

# Information systems alignment in uncertain environments

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## Abstract

*Managing an organization is a delicate art of achieving alignment between its various internal and external components. In particular, the alignment between an organization's strategy, its environment and its information system has traditionally been a key management issue and has been largely investigated. However, the contribution of information systems towards achieving alignment between these components has been much less considered. This paper presents a theoretical framework for designing a strategic DSS for assessing the organization's environment and evaluating its potential evolution scenarios.*

## Keywords

Information systems alignment, environment assessment, scenario planning

## 1. INTRODUCTION

Management is a subtle art of achieving alignment between the various components that comprise the company and its environment. The alignment between the strategy and the various internal constituents of the enterprise has been a key management research issue and has been largely investigated. In particular, research has tackled the question of the alignment between business strategy, organizational structure and information systems (Henderson and Venkatraman 1993). Furthermore, the importance of achieving coherence between the organization's strategy and its environment has been acknowledged by numerous renowned authors in strategic management (Dill 1958; Learned, Christensen et al. 1965; Porter 1980; Andrews 1987).

In this paper, we are particularly interested in the co-alignment between business and information systems (IS). We suggest considering three levels of alignment. The first level corresponds to the nowadays classical internal alignment of IS with the other constituents of the enterprise, namely its strategy, organization and technology. The second level considers the external environment of the enterprise. It is assumed that IS have to integrate features for assessing the environment so as to facilitate the alignment of the organization with it. Finally, the third level copes with evolution over time and emphasises the necessity to design IS that are able to evolve according to the future changes in the organization and its environment so as to achieve an enduring alignment.

While the internal alignment has been largely investigated by numerous information system researchers (Henderson and Venkatraman 1993; Luftman, Lewis et al. 1993; Hirschheim and Sabherwal 2001), the contribution of information systems towards achieving alignment with the environment and its evolution have been much less considered and formalized. Even though the internal level of alignment remains an essential and necessary first step in achieving alignment, we estimate that the two others levels of alignment will progressively gain importance due to the increasing uncertainty, complexity and disruptiveness that characterize the recent evolution of the business environment of many technology-intensive industries.

This paper aims at describing a theoretical framework which provides a foundation for designing strategic decision support systems for assessing the organization's environment and appraising its potential evolution scenarios. In particular we propose an ontology indicating the relevant elements to investigate in technology environments as well as a selection of methods and tools that can be employed to analyse them. This ontology draws upon these three characteristics and provides three perspectives: the actor perspective to deal with complexity, the uses perspective to deal with disruptiveness and the issues perspective to deal with uncertainty.

The paper is structured as follows. The next section briefly considers the internal alignment problem and suggests that alignment can be facilitated by the formal definition of the company's business model. Section three deals with the external alignment and suggests a theoretical framework with its associated tools for assessing the organization's environment. The fourth section sketches a scenario approach aiming at integrating assumptions on the future evolution of the environment when designing information systems. Section five illustrates the application of these concepts to the realization of a prototype information system. Finally, section six, summarizes the main contributions of this paper and highlights interesting possibilities for further research.

## 2. ALIGNMENT WITH STRATEGY

The existence of a strong mutual relationship between information systems, organizational structure and corporate strategy components has been amply documented. Whereas the early work on strategic IS alignment was 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 and Venkatraman 1993).

Many companies are still struggling to achieve a satisfactory alignment between their current business and information strategies. In many instances, a major problem in achieving alignment is the lack of common understanding and communication between the strategy and information system worlds. In fact, most of business people have an intuitive understanding of how their business works, but they are rarely able to communicate it in a clear and simple way. As a result, IS people rarely understand what it is expected from them and how they can improve the company's business goals. Conversely, IS people have a clear idea of what information technology is able to provide, but they have difficulty in achieving an IS strategy that fits the general business picture.

We propose that an accurate and detailed formalization of the organization's business model can facilitate the alignment with the information system. The main reason is that a formal approach forces managers and IS staff to adopt a common vocabulary which allows them to unambiguously communicate and share their understanding of the business logic among each other (Fensel 2001). Moreover, the process of modelling helps identifying and understanding the relevant elements in a specific domain and the relationships between them (Morecroft 1992).

The Business Model Ontology presented in (Osterwalder and Pigneur 2002) is the conceptualisation and the formalization into elements, relationships, vocabulary and semantics of the essential elements of a business model. This ontology is structured into several levels of decomposition with increasing depth and complexity. The first level of decomposition of our ontology contains the four main elements of a business model.

- The *product innovation*. This element essentially covers all aspects related to the value proposition of the firm. This comprises not only the set of benefices the firm proposes to its customers, embodied in its products and services, but also the manner in which it differentiates itself from its competitors.
- The *customer relationship*. This element describes who are the target customers, the way a firm gets in touch with them (i.e. its distribution channels) and the mechanisms used to acquire new customers and retain the current ones (i.e. to maintain a customer relationship).
- The *infrastructure management*. This element describes the value configuration that is required to deliver the value proposition and 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 partner network allowing the firm to access these resources and fulfil these activities.
- The *financials*. This element is the culmination of the business model: a valid business model must guarantee long-term financial success. It is composed of the company's revenue model and its cost structure, which finally define the profit of a firm.

From an alignment standpoint, if the business model has been defined using such approach, the contribution of information system to the business logic of the firm can be accurately identified. Consequently, it would be easier to work out the functionalities that information systems are expected to perform in order to achieve a better alignment with the business requirements of the firm. Similarly, a formal business model would facilitate the choice of the indicators of an executive information system for monitoring the strategy implementation, using for example a balanced scorecard approach with its financial, customer, internal business, and innovation perspectives (Norton and Kaplan 1996).

## 3. ALIGNMENT WITH THE ENVIRONMENT

Achieving the internal level alignment is a highly valuable and essential first step. The formalization of the company's business model can attenuate one major problem in achieving business/IS alignment. However, the validity of any business model largely depends on its adequacy with the environment in which it is deployed. Therefore, it is fundamentally important for organizations to assess and monitor the environment in which they deploy their activity.

Assessing or scanning the environment of an organization has been 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 (Aguilar 1967). Organizations basically 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.

Many renowned strategic management researchers have considered the co-alignment between the organization's strategy and its environment as essential for performance. A few well known models have been proposed for helping managers to achieving alignment with their environment. For instance *the SWOT model* sees strategy as the result of the matching between the present and future opportunities and threats in the environment with the organization's unique strengths and weaknesses (Learned, Christensen et al. 1965; Andrews 1987). Similarly, the well known *five forces model* advocates that strategy shall be formulated by considering the fundamental competitive forces that shape industry structure, i.e. the pressure of existing competitors, suppliers, buyers, new entrants and substitute producers (Porter 1980). The *disruptive technology framework* suggests that a company must pay sufficient attention to its environment (and not overly focus on current products, processes and customers) unless it wants to take a great risk of not perceiving and dealing with change that does not initially affect their mainstream market but can later disrupt it (Christensen and Bower 1996). Finally, the *prospective approach* explicitly recognizes the fundamental role of monitoring the environment and its evolution by tightly intertwining strategy formulation with environmental analysis and a scenario planning approach (Godet 2001).

Furthermore, a few empirical studies support the importance of environmental scanning and suggest a positive relationship with organizational performance (Choo 2001). For instance, it has been found that higher-performing firms are characterized by more frequent scanning and by careful tailoring of scanning to perceived strategic uncertainty (Daft, Sormunen et al. 1988). Conversely, firms having advanced environment monitoring systems has been shown to exhibit higher growth and profitability than firms that did not have such systems (Subramanian, Fernandes et al. 1993).

Research has also shown that environmental analysis is even more essential in industries which are characterized by disruptive, uncertain and complex environments such as those that characterize technologically intensive industries like the mobile business, e-business and software industries. These characteristics are indeed considered as the major drivers of environmental scanning (Daft, Sormunen et al. 1988; Boyd and Fulk 1996). Ironically, while these characteristics increase the value of environmental analysis, they also make it more difficult and costly, hence contributing to the necessity of having specialized information system to facilitate the task and make it more efficient.

Unfortunately, while the development of knowledge has produced many models and techniques to deal with parts of the problem, there is no easy methodology allowing for a systematic assessment of an organization's environments that can be used to design such information systems. Hereafter, we expose a theoretical framework that integrates a set of complementary perspectives with the aim to facilitate the design and development of information systems seeking to support the assessment and the monitoring of such environments.

From a conceptual modelling or ontology point of view, we suggest three main perspectives for modelling an information system dedicated to assessing such technology environments. The perspectives have been identified through a literature review of the major environment analysis approaches and correspond to the major properties of technology environments: the actors perspective deals with complexity; the issues perspective is concerned with uncertainty; the uses perspective copes with disruptiveness. In addition, these perspectives are linked by the concept of influence as illustrated in Figure 1.

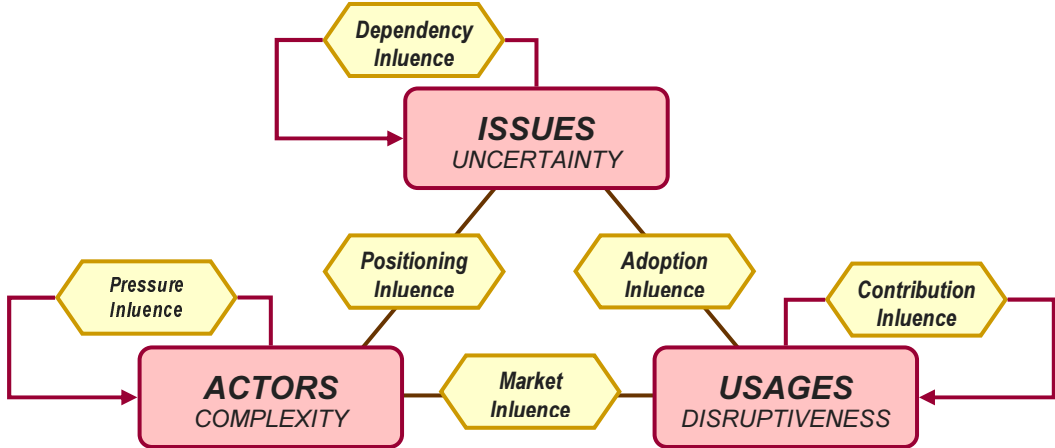


Figure 1: Environmental analysis framework

**3.1. Actors Perspective**

The actors perspective deals with environmental complexity. It arises from the large number of environmental factors facing the enterprise and the level of interdependence among them. In particular, the recent evolution of many business environments is characterized by an increasingly complex network of actors. These networks

encompass a large number of interdependent organizations which are interrelated in an intricate way. As a result, their behavior is increasingly heterogeneous and difficult to understand.

Understanding the roles of the different actors participating in a business system is essential because of their central role in shaping the future environment conditions by partly influencing some of the forces that govern its evolution (Godet 2001). The analysis of the other actors in the environment is also advocated by the competitor intelligence approach as well as several authors in strategic management.

The relevant actors are those that have the power of directly or indirectly influence the organization's performance. A prominent place is taken by the various actors in the immediate business environment that contribute to satisfy the same end-user needs such as direct competitors, suppliers, buyers, new entrants and substitute product producers (Porter 1980). Still, other influential players in various environmental areas must be taken into account. It is indeed suggested to consider all the actors which can influence some of the factors that determine the environment evolution. In particular, it is worth considering players in the less immediate environment such as regulatory authorities and technology suppliers.

In order to analyse the actor perspective we recommend to briefly but clearly describe their business models, as described in the previous section, in order to gain a systematic understanding of the actors under study. Based on these business models, it is possible to use the value chain framework (Porter and Millar 1985) and its value shop and value network extensions (Stabell and Fjeldstad 1998) in order to assess the exchange of value among the different actors in a value system. In addition, there are important indirect relationships that must be taken into account. For instance, one must consider the pressure of other players such as the existing competitors, suppliers, buyers, new entrants and substitute products producers (Porter 1980), but also players in the regulation and technology areas. Similarly, the MACTOR tool (Arcade, Godet et al. 1999) uses the concepts of objectives, pressure means and influence to examine actor's relationships.

A deeper analysis of actors in a social context requires to complement this industrial organization perspective with intentional and social dimensions. Consequently, one can express and reason about motivations and rationales, and capabilities and vulnerabilities of social actors (Mylopoulos 1998; Yu, Liu et al. 2001). Moreover, the social network analysis approach can be used to study the structure of inter-organizational relationships so as to make the web of direct and indirect relationships more explicit and analyse the transactional content, nature of the links and structural characteristics of the business network (Tichy, Tushman et al. 1979).

### 3.2. Uses

The uses perspective deals with disruptiveness, with its potential non-continuous development, adoption and use of mainstream and alternative technologies and products. Disruptive technologies are usually simpler, cheaper, more convenient-to-use innovations that initially underperform established products in mainstream markets and are used only by the unsophisticated customers at the low end of the market. However, uneven technological developments can lead these innovations to quickly develop into a competitive threat, dramatically transforming the marketplace. The *disruptive technology framework* suggests that companies which do not monitor their whole market environment (i.e. because of their strict focus on current products and customers) are at risk of perceiving disruptive technologies too late and significantly lose their market share (Christensen and Bower 1996).

For coping with disruptiveness, the use and adoption of the monitored technologies has to be assessed. This basically implies investigating the end user needs and how they are translated into wants (desires to buy specific products to satisfy these needs) and finally demands (capacity and willingness to pay for these products) (Kotler 2003, p. 11). In simpler terms, it is fundamental to understand how customers value the various technologies and value propositions offered by the different actors and how they make their decision to adopt a particular one.

It is worth pointing out that research in marketing has shown that the market is not a homogeneous group, but that buyers rather tend to have individual needs, behaviours and preferences. A process of segmentation is commonly used at the beginning of the study to identify "*groups of customers that have similarities in characteristics or needs that are likely to exhibit similar purchase behavior*" (Smith 1956). The resulting market segments are usually characterized in terms of various socio-demographic, psychological and behavioural variables that characterize their components' profile.

Traditionally, user needs are investigated by asking users to elicit their needs. There are several quantitative and qualitative market research methods including various types of surveys, interviews, customer visits and focus groups (McQuarrie 1996). Unfortunately, they are better suited for descriptive research than to discover or anticipate actual user needs: users are hardly conscious of their real needs and are prone to reporting bias.

An alternative consists in focusing on the user's effective or planned behaviour. There are several 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 societal consequence of innovations on everyday life), observational research

(ethnography, participant observation, usability studies) and experimental methodologies (e.g. simulated shopping experience in a controlled environment) (Pedersen and Ling 2002; 2003).

Finally, we mention a disruption analysis approach for assessing the disruptiveness of emerging value propositions by comparing them to the more established ones on several dimensions (Rafii and Kampas 2002).

### 3.3. Issues

The issues perspective deals with environmental uncertainty, which arises because of the presence of open and unresolved issues whose unpredictable evolution leads the future evolution of the environmental conditions open to many possibilities. 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 (Ansoff 1980). Issues can arise in different environmental areas such as the market, technology, regulatory, economic and social domains

While the actors and uses perspectives provide a good picture of current conditions, they are not a sufficient basis for guiding decisions which deploy their effects in a distant future. The issues perspective adds a long term focus so as to take consider the potential evolution scenarios of the environment. Due to the high uncertainty of future developments, this leads to establishing a number of scenarios rather than a single forecast. As we will illustrate it in section 4, issues are a good mechanism to reflect on possible disruption of current conditions, allowing the development of a broader set of scenarios.

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...), achieving consensus (e.g. Delphi studies, nominal groups) and support collaboration (e.g. group support systems).

The *prospective approach* proposes a systematic and formal method for identifying, classifying and prioritising issues based on expert opinions. This structural analysis method is based on the concept of influence and dependence between issues and classifies them as dominant, relay, dominated and autonomous (Arcade, Godet et al. 1999). It also provides a means to estimate the degree of instability of the environment.

The same author underscores the active role of the actors in the determination of the issues outcome and thus on the environment evolution (Godet 1977). He advises to consider those issues that are open to dispute and upon which actors have diverging positions and means of influence. A few methods try to link actors and issues: the environment is considered as a game between multiple actors which try to influence the issues that govern its evolution either by mobilizing their resources to influence their outcome directly or indirectly by influencing (i.e. negotiating with) other actors. Among these methods, we highlight the *MACTOR* method (Arcade, Godet et al. 1999), which provides an aggregate overview of the system under study through a number of computations on several input matrices, the Negotiator model (Allas and Georgiades 2001), which essentially consists in a set of graphs that provide strategic information to support negotiators, and a few political forecasting models (Bueno de Mesquita 2002) which tackle the problem based on game theory using expected utility calculations

### 3.4. Influence relationships

In this technology assessment context, the various perspectives are interdependent and tightly interrelated. The concept of influence relationship - be it preference, pressure or power - is the pertinent relationship between the three types of concepts. While the influence concept is generic, relationships between a particular pairs of elements have an adapted meaning.

Actors and uses 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 (market pull). Conversely, actors can often shape and even create user needs by offering innovative value propositions (technology push).

Actors and issues are linked by a "*position*" relationship. On the one hand, actors can influence the outcome of certain issues by strategically positioning themselves on them and exerting their power. On the other hand, the realization of certain issues constrains the strategic positioning that actors can take and influences their power.

Uses and issues are linked by an "*adoption*" relationship in the sense that the realization of issues can affect end user needs and, therefore, their decision to adopt a particular value proposition or technology. Conversely, the adoption of certain solutions may affect, positively or negatively, the future outcome of certain issues.

Actors are linked to other actors by "*pressure*" relationships which may stem from an uneven power balance in a business negotiation, competitive threats or other kinds of intentional and social relationships (Porter 1980).

Issues are linked to other issues by "*dependency*" relationships: the realization of a particular outcome of an issue can have an impact on the likelihood of realization of the outcomes of another issue (Godet 2001).

Finally, uses are linked to other uses by “*contribution*” relationships: the adoption of a particular use or technology can influence the one of another one. The contribution can be positive, such as with complementary uses, but also negative, such as with substitute uses, as well as disruptive.

These relationships give rise to 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. A decision support system can greatly facilitate the assessment of these influence networks.

#### **4. ALIGNMENT WITH UNCERTAIN EVOLUTION**

Once information systems have been aligned with the organization’s strategy and its environment system, the alignment task is not over. Evolution in the environment or organization’s strategy would require information systems to be aligned repeatedly. It would therefore be useful to incorporate features to cope with the potential evolution of these components in the information system design. This is particularly the case in uncertain, disruptive and rapidly changing environments.

The ontology and the associated analysis methods 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 technology-intensive environments. These elements can be used not only for assessing the environment at a given time, but they can also be exploited to provide valuable insights for elaborating future evolution scenarios. These scenarios provide a means to design information systems which consider these evolution possibilities in advance and are thus likely to remain aligned for a longer time.

There is a large variety of forecasting methods that might be envisioned to assess the future prospects of the technology environments such as extrapolation and probabilistic forecasts, casual models, forecasting by environment scanning, expert opinion and scenario planning (Martino 2003).

Traditional forecasting and strategic planning methods based on extrapolation and casual models are not appropriate in such uncertain and potentially disruptive environments, because they are based on the assumption that there is a single future which will be a simple continuation of the past. Moreover, they fail to take into account the effects of the actors inside the environment of its evolution, which can significantly alter its future trajectory through strategic action (Godet 1977). The danger of relying on this type of forecasting model has been evidently illustrated by their repeated failure to predict the various oil and economic crises. In uncertain and potentially disruptive environments, the danger can be as high as the danger of relying on intuition alone (Courtney, Kirkland et al. 2001).

Since the future developments of technology landscapes are so uncertain and the pace of development so fast, a scenario-based forecasting approach seems a better alternative. Indeed, scenario-planning approach are claimed to be well suited to address the high levels of complexity, disruptiveness and uncertainty observed in these environments industry (Dyson 1990). Scenario planning follows a systematic, interactive, and imaginative process with the aim of creating a certain number of scenarios (usually three or four) presenting plausible and surprising alternative future. Scenarios are descriptions of possible or probable futures as well as the hypothetical sequence of events that would lead from the current situation to the future situation (Kahn and Wiener 1967).

Two major approaches for designing scenarios can be identified in the literature. On the one hand, the structural scenario method (Godet 2001) is based on a mixture of facilitated group interaction constantly backed up by formal rules and formal quantitative techniques such as structural analysis, analysis of actor’s strategies, morphological analysis and expert inquiries. On the other hand, the Global Business Network approach popularised by Shell in the 70’s (Schwartz 1991) is much more informal and based on the identification of the key factors and driving forces in the organization’s environment, and alternative visions gathered by a team of experts during scenario workshops.

The ontology and the associated analysis methods we suggest in the previous section can be exploited to provide a solid foundation for elaborating future evolution scenarios. In addition to provide a thorough understanding of the current situation, the three perspectives provide valuable insights on the various factors that might cause the future situation to depart from the one which would have been obtained from the mere extrapolation of current trends. In particular, the issues perspective provides an overview of the most important factors that shall govern the future evolution of the environment. The actors perspective allows the scenario developer to take into account the effect of the different actors’ strategies and their effect on the likelihood of certain outcomes of these issues. Finally, the uses perspective takes considers the potential effects of disruptive innovations and technologies on both actors strategies and issues realization.

An illustration of a similar methodology for constructing scenarios based on a preliminary environmental analysis can be found in (Aarnio, Enkeberg et al. 2002). This scenario exercise used the structural scenario method (Godet 2001) to find a set of likely futures for the mobile commerce industry. In particular, they based the construction of the scenarios on a careful analysis of the relevant issues and actors.

## 5. ILLUSTRATION OF A DSS FOR ASSESSING A TECHNOLOGY ENVIRONMENT

This section illustrates how the concepts exposed in the previous sections could contribute to the realization of a decision support system for analysing an uncertain environment. We will shortly describe a prototype DSS and illustrate its application of to the Wireless LAN Internet Service Provider (WISP) industry.

### A prototype DSS

In order to illustrate the usefulness of an environment analysis system, we conceived a prototype DSS aiming at facilitate the analysis of uncertain environments involving multiple actors with divergent interests on multiple issues (Bendahan, Camponovo et al. 2003; Monzani, Bendahan et al. 2004). This system supports both negotiation and forecasting, allowing its users to devise strategies which consider the objectives and means of the other actors as well as the potential disruptive effects of the realization of certain issues.

This tool is based on the multi actor-issue models proposed by Godet (Arcade, Godet et al. 1999) and Allas (Allas and Georgiades 2001). Actually, it integrates the advantages of these models, corrects some of their flaws and adds a few new features. It currently includes the actors and issue perspectives, but shall be extended in the future to include the uses perspective as well. In the meantime this can be regarded as a particular case of issues (i.e. development of a certain type of use or technology) and actors (i.e. customers).

The tool is based on the collection of the opinion of a number of experts about the environment. They are firstly asked to provide a list of the relevant actors and issues. Then, they must fill a number of input matrices with the *position* (preferred outcome), *salience* (value of attaining the preferred outcome) and *clout* (power to influence the issue's outcome) of each actor on each issue, as well as the *influence* of each actor on each other.

The prototype performs a series of transformations on these inputs in order to aggregate and analyse them and generate valuable information that would be hardly obtainable from an unassisted analysis of the inputs. These allow the user to assess direct and influence between actors, the issues' expected outcomes, the actor's disagreements with these outcomes, the actors' true power repartition and their proximity. This information is useful to identify potential evolution tendencies, negotiation strategies, alliances and conflicts. A visualization tool has also been developed to provide a graphical and interactive representation of this information, providing a means to easily and almost intuitively interpret it (Monzani, Bendahan et al. 2004).

### Application to the WISP industry

In order to illustrate how such models can be employed to give an overview of the current situation of an uncertain environment, we present a relatively simple example taken from a study we conducted in the late 2002 on the WISP industry in Switzerland (Bendahan, Camponovo et al. 2003). This industry has been chosen because of its high uncertainty and potentially disruptive environment as well as for the general interest that surrounds it. The presence of a number of open questions that have not yet been answered and of salient actors with diverging positions is one of the reasons of conducting a study using a multi-issue-actor model. The idea is that by taking into account the effects of the actors on the evolution determinants of the system (i.e. the issues), more realistic future scenarios can be designed.

ISSUES	ACTORS
<ul style="list-style-type: none"> <li>• <b>Mobility:</b> it describes how much mobile the use of WLAN will be. It ranges from stationary use (wireless connectivity within a very limited area) to mobile use (continuous connectivity while on the move).</li> <li>• <b>Device:</b> it shows which device will access WISP services. It ranges from notebook-type devices to mobile phone-type devices, passing through PDAs.</li> <li>• <b>Wide Area WLAN development:</b> it refers to the extent of coverage offered by WLAN networks. It ranges from a scarce and spotty coverage (i.e. only a small set of venues) to a truly ubiquitous coverage (i.e. through integration of WLANs with cellular networks).</li> <li>• <b>Free networks emergence:</b> it reflects the extent to which free community networks arise. It ranges from a pure commercial WISP environment to a pure community network environment, with different degrees of coexistence in the middle.</li> <li>• <b>Regulation:</b> it represents the tightness of the national WLAN frequency allocation, emission rights and the related policies.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Mobile network operators:</b> they operate cellular wireless networks such as GSM, GPRS and UMTS networks.</li> <li>• <b>Other network operators:</b> they include operators of wireline telephony, packet-based data networks and WLAN networks.</li> <li>• <b>Venues:</b> they include a variety of property owners which provide the place where the access points are installed (e.g. airports, hotels, public buildings and so forth).</li> <li>• <b>Communities:</b> they are loose federations of people willing to cluster their private hotspots together to provide networks access to other community members.</li> <li>• <b>Informatics-related enterprises:</b> they are companies active on the informatics industry, whether by selling hardware, software or network equipment.</li> <li>• <b>Telephony-related enterprises:</b> they are companies active on the telephony industry, whether by selling hardware, software or network equipment.</li> <li>• <b>Regulation authorities:</b> they are the local regulation authorities controlling the frequency allocation.</li> </ul>

Figure 2: Issues and actors

In order to keep the example simple, we focused ourselves on a very limited number of issues and actors (see Figure 2). The necessary information (position, salience, clout and influence) was gathered on the basis of interviews with 5 academic experts of the field under study. Notice that the opinion of these experts does not necessarily represent a veracious image of the WISP battlefield, the number of experts is fairly low and no experts representative of the different actors' categories have been interviewed. This has been a deliberate choice, as the goal of this brief study is to simply illustrate the previously described concepts.

Hereafter, we present a selection of the results that were obtained during this study. It is desirable to firstly analyse the relationships between actors. The influence graph of the visualization tool (cf. Figure 3) illustrates the relative power of actors well as the influence between actors. It suggests that mobile network operators are by far the most important actors, since they are both a powerful and influent actor (having in particular a sizeable influence on regulation authorities). On the contrary, venues are much less important, with little overall power and highly influenced. This was quite surprising because at that time venues were considered as important actors (Herslow, Navarro et al. 2002). It is also useful to consider possible negotiation strategies: for example network operators might use their influence on the regulator to get more stringent WLAN regulations.

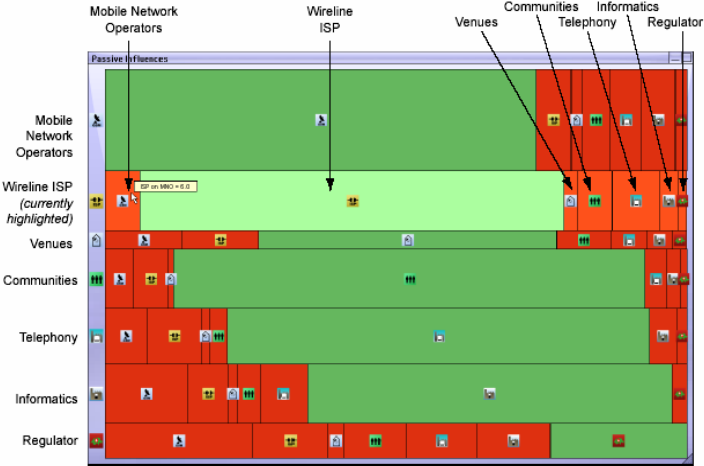


Figure 3: Influence graph. This mosaic graph represents each actor with one horizontal band. Its height is proportional to the power of the actor. Each band is then segmented according to the influences of the other actors on this actor. The brighter surface distinguishes the self determination.

In addition, the power repartition graph illustrates the relative importance of issues, the power repartition and salience of actors over each issue (cf. Figure 4). This graph suggests that the most important issue is the emergence of free networks. Two groups of salient actors dispute on its outcome: network operators and ISPs which are against free network emergence, and communities which are in favour. These players may seek the support from the other players which are less salient. In particular, network operators should try to obtain support from telecom firms (e.g. by offering its support on the device issue), while communities might try to get support from certain types of venues.

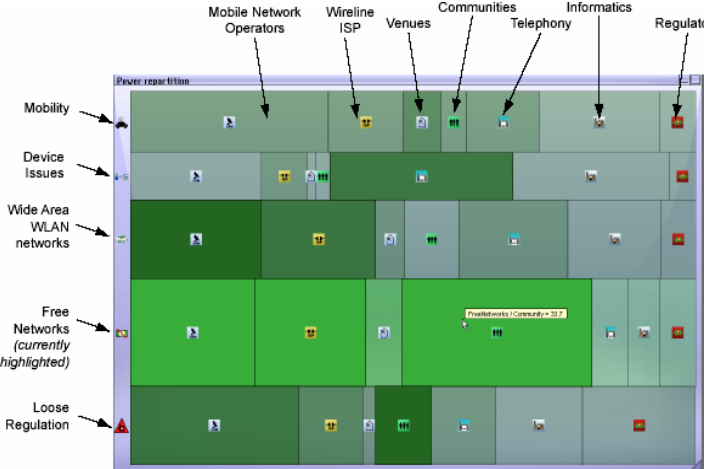


Figure 4: Power repartition graph. It represents each issue as a horizontal bar. The relative importance of each issue is proportional to the surface of the bar. The power of actors on issues determines the widths of the rectangles inside the bar. The darkness of these surfaces shows the salience of each actor on each issue.

Finally, this intuition can be checked by looking at proximity map (cf. Figure 5), which illustrates the relative proximity of actors based on their preferences on the different issues. In our example, two major dimensions of divergence can be identified. A neat difference of opinion can be found between communities and commercial providers. In addition, players favouring mobile use of WLAN (i.e. mobile network operators and telecom firms) are clearly apart from players favouring a more stationary use (i.e. ISPs and informatics firms). The regulator and venues are somewhat in the middle of the different groups, which suggests that they could be interesting allies.

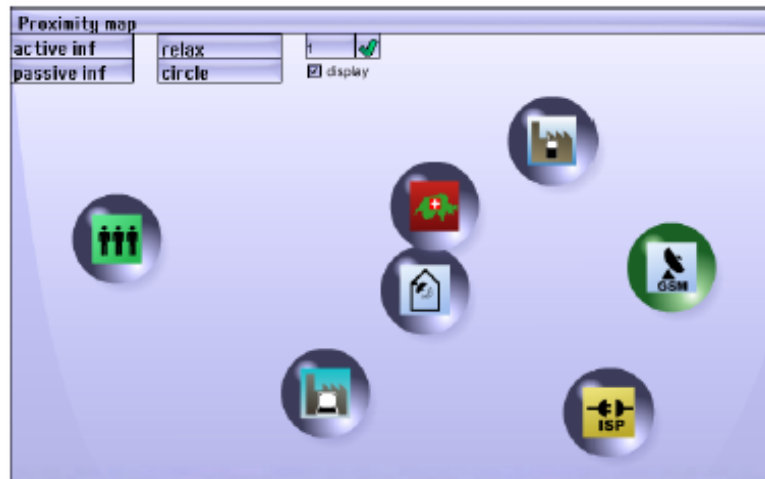


Figure 5: Proximity map. It represents the relative proximity of the different actors.

Based on these considerations, it is possible to identify three coalitions of actors that might emerge and try to bring the WISP industry towards different uses. The first is composed by mobile operators and telecom firms, which will try to position WLAN to offer mobile services (targeted at mobile workers) which are complementary to their wireless cellular networks services. The second comprises ISPs and Informatics which favour a more private use of the WLAN technology to add wireless connectivity to their local and internet access networks. Finally, communities will try to use WLAN technologies to share a common network access infrastructure and provide a cheap wireless Internet access to the ordinary people. These findings could be employed to build a set of scenarios which present a few potential future directions in which the WISP industry can evolve.

## 6. CONCLUSIONS

This paper illustrates how information systems can significantly contribute to the strategic alignment of the enterprise. We advise considering three levels of alignment and propose three simple mechanisms to improve it.

The first level of alignment corresponds to the nowadays classical internal alignment between business strategy, organization and technology. One major unresolved problem is a lack of shared understanding between managers and IS people and we suggest that this can be attenuated by the formal definition of the firm's business model.

The second level considers the external alignment of the enterprise with its environment. It is assumed that IS should integrate features for assessing the environment so as to facilitate this external alignment. We proposed a conceptual framework indicating the relevant elements (actors, uses, issues) to investigate and presented a selection of methods and tools to analyse them. This framework is especially suitable for technologically-intensive environments with their complexity, disruptiveness and uncertainty characteristics.

Finally, the third level copes with evolution over time and emphasises the necessity to achieve an enduring alignment. We suggested that a scenario based approach building on a thorough environmental analysis is a means to include the potential future developments in the information system design.

We end this paper with some propositions for future research.

Firstly, even though there are many models and techniques that deal with one or two different perspectives, there is no easy methodology that integrates them in the same framework. One important future research direction is to create a methodology for analysing the environment from multiple complementary perspectives (e.g. the actor, issues and uses perspectives) so as to give a comprehensive assessment of the environment. A prototype DSS shall also be implemented in order to illustrate the usefulness of such systems.

Secondly, the theoretical framework and its underlying proposition have not yet been validated and could be the basis for more empirical studies. In particular, we intend to apply this framework to analyse a number of concrete environments such as the Wireless LAN, mobile payment and location based services industries.

Thirdly, the huge amount of data that will be collected and generated by such systems is likely to surpass the understanding ability of the user. Suitable visualization mechanisms must be researched to offer the user a simple and intuitive way to navigate to the data and draw the most pertinent information. For instance, areas of interest could be the search for adequate representation metaphors and an AI assisted interpretation of the results.

Finally, the framework we presented in this paper is essentially static (even though projected in the future). A repeated analysis of several environments at different moments in time could help discovering their evolution dynamics and finding common evolution patterns. Simulation methods could also be envisioned to reveal what could happen if actors adopt different strategies under different markets and competitive conditions and facilitate the identification and understanding of these evolution dynamics.

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