Model Driven Architectures
for Enterprise Information Systems

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Abstract. Over the past decade, continuous challenges have been made to traditional business practices. At the same time, organisations have also experienced the effects of the integration and evolution of information and communication technologies (ICT). The Enterprise Information Systems (EIS) gained a new strategic support role as enabler of automation, monitoring, analysis and co-ordination of whole business functioning, a central role in the evolution of today organisations. These rapid changing situations originate a critical need for realistic representations -called business models- of what are the current or future business situations or what should be changed as well as its potential organisational impacts. This paper characterises the strong relationship existing between Business Models and EIS Architectures in a changing environment. Our main contribution is a set of roadmaps, which highlight the relationships between business process models and the requirements of EIS. These roadmaps provide guidance during the business modelling and the information system (IS) modelling processes.

1 Introduction

The last twenty years, the evolution of Information and Communication Technologies (ICT), along with the search for management strategies that could take advantage of them, are pushing organisations into a very competitive and changing environment. Rapid market changes such as electronic commerce, deregulation, globalisation and increased competition have led to a business environment that is constantly evolving. Companies change to better satisfy customer requirements, address increasingly tough competition, improve internal processes and modify the range of products and services they offer [1]. While information systems (IS) continue to serve traditional business needs such as co-ordination of production and enhancements of services

offered, a new and important role has emerged for them. ICT are thus positioned as a strategic resource that enables automation, monitoring, analysis and co-ordination to support the transformation of business processes [2].

In that sort of environment, only those organisations, which can react quickly to environment demands, are the ones that survive. That capacity of quick reaction is often due to their capacity of handling ICT in favour of the business evolution requirements. ICT and management go hand by hand in the way of reacting, adapting and implanting new ways of doing business in today dynamic environments. IS are thus not just supporting businesses; they are an integral part of them.

All these ICT and management changes have imposed serious challenges to traditional business practices. For instance, in a competitive and evolving environment, quality became a fundamental key to obtain and to keep market share [3]. Another important wave in the evolution of management strategies was the Business Process Reengineering [4], which consists of a radical remodelling of the organisation around its processes[1]. In all these management challenges, the ICT and the EIS act as facilitators of business changes implementation and standardisation.

In the field of Information Systems, the notion of "Enterprise modelling" refers to a collection of conceptual modelling techniques for describing different facets of the organisation including operational (IS), organisational (business processes, actors, flow of information etc), and teleological (purposes) considerations [5]. Existing enterprise modelling frameworks [6], [7], [8], ([9], [10], [11], [12] and [13] stress the necessity of representing and structuring enterprise knowledge taking into account all these facets in order to develop IS and IT architectures that enterprises need.

In order to take business through a well managed change process, the organisation needs to strike a balance between the technical and the social organisational levels; i.e. there must be a consolidation of the diversity of perspectives that stakeholders, managers, and IS engineers have about the business and the way organisation must change.

The work presented in this paper concerns principally the need of methods providing guidance while the transformation process takes place. We present an extension of the EKD-CMM[2] method previously presented in [14],[15], [4], [16], [17], [18], and [19]. This extension provides a clear and complete picture of what are the main activities related with the definition of IS architectures in a dynamic and evolving environment. Considering that our approach is requirements driven, we describe the way of moving from business processes to EIS architecture and from ICT requirements to business process redesign.

This paper is organised as follows. In Section 2, we present the concepts associated to our representation of an enterprise model. We made special emphasis on the relationships between business processes and IS. Section 3 presents the concepts associated to the IS architecture of an organisation. We highlight those elements that

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[1] A set of activities which produces, from one or several inputs, an output valuable for the customer.

[2] The term EKD-CMM stands for Enterprise Knowledge Development-Change Management Method.

are more vulnerable to environment changes. This section presents also the modelling needs for those who define the IS architecture of an organisation. The guidance offering a methodological response to these needs is expressed by roadmaps that show a set of alternative ways of moving from business processes to IS architecture. Section 4 illustrates an example of path for the specification of an IS model through the conceptualisation of the enterprise process model. Finally, section 5 concludes the paper.

2   Business Modelling through EKD-CMM

As introduced before, the recent transformations in economical and ICT environments have imposed radical changes in the way business is driven nowadays. There is an increasing need for ICT support in achieving competitive business goals. Examples of this are the Enterprise Application Integration (EAI) approach, the Enterprise Resources Planning (ERP), and the e-Business [20], among the most known.

Analysing these innovative approaches, we found that they are based on a common business driver: "the urgency of adapting business to the dynamical environment demands". This adaptation must be made by taking into account not only the internal processes and ICT exigencies, but considering the reasons that caused the change process. For example, if the change is caused by a modification in business goals because of a predefined surviving strategy, then the change problem must be analysed in a top-down manner. In this case, the ICT technologies must act as a support for the decision making process and also as a solution for implementing and consolidating change in the organisation. The perspective for analysing the change process is different if the origin of change is at the IS layer, i.e. if the change process is caused by the introduction or modification of some ICT technologies. In that case, the change situation must be analysed in a bottom-up manner so the advantages for the whole business can be elicited. In this case, the ICT is a cause of the business change, thus its impacts must analysed from many perspectives. For instance, the IS Architecture, as well as the way business processes are organised and executed, may change.

These two complementary examples of the ICT role in a business transformation process aim to help us to state that the relationships between business processes and IS are the nucleus of a successful organisational change process. In other words, it does not matter what causes the change process. What it is relevant is how well the relationships between business functioning and ICT are characterised and implemented. This characterisation will allow business managers to visualise, analyse and implement business changes without neglecting the crucial effects that ICT have over business functioning and vice versa. Moreover, models facilitate understanding and communicating about the business and its support systems only if the objective of the model is well understood. For instance, if the objective is to understand the business well enough to specify supporting systems, it is not useful to model the entire business in detail. Contrary, if the aim is to innovate the business, it is necessary to provide more effort to define and/or redefine the entire business and to find improved ways of conducting it [18], [14].

2.1   A Survey of EKD-CMM Method

EKD-CMM is a method for documenting an enterprise, its objectives, business proc-
esses and support systems, helping enterprises to consciously develop schemes for
implementing changes. EKD-CMM satisfies two requirements: (i) assisting enterprise
knowledge modelling and (ii) guiding the enterprise modelling and the organisational
transformation processes.

The EKD-CMM *enterprise knowledge modelling* component [14], [15], [21], [18],
[16] recognises that it is advantageous to examine an enterprise from multiple and
inter-connected perspectives. Thus, EKD-CMM models describing an enterprise are
structured in three layers of concern (see Figure 1): *Enterprise Goal Model*, *Enter-
prise Process Model* and *Enterprise Information System Model*. The first two layers
focus on intentional and organisational aspects of the enterprise, i.e. the organisa-
tional objectives and how these are achieved through the co-operation of enterprise
actors manipulating such enterprise objects. The third layer is useful when the EKD-
CMM approach is applied to define the requirements for the IS supporting the enter-
prise.

The result of applying EKD-CMM method is an *enterprise model*, which repre-
sents a set of operational (information systems), organisational (business processes)
and intentional (business objectives) models describing several views of the organisa-
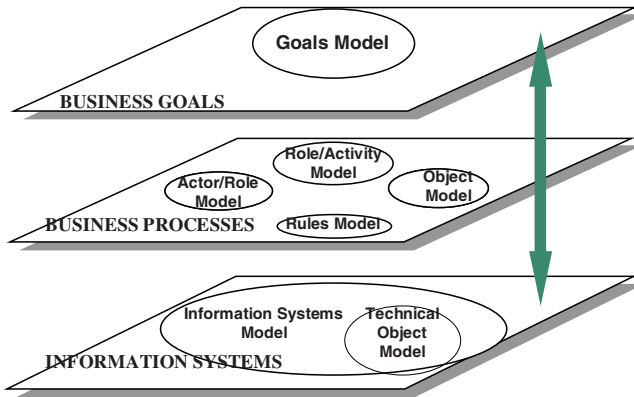tion.

Fig. 1. EKD-CMM enterprise representation layers

From the point of view of method engineering, an enterprise model is a product
[22], [23]. In fact, the product is the desired output of the design process, whereas the
process keeps track of how the product has been constructed. A *Product Model* de-
fines the set of concepts and their relationships that can be used to build a product,
i.e., in our case, to build a model representing a given enterprise. The *Process Model*
defines how to use the concepts defined within a Product Model. A *Process Model*

and its related *Product Model* [3] are specific to a *method*. The EKD-CMM Product and Process Models, according to method engineering principles, have been previously presented in [18], [19], [24], [25] and [26].

The intention oriented modelling used in EKD-CMM provides a basis for understanding and supporting the enterprise modelling, and the managing the organisational changes. At the same time, it helps to define the supporting IS. Process guidance provided by EKD-CMM is based on the map formalism [27], which is a navigational structure in the sense that it allows the modellers to specify paths from *Start* intention to *Stop* intention. The approach suggests a dynamic construction of the most appropriate path by navigating in the map. Thus, EKD-CMM proposes several ways of working, and in this sense, it is a multi-method. In fact, using the EKD-CMM framework, one can start at any enterprise representation layer and move on to other layers, depending on the modelling and organisational situations.

The method may be used for both business engineering and IS engineering purposes, permitting: *(a) Business process reengineering*: from business processes layer to the business objectives for change [11], [14], [28], [29] and then to the business process architecture for the future; *(b) Reverse engineering*: from legacy information systems at the IS layer to the business processes layer [30], [31]; *(c) Forward engineering* or *information system design*: from business objectives to business process modelling and to the choice of the processes to be supported by the information and communication technologies (ICT) and than to the IS modelling [19]; *(d) Business process improvement*: by modelling and analysing the business processes in order to enhance them by specific modifications such as role definition or activity flow; *(e) Quality management*: by defining the business processes and quality procedures and by aligning them, ones with respect to others.

The EKD-CMM three layers framework and the associated Process Model allow us to understand, to analyse and finally to model the enterprise according to its multiple perspectives, i.e. its strategy, its structure, and its IT strategy and support systems, in a global, interrelated and guided manner.

During our previous work, we were particularly interested in the definition and modelling of the organisational change processes. To this end, we focused our attention on business processes to understand the current way of working of the enterprise (second layer in Figure 1) and reasoned on the organisational change at the intentional level [14], [28], [29]. The EKD–CMM approach has been thus successfully applied in an ESPRIT Project (ELEKTRA) aiming to discover generic knowledge about change management in the electricity supply sector for reusing it in similar settings. Two end-user applications have been considered within the project. Our conclusion at the issue of these two real life projects was that reasoning on the enterprise objectives makes easier understanding of problems and communication on essential aspects (*what* and *why* instead of *who*, *when*, *where* and *how*). Our current work focuses on the two lower layers shown in Figure 1, namely business processes

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[3] We use capitalised initials in order to differentiate the method specific Models from the application specific models (for instance a business model) that compose the product.

and information systems in order to highlight the relationships between the enterprise process models and the specifications of the ICT systems.

2.2 EKD-CMM Product Models

A business model can act as the basis for designing the supporting software systems in an enterprise. Typically, business modelling and software modelling use different languages and concepts making integration of the two models difficult [32]. The set EKD-CMM Product Models aims to ease this integration by providing methodological tools to use a *business model* (enterprise goal model and enterprise process models) to define the supporting IS' architecture.

From the EKD-CMM perspective and experience, an important conclusion about *business models* use, is that it has a twofold goal: first, a model helps organisational members to understand what they are, what they want to be as an organisation, and how they can achieve an identified set of business goals by reorganising or (re)defining the business processes. Second, a model aims to design the IS architecture that best fits organisational needs already expressed by the business goals and their corresponding business processes.

The instantiation of the Product Model's concepts allows business modellers to build specific *business models*, which represent particular business situations. Let us suppose that the future business has been modelled from different perspectives (see [18] and [25] for details), i.e. by modelling the business goals, the actors that are responsible for the execution of the underlying business processes and the set of activities that are under the responsibility of those actors, as well as the resources involved in the execution of those activities. The resulting *business models* are instances of the Goal Model, the Actor/Role Model, the Role/Activity Model and the Business Object Model with their relationships.

2.3 EKD-CMM Process Model

A map [27] is a Process Model in which a non-deterministic ordering of intentions and strategies has been included. It is a labelled directed graph with intentions as nodes and strategies as edges between intentions. A map consists of a number of *sections* each of which is a triplet < source intention I_i, target intention I_j, strategy S_{ij}>. The map is a navigational structure that supports the dynamic selection of the intention to be achieved next and the appropriate strategy to achieve it whereas the associated guidelines help in the achievement of the selected intention.

The EKD-CMM high-level map, shown in Figure 2, contains a finite number of paths; each of them is a *EKD-CMM Process Model*. Therefore the EKD-CMM map is a *multi-model*. None of the finite set of models included in the map is recommended 'a priori'. Instead the approach suggests a dynamic construction of the actual path by navigating in the map. In this sense the approach is sensitive to the specific situations as they arise in the modelling process. The EKD-CMM multi-model allows us to

express all modelling strategies that can be followed to build an enterprise model (a business model and an IS model). The formalisation used to define the EKD-CMM Process Model is intention oriented, i.e. the business owners', the business modellers' and the systems developers' modelling intentions are directly expressed by maps. This is carefully described in [24] and [25].

The experience gained during our previous work shows that the path to be followed in the map during a particular enterprise modelling project is situation-dependent. For instance, the selection of the bottom-up[4] path for one of the two end-users in the ELEKTRA project was influenced by the uncertainty regarding both the current Electricity Distribution Business Unit situation and its possible re-organisation alternatives. The application of the specific strategies forming this path was also affected by a number of situational factors including: (i) *organisational culture*; (ii) *ability to commit resources*; (iii) *social skills and consensus attitudes of participating actors*; (iv) *use of software tools* to facilitate the process execution; and (v) *familiarity with applied strategies and supporting technologies.*
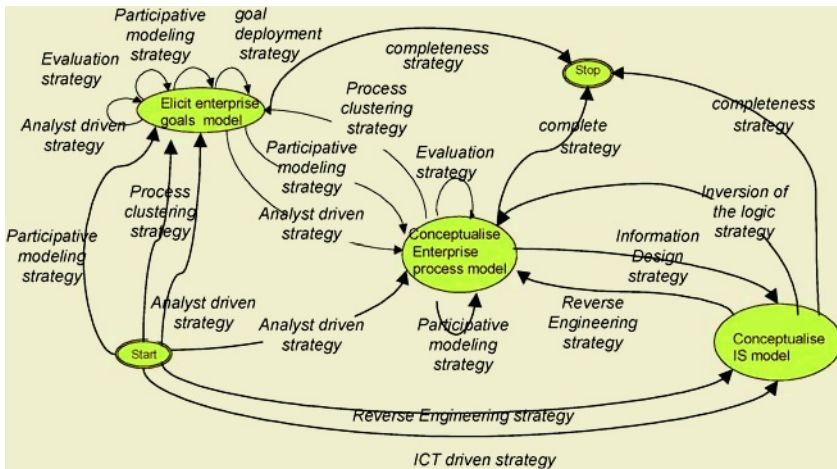

Fig. 2. EKD-CMM Roadmap

By opposition, for the second end-user a different path of the map, called top-down, was used. The map sections composing this path use mainly the participative modelling strategy. For this end-user, the future enterprise goal structure was first elicited and then future enterprise process models were conceptualised.

The EKD-CMM Process Model is shown in Figure 2 as a roadmap. Guidelines help users to choose between two alternative sections between a source process intention and a target process intention (strategy selection guidelines) or to choose be-

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[4] So called because this part suggests first to conceptualize the current enterprise process model, then to elicit the current enterprise goal structure and finally to model alternative change scenario.

tween possible target intentions when moving from a source intention (intention se-lection guidelines). This will be described in Section 4. The execution of each map section is also *supported by* a guideline.

Some map sections can be defined as maps in a lower level of abstraction. For in-stance, the global map section <*Start, Conceptualise enterprise process model*, Ana-lyst Driven Strategy> is defined as a local map shown in Figure 3. This means that the method knowledge embodied in the guideline supporting the execution of this map section is too complex and too rich to be described in operational terms and requires an intermediary intentional description in a lower level of abstraction.

All guidelines corresponding to the sections between the process intentions *Elicit Enterprise Goal Structure* and *Conceptualise Enterprise Business Process Model* have been developed in [18] and [24]. Our current work consists in identifying and developing the methodological guidelines associated to the map sections having the process intention *Conceptualise Information System Model* as source or as target. For instance, Figure 4 shows the local map defined to provide guidance to the global map section (see Figure 2) <*Conceptualise Enterprise Business Process Model, Conceptu-alise Information System Model,* IS design strategy>. The next sections concentrate in developing guidance (using local maps) for passing from the Business Process layer to the IS layer.
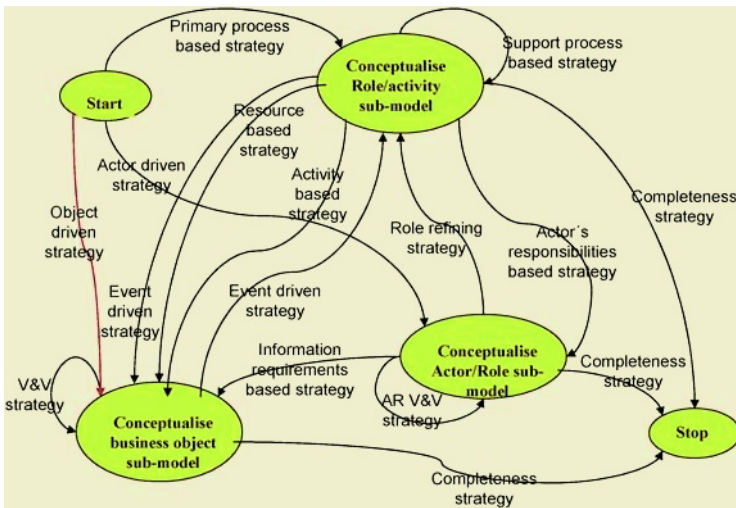

Fig. 3. Roadmap for conceptualising a *business process model* from scratch

3   The Information Systems Architecture (ISA)

The Information System Model contains not only the representation of the set of IS, but also the definition of the local and shared databases, as well as the information

requirements and management indicators that should be satisfied by applications or IS.

As we explained before, the main goal of the IS architecture (ISA) is to support business processes at the operational and strategic levels. The definition of *information requirements* and *management performance indicators* is directly associated to business processes through the *Business Objects Model* (BOM) shown in Figure 1.

As stated in [33], business objects do not only provide a natural way to model the enterprise, but also guarantee a close link to the business applications. Considering that the BOM constitutes the central link between the business processes and the IS that support them, special implementation requirements must be considered when designing and distributing the enterprise databases and the software components that handle them. In order to complete the *business objects model* of the Business Process layer (BOM), the *business rules* must be linked to the *business objects model* built at the IS layer. We call the latter *technical business objects model* (TBOM). Business rules are useful for defining (i) the set of operations that should be performed over the business objects for satisfying information requirements; (ii) the conditions under which these operations should be performed. Business rules set up also what business objects attributes may change, and what are their domains of validity, when operations are performed. Finally they can set the non-functional requirements (security, accuracy, etc.). Consequently, the TBOM constitutes the heart of the ISA.
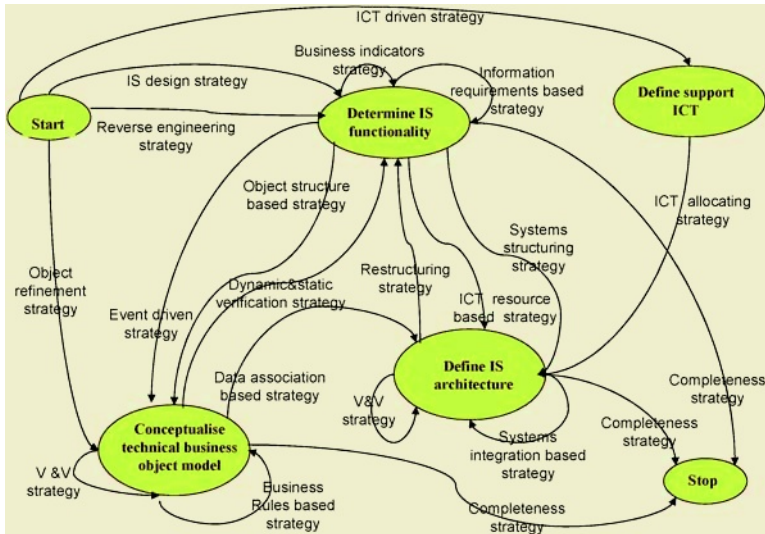

Fig. 4. Roadmap for conceptualising *IS model* after the BP model being conceptualised

An ISA comprises the set of enterprise IS, the connections and dependencies between them and the ICT required for their implementation. ICT includes hardware (PC, servers, nets, and storage, input/output devises, etc.), software (exploitation, support, development, and applications) and finally, methodological (project man-

agement, development, change control, maintenance, etc.) and technical (languages, modelling tools, etc.) artefacts. Considering the evolving environment where enterprises are immersed nowadays, the ISA may include all or part of these types of IS: legacy systems, enterprise resource planning applications (ERP), and new specific developments. The data distribution and exploitation is directly associated to each IS functionality. For completing the set of concepts associated to the enterprise IS layer, we include strategic and operational plans which define what, when and how developing, maintaining, integrating, or purchasing the systems contained in the IS architecture.

3.1   Technical Business Objects in the Information Systems Layer

At the IS layer of the EKD-CMM framework, the technical business objects model (TBOM) is defined as a refinement of the BOM, which is a sub-model of the Business Process layer (see Figure 1). The BOM must be refined and expressed according to the adopted software engineering techniques. Therefore, we determine two complementary perspectives for defining the set of business objects of an enterprise. Each perspective is associated with an enterprise representation layer: (1) the business object model (BOM), built at the business process layer, and (2) the technical business object model (TBOM) built at the IS layer.

Processes inputs and outputs, as well as business resources involved in activities drive the business process perspective. Figure 5 shows the process map associated to the BOM definition. This map provides guidance for the map section <*Start*, *Conceptualise business objects sub-model*, Object driven strategy> shown in Figure 3.

Observe that there are many ways of conceptualising business objects involved in business process executions. There are two main intentions that can be achieved in a non-deterministic manner: *Define business objects* and *Elicit business objects*. Each intention has a set of achieving strategies that may be chosen according to specific modelling situations. For instance, there are three different ways of "eliciting business objects", the *resource based* strategy; the *event based* strategy, and the *activity-based* strategy. Selecting the *activity based strategy* means that the business objects will be discovered by analysing low level activities of the business processes. Notice that, the selection of one of these strategies for achieving the *elicit business objects* intention does not eliminate the possibility of selecting the others (two strategies) for completing the knowledge associated to the business objects already elicited. The BOM at the business process layer, is expressed in conceptual terms without technical considerations, thus managers and others enterprise members can easily understand it.

The IS perspective is technology driven; i.e. technical factors such as formal languages, and graphical notations controls the modelling process. Figure 6 shows the process map associated to TBOM at the IS layer. This map provides guidance for the map section <*Start*, *Conceptualise technical business objects model*, Object refinement strategy> shown in Figure 4. Observe that the intentions associated to TBOM construction are different from those depicted at Figure 5: *Debug business objects*

and *Build technical business objects model*. The associated strategies allow modellers to choose complementary ways of building and validating the TBOM.

Notice that the BOM obtained at the BP layer is here refined (see Figure 6) with respect to the software engineering and database concepts and techniques for obtaining first, the logical data model expressed according to the object oriented paradigm; and then, the object implementation model. In order to assure the complete correspondence between the resulting data model and the business information requirements and rules, the data model must be validated against the business process model built at the BP layer. Thus, the possible inconsistencies on business object representations can be corrected assuring the correspondence between the two business object models.

Fig. 5. Conceptualising BOM using the object driven strategy at the *BP layer*
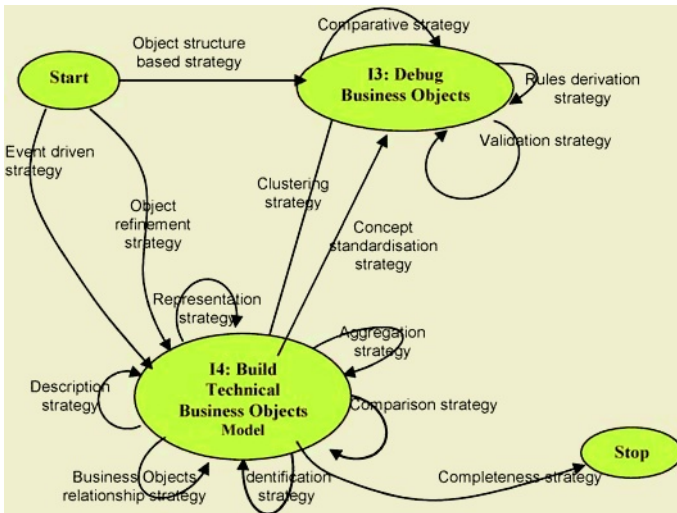

Fig. 6. Conceptualising TBOM using the object refinement strategy at the *IS layer*

3.2   The ISA and the BP Needs

It is not easy to discover what the appropriate ISA for a particular enterprise is. There are many factors that must be considered while specifying business objects, information requirements, and business processes and activities. The way an activity or a set of activities (a business process) is performed, determines if one or several IS are needed. This determines also if the business objects should be shared or not, and security, quality and access restrictions that must be included in the IS functionalities.

Therefore, the relationship between the IS layer and the BP layer goes further than the simple business objects model definition (BOM and TBOM). The way a set of IS is structured, the definition and distribution of IS responsibilities, is a consequence of the way that business processes are performed. Besides, there are many other enterprise factors such as priorities, financial and technical issues, that affect the decision of implanting a particular IS structure or another.

3.3   The BP and the IS Issues More Vulnerable to Changes

In the context of the work still done, we just considered the technical factors associated to the technologies needed for business process execution and for supporting the exchange of information between business processes. Besides, we should consider the strategic perspective of an enterprise that wish to survive in an evolving environment, and then its requirement for a flexible ISA. That way, the changes can be analysed, defined and implanted easily and with minimal business and ICT impact. From this perspective, the definition of the ISA for a business is based on:

- Business processes execution dependencies, such as inputs/outputs, support, and workflow coordination.
- Business objects owners and users, thus the set of permitted manipulations can be elicited and imposed.
- Legacy and acquired systems and their integration through an Enterprise Application (EAI) perspective.
- The kind of technology required for the execution of business processes, as well as the standardisation of some related procedures.
- The ICT available and required (restricted according to business financial possibilities) in the enterprise.

Almost all of these subjects concern with BP layer characterisation. Nevertheless, the responsibility of implementing an appropriate and flexible support for them belongs to the IS layer.

At the IS layer, the elements more vulnerable to changes are: business objects definition (operations, structure, dependence degree, and owner); IS functionalities (requirements, dependence degree, and support technology); ICT use (obsolescence, flexibility, versions, security, growth capacity); IS implantation (purchase, ERP, integration, performance improvement).

At the BP layer, the elements more vulnerable to changes are: process change (re-engineering- new way of working, TQM); standardisation requirements (business processes, procedures, methodologies); work technologies (basic, new, improved); business structure (new, restructured); organisation (actors, roles, workflow).

For concluding this section, it is important to recall that any of these changes affects the two other business representation layers (Figure 1) or it may comes from one of them. For instance, a reengineering process may be the consequence of a change in the organisational politics (goals layer). In that case, this change causes a redefinition of a set of business processes, and also a redefinition of the IS that support them.

4   How to Use the Process Maps

This section illustrates an example of path for the specification of an *IS model* through the conceptualisation of the *enterprise process model*. Our purpose is to explain how to use the process maps as methodological guidelines. In fact, those maps assist business owners, business modellers and IS modellers while specifying *business models* and *IS models*.

Enterprise modelling using EKD-CMM is an intention driven process that resolves two issues, namely, (1) how to fulfil the modelling intention according to a strategy and (2) how to select the right map section to progress. Because the next intention and strategy to achieve it are selected dynamically, *guidelines* that make available all choices open to handle a given situation are of great importance. Maps have associated guidelines [27], namely one *'Intention Selection Guideline'* per node I_i, except for *Stop*, one *'Strategy Selection Guideline'* per node pair $<I_i,I_j>$ and one *'Intention Achievement Guideline'* per section $<I_i,I_j, S_{ij}>$. Given an intention I_i, an *Intention Selection Guideline* (ISG), identifies the set of intentions $\{I_j\}$ that can be achieved in the next step. Given two intentions I_i, I_j and a set of possible strategies S_{ij1}, S_{ij2},..S_{ijn} applicable to achieve I_j, the role of the *Strategy Selection Guideline (SSG)* is to guide the selection of one S_{ijk}. Finally, the execution of each section is *supported by* an IAG that provides an operational or an intentional means to fulfil a modelling intention. For the former, the IAG provides process knowledge specified by the means of operational models. For the latter, the IAG is defined as a map in a lower level of abstraction.

All ISGs and SSGs and also the IAGs providing a methodological knowledge described in an operational level are specified according to the contextual formalism developed within the ESPRIT project NATURE [34]. We just recall here that a *context* is defined as a pair <(*situation*), intention>. The kind of EKD-CMM guidelines specified above are organised into hierarchies of contexts of three types, namely *choice* (refinement of contexts), *plan* (composition of contexts) or *executable*. More details about EKD-CMM guidelines can be found in [14], [24] and [25].

Let us suppose that we are performing an enterprise modelling process in the following situation: the organisational maturity of modelling and the participative involvement are low and there is no available documentation of the business processes.

The ISG associated to the intention *Start* in the EKD-CMM map shown in Figure 2 suggests us to choice *Conceptualise enterprise process model* as next intention and to apply the IAG associated to the unique map section between these two intentions. This IAG is defined as a map, shown in Figure 3, in a lower level of abstraction.

The ISG associated to the intention *Start* in the map shown in Figure 3 provides us a choice between three intentions. Let us suppose that the modelling team has a great experience with object modelling -and less with activity modelling- and a partial documentation of the legacy systems is available. Than the ISG associated to the intention *Start* suggests us to choice *Conceptualise business objects sub-model* as next intention and to apply the IAG associated to the unique map section between these two intentions. This IAG is again defined as a map shown in Figure 5.

Let us suppose that the modelling team has a great experience with event-based object modelling techniques, for instance Remora. The ISG associated to the intention *Start* in the map of Figure 5 suggests to choice *Elicit business objects* as next intention, and the SSG associated to the couple *<Start, Elicit business objects>* suggests to select the *Event based strategy* and to apply the IAG associated the section supporting this strategy. To make short, let us suppose that navigation is terminated in the map of Figure 5 and the other sub-models of the BP layer are specified successively leading thus to end the navigation in the map of Figure 3. The specification of the *business process model* being completed, the EKD-CMM map of Figure 2 suggests us to *Conceptualise information system model* using *IS design strategy*. The IAG associated to this map section is again defined intentionally as shown in Figure 4. The map section *<Start, Conceptualise technical business objects model*, Object refinements strategy> is, in its turn, defined intentionally as shown in Figure 6. When the navigation is terminated in the map of Figure 6, modellers go back on the upper intentional level to navigate in the map of Figure 4, and finally in the map of Figure 2.

5 Conclusions and Future Work

This paper reports on the use of an intentional framework for modelling enterprise knowledge using *business models* and *IS models*. A major advantage of the proposed approach is the systematic way of dealing with enterprise modelling and organisational transformation in terms of *knowledge modelling* used with a *process guidance* framework. The experience gained during our previous work has substantiated the view that, paths of the EKD-CMM maps to be followed in a particular enterprise modelling project are very much dependent on the enactment context of the enterprise project and a number of situational factors. Including degree of formal hierarchy (few vs. many formal levels), decision structure (authoritative vs. management by objectives), company culture (collectivistic vs. individualistic), degree of distance of power (short vs. long), type of market (deregulated vs. regulated), etc. Thus, the *EKD-CMM framework* provides a systematic, nevertheless flexible, way to organise and to guide the enterprise modelling processes.

The EKD-CMM modelling framework allows us to represent an enterprise from interrelated perspectives using a three-layer model. It integrates enterprise objectives, processes and systems in a single modelling framework. The more relevant feature of our framework is that it makes explicit the link between these three modelling layers. The way the three layers model has been structured assures that business processes are at the origin of the technical business objects as well as the definitions of information requirements and management performance indicators. In consequence, they will be taken into account for the design and distribution of the software components.

The EKD-CMM requires the domain knowledge to fully understand the organisation from its multiple perspectives. Rather than trying to gain huge amounts of knowledge, a better solution seems to involve several key persons of the enterprise in the modelling process. These persons will provide organisational knowledge or will know where it may be found. Simultaneously they will become an important resource by gaining knowledge of EKD-CMM, which will be useful if the organisation desires to continue working with enterprise analysis and modelling.

Our framework contributes to define accurate decision making processes inside modern organisations, which are highly dependent of ICT. It reinforces also the ability of companies, which apply it to adopt a policy of knowledge management.

Our future work will consist to integrate in the EKD-CMM modelling framework, the ability to handle the issues listed in Section 3.3.

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