Strategic Modelling of Enterprise Information Requirements

A normative model of information domains and information types

Gianmario Motta, Giovanni Pignatelli

Department of Informatics and Systems, University of Pavia, Pavia, Italy

gianmario.motta@unipv.it , giovamni.pignatelli@unipv.it

Abstract: We illustrate a model to define information requirements for the whole Enterprise. The key novelty is that the model is a normative one. Actually it assists the analyst in defining the contents data bases should have. The approach is founded on some key ideas. First, an enterprise processes information on domain families, that include stakeholders, products, process and contexts. By specializing these domain families the analyst identifies domains specific to an individual enterprise. Second, information of a given domain includes different information types, namely master information, that defines structural properties, transaction information, performance / analytical indicators. By crossing information domains and information types the analyst identifies normative entities, that can be used to assess effectiveness and coverage of actual data bases and other IT strategy issues and, of course, to design a top-down design of the data base. The model develops and generalizes the Aggregate Business Entity incorporated the e-TOM framework, a reference model developed for telecommunications, and it has been tested in a pilot project in health care.

1 Introduction

Defining information domains for an enterprise is an issue from the heydays of Information Technology and it implies questions as “are we processing the information we should?”, “which is the coverage of our data bases?”, “are we buying software that fits our information needs?”… Of course, these issues are critical for the quality of the IT strategic plan.

To deal with such issues in a very simplistic way, an enterprise can look on data schemas of its computerized databases. This can be practical but never will realize the gap between what the enterprise should have and what actually has. Furthermore, distilling into a compact strategic design hundreds of relations of actual databases can result into a hard if not useless task.

The need of a structured top-down approach to identify high level information requirements emerged already in Seventies, with first really large information systems. A champion of this early methods is Business Systems Planning (BSP), very popular in Eighties. BSP [5] associates data classes and processes in a grid, that shows which data are used by which process. BSP is a robust, structured, comprehensive but time consuming methodology, and, specifically, it does not indicate the information classes a system should process. Nor the subsequent champion, Information Strategy Planning (ISP) in the comprehensive Information Engineering framework [9], that integrates different information models, such as BSP, Entity Relationships and Data Flow Diagrams (DFD), gave a normative framework. The flood of methods started in the early days [2] but it still continues. However, all of them only structure information requirements. To define “what information do we need?” you depend on interviews and on a costly process you cannot always afford.

In recent times, normative industry models are emerging. Some model provides reference frameworks of business processes, as SCOR (Supply Chain Organization and Reference Model) that has been developed for the manufacturing industry [1, 13]. In telecommunications industry, the Shared Information Data Model (SID) of eTOM (Enhanced Telecom Operations Map®) proposes a normative framework for shared information / data. SID uses, based on the concepts of Business Entities and Attributes [14, 15]. A Business Entity is a thing of interest to the business, while Attributes are facts that describe the entity. SID is a real normative model but it lacks universality, since it is solely oriented on telecommunications, and it does not provide an axiomatic approach to identify Entities.

Also some management theories have addressed the issue of information needs for management. In the Nineties and in New Century, Balanced Score Card (BSC) [7, 8] and 6Sigma [4] had a great success not only as models for overall strategic and management control but also as frameworks for identifying management information needs. Actually BSC proposes a list of indicators for strategic control, that includes data on various domains (financial performance, performance of internal processes, performance on learning and growth). However, these models are normative but not universal, since they consider management and not the operational aspects.

To summarize the positions of the existing approaches we have used three axes (Figure 1). The axis of generality represents the universality of an approach in front of industries: the wider the range the higher the universality. The axis of normative capacity measures the ability to suggest the “right” information requirements. The axis of completeness of domains represents the capacity of considering all information uses, namely management, analytic, operational. Different approaches excel on different axis, but no one of them offers a comprehensive coverage. BSP is universal but it is not normative at all. BSC is general and normative but not complete. Finally, SID is normative, but not general nor complete.

Our purpose is a normative model that fills the three axes of normative capacity, generality and completeness. With such model, the analyst will get a list of the potential contents of the data base of the enterprise, that can be further validated and expanded.

Of course, our analysis considers aggregated information requirements. The output of the analysis are schemas of aggregated information. However, these schemas nay be a first deliverable of a top down design process or be used in IT strategic planning to assess the coverage of information needs by existing databases or the impact of business and technological discontinuities on information domains.

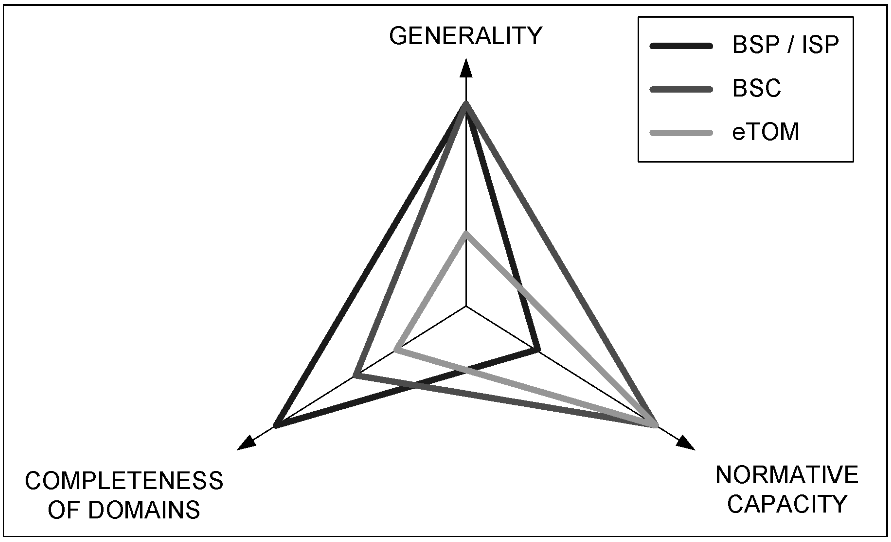

Fig. 1. Comparison of frameworks for enterprise information analysis

2. The information catalogue

"An Aggregate Business Entity (ABE) is a well-defined set of information and operations that characterize a highly cohesive, loosely coupled set of business entities" [14]. However, the key point is to identify are candidate ABEs of enterprises. As we have said at the very beginning of our paper, the catalogue of candidate ABEs result from crossing two main categories, information domains and information types.

2.1 Information domains

The concept of information domain is already used in the SID model. We assume an enterprise process information on the domains where it operates. Our first level is nothing else but a generalization of the SID semantics and it includes stakeholders, resources, context, output. Let us consider each of these domain.

Our vision of stakeholders reflect Freeman's concept [3], where "a stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives". In our catalogue stakeholders include Law, Competitor, Customer, Supplier, Broker, Shareholder. In short, stakeholders are the who's of the enterprise.

The domain of output reflect the operations of the enterprise and include Process, Product and Service information.

Resource domains reflect classic economics and includes Personnel (= Human Resources), Plants and equipments (= Technological Assets), Materials, Cash (= Monetary Resources). In short, resources are input used by enterprise to produce its outputs.

Finally, the domains of context reflect the environment where the enterprise operate and include and its structure and include Structure, Project, Region.

2.2 Information types

From countless years, analysts classify information in database in three classes, namely master data, transactions data, analytical / calculated data. This intuitive taxonomy is very valuable when generalized.

Master Data represents structural entity properties and are typically "strong entities". Transaction Data describe the properties of events a given strong entity is generating or receiving, as orders, state changes and alike, and are typically weak entities. Finally Analysis Data are indicators that are calculated from Transaction and Master data, and provide information for management and governance e.g. profitability of a plant, a customer or quality of a supplier.

2.3 The structure of the catalogue of ABEs

The result of the combination of information types and information domain is a grid that contains the ABEs of "level zero" (Table 1). Each cell represents an ABE that could be seen as a couple (D,E) where D is the domain and E is the information type.

Table 1. The first level of Aggregated Business Entities

			INFORMATION TYPE		
			Master Data	Transaction Data	Analysis Data
INFORMSTION DOMAIN	Stakeholders	Law	LAM	LAT	LAA
		Competitor	COM	COT	COA
		Customer	CUM	CUT	CUA
		Supplier	SUM	SUT	SUA
		Broker	BRM	BRT	BRA
		Shareholder	SHM	SHT	SHA
	Resources	Personnel	PEM	PET	PEA
		Plants	PLM	PLT	PLA
		Raw materials	RAM	RAT	RAA
		Cash	CAM	CAT	CAA
	Context	Structure	STM	STT	STA
		Project	PJM	PJT	PJA
		Region	REM	RET	REA
	Output	Process	PRM	PRT	PRA
		Product	PDM	PDT	PDA
		Service	SEM	SET	SEA

2.4 Customization, refinement and validation of the catalogue of ABEs

The simple grid is of course useless. To get real data the analyst customizes ABEs that are specific to the individual enterprise within the analysis scope. An example of such customization is Table 2 where the aggregate domain “customer” is specialized in the sub-domains “private” and “enterprise”. Similarly, master data are specialized into “Identification and “Social” and the same happens with Transaction data.

In short the customization is obtained by well known primitives of Creation, Specialization, Decomposition used on aggregate information domains and information types. Actually, the customization is iterative, with refinement and validation sessions with key business representatives. In this process, the analyst will also identify attributes, e.g. key and attributes of customer identification information.

Of course the information requirements can be also expressed by using standard ER notation. In this case, you can track the process of specialization and decomposition, but you loose the double dimension of information types and domains.

Table 2. An example of specialization of "Customer"

		INFORMATION TYPES				
		Master Data		Transaction Data		Analysis Data
		Identification	Social	Man-Machine transaction	Machine-Machine transaction	
Customer	Private					
	Enterprise					

3 Aggregated Entities and IT Strategic Planning

The main use of strategic information requirements is in IT strategic planning. An IT strategic plan will summarize (a) the architecture of applications, data and infrastructure and (b) assess the impact of technology and business discontinuities [10, 11].

The architecture of data is obtained by customizing the general catalogue of ABEs. Also, by crossing the catalogue and the actual database the analyst can assess the current information support.

In a similar way, the analyst can do some form of sensitivity analysis of technology and business discontinuities. Technology discontinuities, e.g. Service Oriented Architecture, may impact on a wide span of elements of the enterprise architecture. Business discontinuities are strategic business moves of the enterprise, e.g. the convergence between telecom and media business, or change of the whole business, e.g. the switch from analogical to digital TV.

3. 1 Assessment of information support

To assess to what extent ABEs are supported and / or used, ABEs are crossed with business processes, organizational structures, IT applications and IT architecture. The grids describe relations G information classes I to information users U (business processes, organizational structures, IT applications and IT architectural elements): G = {U,I,A}.

The ABE meta-model (Figure 2) may be used to assess both as-is and to-be scenarios from a variety of perspectives:

1. Information and Databases grid: assesses the databases coverage by qualitative metrics
2. Information and Application grid: assesses the use of information by applications in terms of information lifecycle and/or qualitative metrics
3. Information and Organizational structure grid: it identifies information ownership;
4. Information and processing levels: it identifies how information is distributed on and used by the processing architecture (client, server, mobile devices)

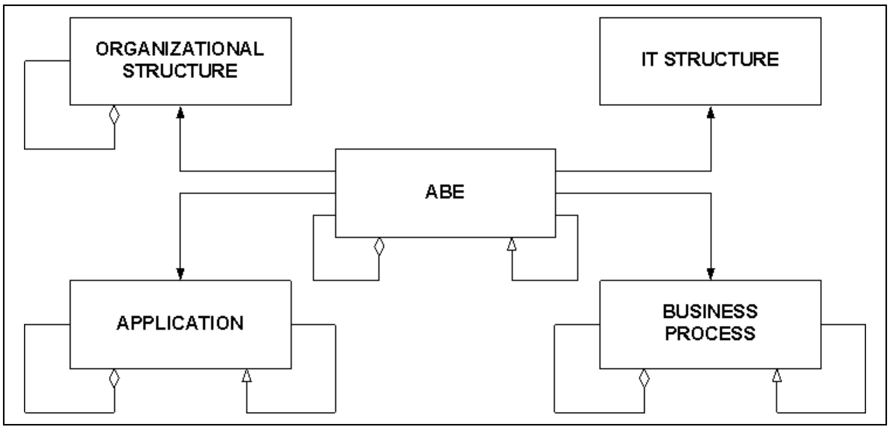

Fig. 2. Relationships between Aggregated Business Entities and other ABE Relations of IT Strategic Planning

In Table 3 the coverage given by actual databases (Laboratory, Financial, Reservation) of a healthcare institution is assessed. The coverage looks poor and no integrated of patient and service data are possible. Of course assessment metrics is qualitative and reflects a joint evaluation by analysts and user, but, management know where gaps are.

Table 3. Assessment of ABE coverage (absent, poor, average and good) in a generic Healthcare Institution by using qualitative evaluation scale (**M** = Master information; **T** = Transaction Information; **I** = Indicators information)

					LAB			FINANCIAL			RESERV		
					Completetness	*Correctness*	*Timeliness*	*Completetness*	*Correctness*	*Timeliness*	*Completetness*	*Correctness*	*Timeliness*
Regulation		**M**	Regulation ID	Privacy Laws Healthcare regulations				Red	Red	Red			
		T	Certification Events	List of Certifications				Green	Yellow	Yellow			
		I	Certification KPIs	Certification levels				Yellow	Yellow	Yellow			
Customer	*Emergency*	**M**	ID	Master data	Yellow	Yellow	Yellow						
			Properties	Patient Record	Yellow	Yellow	Yellow						
		T	Emergency events	Reception	Yellow	Yellow	Red				Red	Red	Red
				Prescriptions	Yellow	Green	Yellow						
				Treatments	Yellow	Yellow	Yellow						
				Other	Red	Red	Red						
			Release	Referral & payments	Yellow	Green	Red						
		I	Process KPIs	Quality - Service - Cost	Red	Red	Red						
	Hospital	**M**	ID	Master data	Yellow	Yellow	Yellow				Yellow	Yellow	Yellow
			Properties	Patient Record	Yellow	Green	Yellow						
			Care process events	Reservation							Yellow	Yellow	Yellow
				Check-in	Yellow	Green	Yellow						
				Prescriptions	Yellow	Green	Yellow						
				Treatments	Red	Red	Red						
				Patient management	Yellow	Yellow	Yellow						
			Release	Referral & payments	Yellow	Green	Red						
		I	Process KPIs	Quality - Service - Cost	Red	Red	Red						
Commis-sioner	*authorities Healthcare*	**M**	ID	Master Data				Yellow	Yellow	Yellow			
			Properties	Financial data				Yellow	Yellow	Yellow			
		T	Events	Advance payments				Green	Green	Green			
				Reimbursements				Green	Green	Green			
		I	Process KPIs	Quality - Service - Cost				Yellow	Yellow	Yellow			
	Medical Technical &	**M**	ID	Master data	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow			
			Properties	Job data	Green	Yellow	Yellow	Green	Yellow	Yellow			
				Skill and education	Green	Green	Green	Green	Green	Green			
		T	Events	Presences & Payroll				Green	Green	Green			
				Career				Yellow	Yellow	Yellow			
			Certifications	Skill certificates				Yellow	Green	Green			
		I	KPIS	Performance & potential				Red	Red	Red			

3.2 Sensitivity Analysis

Sensitivity analysis identifies information domains impacted by strategic discontinuities, e.g.:

1. Business Discontinuity: the impact of enterprise strategies e.g. mergers, acquisitions, new products, new services is assessed (which ABEs will be affected and how much?)
2. Technology Discontinuity: the impact of technology changes on information is considered (which ABEs will be affected by emerging technologies e.g. Service Oriented Architecture and how much?)
3. Normative Discontinuity: the impact of regulations e.g. privacy, security etc. is identified and possibly described (which ABEs will be affected by privacy restrictions etc?)

3. 3 Position of the ABE method in Zachman's Framework

The method as described here has a rather good coverage in the Zachman's framework [6], a popular reference to position what really a method does (Table 4).

Table 4. Coverage of the ABE method in Zachman's Framework

Layer	What (Data)	How (Function)	Where (Network)	Who (People)	When (Time)	Why (Motivation)
Scope (Contextual) Planner	List of things important to the business	List of processes the business performs	List of locations in which the business operates	List of organizations important to the business	List of events significant to the business	List of business goals/strategies
Business Model (Conceptual) Owner	Semantic or ER Model	Business Process Model	Business Logistics System	Work Flow Model	Master Schedule	Business Plan
System Model (Logical) Designer	Logical Data Model	Application Architecture	Distributed System Architecture	Human Interface Architecture	Processing Structure	Business Rule Model

Layer	What (Data)	How (Function)	Where (Network)	Who (People)	When (Time)	Why (Motivat ion)
Technology Model (Physical) Builder	Physical Data Model	System Design	Technology Architecture	Presentation Architecture	Control Structure	Rule Design
Component Configuratio n Implementer	Data Definition	Program	Network Architecture	Architecture	Timing Definition	Rule Specificatio n
Functioning Enterprise Worker	Data	Function	Network	Organization	Schedule	Strategy

4. Conclusions

We have illustrated a strategic information model, based on a normative framework with numerous advantages:

1. It assists the analyst in identifying “right” information requirements
2. It is cross-industry and can be specialized as needed
3. It is strategic and it can stop at the detail levels defined by the planning process, by zooming critical areas and summarizing non critical ones
4. It easy to understand for management and supports a what-if analysis of business strategic alternatives
5. It can be linked to detailed information requirements analysis.

The framework has been partially used in a strategic planning of a very large telecom corporation and has been successfully tested in healthcare to identify the information strategy. On going work includes the development of a web application to customize the overall catalogue and of a knowledge base where the analyst can find and modify predefined information models.

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