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META DATA REPOSITORY DESIGN AIDED BY TELEONIC PROCESS AND GOAL ANALYSIS

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Abstract

Building high quality Meta Data Repositories for medium and large private and governmental organizations is a very topical task with innumerable challenges. The MDR can not be considered simply as ‘yet another database’ in the organization, or they loose they main purpose and value. Examining the business processes and aims of the organization helps us to identify the place and role of the MDR in the organization. Terms, such as process modelling and process patterns come immediately into the picture. Apart from the many successful implementations and uses of business process models, the literature of possible pitfalls and ’bad practices’ has grown considerably too. Regarding the latter issue, prevention is undoubtedly the best solution and the application of a process-oriented approach based on the notion of goal rather than on the sequence of activities is suggested. The framework we examine here has a broad coverage of process patterns offering safeguards against many of the most common and painful pitfalls. This framework is called teleonics, and besides the concise description of its terms, it will also be demonstrated how well they fit one of the business process extensions of the Unified Modelling Language (UML). Several important design issues and some golden rules of the MDR design will demonstrate how teleonic considerations can help us keep projects on the right track.

Keywords: teleonics, business modelling, meta data, managed meta data environment, meta data repository, business extension of UML.

1. Introduction

Meta data repositories were brought to life as organizational wide storage places of both business and technical metadata. One of their main purposes was to provide easy and fast access to details of the major organizational process for decision makers. After their early evolutional phase, it became quickly evident that their role from a ‘passive’ database, which is ‘only’ a source of information for answers to questions and can only provide simple answers to the users, will soon be changed. System automation can not be stopped, and these precious sources of information started to be involved in the control and governance of other corporate information systems, thus actually becoming an active and influential ‘player’ in organizations.

The essentially symbiotic nature of information systems and their users, can not be overemphasized here. On the one hand, requirement analysis for the design of information systems is based on the customers’ current needs and future plans, while the influence is also strong the other way round. Organizations installing and using more and more wide-spread computer systems have to be aware of the changes in their internal and external business processes. It also implies that corporate level information systems can not be considered as purely technical systems. They are part of a highly complex biotic system where human and machine players are involved in many different processes of the organization.

Although process modelling and a serious goal-oriented approach are undoubtedly necessary to approach this type of highly complex problem domain, but a more robust framework would also be advantageous to escape of the pitfalls of the average business process modelling approaches. The framework reviewed here is called teleonics, and it facilitates the wholistic approach of analysis and design with a well-proven and many times reused set of process patterns supported by a solid conceptual armature for analysis and system design.

The rest of the text is structured in the following way. In section 2 a business extension of UML is introduced, which I suggest to use for the graphic representation of teleonic concepts. In section 3 I have collected the main principles of teleonics, and in section 4 the teleonic model of organizations is described. Section 5 gives a summary of meta data and meta data repositories, which I use in section 6 as an example to demonstrate the benefits of the use of the teleonic framework. Here, the major activity areas around an MDR are identified and interpreted from a teleonic perspective. Further examples are given, how more detailed business considerations can enrich the picture. A selection of golden rules or best practices for MDR design is also listed to demonstrate their correspondence to teleonic patterns, and to suggest the setup of a more uniform collection of these design rules. Section 7 gives a short summary of the main features and benefits of teleonics, and makes plans for the future. In section 8 I give a short glossary of teleonic terms.

2. Business Process Modelling with UML

The Object Management Group (OMG) created its first business extension for the Unified Modelling Language (UML) [4] in 1997. This extension already has some basic concepts and examples, which also provided a good starting point for further efforts on creating business modelling extensions [5]. ERIKSSON and PENKER published their results in 1999. Their book shows a profound knowledge and a deep understanding of modelling business processes, and it offers a wide range of tools for business modelling in UML [6, p. 65]. The authors' purpose was to provide help with modelling the environment of information systems, namely existing businesses where the current information system under development should work. These business models contain valuable corporate knowledge for both technical and business users. They can be used both by IT experts in assisting the requirement-analysis of information system design, and also by business professionals to improve and redesign the business processes, e.g. in Business Process Re-engineering activities.

The ERIKSSON-PENKER extension of UML introduces four common business views, from which perspectives one can study the aspects of the business in question. The views are: business vision, business processes, business structure and business behaviour. The first view, describes i.) organizational goals. The second one is ii.) the study of activities, processes and resources in the organization in order to reach its goals, as well as illustrating the interaction between the business processes. The third view describes iii.) the structure of the organizational resources, while the last view offers the specific iv.) study of the behaviour of each resource and process. All of them use different types of diagrams to fulfil their purposes. Later on, we are going to see that they are in very close relationship with the teleonic projections, which were developed independently some 30 years ago.

2.1. *Business Processes and their Goals*

A *business process* according to the ERIKSSON-PENKER extension of UML: 1. has a goal (either quantitative or qualitative) 2. has specific inputs 3. has specific outputs 4. uses resources (physical entities and/or people, abstract things, information) 5. has a number of activities (subprocesses) that are performed in some order. Atomic processes are called activities, and depicted with the usual symbol of a rectangular with round corners. 6. may affect more than one organizational unit at the same level (has a horizontal impact) 7. creates value of some kind for the customer (either internal or external).

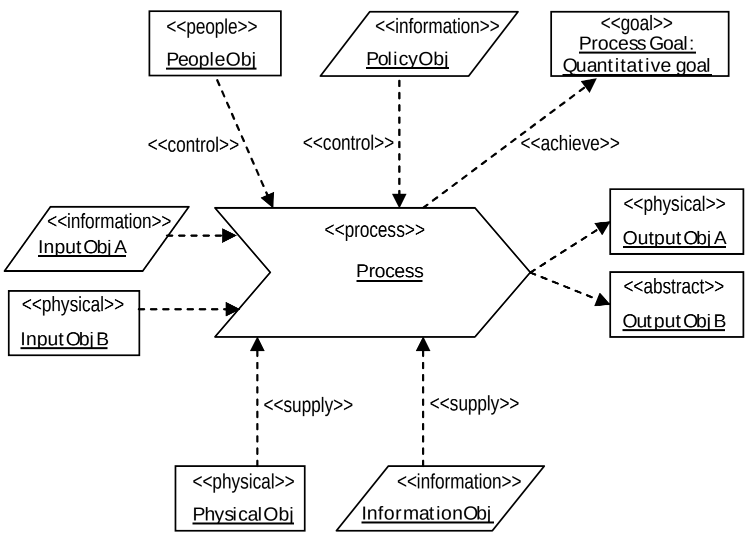

Fig. 1. Generic process diagram

In these diagrams, the process symbol has objects attached to it with dependencies stereotyped in different ways (see *Fig. 1*).

Goal objects have the role of motivating processes to 'achieve' a preferred state envisaged with the goal. There are quantitative and qualitative goals in the model, where the descriptive qualitative goals more closely fit the concept of teleos, while the measurable quantitative goals are what we usually call 'goal' in teleonics. Goals can be broken down into subgoals, and they have strong relationship with problems, both of which are displayed in *goal/problem diagrams* (see *Fig. 2*).

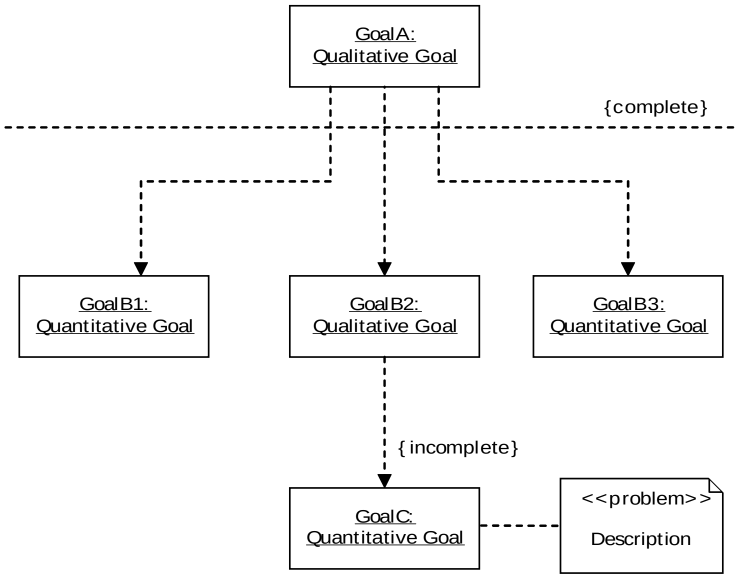

Fig. 2. Simple goal/problem diagram example

The observer can select *goal objects* for the process diagram from the set of available objects in the system's goal/problem diagram.

3. Teleonics in a Nutshell

3.1. Main Principles of Teleonics

Teleonics is a systemic approach with the overall purpose of studying living systems. When we speak about living systems, we mean complex systems of biotic and/or abiotic entities.

Teleonicrs have provided a useful method for dealing with complex problems in many fields of science for system analysis and development: in business process modelling, education, social organizations, medical sciences, health-care, psychology, etc. Teleonics' point of view is somewhat unusual, which explains why it needs to clarify its terminology and why it has introduced a handful of neologism [1] rather than reusing common terms.

The origin of teleonics reaches back to a series of computer studies in human physiology organized by Professor György JÁROS and his colleagues during the 1970's. This proved that the essence of living systems is in the flow of *mei* (matter-energy-information) rather than in some rigid material structure. Resources/entities fulfilling various roles in processes can be and are changed from time to time, while the system of processes is far more persistent at any level of the web of life. The similarity between the dynamics of processes at different levels of the universe soon became evident too, and the foundation of basic teleonic principles started.

Teleons are goal-oriented processes forming coherent self-regulated systems, which have a prominent role among the building blocks of teleonic modelling. They show a high level of integrity and coherence, which implies the presence of two things. Firstly, there should be an overall goal called *teleos*, which attracts the behaviour of all the processes in the teleons. The term of 'goal' in the ERIKSSON-PENKER extension at the level of supra-processes corresponds to the teleos of a teleon. Establishing and maintaining goals is impossible without an *ethos*, which in teleonic terms is the value system, i.e. a set of rules and guidelines focusing on preferences and constraints. This ethos can be either observed in nature, or designed in man-made systems. Secondly, teleons should have their own independent means of regulations, which are usually different feedback and feedforward loops with differing time constants. One of the above-mentioned roles in teleons has a premier status compared to the others, namely the *teleon champion*, who is in charge of everything happening in the teleon.

Ethos can be considered as the 'environment', where goals receive their meaning in the context of the observation and in the observer's point of view. Teleons with their processes and resources also have their physical environment where they are happening and acting, respectively. The web of life is a rather general term for this environment, which we always section into different levels, and which are relevant from the observation point of view (see Glossary for examples). During the study of teleons, one has to take a *reference level*, above which are the levels of the *external environment*, and below which are the levels of the *internal environment*.

The value of teleonics resides in its very different point of view and specific approach to studying problems. This is the source of many important process patterns.

Teleonics introduces the term *mei*, which stands for the inseparable amalgam of matter, energy and information. Matter, energy and information have their own states in space and time.

The *substance (mei) perspective* of teleonics actually studies the mei-changes in the more or less traditional sense. According to teleonics, there are also three groups of mei components to be attached to the process: input/output, transfor-

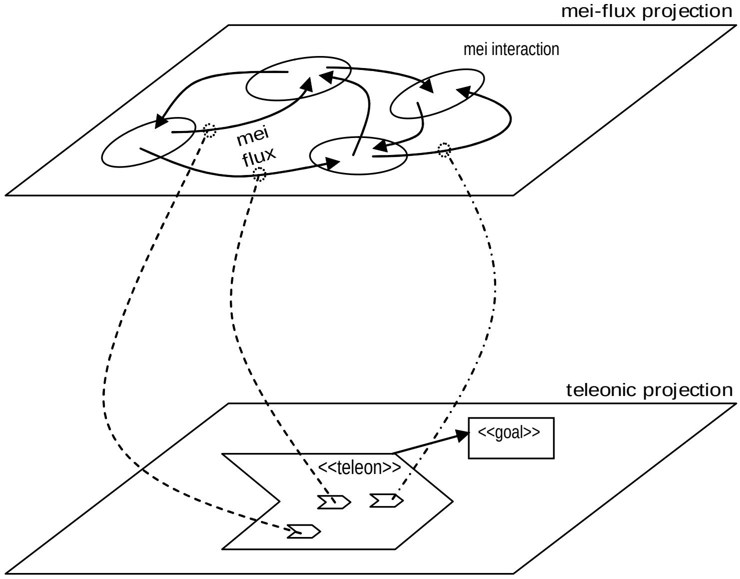

Fig. 3.

mer/actor and supporter [2, p. 220] which are also represented on the ERIKSSON-PENKER process diagrams (see points #2, #3 and #4 in section 2 and *Fig. 1.* To have an idea about the mapping between the layer of mei changes and the teleonic layer see *Fig. 3*).

The concept of *goal* belongs to the teleos-class of teleonics, as mentioned previously, and obviously goal/problem diagrams can be also perfectly used for the display of teleons and their relationships.

The goal-relatedness of teleons raises the essential question of whether or not a teleon can reach its goal. The term *telentropy* is used to measure on the [0,1] scale the possibility of a teleon to fail before reaching its teleos. Full success has a value of zero telentropy, while complete failure has a telentropy value of one. Telentropy can be transferred from one teleon to another, and it very often does happen. Depending on the case, the telentropy-transfer can be either measured or only its path can be followed in a more qualitative manner. The study of trajectories of telentropy-transfers helps us discover and predict potential problems in and among systems. There are various studies available on these issues.

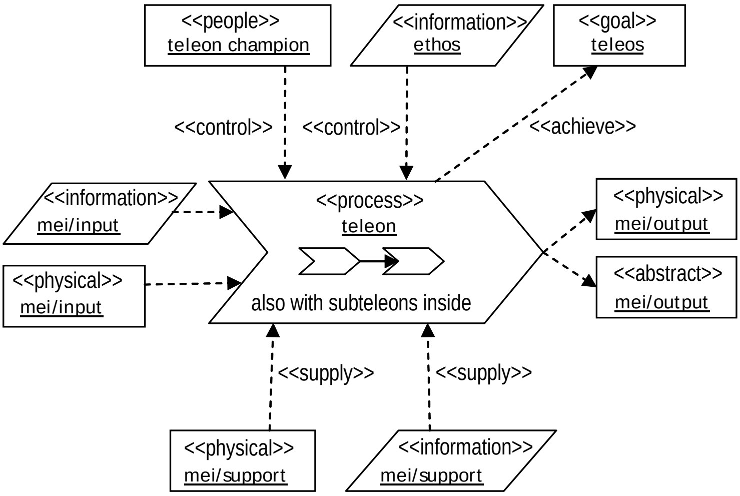

Fig. 4. Generic process diagram with the corresponding teleonic terms

4. Organizations from a Teleonic Point of View

The study of the nature of teleons gave rise to different groupings of teleons (see e.g. *Fig. 5*) and to a set of process patterns. The most important categorization of teleons uses the relative level of the teleos compared to the reference level of the teleon. One can differentiate between *endoteleons* and *exoteleons* which have their teleos in the internal environment and in the external environment respectively (see more in the glossary). Entities such as organizations have many of these endoteleons and exoteleons, which stretch over the boundaries of the entity they are part of. A typical exoteleon in a business organization is the manufacturing of products for sale. Customers who are typically not associated with the company have a very important role in these exoteleons: first of all, without them the organization can not specify the teleos of these exoteleons, and, secondly, they contribute useful feedback for the further improvement for these exoteleons. The informationally determined boundaries of the teleon are set according to its teleos. The concept of organizations' rigid physical boundaries has been challenged many times. Exoteleons form the *exopole*, while endoteleons form the *endopole* in a doublet, and the balance between them is maintained by the doublet's centroteleons. Processes at the referential level are called *centroteleons* and their teleos is to organize the other teleons around the entity and to sustain the entity as a larger system, which is called the *doublet* (see Glossary).

It is remarkable that among the process patterns published by ERIKSSON AND PENKER there are several patterns corresponding to the concept of these endoteleons, exoteleons and centroteleons [6, p. 315, 323]. These process patterns were collected during their work on business process modelling, but they can be very effectively applied to different problem domains.

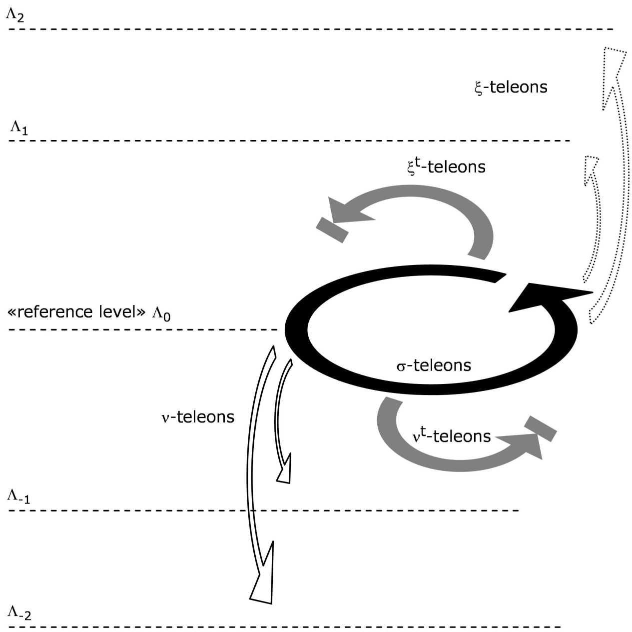

Fig. 5. Typical grouping of teleons constructing a doublet

Doublets as self-organized and autonomous entities also have *tappingteleons*, the goal of which is to establish and maintain necessary connections between the doublet at the reference level and the teleons in the internal and external environment.

From the example above, it is obvious that organizations have the most important criteria of doublets. Their overall *attractor* is the formalized or unwritten mission statement of the organization, which gives meaning for every activity in the organization. Not each entity can be considered as a doublet, however, it depends very much on the purpose and depth of the observation and the viewpoints of the observer himself [15, p. 243].

Organizational exoteleons are the processes of manufacturing a product for, or giving some kind of service to people or other organizations in the organization's external environment. Teleonics advocates the importance of *teleon champions* rather than simply having *product champions*. Only the teleon champion can efficiently preserve the overall goal-relatedness in the teleon, the focus should not be reduced to a mere artefact. Missing the person in charge, or cutting teleon's internal control loops from the external world causes a great deal of damage to the teleon, which decreases its efficiency and increases telentropy.

Endoteleons of the organization ensure the *mei* resources required by the exoteleons. These resources can be either raw-material and power-supply, or machines and manpower, or any form of knowledge (basically any *mei* component). Here again, we can realize what soft boundaries can mean, since the organization has many connections with its so-called external environment e.g. the raw-material and power-supply teleons purchase their inputs from other organizations and in case of subcontractors it can mean that the organization itself is not involved in the physical part of the mei-flux at all [2, p. 13.].

5. Meta Data in Business Organizations

5.1. Why Meta Data?

Information systems have climbed each of the three levels of the *knowledge pyramid*, namely the collection and management of data, information and knowledge [8]. Data is never more considered to be a mere digit, a string or an isolated piece of information. It is, or at least it should be, always considered in its context, purpose and meaning.

The systematic categorization, advanced quality checking and analysis of data have dramatically increased the value of data in every application, in decision making processes or in operational systems. To achieve this we have to collect not only data, but data about data. Actually, this is the 'classic' definition of *meta data*: data about data.

There are many different extensions of this definition, usually each emphasizing the business-knowledge aspect of meta data. For that matter, 'business' can mean any type of organization: manufacturing companies, governmental organizations, libraries, hospitals etc. Some of the more extended definitions of meta data enlist the what-abouts of meta data, such as the nature of the business and technical processes in question; others gather 'data' about the rules, constraints on the data and its structure. There are definitions that emphasize the origin of meta data, which can be either internal or external from the organization's point of view (see 5.2).

A leading meta data consultant company Enterprise Warehousing Solutions performed a survey on meta data usage and the construction of meta data repositories [7]. They collected answers from 28 countries world wide mainly from huge financial, insurance, telecommunication and governmental organizations.

More than half of the respondents intended to collect their meta data from every part of the company at the organization-level, and already 82% of them gather both technical and business type of meta data. What is also important, is that almost one third of these significant market players have already built their meta data repositories and another 25% were in the process of building them, what unequivocally shows the rapidly growing interest in the meta data field. Currently the main user-groups of meta data repositories are executives, managers and application developers, totalling almost 75% in all.

5.2. *Meta Data Sources and Categories*

Collecting in-house meta data, i.e. *internal meta data* in an organization is a challenge. Sources can vary enormously: ETL tools, data modelling and reporting tools, data quality applications, free-text documents, reports with employees, etc.

External meta data is collected from the outside world either in electronic format (e.g. Internet downloads, e-mail correspondence) or in non-electronic format (e.g. printed industry standards, best practices, white papers, articles). This type of information also necessitates meta data gathering, such as the source of information, its classification, date of entry into the organization.

Typically, there are two main categories of meta data: technical meta data and business meta data. *Technical meta data* is used by developers and the technical staff of the company to help their decision making processes and feed their operating systems, e.g. data models; system tables, keys; domain values; program names, descriptions, version management; security issues. *Business meta data* supports the work of business users in the broadest possible sense. It includes all the assumptions around data, and the business meaning of the terms used. Typical examples are: data location, responsibility issues, data quality statistics, business definition for columns in database tables, etc [9].

Structured meta data sources are the organization's own 'standardized' formats where meta data is stored. They are well documented and agreed upon throughout the organization, and can contain business and technical meta data as well.

We can also find many *unstructured meta data* sources in an organization, where the information is stored in the mind of the employees, or on websites, or in business policies. Unstructured sources present even greater challenges, since they have to be documented and formalized, i.e. 'structured' in some way.

5.3. *Meta Data Modelling with UML*

The OMG specifications also include Meta-Object Facility (MOF) and XML-based Meta data Interchange (XMI). MOF is a standard for meta-modelling and meta data repositories, while the XMI standard describes the exchange of objects defined with MOF and UML. XMI even enables the creation of XML Data Type Definitions (DTD). There are also existing UML extensions to design XML schema, which also facilitate the generation of XML schema from UML diagrams [13].

5.4. Meta Data Repositories and the Managed Meta data Environment

Many governmental and business organizations have already started to build their meta data repository. It often happens, typically with larger organizations, that different departments of a company build their own meta data repositories, creating many so called *islands of meta data* [11] without a centralized organizational meta data management and without any shared knowledge about each other. This is a rather inauspicious architecture, since in this manner meta data islands have no access to other meta data repositories. Another weak point of the structure is that redundant information is often stored and sometimes collected even from the same source.

The advantages of well-designed and carefully implemented organization-wide meta data repository solutions are obvious compared to isolated meta data islands. What soon becomes evident is that 'simply building a database' for meta data is not enough. Instead, what is needed is an integrated solution targeting the whole organization, a so called 'managed meta data environment' [10].

Managed meta data environment (MME), as it is referred to in literature, is the organizational solution to meta data gathering, storage and dissemination. It covers all possible facets, such as processes, technical solutions, resources, staff members involved. Although questions about MDR and MME are often come up with issues on data warehousing, it is important to mention that an MME is not a data warehouse for meta data: it is rather an operational system, and it essentially should be designed like that. Typically, contemporary corporate MMEs hold 5GB-20GB of meta data [10, P. 35].

6. Goals and Processes in the Managed Meta Data Environment

6.1. MME's Main Purpose

In business terms, organizations have many goals: they want to reduce costs and increase revenue, adhere to industry regulations and standards, improve on security and health related issues, provide more training for staff and customers, etc.

The overall purpose (teleos) of MME's development and its maintenance is definitely at the organizational level (Λ_0). From a teleonic point of view, MME is a centralized setup of a set of teleons to create the informational backbone for the organization doublet (D_0). Because of its very nature, MME's teleoses can be found in many of the main streams of the organization's endopole and exopole, as we will see in the following sections. It also contributes to the organization's centroteleons.

Its development and its maintenance are obviously two different organizational teleons. Here we focus on the issues of MME's development, and we are less concerned with the issue of maintenance, which have no lesser importance from the organizations point of view.

6.2. The Organizational Environment of the MME

The teleons of the MME in the organizational doublet, work on the reference level of the organization. In terms of meta data sources (see 5.2), MME should communicate in both directions to its internal and external environments, i.e. with all the departments, sections, staff members, and also with other organizations, such as contractors, competitors and other national and international organizations. These environments constantly change in time, usually in a rather dynamic manner, what will necessitate the creation of further management teleons to successfully manage the MME. The MME should also focus on multiple levels within the environments, since the overall purpose is to gather available 'business and technical data about data' on every organizational level.

The ethos of the examined business can help us to put the teleos of MME and the other business-related teleoses in the right context and evaluate them. The ethos is usually something quite stable in the long run, but its natural complexity, and the conflicts originated from its inner contradiction, can obscure matters even further. In case of MME design, the ethos contain designs rules, code conventions, timetables, technology restrictions, recommendations, etc.

6.3. The MME Activity Areas and the Main Teleons

When we talk about the managed meta data environment and its implementation, we think about the six main areas of activities an organization should take care of.

1. The purpose of *meta data sourcing* (MDS) is to extract meta data from various sources, and to transfer it either to the MDI or to the MDR directly.
   These kinds of activities are typically executed at the level of the meta data sources (Λ_2, Λ_1 or $\Lambda_{\ 1}$, $\Lambda_{\ 2}$). Their teleos is to obtain meta data for the MME, which is at the organizational level and it means that they are either endoteleons ($\nu_{1\ \ 0}$ or $\nu_{2\ \ 0}$) from the higher levels (e.g. that of governmental organization, national and international standards) or are exoteleons of the organization's different subsystems and departments ($\xi_{\ 1\ \ 0}$ and $\xi_{\ 2\ \ 0}$ teleons, see also the appendix). Typically, each meta data source should have its own sourcing teleon and they should be kept separate from each other (see also 6.5.2).
2. *Meta data integration* (MDI) takes all the extracted meta data collected with the teleons in the sourcing area, and integrates and loads them into the MDR. It improves the flexibility of the MME when the sourcing teleons are kept apart from the integration teleons according to the industry's best practices. Teleonics emphasizes the same since the latter are typical examples for tappingteleons ($\nu^t_{0\ \ \ 1\ \ 0}$, $\nu^t_{0\ \ \ 2\ \ 0}$, $\xi^t_{0\ \ 1\ \ 0}$ or $\xi^t_{0\ \ 2\ \ 0}$) coupling meta data from the lower and higher levels sources into the MDR.

3. *Meta data repository* (MDR) covers all the functionalities around a ‘normal’ database. Although the MDR itself is in the mainstream of the organizational centroteleons (σ_0), the processes and resources implementing its inner functionalities are obviously at a lower level.
   A further rather unique aspect of MDR should be also mentioned: it contains current and previous versions of meta data as expected, but it also stores future meta data, what means that we also store expectations and plans about the organization.
4. Teleons of the *meta data management* (MDMg) area are the centroteleons of the MME. They harmonize the functioning of all the other parts, in order to fulfil the expected result of a well-functioning organization-wide MME. Some on the meta data related functions performed here: archiving, database tuning, job scheduling, maintenance of query statistics, security processes, user interface management.
5. *Meta data marts* (MDMr) are small-scale MDRs that have their own specific teleoses, i.e. to fulfil the specific requirements of user-groups with similar needs. They also represent an extra buffer layer between the MDR and its customers. Just like the MDR, MDMr are also part of the organizational centroteleons, but their functioning is happening at an internal level. The customers of meta data marts can be either internal or external from the organizations point of view, what means that meta data marts are heavily involved in both the organizational endoteleons ($\nu_{0\quad 1}$or $\nu_{0\quad 2}$) and exoteleons ($\xi_{0\quad 1}$ or $\xi_{0\quad 2}$).
6. *Meta data delivery* (MDD) covers all the activities, tools and resources that contribute to the delivery of meta data from the MDR to the customers, which can be either business or technical staff, or actually non-human, such as SW applications and tools, websites, data warehouses. Here we also find both organizational endoteleons ($\nu_{0\quad 1}$ or $\nu_{0\quad 2}$)and exoteleons ($\xi_{0\quad 1}$ or $\xi_{0\quad 2}$).

6.4. Users and Roles in the MME-teleons

An actor is considered to be a role that a user or another system plays in the *use-case* modelling of UML. The purpose of these exercises is to identify the functional requirements for the system. Functional requirement as a concept belongs to the teleos-class of concepts (see [15] p. 276), and it specifies the subteleoses of the MME-teleons.

6.4.1. Meta Data Users/customers

Customers are the ‘target group’ of the MME projects. The main purpose of the MME is to deliver quality meta data in a safe and reliable way. Its success can

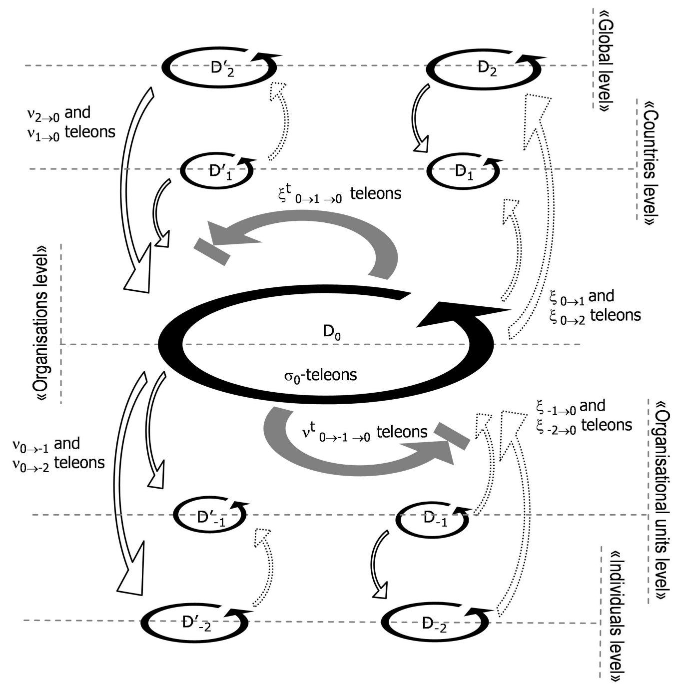

Fig. 6. Schematic diagram of the major teleons in MME

only be realistically estimated, when customers are involved in the feedback. We differentiate between machine and users of the MME. Users are usually further categorized into three broad groups, such as business users, technical users and power users. *Business users* are the staff members with a business background, who are not very technical. The MME should mainly support their decision making processes with standard queries and reports. Meta data quality estimates and statistics and the system's response time is often an important issue. When we speak about *technical users,* we mean the organization's IT staff (at any level and in any role in the organization) who want to understand the functioning of the current IT systems, either for development or maintenance purposes. And, finally, business users with solid technical background are called *power users*. These users also need the available technical meta data about the systems to be able to make their sophisticated queries against the MME. Like technical users, they also rely on future meta data.

Not surprisingly, this rough categorization of meta data users corresponds to the grouping of meta data into business and technical meta data (see 5.2).

6.4.2. The Staffing of the MME Teleons

We have mentioned the customers of MME, but naturally there are many internal contributors to the teleons themselves. The project (or teleon) champion has already been mentioned as a central figure. The MME's development teleons offer many positions in different, either business related or more technical roles for data modellers, business analysts, front and back-end developers, data stewards, etc. [9, p. 123].

6.5. Golden Rules of MME Design and their Corresponding Teleonic Process Patterns

Although, the following golden rules sound obvious to our ears when mentioned explicitly, they are still among the very common sources of failure in organizations implementing MMEs. The reason behind overlooking these rules are very often the lack of efficient communication, typically inside large organizations.

6.5.1. Golden Rules 1 *and* 2

> 'Do not put integration processes on the platform where the meta data is stored' and 'Don't merge meta data sourcing and integration' [10, p. 27.]
> It is obvious from the teleonic representation of organizations that sourcing and integration belong to different groups of teleons. The first to either an endoteleon or an exoteleon, while integration is typically a tapping teleon. The different teleonic natures of these teleons make this an obvious recommendation also from a teleonic point of view.

6.5.2. Golden Rule 3

> 'Never have multiple processes extracting the same meta data from the same source' [10, p. 28.]
> This is the typical case of 'shared entities' [3, p. 20] in teleonics. Shared entities influence telentropy-transfer in the system to a great extent, creating a win-loose scenario, where only the winner teleon can deliver its teleos, the other(s) not. This can happen even by chance in huge organizations that have large number of meta data sources, and build meta data islands.

6.5.3. Golden Rule 4

> 'Define the tangible business and technical objectives of the meta data repository' [12, part 1]

This scenario described by David MARCO is the typical problem of ‘non-defined’ or ‘not-well-defined’ teleoses. This is one of the most common causes of serious telentropy-increase in a teleon, which can jeopardize the success of the entire MME project.

6.5.4. Golden Rule 5

‘Thinking too late if at all about security issues leaves dangerous loop holes in the system.’[10]
Security issues belong to the MDMg area of activities (see point 4 in 6.3). These are typical centroteleon type of activities, and without them there is no well-functioning system. They have extremely important roles in natural doublets, and they should be very carefully designed in man-made systems according to teleonics governance and control recommendations.

7. Conclusion

The application of process-oriented, goal-centred frameworks, such as teleonics, in problem-analysis and system-design provides results that are less likely to be reached with the help of different individual methodologies focusing on narrower field of interest in the ‘process world’.

Teleonics covers the following major areas:

Processes and structures	Besides its devoted process-orientation, teleonics as a framework encourages us to see and examine the problems in the broadest possible wholistic view, and also facilitates the re-evaluation of traditional concepts in order to achieve deeper understanding (see e.g. the results in the medical and health care field). Its unique concepts of *teleon* and *doublet* are of special value in this.
Goals	Goals give direction to processes, without their identification and analysis one can not imagine real process modelling. No wonder that they play a central role in teleonics. Their analysis provides us with goal-maps / goal-hierarchies, so important in the design of process-systems. Different levels of abstraction of goals are also available, which creates a very comfortable environment to work with process patterns.

Environments	On the one hand, teleonics emphasizes the importance of the *physical environment* where the processes are executed. It introduces and works with different levels of complexities, depending on the target of the analysis. A set of process patterns is gathered to help us handle the connections between these different levels of the external and internal environments.
Policies	Besides the physical environment, teleonics also operates with a *conceptual environment*. This strives to cover both the relevant major laws of nature and the man-made laws, policies, business rules, etc. which all influence the processes in problem domain. The conceptual environment also includes the value system in which the goals are evaluated and ranked.
Control / governance	The governance of the functioning of processes is an essential question when we identify goals. This keeps processes on the right track towards their goals. Giving no attention to this area is usually fatal, especially during the maintenance phase. Different process patterns, which are categorized by the type of the goal, are also collected from this area.

Further investigation will elaborate on the specific needs of statistical data warehouses, including the in-house requirements of statisticians and other business users, and also on the increasing demands of the international data and meta data reporting and dissemination situation. This necessitates the extension of our teleonic model, with the further study of international recommendations and standards, and the tighter integration of the teleonic view with UML modelling.

8. Glossary

For a more detailed summary of teleonic terms see [3].

centroteleon: The centroteleon is a teleon ($\sigma \quad \mathbb{X}_i$) at the reference level Λ_i with its teleos $\tau(\sigma)$ at the same level. Centroteleons with their self-referring teleons, referring back to the reference level of the organization, are usually associated with the maintenance of the integrity and autonomy of the organization (doublet), relative to its environments. On the organizational level, centroteleons are associated with policy-formulation, with the allocation of resources to different departments. All the processes that focus on the interest of the whole instead of the parts are considered to be part of the organization's centroteleons. Centroteleons maintain the balance between the endopole and the exopole of the organization. The mei transfer (Δmei) does not leave the reference level: $\sigma \quad x \quad \mathbb{X}_\mathrm{i}\ \tau(x) \quad \Lambda_i \quad \Delta mei \quad \Lambda_i$.

doublet: Doublets ($D \quad \mathbb{D}_i$) are self-organized entities. Doublets consist of three fields of teleons: the exofield (exoteleons directed out of the organization), the centrofield (centroteleons at the organization own level) and the endofield (endoteleons pointing into the internal levels of the organization). The necessary conditions for a discrete entity to become a doublet are the following: it would be autonomous (achieved through tapping and centroteleons), self-referring (in terms of its processes), self-governing and satisfying the criteria of autopoiesis (being self-maintaining and self-reproducing) [15]. In teleonics the emphasis is seemingly on teleons, but there is an important reciprocity between teleons and doublets: one at a certain level giving birth to the other on a higher level throughout the levels of the Universe. There is another reciprocity in terms of interaction between entities and processes: entities taking part of processes usually change while they 'play their role' there, but also processes are influenced and modified by the actual actors there.

endoteleon: The endoteleon is a teleon ($\nu \quad \mathbb{X}_i$) with its teleos $\tau(\nu)$ at a lower level (in the internal environment Z_{int}) compared to the level of the mei-flow in the teleon. The mei-transfer (Δmei) does not leave the reference level of the endoteleon: $\nu \quad x \quad \mathbb{X}_\mathrm{i}\ \tau(x) \quad Z_{int} \quad \Delta mei \quad \Lambda_i$.

exoteleon: The exoteleon is a teleon ($\xi \quad \mathbb{X}_i$) with its teleos $\tau(\xi)$ at a higher level (in the external environment Z_{ext}) compared to the level of the mei-flow in the teleon at the reference level. The mei transfer (Δmei) does not leave the level of the exoteleon: $\xi \quad x \quad \mathbb{X}_\mathrm{i}\ \tau(x) \quad Z_{ext} \quad \Delta mei \quad \Lambda_i$.

levels: We differentiate between different levels (Λ_n) in the observed universe of the biomatrix: e.g. global level, level of countries, organizations (with different sub-levels, such as directorates, departments, divisions), groups, families, individuals and cells.

mei: MEI is the inseparable amalgam of matter, energy and information.

tapping-teleon: There are exotapping (ξ^t) and endotapping-teleons (ν^t) that are considered to perform the function of coupling teleons from the inner and outer environment to the double of focus respectively [15].

$$\xi^t \quad x \quad \mathbb{X}_0\ \tau(x) \quad Z_{ext} \quad \Delta mei \quad \widehat{\Lambda_0\Lambda_j\Lambda_0},\ where\ j \quad \mathbb{N} \quad ,$$

$$\nu^t \quad x \quad \mathbb{X}_0\ \tau(x) \quad Z_{int} \quad \Delta mei \quad \widehat{\Lambda_0\Lambda\ _k\Lambda_0},\ where\ k \quad \mathbb{N} \quad .$$

telentropy: is the measure of uncertainty associated with the teleon reaching its teleos. Telentropy changes in time and it always depends on the present state of the teleon and its influences. It can be also defined as a measure inversely proportional to the probability that the teleon reaches its teleos: **TS**$(x) \quad \mathbb{X} \qquad 0, 1$.

TS('*full success of teleon x*') = 0 while

TS('*complete failure of teleon x*') = 1.

teleon: is a process system (P, R_P) where $(R_P \qquad P^n)$ with strong, multiple feedback-loops of self-governance ($C \qquad P$), organizing its actors and resources (O) in accordance with its goal-related characteristic, its teleos (τ).

$x \quad (\tau, P \quad C, O, E)$ where $P \quad P \; P \quad C$ and $x \quad \mathbb{X}$ of the set of teleons in the observed universe. On the interdependence of teleons and doublets see the description of doublets.

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