Strategic Planning for Information Resources: Enhancing Managers’ Participation through Ontology-based Modeling

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Abstract
Successful strategic planning for information resources (SPIR) requires active participation of managers-users who are familiar with the cooperative and collaborative nature of the strategic planning processes. Hence, there is a need to provide them with reusable, flexible, agile and adaptable training material in order to enable them instil their knowledge and expertise in the SPIR process and automation activities. Knowledge reusability is of paramount importance in designing training material on process modelling since it enables managers-users participate actively in process design/redesign activities stimulated by the changing business environment. This paper presents a prototype approach for the design and use of training material that provides significant advantages to both the designer-strategic planner (knowledge - content reusability and semantic web enabling) and the user-manager (semantic search, knowledge navigation and knowledge dissemination). The approach is based on externalizing domain knowledge in the form of ontology-based knowledge networks (i.e. training scenarios serving specific training needs) so that it is made reusable.

Keywords: Strategic Planning for IT; Business process modelling; User training; Ontology-based knowledge networks.

Classification: Research paper
1. **Introduction: From Corporate Planning to Strategic Planning for Information Resources**

Planning, simply put, is the process of deciding how to achieve a set of goals. This definition implies future considerations (“goals”), as well as current actions (“how to achieve”). However, planning activities that comply with this simple definition are not necessarily strategic in nature. Thus, *strategic planning* is the process of deciding how to achieve a set of strategic goals. This definition also implies future considerations, but adds the notion of *importance* and *long-range* considerations by targeting management actions to “strategic goals”.

For any organization, a generic strategic planning process includes the following analyses: (a) evaluation of the organization’s *current situation* and accomplishments to determine its position in relation to its competitors and stakeholders; (b) scanning of the organization’s *external environment* to identify possible *opportunities and risks* related to future actions; (c) assessment of the organization’s unique capabilities and resources to determine its *strengths and weaknesses* that could help or hinder the organization in its future actions; (d) development of a set of *alternative actions and plans* to achieve the firm’s strategic goals and evaluation of each alternative to determine the *best choice*; and (e) development of *evaluation and control mechanisms* to measure the results towards the effective and efficient accomplishment of strategic goals, as well as any necessary *modification* to the initial planning process if such results are not found satisfactory.
Specifically for the function of information systems/IT, strategic planning for information resources (SPIR) is the process of deciding how to accomplish an organization’s IS objectives and align them with the organization’s overall strategic goals. Thus, SPIR incorporates all of the above analyses included in a generic strategic planning process, plus the notion of alignment between corporate and IS strategies (Reich and Benbasat, 2000; King and Raghunathan, 1987; King, 1978).

Hence, the primary purpose of SPIR is to take full advantage of the existing and potential capabilities of IT by aligning the IS objectives with the overall strategic objectives of the organization. Its secondary purpose is to facilitate the strategic transformation of an organization due to the IT-based changes occurring in today’s business environment (e.g., new market forces, new technologies, reengineering pressures, new information-based alliances among firms in the same or unrelated industries, changing economies, emphasis on customer satisfaction, and global competitive forces). Such strategic transformation enables an organization to reshape its traditional views on business competition by creating a more ‘open’ environment. In such an environment, the organization’s internal components (i.e., people, structure, tasks, technology) and its external components (customers, suppliers, competitors, etc.) can utilize IT developments to allow unlimited access to everyone involved (Pollalis, 2003; Pollalis and Grant, 1994).

In order (1) to facilitate this alignment process between the IS objectives and the overall strategic objectives of the organization, (2) facilitate this strategic transformation of the organization using IT technologies and (3) help users-managers involved in these
Participative strategic implementation is concerned not only with making users-managers’ knowledge explicit (i.e. eliciting users’ knowledge) but also with developing users-managers’ knowledge and producing new conceptions (Barrow and Mayhew, 2000; Lee, 1986; Anderson, 1985). In this context, enabling active user-manager participation requires an in-depth understanding of each business process involved. Along with the adoption of a participative approach to strategic implementation comes concern about providing users-managers with an appropriate training aid that will enable them understand SPIR process concepts, assimilate the business logic of existing business processes and identify areas where redesigning or streamlining of existing
processes is required to adapt to today’s complex and dynamic business environment (Wieringa et al. 2003; Rinderle et al. 2005). To this end, an ontology-based knowledge network is developed that can be used as a tool for the semantic representation of SPIR process concepts and, hence, as a means for the development of an appropriate training aid.

2. The Process of Strategic Planning for Information Resources

Figure 1

As articulated in Figure 1, the SPIR process involves a number of phases. These phases are:

(a) Assessment of Current Position: Where are we Now? This assessment includes the answers to such questions as “what is our business?”, “what are the critical success factors in our industry?”, “what resources -human, technological, and informational- do we have?”, “who are our customers?”, “what is our current IT applications portfolio?”, “how satisfied are our customers?”, “what relationships with our suppliers, distributors, and customers can we add value to via IT?”, and “to what extent have our existing ITs been fully deployed/diffused within our firm?”. Porter’s value-chain and value-system analyses (1985) and Rockart’s critical success factors analysis (1979) are also appropriate in this stage (King and Burgess, 2006; Teo and Ang, 1999).
(b) Internal Resources, Unique Capabilities, & Distinctive Competencies’ Analysis. In conjunction with the previous analysis, this one looks inside the organization to identify its strengths and weaknesses. The resources one could identify in a firm can be tangible (e.g., capital, technology, plants) or intangible ones (e.g., know-how, reputation, corporate culture, motivation, empowered groups). This kind of know thyself analysis helps an IS organization to focus on its capabilities, core competencies (i.e., those capabilities that are detrimental to a firm’s strategy and plans), or its distinctive competencies (i.e., those things an IS organization does particularly well when compared with other IS organizations).

(c) Environmental Scanning: Identifying Opportunities & Risks. This phase involves the identification of opportunities and risks (or threats) in a firm’s external environment. One approach would be to use Porter’s model of industry structure and identify the opportunities and risks in the relationships of the IT organization with the organization’s suppliers, customers, new entrants, substitutes, and competitors. Another methodology is the stakeholder analysis which would provide information about the various constituents with whom a firm interacts: customers, suppliers, the government, labor unions, financial and insurance institutions, the public, its employees, and its competitors. Since each business organization represents an open system, it is inevitable that each of an organization’s constituents could be the source of opportunities and risks for the IT function. Finally, benchmarking activities are part of this stage of strategy analysis. The information resources planning process includes various analyses to determine what organizational actions might generate opportunities
and risks for a firm’s future actions (Min et al. 1999; Ahituv et al. 1998; Pollalis and Grant, 1994).

(d) Strategic Alternatives, Choices and Evaluation. Based on the maturity of an organization (i.e., the number of years of its existence in the market and its ability to learn from its past strategic behavior), its resources and capabilities, and its quality of search activities for alternative solutions, the organization identifies a number of strategic alternatives to attain its goals and objectives. Such alternatives could include different IT applications, different IT architectures, and the development or acquisition of a number of additional resources that will complement its existing ones.

The choice and evaluation of these alternatives are based on a number of analyses, the most prevalent of which are: cost-benefit analyses, where each alternative is compared based on its expected returns and its total cost; market share analyses, where an alternative is judged based on the market share it can capture, therefore the potential profitability it can generate; opportunity costs analyses; and turnover or improvement in management training analyses, as surrogates for the generation of cost savings. Finally, other considerations might include not-so-rational choices, based on individual values, experience and perceptions of the environment (e.g., the decision by IBM to introduce PCs in the early 1980s was first rejected by a cost-benefit and market share analyses).

(e) Implementation Issues. A number of publications seem to question the usefulness of business strategic planning, and additional empirical evidence shows that most strategic planning efforts were unsuccessful or that very few strategic plans were ever
implemented (Salmela and Spil, 2002; Teo and Ang, 2001). Overall, recent research suggests that strategic planning failures can be attributed to implementation difficulties, such as (Teo and Ang, 2001; Lederer and Sethi, 1988):

- Failures in implementation after strategy formulation
- Failures in concepts underlying plan formulation
- Inadequate relevant information-poor assumptions, and
- Failures in analysis of information and data

Similar studies have investigated the effectiveness of information resources planning’s effectiveness (e.g., King and Raghunatahan, 1987; Lederer and Sethi, 1988). Some of the underlying causes for such implementation failures include: (a) focusing on “quick fixes”, (b) emphasizing planning documents rather than the content of the plans, (c) detachment of plans from the day-to-day activities and their management (detachment of strategic from tactical planning). Some other reasons for implementation failures are: too much emphasis on “ends” (e.g., financial goals and control systems) and not on the organizational capabilities (means); ignorance about the customers’ needs; IS plans are not aligned with corporate plans and lower management is not involved in the development of strategic plans; the planning horizon is too long causing primary strategic goals to change during the implementation.

Overall, the two main causes of failure for information resources planning are: (1) poor formulation of strategy and plans, and (2) poor implementation of plans (i.e., coordination between strategic and tactical plans).
The final output of the SPIR process includes the development and evaluation of an IT Architecture and an IT Investment Portfolio.

2.1 Problems and Issues Facing Information Managers when implementing the SPIR process

Many periodicals have published “top ten” lists of issues facing information managers (Andersen, 2000; Brancaeu and Wetherbe, 1987; Brancaeu et al. 1996). By summarizing and evaluating these lists, authors present here, in no particular order, their own list of issues currently facing those who are responsible for the deployment of information resources in an organization:

(a) Building and managing a responsive IT infrastructure which integrates centralized and distributed IT assets. Many firms have found it difficult to reconcile their large, centralized, mainframe architectures with distributed paradigms such as client-server.

(b) Aligning IT strategy with business strategy. While it has been recognized for nearly two decades that strategic alignment is a critical factor for successful use of IT, practical methods for evaluating and achieving alignment have been elusive.

(c) Demonstrating the business value of information technology. Traditional financial, measures of business performance (e.g. ROI, ROA, ROE) have generally not provided convincing evidence of the contributions of IT investments. Alternative methods have often been considered too “soft” to be wholeheartedly embraced by business managers.
(d) Integrating new and existing IT applications. For a number of years the so-called legacy problem has been clear to information technology practitioners. However, the problems associated with successful deployment of new technologies and architectures seamlessly, side by side with older existing technologies, are significant.

(e) Analyzing, redesigning and supporting business processes with information technology. The focus on re-engineering business processes is driven by the competitive need to dramatically lower costs, improve product and service quality, and squeeze out cycle time from all business activities.

(f) Integrating internal and external sources of information. A wide variety of inter-organizational systems (e.g. electronic data interchange, the Worldwide Web, business intelligence systems) have dramatically changed the way in which information managers think of technology investments.

(g) Acquiring, developing and obtaining the needed mix of IT skills. This problem is evident both in the IS professional core as new technologies such as client-server architectures and object oriented software make old technical skills obsolete, and in line departments as end users at all levels of the organizational hierarchy assume the mixed roles of professional system developers and users of information resources (Heckman, 1997).

(h) Integrating new and emerging technologies into business and IT strategies. All businesses must continually assess the impact that emerging technologies will have on their future endeavors. How can the risks and cost penalties associated with "bleeding edge" technologies be avoided without missing fleeting windows of
opportunity? What is the impact of such integration on performance and productivity (Pollalis, 1994).

(i) Creating a viable and effective IS organizational structure. This issue goes beyond the centralization-decentralization question, and includes the issue of building effective relationships between IT professionals, line managers, executive management, and external suppliers.

(j) Responding to rapidly changing IT acquisition strategies. The acquisition and development of information resources is rapidly changing along two dimensions. First, the source of information resources is increasingly shifting from internal or hierarchical sources within the firm to a variety of external suppliers of software, data, and human resources. Second, the process of acquiring information resources (whether from internal or external sources) is becoming rapidly more structured and disciplined. It is evolving from a craft-based to an engineering orientation (Heckman, 1997).

(k) Managing and reducing the full life-cycle cost of ownership of information assets. Recent research has suggested that the lifecycle costs of deploying distributed information resources is significantly greater than the cost of their initial investment. How should these costs be captured and tracked?

(l) Ethical issues involved in the deployment of information technology. These issues include questions of privacy, access, security, ownership, and the social impacts of technology deployment.

Based on all the above critical issues faced by designers-strategic planners, the process of SPIR is examined by using ontology-based modelling. The purpose is to build an
ontology of all interrelated components of the SPIR process in order to facilitate both designers-strategic planners and users-management in using the planning process as a tool for learning and training within an organization, thus avoiding some of the implementation problems associated with SPIR (Lee, 1986).

3. Design of an ontology-based learning and training aid

The proposed model is developed on the bases of the principles set by various initiatives concerning the semantic web, all having in common the focus on extending current web technology with machine-understandable metadata (Berners-Lee et al. 2001). Those metadata are stored in ontologies (Gruber, 1993) and play an essential role in semantic web, since they provide the shared conceptualizations expressed in a logical form. Web services are layered services, able to exploit the semantics provided by these metadata descriptions in order to expand the current capabilities of web technology (Sycara, 2004).

The semantic web vision has been combined with the principles of knowledge transformation in order to provide a theoretical model of e-learning processes (Naeve et al. 2005; Nonaka and Takeuchi, 1995; Yli-Luoma and Naeve, 2006), thus enhancing the Knowledge-creating company towards the vision of the Semantic Learning Organization (SLO) (Sicilia and Lytras, 2005).
In essence, active user participation which is enabled through user training is considered a knowledge-creation spiral that emerges when the interaction between tacit and explicit knowledge is elevated dynamically from lower to higher ontological levels (Nonaka and Takeuchi, 1995). Figure 2 shows graphically how existing individual’s tacit knowledge (as-is) is converted by SPIR process analysts into explicit knowledge. In turn, this knowledge is enriched in order to be converted into group’s knowledge through group training, thus enabling user groups participate in the development of new systems (to-be) in co-operation with SPIR analysts. New IT processes designed represent organizational knowledge in intra-organizational process activities and inter-organizational knowledge in inter-organizational process activities.

3.1 Ontology design

Ontologies are collections of concepts (universals), instances of concepts (particulars) and relations among them (Fielding et al. 2004). Attributes are assigned to concepts, instances and relations in order to specify the content of the knowledge network. In addition, ontology constructs (e.g. concepts, relations and instances) could be enriched with terms, definitions, axioms and constraints that are expressed at the desired level of formality and that are deemed to be important in characterizing the knowledge domain under consideration at the desired level of detail (Grenon, 2003; Sowa, 2000; Gruber, 1993). These are used in asking and answering questions, making assertions, offering insights, describing practices and discussing investigations.

The development of an ontology is usually a top-down process which starts at the highest level of abstraction considered and finishes at the lowest level of abstraction.
which is considered appropriate for the purpose of the ontology building process (Colomb and Dampney, 2005; Cristani and Cuel, 2005; Masuwa-Morgan and Burrell, 2004). As an example, in an ontology development process there could be considered three levels of resolution: the upper-ontology (which includes the basic concepts and relations), the mid-ontology (which includes more detailed concepts and relations) and the lower-ontology (which includes all the concepts, instances and relations necessary for the specific purpose of the ontology).

3.2 Knowledge Networks – using Semantic Web principles in training

Most of the existing automated training aids are essentially collections of multimedia objects (content). These multimedia objects are usually grouped hierarchically (e.g. in units and sub-units), indexed and combined, through hyperlinks, in order to support various training needs. However, these training aids only provide for manipulating and restructuring multimedia objects in order to create training material, serving specific needs, for the knowledge domain under consideration. Hence, this knowledge must be externalized and made explicit by the user in order to become diffused and reusable.

The approach proposed in this paper enables experts in the domain of SPIR to externalize the domain knowledge in the form of ontology-based knowledge networks (training scenarios serving specific training needs) and, hence, better communicate it and make it reusable. The basic structure of the proposed approach is a domain specific ontology which captures the relevant knowledge. Thus, training scenarios combine ontology constructs with supportive multimedia objects helping trainees acquire an in depth understanding of the knowledge domain. The approach is based on Sowa’s
definition of user perception as the process of building a working model that represents and interprets sensory input (mosaic of percepts) into a more abstract part (conceptual graph) (Novak and Gowin, 1984; Sowa, 1984). Hence, understanding of a training material by a trainee can be modeled as a two stage process: (i) the analysis sub-process, where the material is broken down into concepts, and (ii) the synthesis sub-process where concepts are linked to other concepts which are found either in the training material at hand or in other related material that the trainee has already analyzed before in order to form more complex structures (conceptual graphs). Thus, meaning is not discovered but constructed and training material has meaning only in relation to other material, being interconnected to each other as codes and systems in the minds of the trainees according to their cultural and social traits.

In designing an ontology-based training aid, the main objective is to capture and represent the knowledge which is implicit in the application domain so that it can be made reusable. Thus, domain experts record their knowledge on the particular field under consideration in terms of an ontology which is recorded in the ontology repository. Hence, each ontology construct is recorded only once and can be made available to every training scenario using it. In addition, relevant supportive material (either existing or created) in the form of multimedia objects (e.g. text, image, video and animation) is used in order to develop a collection of reusable multimedia objects that are related to the knowledge domain under consideration (Chebotko et al. 2005; Steinmetz and Seeberg, 2003). This collection of multimedia objects comprises the
content repository. The ontology and content repositories are then used to create knowledge networks (collections of training scenarios), which are recorded in the knowledge repository. Figure 3 shows a schematic representation of the three repositories used in the proposed approach.

Contrary to traditionally designed training scenarios which are based on mere user navigation to multimedia objects, training scenarios that are based on the proposed approach are enhanced and empowered in that they allow users to navigate into the domain knowledge which has been represented in the form of a knowledge network. Thus, the user of the training scenarios is guided either through a semantic search followed by a navigation to the knowledge network, or directly through navigation to the knowledge network. To enhance his/her understanding of each ontology construct included in a knowledge network, the user can access relevant supportive material in the form of multimedia objects and identify the relation of the particular construct with other relevant constructs.

4. Problems and solutions in communicating SPIR issues to an audience

When we started discussing SPIR in our classes and applying it in business cases, it became apparent that both full-time students and experienced managers include the connotation “long-range” in their conception of SPIR. Yet, we also soon realized that most of our students and managers do not believe anymore in the value of long-range planning for IT, regardless of whether it is called “strategic” or not! One partial interpretation of this paradox can be attributed to increasingly rapid pace of change in
IT and to the continuous restructuring of organizational processes. During turbulent times (when planning is extremely important and needed), forecasting becomes more speculative, and plans cannot afford to be rigid and very long-range.

However, even though long-range information resources planning (e.g., more than two years in expected implementation of plans) might be difficult due to rapid changes in organizational structures and IT developments, it is also true that short-range planning (e.g., planning horizon of less than two years) is of little use in most truly strategic situations. This statement is based on two assumptions: (1) Strategic decisions tend to be very important and thus have long-term effects, and (2) strategic decisions are not easily reversible in the short-run because many strategic IT projects have long implementation schedules.

In order to avoid such contradictions, good planners tend to build flexibility in their plans by making them less formalized and rigid. Since it is impossible to accurately predict the future (especially in volatile business environments), it is almost certain that most plans will “fail.” However, failure here does not necessarily indicate an undesirable event but rather, simple reality. In other words, even if an organization were to revise its IT strategy every few months in order to “catch up” with technology changes, the full plan development, its communication to subordinates, and coordination with business strategy would require much more additional time for their full implementation. Therefore, even short-range strategic plans for information resources cannot really be implemented in time to take advantage of the IT changes.
This leads to the conclusion that strategic plans are only approximations of “future reality,” and that they merely show what was thought of as the best solution when the plans were first made. This is the reason why strategic plans should be flexible enough to allow quick responses to dramatic changes in the environment (crises) by incorporating a series of well-coordinated tactical plans that are easier to modify and test in a short time.

Another issue that became apparent when implementing the SPIR process is that of better alignment between business experts and IT experts. Many software vendors have pledged to have met this request over the recent past. However, actual results of alignment initiatives have been disappointing in most organizations. The reasons are manifold. For most organizations, the top-three reasons are:

(a) Business experts and IT experts do not understand each other well. Both groups seem to “speak different languages”, using different vocabularies. It would not be just to put the blame solely on IT. Very often, different organization units are using different terms to mean the same thing, and the same term to mean different things. Such issues may go unnoticed, if an IT expert, such as a software engineer, is not versed in business management, which is usually not the case.

(b) IT experts define representations of things active in business domains. This is done by abstracting real-world things and concepts. Hence, such a representation reflects a reification of some abstraction that is important in the respective business domain. Basically, there is nothing wrong with this approach. However, there is a danger that business and IT lose synchronization. Rather than IT experts, business experts should be able to describe real-world things and concepts using their terminology. That kind of business semantic
layer is generally missing in most organizations.

(c) Business process flow logic and business rules are often buried in application code. As a consequence, changing business processes is time-consuming and labor-intensive. A business may even lose its competitiveness if it is not able to quickly react to changing business needs.

In order (1) to make the model as flexible as possible, (2) to better align IT with business and (3) to enhance users-managers participation through training, the ontology-based knowledge network approach was chosen. An ontology model provides a powerful solution to this need, in that it provides the long-needed business semantic layer and hence it helps to bridge the “understanding gap” between business and IT experts (Lee, 1986; Magretta, 2002; Shafer et al. 2005). Therefore all the elements of the SPIR process were defined in a SPIR ontology repository. All supportive material about SPIR process elements in the form of multimedia were collected in the content repository. The adaptable training scenarios, showing specific implementations of the SPIR process, that combine ontology constructs (from the ontology repository) with supportive multimedia (from the content repository) are stored in the knowledge repository.

The prototype was created using the tools developed by the CULTOS (Cultural Units of Learning - Tools and Services; http://www.cultos.org) project. These tools are: (i) K-infinity (http://www.i-views.de) tool (for creating and populating the ontology repository), (ii) CULTOS media import tool (for creating and populating the content repository) and (iii) CULTOS authoring tool (for creating and populating the knowledge
repository). The training scenarios (knowledge network) created for SPIR process modeling is saved as a structured multimedia meta-object containing expert knowledge which is called enhanced multimedia meta-object (EMMO). Thus, each scenario is a self-contained entity that includes relevant entries of the three repositories defined above.

4.1 The SPIR process training ontology

For the purpose of this research, which is mainly to show the advantages of the knowledge network approach, the ontology model proposed by Sowa was used due to its simplicity (Sowa, 2000). However, the dynamic spatial ontology model SNAP and SPAN, proposed by the Institute for Formal Ontology and Medical Information Science (IFOMIS; http://www.ifomis.uni-saarland.de) can also be considered as a more elaborate model.

Figures 4 and 5 show the ontology concepts of the SPIR process considered, in the form of a generalization-specialization hierarchy, linked with relations. The upper ontology consists of the six categorizations of concepts proposed by Sowa (Sowa, 2000): Physical (concerning matter or energy) and Abstract (concerning pure information structures) which are further broken down into Physical and Abstract Continuants (having stable attributes that enable their various appearances at different times to be recognized as the same object) and Physical and Abstract Occurrents (processes or events that are in a state of flux and that can only be identified by their locations in
some region of time-space). These concepts are then further specialized into lower level sub-concepts. For example, in Figure 4, the Abstract Occurrent concept is specialized into the concepts Elements of External Environment, Elements of Internal Environment, Types of IS/IT Strategic Choices, Corporate Strategy, IS/IT Strategy, Align IS/IT & Business Strategy, IS/IT Strategy evaluation, IS/IT strategic choices, IS/IT evaluation & control and Tactical Planning Activities. In Figure 5 the Tactical Planning Activities concept is further specialized into the concepts IT infrastructure to integrate & decentralize processes, Develop infrastructure to collect IS/IT metrics etc. Moreover, relations are defined between ontology concepts of upper and lower level of resolution. Any relation defined between two concepts holds also for lower level concepts and for concept instances. For example, the relation R between concepts X₁ and Y₁ holds also for concepts X₂ and Y₂ that are sub-concepts of X₁ and Y₁, respectively. Also, the relation R between concepts X₁ and Y₁ holds also for x₁₁ and y₁₁ that are concept instances of concepts X₁ and Y₁, respectively.

4.2 The SPIR process training scenario

In the training scenario designed for the SPIR process, concepts are represented as rounded rectangled nodes and relations are represented as oval edges. In what follows, a description of the SPIR process is provided using ontology concepts (shown in italics) and ontology global and local relations (shown in single quote enclosures).
Figure 6 shows the entire training scenario on the SPIR process constituted by the following elements:


c. External Environment/Industry Structure ‘determines’ all that follow: (1) External Sources of Information, (2) IS/IT organizational structures, (3) IS/IT skills requirements, (4) IS/IT technological developments, (5) IS/IT opportunities & threats, (6) External Value Chain, (7) Business Opportunities & Threats and (8) Planning Approaches Tools & Techniques.

d. Internal Environment ‘determines’ all that follow: (1) Current applications portfolio, (2) Internal sources of information, (3) Current IS/IT Architecture, (4) Internal IS/IT skills, (5) Internal Value Chain, (6) IS/IT Strengths & Weaknesses, (7) Business Strengths & Weaknesses, (8) Internal IS/IT organizational structure and (9) Implementation Planning Approaches.

e. IS/IT Strategy evaluation ‘considers’ IS/IT evaluation & control mechanisms and Corporate Strategy. IS/IT Strategy evaluation ‘evaluates’ IS/IT Strategy.

g. *IS/IT evaluation & control mechanisms* (business and IS/IT metrics) is ‘based on’ *IS/IT strategic choices.*

Instances and links to multimedia objects are not shown in Figure 6. However, instances have been defined for each concept and links to multimedia objects have been defined for all concepts, concept instances and relations in order to further clarify the ontology constructs. For example, multimedia objects associated with *IS/IT evaluation & control mechanisms* can define all business and IS/IT metrics needed for the evaluation and control processes, giving details about how they are calculated and used. These objects can be modified when needed without affecting the knowledge network structure.

In practice, using the above approach for designing training material would involve not only a high level view of the SPIR process model, such as the one described above, but a low level view of the process model regarding specific SPIR implementations in specific business environments. In addition, multimedia objects will be associated with concepts, concept instances and relations in order to demonstrate both the static and the dynamic features of the SPIR process under investigation. Thus, each training scenario designed can be easily modified to represent another version of the SPIR process model considered so that to enable users assess the pros and cons of a SPIR process redesign exercise. Redesign of a SPIR process model can be performed by simply manipulating already defined objects, hence providing flexibility, agility and reusability of the training material designed.

4.3. *The tactical planning training scenario*
Figure 7 shows the tactical planning training scenario constituted by the following elements:

*Tactical Planning Activities ‘are’:

1. *IT infrastructure to integrate & decentralize processes that ‘considers’ New IS/IT architecture and New applications portfolio*

2. *Develop infrastructure to collect IS/IT metrics that ‘considers’:* (a) New IS/IT architecture, (b) New applications portfolio, (c) Current applications portfolio and (d) IS/IT Strategy and is ‘based on’ IS/IT evaluation & control mechanisms

3. *Integrate new & existing IS/IT applications that ‘considers’ New applications portfolio and Current applications portfolio*

4. *Integrate new & emerging ITs into business & IS/IT strategies that ‘considers’ New IS/IT architecture and IS/IT Strategy*

5. *Analyze, redesign & support business processes with IS/IT that ‘considers’ IS/IT Strategy and Corporate Strategy*

6. *Integrate internal & external sources of information*

7. *Analyze, design & realize the new implementation approach that ‘considers’ the New implementation approach*

8. *Manage & reduce the life-cycle cost of ownership of IS/IT*

9. *Respond to rapidly changing IS/IT acquisition strategy*

10. *Create a viable & effective IS/IT organizational structure that ‘considers’ Internal IS/IT organizational structure and New IS/IT organizational structure*
(11) Acquire, develop & obtain IS/IT skills that ‘considers’ Internal IS/IT skills and New IS/IT skills.

Although the scenario introduces new instances, many instances used were defined in the previous scenario and their use into the current scenario is just a drag and drop exercise.

5. Discussion

The approach proposed in this paper is mainly concerned with capturing and representing the knowledge found in the logic, the structure and the ways of use of SPIR processes as an ontology-based knowledge network (collection of training scenarios serving a specific training need). The ontology contains all the relative concepts and instances of concepts and the relations between them. Each scenario, built into the knowledge network, relates the basic entities defined in the ontology with the various multimedia (text, image, video, animation etc.), which are supportive for better understanding the entities of the ontology. Thus, the user-manager of the resulting training material is enabled to search for a SPIR process concept and understand its meaning and usage with the help of the supportive multimedia. Furthermore, the user-manager can navigate to associated business process concepts in order to acquire an in depth knowledge about the business process, the data and control flows between processes and the needs for designing new or redesigning old business processes.

The proposed model does not disregard existing methodologies for structuring training material, but enhances and empowers them by allowing the semantic representation of
knowledge so that to enable users-managers navigate into a knowledge network based on the characteristics of the application domain under consideration. Thus, the model can combine the existing multimedia material with ontology entities, using knowledge-based multimedia authoring tools, in order to build user training scenarios and satisfy specific training needs. Hence, in addition to the existing multimedia objects, the knowledge built into both the ontology and the training scenarios is fully reusable.

With regard to the designer-strategic planner of the training material, the main advantages of the proposed model are the following: a) Reusability of the knowledge recorded into the ontology and the knowledge instilled into older scenarios to meet new training needs. b) Unique definition of ontology constructs since they are recorded once and can be used where and when required with the same name and the same features (synonyms, attributes, relations to other concepts, supportive multimedia related to it etc.). c) Inheritance in ontology creation whereby lower-level concepts inherit all the characteristics of higher-level concepts (attributes, relations etc.). and d) Semantic web that allows combining and using geographically dispersed training ontologies by both designers-strategic-planners and specially designed software components (i.e. web services) (Berners-Lee et al. 2001).

With regard to the user-manager, the main advantages of the proposed model are the following:

a) Semantic search – This allows to search ontology constructs semantically instead of textually (i.e. the search is based on language-agnostic semantic matching instead of
keyword matching) putting emphasis on matching the content and the real meaning of each relevant concept searched.

b) Knowledge navigation - This allows the use of browsing and navigation capabilities in order to identify the ontology constructs as they are recorded into the ontology repository and used in the training scenarios.

c) Knowledge dissemination – This is an important function of any kind of training activity that can only be achieved if the users-manager is provided with the ability to extract the knowledge implicit in the problem domain, as opposed to the mere presentation of facts and disconnected information which, in most cases, is not adequate.

With regard to SPIR process modelling, considering a business process from another viewpoint besides your own leads to deeper understanding of the business processes under consideration and this understanding is essential when trying to develop critically thinking users-managers. And the ability to think critically is a necessary criterion in order to say that knowledge has been disseminated. Obviously, this ability is much more important when studying complex SPIR processes that consist of many interrelated tasks that combine various business resources available in an organization.

The proposed approach to user training may have significant impact to enabling users-managers participate actively in SPIR process management activities since they are equipped with an appropriate tool for acquiring a clear and an in-depth understanding of business processes. Based on this understanding, increased cooperation and collaboration between users-managers and IT-specialists can be achieved towards a
common objective of improving business performance in an ever changing business environment since process changes that are deemed appropriate can be incorporated easily by simply manipulating objects already defined in the ontology and/or in the knowledge network. Besides, the training tool provides users-managers with business process objects, such as mock-ups and animations, to enable them get a grip of the situation under study. Hence, user acceptance of designed, or redesigned, business processes can be considerably improved due to an increased likelihood of being perceived useful and usable by users. Due to the encouraging results of the approach described, it is intended to evaluate it extensively using more elaborate implementation tools and more complex business processes in real-world situations.

6. **Concluding remarks**

This paper presents an ontology-based prototype approach for the construction of user training scenarios on SPIR process modelling concepts, whereby both the multimedia objects used and the knowledge built into the training scenarios are fully reusable. The approach consists of the following steps: (i) define and implement a general ontology, (ii) design the training scenarios that best fit training objectives and define the multimedia objects required, (iii) refine the general ontology by adding all ontology constructs required by the various training scenarios, (iv) develop or select the multimedia objects which are deemed necessary to support the various ontology constructs to be used in the training scenarios, and (v) construct each training scenario by combining ontology constructs with multimedia objects.

The objective of the approach presented in this paper is to enable users-managers get familiar with and, hence, participate actively in SPIR process modeling activities. In this
context, two sample training scenarios were built, using the CULTOS tools, that are based on a self-contained reusable knowledge repository which combines the ontology constructs (stored in the ontology repository) with supportive multimedia objects (stored in the content repository). Hence, these training scenarios can also be used by third party hypermedia production tools in order to present both the knowledge and the content of the training material for various purposes.
REFERENCES


Figures

Figure 1: The SPIR Process
Figure 2: Developing organizational knowledge through users’ participation
Figure 3: Knowledge Networks - Linking ontology constructs to Multimedia objects
Figure 4: The SPIR process training ontology (part 1)
Figure 5: The SPIR process training ontology (part 2)
Figure 6: The SPIR process training scenario
Figure 7: The tactical planning training scenario