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Model Driven Architectures for Enterprise Information Systems

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ABSTRACT:
Over the past decade, continuous challenges have been made to tradi-tional business practices. At the same time, organisations have also experiencedthe effects of the integration and evolution of information and communicationtechnologies (ICT). The Enterprise Information Systems (EIS) gained a newstrategic support role as enabler of automation, monitoring, analysis and co-ordination of whole business functioning, a central role in the evolution of to-day organisations. These rapid changing situations originate a critical need forrealistic representations -called business models- of what are the current or fu-ture business situations or what should be changed as well as its potential or-ganisational impacts. This paper characterises the strong relationship existingbetween Business Models and EIS Architectures in a changing environment.Our main contribution is a set of roadmaps, which highlight the relationshipsbetween business process models and the requirements of EIS. These roadmapsprovideguidanceduringthebusinessmodellingandtheinformationsystem(IS)modellingproce sses.

INTRODUCTION

The last twenty years, the evolution of Information and Communication Technologies(ICT), along with the search for management strategies that could take advantage ofthem, are pushing organisations into a very competitive and changing environment.Rapid market changes such as electronic commerce, deregulation, globalisation andincreased competition have led to a business environment that is constantly evolving.Companieschangetobettersatisfycustomerrequirements,addressincreasinglytough competition, improve internal processes and modify the range of products andservices they offer [1]. While information systems (IS) continue to serve traditionalbusinessneedssuchasco-ordinationofproductionandenhancementsofservices
offered, a new and important role has emerged for them. ICT are thus positioned as astrategic resource that enables automation, monitoring, analysis and co-ordination tosupportthe transformation of business processes [2].

In that sort of environment, only those organisations, which can react quickly toenvironment demands, are the ones that survive. That capacity of quick reaction isoften due to their capacity of handling ICT in favour of the business evolution re-quirements. ICT and management go hand by hand in the way of reacting, adaptingand implanting new ways of doing business in today dynamic environments. IS arethus notjustsupporting businesses;they are an integralpartof them.

All these ICT and management changes have imposed serious challenges to tradi-tional business practices. For instance, in a competitive and evolving environment,quality became a fundamental key to obtain and to keep market share [3]. Anotherimportant wave in the evolution of management strategies was the Business ProcessReengineering [4], which consists of a radical remodelling of the organisation aroundits processes[1]. In all these management challenges, the ICT and the EIS act as facilita-torsof business changes implementation and standardisation.

InthefieldofInformationSystems,thenotionof"Enterprisemodelling"referstoa collection of conceptual modelling techniques for describing different facets of theorganisation including operational (IS), organisational (business processes, actors,flowofinformationetc),andteleological(purposes)considerations[5].Existingenterprise modelling frameworks [6], [7], [8], ([9], [10], [11], [12] and [13] stress thenecessity of representing and structuring enterprise knowledge taking into account allthese facets inorder todevelop IS andITarchitecturesthatenterprisesneed.

In order to take business through a well managed change process, the organisationneedstostrikeabalancebetweenthetechnicalandthesocialorganisationallevels;
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 mustchange.

The work presented in this paper concerns principally the need of methods provid-

ingguidancewhilethetransformationprocesstakesplace.Wepresentanextensionof 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 ac-tivities related with the definition of IS architectures in a dynamic and evolving envi-ronment. Considering that our approach is requirements driven, we describe the wayof moving from business processes to EIS architecture and from ICT requirements tobusiness process redesign.

This paper is organised as follows. In Section 2, we present the concepts associ-ated to our representation of an enterprise model. We made special emphasis on therelationships between business processes and IS. Section 3 presents the conceptsassociatedtotheISarchitectureofanorganisation.Wehighlightthoseelementsthatare more vulnerable to environment changes. This section presents also the modellingneeds for those who define the IS architecture of an organisation. The guidance offer-ingamethodologicalresponsetotheseneedsisexpressedbyroadmapsthatshowasetofalternativewaysofmovingfromb usinessprocessestoISarchitecture.Section4 illustrates an example of path for the specification of an IS model through the con-ceptualisationoftheenterpriseprocessmodel.Finally,section5concludesthepaper.

[1]Asetofactivitieswhichproduces,fromoneorseveralinputs,anoutputvaluableforthecustomer.

[2]ThetermEKD-CMMstandsforEnterpriseKnowledgeDevelopment-ChangeManagementMethod.

1 Business Modelling through EKD-CMM

As introduced before, the recent transformations in economical and ICT environ-ments have imposed radical changes in the way business is driven nowadays. There isan increasing need for ICT support in achieving competitive business goals. Exam-ples of this are the Enterprise Application Integration (EAI) approach, the EnterpriseResources Planning (ERP), and the e-Business [20], among the mostknown.

Analysing these innovative approaches, we found that they are based on a commonbusiness driver: "the urgency of adapting business to the dynamical environmentdemands". This adaptation must be made by taking into account not only the internalprocesses and ICT exigencies, but considering the reasons that caused the changeprocess. For example, if the change is caused by a modification in business goalsbecause of a predefined surviving strategy, then the change problem must be analysedin a top-down manner. In this case, the ICT technologies must act as a support for thedecision making process and also as a solution for implementing and consolidatingchange in the organisation. The perspective for analysing the change process is dif-ferent if the origin of change is at the IS layer, i.e. if the change process is caused bythe introduction or modification of some ICT technologies. In that case, the changesituation must be analysed in a bottom-up manner so the advantages for the wholebusinesscanbeelicited.Inthiscase,theICTisacauseofthebusinesschange,thusits impacts must analysed from many perspectives. For instance, the IS Architecture,as well asthe way businessprocesses areorganised and executed,may change.

These two complementary examples of the ICT role in a business transformationprocessaimtohelpustostatethattherelationshipsbetweenbusinessprocessesandIS are the nucleus of a successful organisational change process. In other words, itdoes not matter what causes the change process. What it is relevant is how well therelationshipsbetweenbusinessfunctioningandICTarecharacterisedandimple-mented. This characterisation will allow business managers to visualise, analyse andimplement business changes without neglecting the crucial effects that ICT have overbusiness functioning and vice versa. Moreover, models facilitate understanding andcommunicating about the business and its support systems only if the objective of themodel is well understood. For instance, if the objective is to understand the businesswell enough to specify supporting systems, it is not useful to model the entire busi-ness in detail. Contrary, if the aim is to innovate the business, it is necessary to pro-vide more effort to define and/or redefine the entire business and to find improvedways of conducting it[18], [14].

ASurveyofEKD-CMMMethod

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

TheEKD-CMMenterpriseknowledgemodellingcomponent[14],[15],[21],[18],

[16] recognises that it is advantageous to examine an enterprise from multiple andinter-connected perspectives. Thus, EKD-CMM models describing an enterprise arestructured in three layers of concern (see Figure 1): Enterprise Goal Model, Enter-prise Process Model and Enterprise Information System Model. The first two layersfocus on intentional and organisational aspects of the enterprise, i.e. the organisa-tional objectives and how these are achieved through the co-operation of enterpriseactors 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.

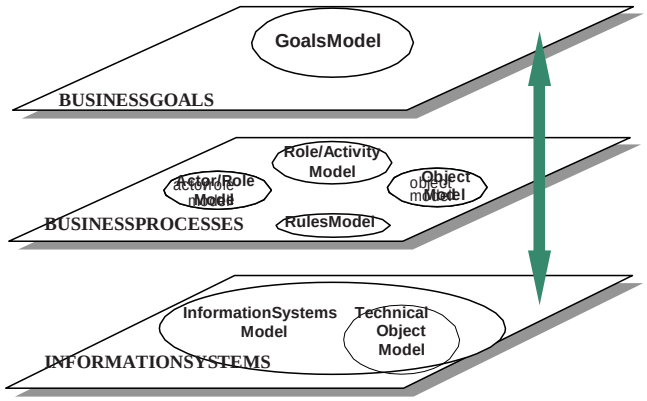

Fig.1.EKD-CMMenterpriserepresentationlayers

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 theprocess keeps track of how the product has been constructed. A Product Model de-finesthesetofconceptsandtheirrelationshipsthatcanbeusedtobuildaproduct,i.e., in our case, to build a model representing a given enterprise. The Process ModeldefineshowtousetheconceptsdefinedwithinaProductModel.AProcessModel and its related Product Model [3] are specific to a method. The EKD-CMM Product andProcess Models, according to method engineering principles, have been previouslypresented in[18], [19], [24], [25] and [26].
The intention oriented modelling used in EKD-CMM provides a basis for under-standing and supporting the enterprise modelling, and the managing the organisa-tional changes. At the same time, it helps to define the supporting IS. Process guid-anceprovidedbyEKD-CMMisbasedonthemapformalism[27],whichisanavigational structure in the sense that it allows the modellers to specify paths fromStart intention to Stopintention. The approach suggests a dynamic construction of themost appropriate path by navigating in the map. Thus, EKD-CMM proposes severalwaysofworking,andinthissense,itisamulti-method.Infact,usingtheEKD-CMM framework, one can start at any enterprise representation layer and move on tootherlayers, depending on the modelling and organisationalsituations.
The method may be used for both business engineering and IS engineering pur-poses, permitting: (a) Business process reengineering: from business processes layerto the business objectives for change [11], [14], [28], [29] and then to the businessprocess architecture for the future; (b) Reverse engineering: from legacy informationsystems at the IS layer to the business processes layer [30], [31]; (c) Forward engi-neeringor information system design: from business objectives to business processmodelling and to the choice of the processes to be supported by the information andcommunication technologies (ICT) and than to the IS modelling [19]; (d) Businessprocess improvement: by modelling and analysing the business processes in order toenhance them by specific modifications such as role definition or activity flow; (e)Quality management: by defining the business processes and quality procedures andbyaligning them, ones withrespecttoothers.
TheEKD-CMMthree layers framework and the associated Process Model allowus to understand, to analyse and finally to model the enterprise according to its multi-ple 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 andmodelling of the organisational change processes. To this end, we focused our atten-tion 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 inten-tional level [14], [28], [29]. The EKD–CMM approach has been thus successfullyapplied in an ESPRIT Project (ELEKTRA) aiming to discover generic knowledgeabout change management in the electricity supply sector for reusing it in similarsettings. Two end-user applications have been considered within the project. Ourconclusion at the issue of these two real life projects was that reasoning on the enter-prise objectives makes easier understanding of problems and communication on es-sentialaspects(what andwhyinsteadofwho,when, where and how). Our currentworkfocusesonthetwolowerlayersshowninFigure1,namelybusinessprocesses

and information systems in order to highlight the relationships between the enterpriseprocess models andthe specifications of the ICT systems.

EKD-CMM ProductModels

Abusinessmodelcanactasthebasisfordesigningthesupportingsoftwaresystemsin an enterprise. Typically, business modelling and software modelling use differentlanguages and concepts making integration of the two models difficult [32]. The setEKD-CMM Product Models aims to ease this integration by providing methodologi-cal tools to use a business model (enterprise goal model and enterprise process mod-els)todefine the supporting IS' architecture.

From the EKD-CMM perspective and experience, an important conclusion aboutbusiness models use, is that it has a twofold goal: first, a model helps organisationalmembers to understand what they are, what they want to be as an organisation, andhowtheycanachieveanidentifiedsetofbusinessgoalsbyreorganisingor(re)defining the business processes. Second, a model aims to design the IS architec-ture that best fits organisational needs already expressed by the business goals andtheir corresponding business processes.

The instantiation of the Product Model's concepts allows business modellers tobuild specific business models, which represent particular business situations. Let ussupposethatthefuturebusinesshasbeenmodelledfromdifferentperspectives(see [18] and [25] for details), i.e. by modelling the business goals, the actors that areresponsible for the execution of the underlying business processes and the set of ac-tivities that are under the responsibility of those actors, as well as the resources in-volved in the execution of those activities. The resulting business models are in-stances of the Goal Model, the Actor/Role Model, the Role/Activity Model and theBusinessObject Model withtheirrelationships.

EKD-CMMProcessModel

Amap[27]isaProcessModel in which a non-deterministic ordering of intentionsand strategies has been included. It is a labelled directed graph with intentions asnodes and strategies as edges between intentions. A map consists of a number ofsections 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 inten-tion to be achieved next and the appropriate strategy to achieve it whereas the associ-ated guidelines help intheachievementofthe selected intention.

The EKD-CMM high-level map, shown in Figure 2, contains a finite number ofpaths; each of them is aEKD-CMM Process Model. Therefore the EKD-CMM map isamulti-model.Noneofthefinitesetofmodelsincludedinthemapisrecommended'a priori'. Instead the approach suggests a dynamic construction of the actual path bynavigating in the map. In this sense the approach is sensitive to the specific situationsastheyariseinthemodellingprocess.TheEKD-CMMmulti-modelallowsustoexpress all modelling strategies that can be followed to build an enterprise model (abusiness model and an IS model). The formalisation used to define the EKD-CMMProcess Model is intention oriented, i.e. the business owners', the business modellers'andthesystemsdevelopers'modellingintentionsaredirectlyexpressedbymaps.This is carefullydescribed in[24] and [25].

The experience gained during our previous work shows that the path to be fol-lowedinthemapduringaparticularenterprisemodellingprojectissituation-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 thecurrentElectricityDistributionBusinessUnitsituationanditspossiblere-organisation alternatives. The application of the specific strategies forming this pathwas also affected by a number of situational factors including: (i) organisationalculture; (ii) ability to commit resources; (iii) social skills and consensus attitudes ofparticipatingactors;(iv)useofsoftwaretoolstofacilitatetheprocessexecution;and (v)familiaritywithappliedstrategiesandsupportingtechnologies.

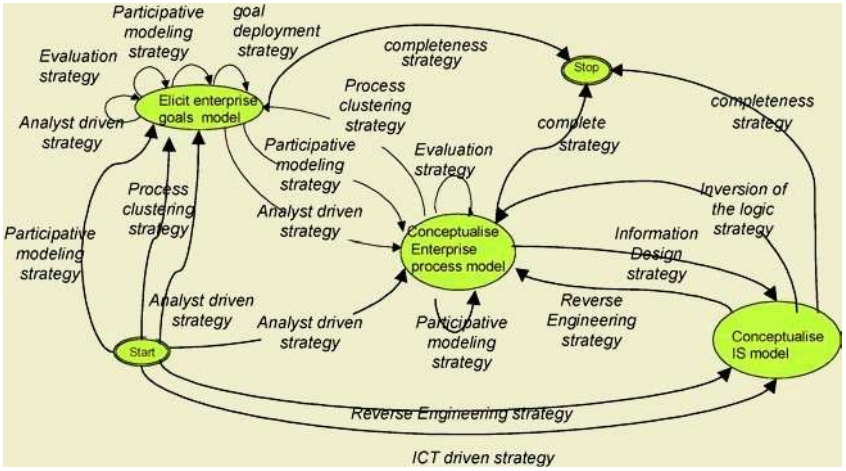

Fig.2.EKD-CMMRoadmap

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 participativemodelling strategy. For this end-user, the future enterprise goal structure was firstelicited and then futureenterprise processmodelswereconceptualised.
TheEKD-CMMProcessModelisshowninFigure2asaroadmap.Guidelineshelp users to choose between two alternative sections between a source process intentionandatargetprocessintention(strategyselectionguidelines)ortochoosebetween possible target intentions when moving from a source intention (intention se-lection guidelines). This will be described in Section 4. The execution of each mapsection 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, AnalystDrivenStrategy>isdefinedasalocalmapshowninFigure3.Thismeansthatthemethodknowledgeembodiedinthegui delinesupportingtheexecutionofthismap section is too complex and too rich to be described in operational terms andrequiresan intermediary intentionaldescription in alowerlevelofabstraction.
All guidelines corresponding to the sections between the process intentions ElicitEnterpriseGoalStructureandConceptualiseEnterpriseBusinessProcessModelhave been developed in [18] and [24]. Our current work consists in identifying anddeveloping the methodological guidelines associated to the map sections having theprocess intention Conceptualise Information System Model as source or as target. Forinstance, Figure 4 shows the local map defined to provide guidance to the global mapsection (see Figure 2) <Conceptualise Enterprise Business Process Model, Conceptu-alise Information System Model, IS design strategy>. The next sections concentrate indevelopingguidance(usinglocalmaps)forpassingfromtheBusinessProcesslayerto the IS layer.

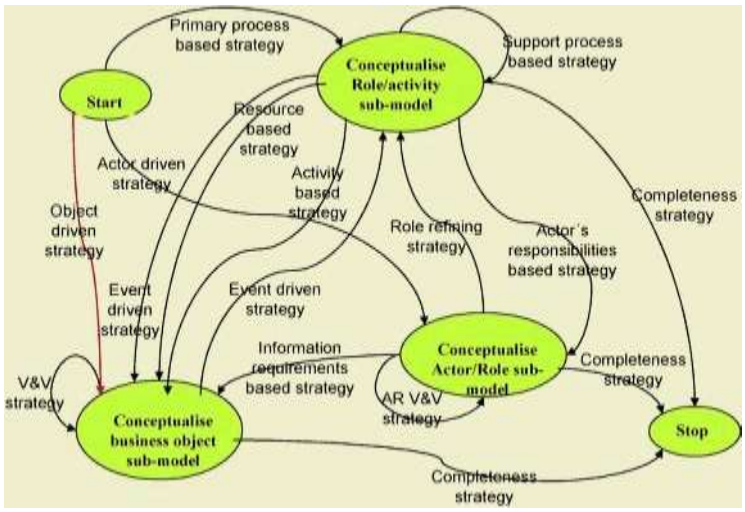

Fig.3. Roadmapforconceptualisingabusinessprocessmodelfromscratch

2 The Information Systems Architecture(ISA)

The Information System Model contains not only the representation of the set of IS,butalsothedefinitionofthelocalandshareddatabases,aswellastheinformation requirementsandmanagementindicatorsthatshouldbesatisfiedbyapplicationsor IS.

As we explained before, the main goal of the IS architecture (ISA) is to supportbusiness processes at the operational and strategic levels. The definition of informa-tion requirements and management performance indicators is directly associated tobusiness processes through theBusiness Objects Model (BOM) shown inFigure 1.

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

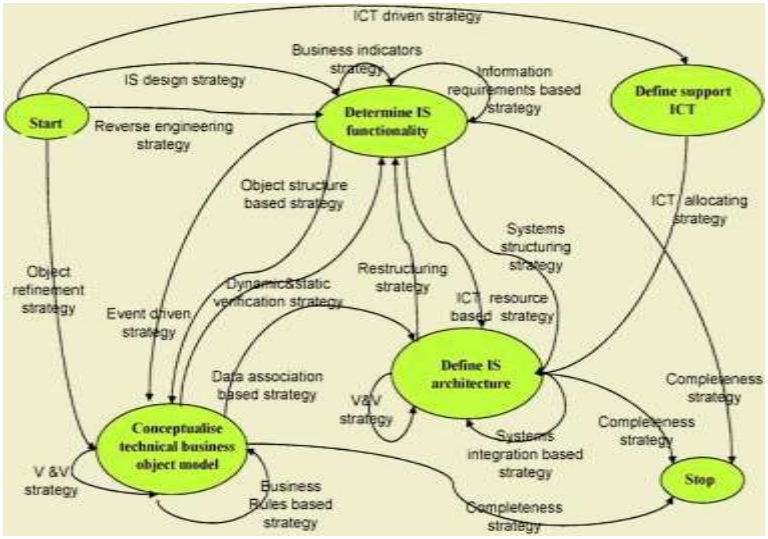

Fig.4. RoadmapforconceptualisingISmodelaftertheBPmodelbeingconceptualised

An ISA comprises the set of enterprise IS, the connections and dependencies be-tween them and the ICT required for their implementation. ICT includes hardware(PC, servers, nets, and storage, input/output devises, etc.), software (exploitation,support,development,andapplications)andfinally,methodological(projectman-agement, development, change control, maintenance, etc.) and technical (languages,modelling tools, etc.) artefacts. Considering the evolving environment where enter-prises are immersed nowadays, the ISA may include all or part of these types of IS:legacy systems, enterprise resource planning applications (ERP), and new specificdevelopments. The data distribution and exploitation is directly associated to each ISfunctionality. For completing the set of concepts associated to the enterprise IS layer,we include strategic and operational plans which define what, when and how devel-oping, maintaining, integrating, or purchasing the systems contained in the IS archi-tecture.

TechnicalBusinessObjectsintheInformationSystemsLayer

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 Busi-ness Process layer (see Figure 1). The BOM must be refined and expressed accordingto the adopted software engineering techniques. Therefore, we determine two com-plementary perspectives for defining the set of business objects of an enterprise. Eachperspective is associated with an enterprise representation layer: (1) the businessobject model (BOM), built at the business process layer, and (2) the technical busi-nessobject model (TBOM) built atthe IS layer.

Processes inputs and outputs, as well as business resources involved in activitiesdrive the business process perspective. Figure 5 shows the process map associated tothe BOM definition. This map provides guidance for the map section <Start, Concep-tualisebusiness objects sub-model, Objectdriven strategy> shown inFigure 3.
Observe that there are many ways of conceptualising business objects involved inbusiness process executions. There are two main intentions that can be achieved in anon-deterministic manner: Define business objects and Elicit business objects. Eachintention has a set of achieving strategies that may be chosen according to specificmodelling situations. For instance, there are three different ways of "eliciting businessobjects", the resource based strategy; the event based strategy, and the activity-basedstrategy. Selecting the activity based strategy means that the business objects will bediscovered by analysing low level activities of the business processes. Notice that, theselection of one of these strategies for achieving the elicit business objects intentiondoes not eliminate the possibility of selecting the others (two strategies) for complet-ing the knowledge associated to the business objects already elicited. The BOM at thebusiness process layer, is expressed in conceptual terms without technical considera-tions,thus managers and others enterprise members can easilyunderstand it.
The IS perspective is technology driven; i.e. technical factors such as formal lan-guages, and graphical notations controls the modelling process. Figure 6 shows theprocess map associated to TBOM at the IS layer. This map provides guidance for themap section <Start, Conceptualise technical business objects model, Object refine-ment strategy> shown in Figure 4. Observe that the intentions associated to TBOMconstructionaredifferentfromthosedepictedatFigure5:Debugbusinessobjects
andBuild technical business objects model. The associated strategies allow modellersto choose complementary ways of building and validating the TBOM.
Notice that the BOM obtained at the BP layer is here refined (see Figure 6) withrespect to the software engineering and database concepts and techniques for obtain-ing first, the logical data model expressed according to the object oriented paradigm;and then, the object implementation model. In order to assure the complete corre-spondence between the resulting data model and the business information require-ments and rules, the data model must be validated against the business process modelbuilt at the BP layer. Thus, the possible inconsistencies on business object representa-tions can be corrected assuring the correspondence between the two business objectmodels.

Fig.5. ConceptualisingBOMusingtheobjectdrivenstrategyattheBPlayer

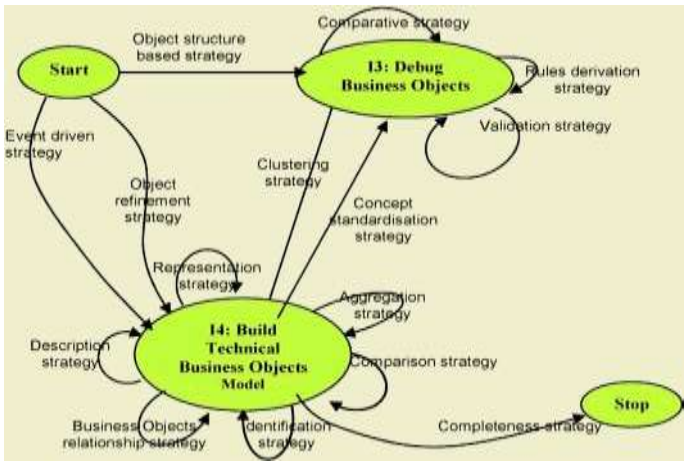

Fig.6. ConceptualisingTBOMusingtheobjectrefinementstrategyattheISlayer

The ISAandtheBP Needs

ItisnoteasytodiscoverwhattheappropriateISAforaparticularenterpriseis.Therearemanyfactorsthatmustbeconsidered whilespecifyingbusinessobjects,information requirements,andbusinessprocessesandactivities.Thewayanactivityorasetofactivities(abusinessprocess)isperformed,determinesifoneorseveralISareneeded.Thisdeterminesalsoifthebusinessobjectsshouldbesharedornot,andsecurity, qualityandaccessrestrictionsthatmustbeincludedintheISfunctionalities.Therefore,therelationshipbetweentheISlayerandtheBPlayergoesfurtherthanthesimplebusinessobjectsmodeldefinition(BOMandTBOM).ThewayasetofISisstructured,thedefinitionanddistributionofISresponsibilities,isaconsequenceofthewaythatbusinessprocessesareperformed.Besides,therearemanyotherenterprisefactorssuchaspriorities,financialandtechnicalissues,thataffectthedecision ofimplanting aparticular IS structureor another.

The BPandtheIS IssuesMoreVulnerabletoChanges

In the context of the work still done, we just considered the technical factors associ-ated to the technologies needed for business process execution and for supporting theexchange of information between business processes. Besides, we should consider thestrategic 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 thisperspective,the definition of the ISA for a business is based on:

- Businessprocessesexecutiondependencies,suchasinputs/outputs,support,andworkflow coordination.
- Businessobjectsownersandusers,thusthesetofpermittedmanipulationscanbeelicited andimposed.
- LegacyandacquiredsystemsandtheirintegrationthroughanEnterpriseApplica-tion (EAI) perspective.
- Thekindoftechnologyrequiredfortheexecutionofbusinessprocesses,aswellasthestandardisation of some related procedures.
- TheICTavailableandrequired(restrictedaccordingtobusinessfinancialpossi-bilities)inthe enterprise.

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

At the IS layer, the elements more vulnerable to changes are: business objectsdefinition (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 (businessprocesses, 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 af-fects the two other business representation layers (Figure 1) or it may comes from oneof them. For instance, a reengineering process may be the consequence of a change inthe organisational politics (goals layer). In that case, this change causes a redefinitionof a setof business processes, and also aredefinition of the IS thatsupportthem.

3 How toUse the Process Maps

ThissectionillustratesanexampleofpathforthespecificationofanISmodelthrough the conceptualisation of the enterprise process model. Our purpose is to ex-plain how to use the process maps as methodological guidelines. In fact, those mapsassist business owners, business modellers and ISmodellers while specifying busi-ness models and IS models.

Enterprise modelling using EKD-CMM is an intention driven process that resolvestwo issues, namely, (1) how to fulfil the modelling intention according to a strategyand(2)howtoselecttherightmapsectiontoprogress.Becausethenextintentionand strategy to achieve it are selected dynamically, guidelines that make available allchoices open to handle a given situation are of great importance. Maps have associ-atedguidelines [27], namely one 'Intention Selection Guideline' per node I_i, exceptfor Stop, one 'Strategy Selection Guideline' per node pair $<I_i,I_j>$ and one 'IntentionAchievement Guideline' per section $<I_i,I_j, S_{ij}>$. Given an intention I_i, an IntentionSelection Guideline (ISG), identifies the set of intentions $\{I_j\}$ that can be achieved inthe 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 guidethe selection of one S_{ijk}. Finally, the execution of each section is supported by an IAGthatprovidesanoperationaloranintentional means to fulfil a modelling intention.For the former, the IAG provides process knowledge specified by the means of op-erational models. For the latter, the IAG is defined as

a map in a lower level of ab-straction.
All ISGs and SSGs and also the IAGs providing a methodological knowledge de-scribed in an operational level are specified according to the contextual formalismdeveloped within the ESPRIT project NATURE [34]. We just recall here that a con-text is defined as a pair <(situation), intention>. The kind of EKD-CMM guidelinesspecified above are organised into hierarchies of contexts of three types, namelychoice (refinement of contexts), plan (composition of contexts) or executable. Moredetails aboutEKD-CMMguidelines can be found in[14], [24] and [25].
Let us suppose that we are performing an enterprise modelling process in the fol-lowing situation: the organisational maturity of modelling and the participative in-volvementarelowandthereisnoavailabledocumentationofthebusinessprocesses.
The ISG associated to the intention Start in the EKD-CMM map shown in Figure 2suggests us to choice Conceptualise enterprise process model as next intention and toapplytheIAGassociatedtotheuniquemapsectionbetweenthesetwointentions.ThisIAG is defined as a map, shown inFigure 3, ina lower levelof abstraction.
The ISG associated to the intention Start in the map shown in Figure 3 provides usa choice between three intentions. Let us suppose that the modelling team has a greatexperience with object modelling -and less with activity modelling- and a partialdocumentation of the legacy systems is available. Than the ISG associated to theintentionStartsuggestsustochoiceConceptualisebusinessobjectssub-modelasnext intention and to apply the IAG associated to the unique map section betweenthesetwo intentions. This IAG is again defined as a map shown inFigure 5.
Let us suppose that the modelling team has a great experience with event-basedobject modelling techniques, for instance Remora. The ISG associated to the intentionStart in the map of Figure 5 suggests to choice Elicit business objects as next inten-tion, and the SSG associated to the couple <Start, Elicit business objects> suggests toselect the Event based strategy and to apply the IAG associated the section supportingthis strategy.
To make short, let us suppose that navigation is terminated in the map ofFigure 5 and the other sub-models of the BP layer are specified successively leadingthus to end the navigation in the map of Figure 3. The specification of the businessprocess model being completed, the EKD-CMM map of Figure 2 suggests us to Con-ceptualise information system model using IS design strategy. The IAG associated tothismapsectionisagaindefinedintentionallyasshowninFigure4.Themapsection
<Start, Conceptualise technical business objects model, Object refinements strategy>is, in its turn, defined intentionally as shown in Figure 6. When the navigation isterminated in the map of Figure 6, modellers go back on the upper intentional level tonavigateinthe map of Figure 4, and finallyinthe map of Figure 2.

4 Conclusions and Future Work

This paper reports on the use of an intentional framework for modelling enterpriseknowledge using business models and IS models. A major advantage of the proposedapproach is the systematic way of dealing with enterprise modelling and organisa-tional transformation in terms of knowledge modellingused with a process guidanceframework. The experience gained during our previous work has substantiated theview that, paths of the EKD-CMM maps to be followed in a particular enterprisemodelling project are very much dependent on the enactment context of the enterpriseproject and a number of situational factors. Including degree of formal hierarchy (fewvs. many formal levels), decision structure (authoritative vs. management by objec-tives), company culture (collectivistic vs. individualistic), degree of distance of power(short vs. long), type of market (deregulated vs. regulated), etc. Thus, the EKD-CMMframeworkprovidesasystematic,neverthelessflexible,waytoorganiseandtoguidetheenterprisemodellingprocesses.
The EKD-CMM modelling framework allows us to represent an enterprise frominterrelated perspectives using a three-layer model. It integrates enterprise objectives,processes and systems in a single modelling framework. The more relevant feature ofour framework is that it makes explicit the link between these three modelling layers.Thewaythethreelayersmodelhasbeenstructuredassuresthatbusinessprocessesare at the origin of the technical business objects as well as the definitions of informa-tion requirements and management performance indicators. In consequence, they willbetaken intoaccountfor the design and distribution of the software components.
The EKD-CMM requires the domain knowledge to fully understand the organisa-tionfromitsmultipleperspectives.Ratherthantryingtogainhugeamountsofknowledge, a better solution seems to involve several key persons of the enterprise inthe modelling process. These persons will provide organisational knowledge or willknow where it may be found. Simultaneously they will become an important resourceby gaining knowledge of EKD-CMM, which will be useful if the organisation desiresto continue working withenterprise analysis and modelling.
Our framework contributes to define accurate decision making processes insidemodern organisations, which are

highly dependent of ICT. It reinforces also the abil-ity of companies, which apply ittoadoptapolicy of knowledge management.

Our future work will consist to integrate in the EKD-CMM modelling framework,theabilitytohandlethe issues listedin Section3.3.

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