better business adaptation to its evolution mainly due to its environment evolution.

In a technology-intensive landscape, forecasting is a difficult exercise, as reminded by the following quotes:

"This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us." West Union internal memo, 1876.

"I have travelled the length and breadth of this country and walked with the best people, and I can assure you that data processing is a fad that won't last out the year." The editor of management books at Prentice-Hall, 1957

"There is no reason anyone would want a computer in their home." Ken Olsen, President and founder of Digital Equipment Corp., 1977

A scenario approach with all its weaknesses and difficulties seems to be the most appropriate solution for examining the possible futures of a given environment, evaluating their potential impacts on a business model, and its repercussions on the evolution of the information systems.

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