Systemic Approach Towards Enterprise Functional Decomposition

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***Abstract* — Functional decomposition is the primary component of enterprise activities description and is often associated with business process architecture. It guides any business improvement initiative, enables to design the enterprise construction – organizational structure, IT- and HR-architectures, etc, as well as to deploy goals and strategies. The paper suggests the framework for enterprise functional decomposition, which includes the ontology for enterprise activities description, foundations and the process of functional decomposition. The suggested framework integrates the following features: alignment with goals decomposition; support for reference models and other reusable activities descriptions; recursive decomposition using a single activities pattern; value-based management and ISO 9004:2009 harmonization. The paper also describes framework implementation at Russian enterprises and IT tool to support the approach.**

Keywords: business architecture, business process architecture, activities description, enterprise engineering, value based management, TQM, ISO 9004:2009.

I. INTRODUCTION

Enterprise activities description constitutes the core of business architecture. It usually covers value chains and streams, services, business processes, functions, transactions and elementary actions. The activities description, or the "black-box" model, is an unavoidable element for the design of any complex system [1-3]. In case of the enterprise engineering (see The Enterprise Engineering Series in Springer) it provides functional requirements for an enterprise as a socio-technical system and allows to design the organizational structure, IT-architecture, HR-architecture, technical architecture, financial structure, as well as deploy the intentional component (goals, strategies, measures) of business architecture. The primary component of enterprise activities description is the functional decomposition or, to put in other words, the hierarchical structure of activity elements, which decompose the overall function of enterprise. This term rests on Jan Dietz ideas [1]:

"*Functional decomposition – a technique for mastering the complexity of the function of a system. The effect of applying the technique is that a functional model of a (sub)system is replaced by a set of functional models? Also called functional subsystems, and vice versa. Where functional model is a black-box model of a concrete system and function is the set of services the concrete system is able to provide."*

Functional decomposition is often associated with "process architecture" [4] in business architecture context, but the authors of the current paper prefer to differentiate these terms and use them supplementary. Reusable activities descriptions (reference models, lifecycle models etc) can be used for functional decomposition, but few organizations can expect to simply take the reusable element and apply it without an assessment and modification according to any method. Methods for the functional decomposition can be found among the process architecture development methods. The choice of a method should be based on the requirements towards its application results. Although top-level functional decomposition often works towards reference, communication and context-setting purposes it also helps identify the necessary enterprise activities and requirements towards enterprise as a system in the context of enterprise engineering. This paper focuses on the latter role of functional decomposition and activities description. As a result, the key features of this description include the correct understanding of the semantics, completeness and consistency of the enterprise functionality. In order to provide for these features, the enterprise functional decomposition must meet the following *requirements*:

1. Alignment of functional decomposition with the enterprise intentional model (supports functionality completeness check),
2. Reuse of the proven normative models or knowledge (reference models, patterns, etc),
3. Consistency of principles within functional decomposition.
4. Due to the rapid environment and technology changes enterprise activities must be adaptable. This requires to embed regulatory and improvement mechanisms in activities description.

It is not only systems engineering that sets the requirements for functional decomposition, but also the managerial best practice. The Value-Based Management [5-7] and Total Quality Management methodologies [8-10] are now essential elements of any systematic business architecture related and process management projects. Consequently, the activities description of an enterprise must be harmonized with these methodologies. It defines a number of additional requirements:

5. Value-based management harmonization,

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6. ISO 9004:2009 harmonization.

These requirements provide the evaluation criteria for the available methods and direct the development of new framework.

Contents of the paper is the following: section II provides an overview of related work, section III describes management methodologies which require harmonization with enterprise functional decomposition – Value Based Management and ISO 9004:2009, section IV describes the functional decomposition framework – the ontology of top-level enterprise activities description, foundations and the process of functional decomposition; section V provides informal evaluation of the suggested framework against the requirements, while section VI mentions the implementations of the framework applied currently,

II. RELATED WORK

A. Reusable elements for enterprise functional decomposition

Reusable elements for enterprise functional decomposition can be in the form of reference models, lifecycle models, etc.

Reference models articulate a set of best practices for viewing and managing the work of organizations. Typically organized as a hierarchy of functions, processes, and activities with or without dependencies among them, provide names, descriptions, performance indicators and other attributes that may be reused. There are a number of models intended to describe organizations of all types in all sectors. The best example of these is the Process Classification Framework from The American Productivity and Quality Center (APQC) [11] There are a number of industry models in place and emerging, such as e-TOM from the Telemanagement Forum [12] which describes a generic telecommunications organization, or manufacturing reference models [13]. There are a number of models developed surrounding particular functions within the organization and the processes within them , such as ITIL (IT Infrastructure Library) [14] which is a framework of best practices supporting IT services management. The longest running framework that takes the perspective of end-to-end processes as the point of view would be SCOR (Supply-Chain Operations Reference) [15].

Different enterprise entities have their own lifecycles. According to [2] every system-of-interest, whatever the kind or size, follows a life cycle or a common series of stages where it is conceptualized, developed, produced, utilized, supported and retired. Some systems have specialized lifecycles, e.g. software lifecycle. Stakeholder relationships move through a lifecycle of state changes – from unawareness through termination of the relationship. The lifecycle approach is quite systematic for item of interest and comprehensive for subject matter staff. Although lifecycle models do not systematically cover the problem of functional decomposition, they can be considered as building blocks within decomposition technology.

The Component Business Models (CBM) [16] has been developed by IBM and is actively applied in the consulting activities by IBM Global Business Services. Business components are the modular building blocks that make up the specialized enterprise. Each component encompasses five dimensions: business purpose, Activities, required Resources, Governance model and provided/received Business services. CBM provides a framework for organizing components by competency and accountability level and IBM provides industry-specific component maps. Although CBM could be considered not just as a reusable element, but as a complete methodology, its method is mostly proprietary and non-public. Thus it is in the current category.

All the reusable elements serve the purpose of providing a starter kit or building block for enterprise functional decomposition. Few organizations can expect to simply take any reference model and apply it without thought or some amount of assessment and modification. All the reusable elements require supplementary method.

B. Methods for enterprise functional decomposition

A number of different kinds of approaches to functional decomposition or, more punctually, to an organisation's process architecture development have been proposed, each with its own distinctive rationale.

Kavakli and Loucopoulos's process architecture is organised around the goals of an organization [17]. Their article [17] presents an ontology for the Enterprise Knowledge Development (EKD) approach in which, at a high level, an Enterprise Goal Submodel is realized by an Enterprise Process Submodel, which in turn is realized by an Information System Component Submodel. The EKD approach could be used to understand an enterprise by starting with either goals or processes or IS systems and then moving to the others. But, for business process re-engineering, "the typical ''top–down'' approach starts with the business objectives and then proceeds with the modeling of how these objectives may be realized in terms of business processes". Thus EKD approach provides a method for identifying an enterprise's process architecture in terms of both the enterprise strategic goals and the processes identified to achieve those goals.

Snowdon and Kawalek have proposed an architecture [18] based upon Beer's Viable System Model (VSM) [19]. They describe the VSM as 'a structure of interacting behaviors (processes) appropriate to the ongoing sustainability of an organization within its environment', and assert that it is 'a rational and rigorous basis for comprehension of organizational complexity... It serves as a model of the architectural properties that an organization must possess if it is to achieve viability.' In their approach, an organization may be viewed as comprising a recursive structure of VSMs, where each VSM has the same structure: it comprises five interacting sub-systems, or processes, 'whose proper operation will both fulfill the purposes of an

organization and will sustain the organization within its changing environment. At any level of the recursive structure, there may be one or more System-one processes; their task is to achieve the main purposes of the organization (at that level). System-two processes coordinate the independent behaviors of the System-one processes. The System-three process is a control process and ensures that the System-one processes are meeting the VSM's main objectives. The System-four process monitors the environment for anything that may affect the relationship of the VSM with its environment and 'thereby threaten the sustainability of the organization in the future.' If necessary, the System-four process also presents options for change. Finally, the System-five process attempts to resolve any conflict between the System-three process and the System-four process by determining 'the purpose of the system in focus and the strategies and policies by which this will be fulfilled'.

Barros [20] suggests to start with a general normative structure that gives a pattern from which to derive a business process architecture for a specific enterprise and suggests such a normative structure. He proposes four major grouping of processes, valid for any enterprise, that he called macroprocesses. They are Value Chain, New Capabilities Development, Business Planning and Support Resource. The relationships among these macroprocesses provide a general architecture. The general architecture is detailed by giving, by mean of the so called Business Process Pattern, the component processes of each macroprocess and the relationships among them by means of flows. The suggested macroprocesses and Business Process Patterns have some features in common with the ones proposed by SCOR and APQC.

The available methods support separately a goal-oriented approach, reuse of proven knowledge and normative models, generate recursively activities descriptions and embed adaptability mechanism. The requirements towards functional decomposition suggest that their advantages be integrated. Besides, the available methods are not aligned with the Value-Based Management and Total Quality Management methodologies.

III. VALUE BASED MANAGEMENT AND ISO 9004:2009

Value Based Management [5-7] is the management approach that ensures corporations are run consistently on value (normally: maximizing shareholder value). Value Based Management includes: creating value (ways to actually increase or generate maximum future value ~ corporate strategy); managing for value (governance, change management, organizational culture, communication, leadership); measuring value (valuation). The corporate purpose can either be economic (Shareholder Value) or can also aim at other constituents directly (Stakeholder Value).

Why is Value Based management important? Any (large) company operates and is competing in multiple markets: the market for its products and services; the market for corporate management and control; the capital markets; the employees and managers market. Any failure to be competitive in one or more of these markets, may seriously jeopardize the survival chances of a corporation. Value Based Management can help organizations to win in each of these 4 markets.

In recent years, traditional accounting methods and metrics have turned out to be very unreliable. This has also supported the emergence of new value-based oriented metrics such as Economic Value Added (EVA), Value Creation Index (VCI), CFROI, Market Value Added and other Value Based Management mechanisms.

ISO 9004:2009 Managing for the sustained success of an organization – A quality management approach

This standard [9] provides guidance to support the achievement of sustained success for any enterprise in a complex, demanding, and ever-changing environment, by a quality management approach. The sustained success of an enterprise is achieved by its ability to meet the needs and expectations of its customers and other interested parties, over the long term and in a balanced way. Sustained success can be achieved by the effective management of the enterprise, through awareness of the enterprise's environment, by learning, and by the appropriate application of either improvements, or innovations, or both. This standard provides an extended model of a process-based quality management system incorporating the elements of ISO 9001 and ISO 9004. This extended model includes the following activities and essential enterprise entities:

1. Managing for the sustained success of an organization: sustained success (*integrating activities); t*he organization's environment; interested parties, needs and expectations;
2. Strategy and policy: formulation, deployment and communication;
3. Resource management: ensure that resources (such as equipment, facilities, materials, energy, knowledge, finance and people) are used effectively and efficiently, it is necessary to have processes in place to provide, allocate, monitor, evaluate, optimize, maintain and protect those resources;
4. Process management: process planning and control, process responsibility and authority;
5. Monitoring, measurement, analysis and review;

Improvement, innovation and learning.

IV. FUNCTIONAL DECOMPOSITION FRAMEWORK

Functional decomposition framework includes the ontology for top-level enterprise activities description, foundations and process of functional decomposition. Ontology specifies the main terms/concepts, foundations describe the models and methods, the process provides a step-by-step guide. These components will enable practitioners to develop a top-level functional decomposition for their specific enterprises.

A. Ontology of top-level enterprise activities description

The majority of concepts for top-level enterprise activities description are well-known within the business process and enterprise architecture management communities:

- **Process** – set of interrelated or interacting actions which transforms inputs into outputs;
- **Action** – basic transformational activity primitive through which processes and operations can be represented;
- **Functional area** - unit of activities description that groups activity elements according to required skills, technology, resources, etc. Functional area offers functionality that may be useful for one or more processes.
- **Functional process** – process which includes activity elements from one functional area.
- **Cross-functional process** – a process which includes activity elements from two or more functional areas.
- **End to end processes** – specified value stream that crosses functional areas and organizations in order to create or deliver a product or service
- **Value stream** – end-to-end collection of activity elements that creates a result for a "customer," who may be the ultimate customer or an internal "end user" of the value stream. Resources pass through the activities, gaining value at each step;
- **Activity element** – any element of enterprise activities description, e. g. process, action, functional area.

The aforementioned concepts do not have adjective "business", e.g., process, action, because *all* the concepts in question are the elements of business architecture.

In addition to enterprise functional description concepts, several neighboring concepts are important for the current framework:

- **Goal** – desired state of a system
- **Purpore** - high level, overall goal of a system. The role of an object within superior system.

The ontology and framework suggested also have unique concept:

Functional system – purposeful system, which consists of activity elements and has the following features:

- purpose as the main system-forming factor,
- self-regulating – it includes a management component/activity elements,
- hierarchy – it consists of other functional systems,
- isomorphism – all the functional systems have a similar structure.

It provides grouping for subsystems and business processes. This concept was adapted from the "theory of functional systems" which was initially suggested by P.K. Anokhin to tie neuro-physiological mechanisms and integral activity of an individual [21]. This theory uses the systems approach in solving physiological problems.

The terms "functional system" and "functional area" are differentiated, because they apply and are used for the varying purposes. "Functional system" is used for requirements engineering and enterprise design, while "functional area" for reusing and analyzing knowledge.

B. Foundations for functional decomposition

Foundations for functional decomposition are centered around the "functional system" concept and its features: purpose-orientation, self-regulation, hierarchical structure and isomorphism.

Purpose-orientation means that any functional system has its purpose and groups all the necessary activity elements, which help achieve the purpose. As a result this functional decomposition differs from the one based on functional areas and similarities in skills, technologies or resources – parallel grouping of activities.

Functional system's pattern and ISO 9004:2009 harmonization

Functional systems of any level have similar (isomorphic) internal structure – "Functional system's pattern" (Fig. 1).

In order to achieve its purpose, every functional system includes value creating, managerial (see self-regulation) and enabling activity elements. Value creating activity elements are the essence of any functional system and their proper operation fulfill the purposes of the system.

Management includes strategy and policy-related processes, design and improvement processes, operational planning and group of processes, which covers measurements, analysis and control.

Enabling activity includes capability-creating activities and handling with environmental elements.

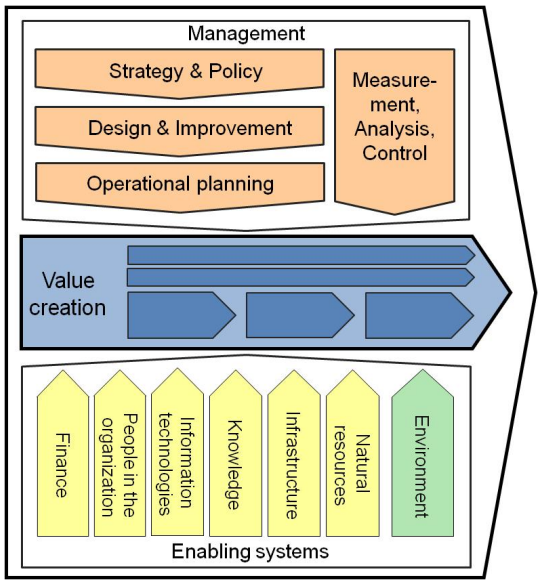

Figure 1. Functional system's pattern

The functional system's pattern is based on the following sources [9,18,19,21-23]. Every top-level component of the pattern consists of detailed subcomponents – typical functional subsystems and business processes. All the pattern components are harmonized with ISO 9004:2009 [9], see Table 1.

TABLE I. FUNCTIONAL SYSTEM PATTERN: DETAILED DESCRIPTION

Activity category	Activity type	Main processes / functional subsystems	Corresponding ISO 9004:2009 activities and entities
Management	Strategy and policy	Define and manage requirements of interested parties; Define the purpose; Define the paradigm; Define fundamental principles; Strategy and policy formulation; Strategy and policy deployment; Strategy and policy communication; Program management	Interested parties, needs and expectations Strategy and policy
	Design and improvement	Business process management (Business process strategy, design, implementation and controlling); Creation of organizational structure; Innovation; Plan-Do-Study-Act (PDSA), Standardization (5S); Manage change	Process management Improvement, innovation and learning
	Planning	Long-, Intermediate- and Short-term Planning; Scheduling production or service provision (e.g. Master production schedule (MPS)); Order Scheduling, Capacity Requirements Planning, Workforce allocation, Shop-Floor Control	Products lifecycles [8]
	Measurement, Analysis, Control	Measurement, Self-assessments, Internal audit, Benchmarking, Analysis, Review	Monitoring, measurement, analysis and review
Value creation		Lifecycles for enterprise entities – activity elements, which depend on the functional system	Products lifecycles [8]
Enabling	Capabilities	Financial resource management, Human resource management, Information Technology management, Knowledge management, Enterprise assets and Property management	Resource management: Financial resources, People in the organization, Infrastructure, Knowledge, information and technology, Natural resources
	Environment	Health and safety management; Security management; Fire safety management; Manage relationships with interested parties	Resources: Work environment, Suppliers and partners The organization's environment

Value-based management (VBM) harmonization

The functional system can be decomposed into 3 subclasses: Corporate-level functional system, Business-level functional system and Functional area-level functional system. In order to simplify the language, these terms are transformed into "Corporate system", "Business system" and "Functional system". In ambiguous situations, the "original" functional system can additionally be named "generic".

Definitions of these 3 systems are based on 4 main features (Table 2): beneficiary, purpose area, key performance indicators, value creation elements. Differentiation of three functional systems types helps focus activities on different value types (corporate, customer, internal client) and corresponding value drivers. Every value type will receive its own responsible functional systems, with relevant value creating, management and enabling activities. Every type of functional system inherit standard pattern, but specialize and customize it according to the own value drivers (see Fig. 2).

TABLE II. MAIN FEATURES OF CORPORATE, BUSINESS AND FUNCTIONAL SYSTEMS

Features	Corporate system	Business system	(Functional area-level) Functional system
Beneficiary	Shareholders, Investors	Customer	Superior system, Internal client
Purpose area (value type)	Corporate value	Customer value	Value for superior system, Value for internal clients
Key performance indicators	Economic Value Added (EVA), Value Creation Index (VCI)	EBITDA, Return-on-Assets (ROA), Free Cash Flow (FCF)	Depend on the functional area.
Value creation elements	Business system, Corporate governance, Environmental health, safety and social responsibility management.	Depend on chosen reference model (APQC, VRM, SCOR or industry specific). E.g. for Porter value chain: Inbound Logistics, Operations, Outbound Logistics, Marketing & Sales, Service.	Depend on functional area. E.g. for Human resources [HR-BRM]: 1. Staff Acquisition, 2. Performance Management, 3. Compensation Management, 4. Benefits Management, 5. Human Resources Development, 6. Employee Relations, 7. Labor Relations, 8. Separation Management.

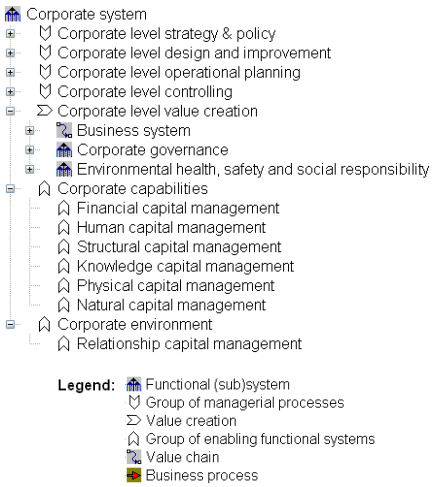

Figure 2. Corporate system pattern.

Purpose-oriented feature

Every functional system has a purpose. Higher level functional system tend to have more detailed goals, which clarify the main one. Purpose(-s) of the whole system is (are) defined by stakeholder concerns, interest and requirements. As the functional system has a hierarchical structure and consists of other functional systems, its purpose is deployed into purposes of its constituent subsystems. The Purpose/goal decomposition method is inspired by Norton and Kaplan strategy maps ideas [24] and quality-function deployment methodology [25]. In order to fulfill the purpose of the whole system and meet stakeholders requirements, it is necessary to have superior value creation elements, while the latter depend on management, measurement, resources and environment. Such logic is reflected in decomposition of goals for the functional systems – "first-level" goals of the system are achieved via goals of the value creation elements ("second-level" goals), which, in turn, are achieved via goals of managerial and enabling activities ("third-level" goals). This three-level goal structure can be named "functional system strategy". QFD encouraged us to transform a multi-level structure of goals into a series of "goal-goal" and "goal-activities" matrixes, which allows to fine-tune the structure of a functional system – to choose the required activity elements, eliminate redundant activities, define priorities.

The hierarchical organization and isomorphism of functional systems [21] (see also recursive structure of Beer's Viable Systems Models [19]), together with the functional system pattern, determine enterprise functional decomposition (see Fig. 3). The corporate system can be structured by using the corporate system pattern. Its components include the business system, functional systems and groups of managerial processes. The business system can also be structured by using the generic functional system pattern. It will include both business-lines and functional systems, together with groups of managerial processes. These can be further broken down into functional systems and processes until the necessary level will be achieved. Strategy deployment typically goes in parallel.

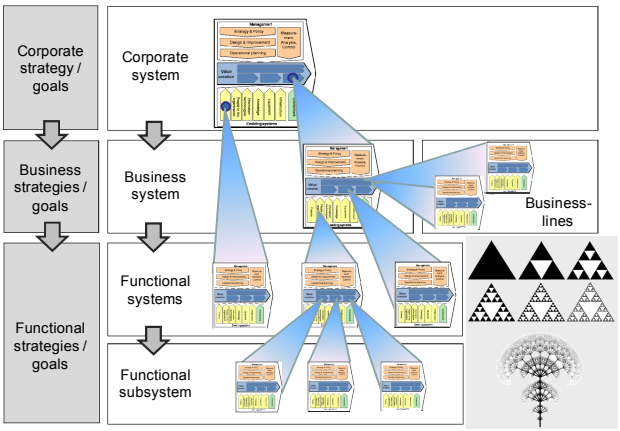

Figure 3. Pattern-based enterprise functional decomposition.

Some activity elements do not depend on the type of the functional system (corporate-, business-, functional), but some do vary. Variances appear in different objects of analysis at different levels.

The main standardization benefit appears in managerial processes of functional systems. All functional systems and subsystems can/should/must choose their processes among the available corporate reference model of managerial processes. It will provide consistency and stimulate the best practice implementation.

C. *Process of functional decomposition for specific enterprise*

1. Identify functional systems and subsystems within business system
   - 1.1. Describe customer-oriented value chain/stream in terms of interacting functional systems,
     Usage of existing reference models (VRM, SCOR, APQC), lifecycle models and patterns.
   - 1.2. Identify groups of managerial processes,
   - 1.3. Identify enabling functional systems.
2. Identify functional systems and subsystems within corporate system (see Fig. 2)
   - 2.1. Describe corporate-level value chain/stream
     Specify and/or fine-tune corporate system pattern
   - 2.2. Identify groups of managerial processes
   - 2.3. Identify enabling functional systems
3. Identify subsystems and processes (see example for enterprise assets management functional system within the pulp and paper enterprise at Fig. 4)
   - 3.1. Describe value creating subsystems or processes within functional systems
     Usage of generic (e.g. APQC) and domain-specific reference models (e.g. ITIL), lifecycle models.
   - 3.2. Generate operational planning processes for value-creating components of functional systems

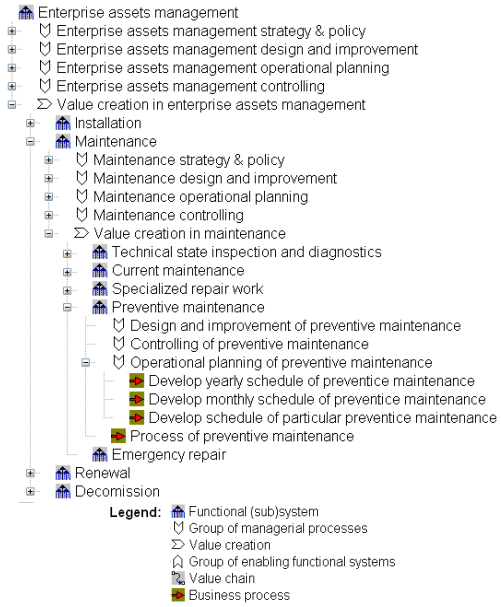

Figure 4. Decomposition of (functional area-level) functional system (partially expanded).

3.3. Choose and customize the required processes from Design & improvement, Strategy & Policy and Paradigm groups of processes for functional systems.

3.4. Identify managerial processes for business system,

3.5. Identify managerial processes for corporate system.

In order to meet the requirements regarding the resultant activities structure, it is necessary to deploy the goal structure in parallel with functional decomposition.

V. EVALUATION OF FUNCTIONAL DECOMPOSITION FRAMEWORK AGAINST REQUIREMENTS

Requirements for the functional decomposition were suggested in the introduction.

System approach driven requirements

Requirement 1: Alignment of functional decomposition with the enterprise intentional model is met through: Introduction of the "functional system" concept; Hierarchy of functional systems (functional decomposition) follow the "help achieve" structure of their purposes; Goals decomposition, together with the maturity level, defines the set of managerial and enabling subsystems and processes to be included into a specific functional system;

Requirement 2: Reuse of proven normative models or knowledge (reference models, patterns, etc) is met through: The internal top-level structure of a functional system follows the relevant pattern (see Fig. 1), which is based on Beer's VSM and ISO 9004:2009 recommendations; Reference models, patterns and other reusable elements help define value creating elements within the functional systems; Managerial and enabling elements applied for functional systems can be chosen from the predefined set of the ISO 9004:2009 recommended activities.

Requirement 3: Unification of activities at different levels of detail is met through functional system pattern recursive reproduction which provides unification of activities description at different levels.

Requirement 4: Functional system pattern includes managerial activities, which are reproduced for different functional systems at various levels.

Management science and business administration driven requirements:

Requirement 5: Value-based management harmonization is met through: Separation and definition of a corporate-level functional system (see Table 2, Fig. 2); Specialization of the generic functional system pattern based on corporate value drivers and a corporate strategy.

Requirement 6: ISO 9004:2009 harmonization is met through the following: The functional system pattern includes all the ISO 9004:2009 connected activities and defines the contents of every functional system; The ISO 9004:2009 maturity self-assessment tool, together with the goals, defines the set of managerial and enabling subsystems and processes to be included into any specific functional system.

VI. IT SUPPORT AND IMPLEMENTATION

The functional decomposition framework is supported by enterprise engineering software tool ORG-Master [26]. ORG-Master tool includes the following modules: Ontology-based enterprise model editor, Reporting and query module, Diagram editor, Integration wizard, Modeling process (method engineering) wizard. The ORG-Master tool together with the corresponding models and methods has had a more than 10-year long history of use in organization development and business process improvement projects. The ORG-Master is used in business entities in Russia and the CIS countries, and the scope of client uses varies from small companies to corporations employing as many as 10,000 staff.

The functional decomposition framework is implemented at 3 Russian enterprises within enterprise engineering projects: Ilim Group, Koryazhma Branch (http://www.ilimgroup.com/about-company/structure/ilim-west/koryazhma/), RMZ Gazprom Neft-Omsk Refinery LLC Omskiy Repair plant, CottonClub.

In 2008, the Koryazhma Mill faced the problem of equipment reliability drop. Breakdowns happened often and that resulted in unplanned equipment downtime increasing from 367 hours in 2006 to 1271 hours in 2008, that is some 3,5 times as much. A maintenance system reengineering project was carried out to eliminate the identified problems. It focused on business architecture elements mostly and included the following tasks:

- Develop maintenance system concept, strategy and measures;
- Redesign organizational structure,
- Identify maintenance processes and raise their maturity,
- Optimize the key maintenance processes;
- Information system improvement;

- Formalize and enhance key maintenance operations;
- Develop organizational documentation.

Maintenance system functional decomposition provided the infrastructure for these tasks. It helped to clarify responsibilities during organizational structure redesign, to identify maintenance processes and check their list for completeness and deploy functional strategy. Functional system pattern provided consistent description of different systems, helped to embed planning and improvement activities in every functional system and to make mid-level managers responsible for these activities.

During the project Koryazhma Branch successfully passed ISO 9001 compliance assessments using the same documentation and plan ISO 9004:2009 certification (ISO harmonization). Corporate and business system identification enabled us (consultants) to get corporate- and business-level prerequisites for maintenance system (VBM harmonization). While business system is mostly concerned with equipment reliability, corporate system set social, safety, health and environmental requirements. All these requirements were reflected in maintenance activities.

The maintenance system reengineering project was done using ORG-Master and ontology-based business architecture model. The organizational documentation was generated from the model. The ontology included about 60 concepts and some 100 types of the relationships. The instance base included more than 10000 thousands elements. The model enable the Koryazhma Mill to generate the following organizational documentation (views): 12 functional system standards, 36 process regulations, more than 400 job descriptions, more than 200 employee performance scorecards, 35 operation instructions. Overall effects of the maintenance system reengineering project: The tendency for the unplanned equipment downtime to keep growing has been reversed for the first time in 4 years. Instead of 1,527 hours of downtime forecasted for 2009, the actual downtime was only 917 hours, a 40 percent decrease; Increased manageability and performance; Repair times reduced; Increased equipment reliability.

VII. CONCLUSION

Enterprise functional decomposition is the primary component of enterprise activities description. The paper suggested the framework for enterprise functional decomposition, which integrates benefits of the existing methods and provides additionally harmonization with value-based management and ISO 9004:2009. The framework aligns functional decomposition with the enterprise goal model, supports reuse of the proven normative models, provides pattern for consistent decomposition and foster enterprise activities adaptability through the embedded regulatory and improvement mechanism (management component of the pattern). The paper also described ORG-Master – framework tool support – and implementation in management consulting project.

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