Enterprise Computing Management
Based on ICT Services

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ABSTRACT
IT Management based on ICT Services is a topic that has been discussed deeply at theoretical and practical levels recently. The number of ICT services is growing with the company size and with the granularity of ICT services. Prerequisite of effective ICT services management is the existence of well structured service catalogue and well defined service architecture. While creating the service catalogue (e.g. in the process of ITIL implementation) one has to categorize the services from different point of views in order the catalogue would be transparent for both the customer and provider.

The article discusses approaches to ICT services categorization, to ICT service architecture design, and to the role of ICT services in Business – ICT alignment. It identifies the unique role of ICT service architecture in effective ICT support to the business.

Categories and Subject Descriptors
K.6.0 [General]: Management of computing and information systems.

General Terms
Management.

Keywords
Enterprise computing, Service, ICT service, ICT service catalogue, ICT service architecture.

1. INTRODUCTION
Enterprise computing efficiency and its relationship towards business has been the subject of interest of business and ICT managers for number of years. By Enterprise computing we understand the system of an enterprise which consists of ICT services, ICT processes, and ICT resources of an enterprise and their relations. The system development and operations are governed according to the rules set by ICT governance principles.

Numbers of methodologies as well as frameworks oriented toward this area are results of this effort. ITIL, COBIT a TOGAF are between the most important. The latest versions of all these methodologies and frameworks include ICT services as key component. SLA (Service Level Agreement) is used for description of ICT service characteristics. All services are then registered in the services catalogue.

At the time being there is neither generally accepted view on the role of ICT services within Enterprise computing management, nor on architecture of ICT services, nor on classification of ICT services. As the result of this situation ICT services providers as well as ICT services users use their own classification, which creates complications in orientation on ICT services market as well as in design of ICT services catalogue in enterprise. Position of ICT services architecture, being not clear, bring difficulties in enterprise IS solution, especially with use of different forms of outsourcing (e.g. using SaaS-Software as a Service, PaaS-Platform as a Service, and IaaS-Infrastructure as a Service).

Based on ICT Service definition (see section 2), the aims of this paper are the following:
- Proposition of ICT services classification suitable for development of service catalogue (see section 3).
- Present arguments for suitability of ICT services architecture (see section 4).
- Present role of ICT services for solution of relationship between business and Enterprise computing (see section 5).

All procedures presented further in this paper are part of SPSPR model (see below), which is oriented towards solution of relationships between business and Enterprise computing, and which was developed at University of Economics, Prague [15]. These procedures have been practically verified by several practical implementations.

2. ICT services
2.1 ICT Service definition
Exact definition of ICT service is necessary prerequisite for further discussion of Enterprise computing management based on ICT services. We may start with definition of service in general. Many definitions have been presented in literature, e.g. [16], [9]. Kotler in [8] defines service as “a dealing, which one party may offer to other party and which is basically immaterial”. Booth’s definition [1] is the following „Service is an abstraction of some source, which is represented by source capability of task processing with coherent functionality from the point of view of service provider as well as of service consumer. In order to use the service, it must be realized by a particular provider’s agent”.

For modeling and management of ICT business support, distinction between business services and ICT services is useful.
Business services are produced by enterprise business processes and provided by enterprise to its customers. ICT services are provided by enterprise ICT department or by external provider for business processes support. In specific case both service types may merge (i.e. ICT service is provided directly to customer).

Number of different definitions of ICT service has been presented in literature. Not only definitions as such but also terminology used as “ICT service” equivalent is different which makes the term fuzzy. Different approaches towards ICT service understanding are represented by following definitions:

“ICT service is coherent group of activities, provided by enterprise ICT department, which may be, as a whole, provided or withdraw from ICT user” [12].

“ICT service is represented by activities and/or information provided by ICT service provider for ICT service consumer” [15].

“ICT service is a particular functionality, provided by ICT service provider, and which enables execution of a particular business process” [14].

“ICT service is provided for one or more customers. It is based on ICT use and supports customer’s business processes. ICT service is created by people, processes and technology and should be specified in service level agreement” [7].

“ICT service is an abstraction of some ICT entity, by which we represent the entity capability to realize a task, which from the point of view of service provider as well as of service consumer has coherent functionality. In order for ICT service to be used, it must be realized by some concrete provider’s source and accepted by suitable consumer’s receptor [3].

“ICT service is implementation of well defined business function, which is executed independently on the state of any other service defined in a system. Services present well specified set of interfaces and are executed on the basis of agreement between service client and service provider that is specified beforehand” [13].

2.2 ICT Service definition in SPSPR model

Basic concept of SPSPR model is represented by Figure 1.

Model is used for solution of relationship between enterprise process management and enterprise ICT management. The basis of the SPSPR model is formed by five interacting layers (S-Strategy, P-Processes, S-ICT Services, P-ICT Processes, R-ICT Resources). ICT services in a model are taken as an interface between business and ICT departments (bold line in Figure 1), through which individual business processes or their partial activities are supported by ICT services. ICT service may be delivered internally or bought at ICT market. In the first case ICT department has to provide both ICT processes for service delivery as well as all necessary ICT sources (hardware, software, data, people) needed for ICT processes execution. Places suitable for use of metrics for quality, volume, efficiency and further characteristics of observed objects are marked by “clocks” in Figure 1.

Figure 1: SPSPR Model

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Based on this model and ICT services definitions mentioned above we present the following definition of ICT service:

“ICT service is represented by coherent activities and information delivered by ICT service provider to service consumer. ICT service is implemented by ICT processes, which consume ICT resources (hardware, software, data, people etc.) during their execution. Service is realized on the basis of agreed business and technological conditions.”

Business and technological conditions are included in SLA (Service Level Agreement) and typically specify the following ICT service characteristics:

- service provider
- authorized service consumers
- localities, where the service is available
- timing of service provisioning (e.g. 24x7, 8x5, daily from 8:00 till 12:00 a.m. etc.)
- service content (functionality, data, support, etc.)
- service volume (number of authorized users, data volume etc.)
- service quality (availability, response time, reliability, etc.)
- service costs (including additional penalties e.g. for provider noncompliance with service quality conditions)
- knowledge/technologies of service consumer necessary for service consumption
- mechanisms for providing service continuity in case of accident
- security rules and mechanisms (e.g. rules for consumer access to service)
- form, content and periodicity of service reporting and revision.

In SPRSPR model, the following operations are defined for individual ICT services:

- service definition,
- service design,
- service implementation,
- installation, including channel selection for service delivery,
- maintenance, modifications, continuous improvement,
- standardization,
- customization,
- contract/agreement conclusion,
- operation and delivery to concrete consumer,
- scaling (management of service volume and of capacities necessary for its provisioning),
- service quality control,
- service costs and payments,
- suspension of operation.

The following operations/activities are implemented over all provided ICT services:

- services strategy,
- services architecture,
- services integration,
- services standardization (merging of several similar services into one service),
- services packet assembly (several services form a “service package” which is delivered and paid for as a whole).

3. ICT services Classification

3.1 Introduction - Why ICT service classification

Services catalogue, i.e. list of services provided by ICT department, is an important prerequisite of Enterprise computing management based on ICT services. Catalogue good arrangement is the basic prerequisite of efficient ICT services management, as well as prerequisite of easy use of ICT services. Therefore, properly selected ICT services classification is an important task of catalogue creation.

Current approaches to ICT services management in ITIL, COBIT and TOGAF are oriented mainly at ICT processes (their quality, maturity, efficiency etc.). They don’t deal with classification of ICT services and with service architecture. ICT services structure in services catalogue are therefore solved differently by service providers and by service consumers. To our point of view this situation brings complications in orientation at ICT services market as well as in ICT services architecture design in enterprise.

As an conclusion, based on above mentioned arguments, we may declare that – Service Level Management i.e. management of ICT services delivery in enterprise, as well as support of easy orientation on ICT services market – are the main aims of ICT services classification.

3.2 ICT Services classification in SPRSPR model

Number of different approaches may be used for ICT services classification. Five different approaches based on service content, way of service consumption, type of service consumer, and type of service provider, resources and knowledge required from provider – are specified in [6].

For SPRSPR model, as well as for management of business ICT alignment, classification of ICT services based on service content is the main classification criterion. This criterion is oriented towards what is delivered by service provider to service consumer and towards relationship of delivered service towards consumer business. In SPRSPR ICT services are classified in two groups, Based on service content, i.e.

- ICT services for business, i.e. services which directly support enterprise processes and end-users. They include information, application, and infrastructural, supporting and mixed ICT services.
- ICT services for enterprise ICT development. These services are used for advancement of current ICT services or for development of new ICT services and are not directly consumed by business. Development and delivery of software or of ICT infrastructure are particularly included. This group includes number of services, especially software development, application implementation and integration, technology infrastructure advancement and consulting.

Because of primary orientation of this paper on business - ICT orientation, only ICT services for business are further described in detail.
3.2.1 Information services
By information service the required information (e.g. current stock price, weather forecast, map of given locality, book, photo, film) is delivered by service provider to service consumer. Information should be delivered in required structure, format and time. By enterprise the information is used in information and decision processes. Service provider is responsible (as opposed to application services) for information quality (e.g. relevance).

These services present certain specific features e.g.
- Easy replication with low costs. Provider of lucrative service may benefit from high revenue.
- For some services the legislation (e.g. author law) may limit service consumers' way of using information.
- Though, the information is delivered by software application, the functionality of this application is not relevant for the user.

3.2.2 Application services
Functionality of business application (e.g. accounting, CRM, e-mail, air-ticket ordering) represent the content of application service. Data, processed by application, may be fully owned by consumer (e.g. accounting, CRM), fully owned by provider (e.g. Google search engine) or combined from both sources (e.g. air-ticket ordering). Service provider is responsible for data transformation (provided by application); data owner is responsible for correctness (quality) of input data.

By application services oriented towards business processes application functionality may implement one or more activities of business process, i.e.
- Service may support only selected activities of business process (e.g. ordering of goods).
- Or a service represents an entire business process (e.g. internet banking).

Application service may often be delivered as a whole together with supporting services (e.g. training, help desk, customization). SaaS (Software as a Service) – e.g. Salesforce CRM - may be regarded as modern and popular way of application service delivery.

3.2.3 Infrastructure services
Implementation and operation of ICT infrastructure (e.g. servers, networks, operating systems, databases) required for application processing represent the content of infrastructure service. By Ross [11] these services include:
- Services for technological resources administration. They include e.g. provisioning and administration of end-user devices, implementation of platform for new business applications development and implementation.
- Communication channels services, which include management and integration of all electronics communication channels used for enterprise communication with consumers. They include e.g. Internet (Web, ICQ, e-mail), phone, EDI (Electronic Data Interchange).
- Communication services oriented towards provisioning of communication links, by communication networks, between individual places of business applications processing.
- Data administration services, which provide an environment for data management (i.e. accessibility, storage, archiving, replication, restoration after failure etc.) independent of applications.
- Services for risk management and ICT security. They are used for provisioning of specified level of information security, which is represented by set of features (e.g. integrity, reliability, non-repudiation etc.) as well as provisioning of ICT trust environment for all parties (customers, partners, employees, owners).

Cloud computing present different approach towards infrastructure services classification by specification of two types of these services, i.e.:
- IaaS (Infrastructure as a Service), which include services without development platform and integration tools.
- PaaS (Platform as a Service), which include services including development platform and integration tools.

3.2.4 Supporting services
These services are needed for user support of information, application and infrastructure services. They include namely training, implementation, application customization and integration, help desk services, consulting services for service design, preparation of service contract or for tender organization and execution.

3.2.5 Mixed services
Often the above mentioned services are tightly connected in practice, resulting in mixed services.

4. ICT services architecture
4.1 ICT services architecture in SPSPR model
ICT services architecture comprise definition of individual ICT services used by enterprise and their relationships. Services dependency, i.e. situation when existence of certain service is determined by existence of another service (e.g. infrastructure service as prerequisite of application service), is depicted by service links.

There are different aims of using ICT service architecture by service consumer (enterprise) and by service provider. Service consumer aims at provisioning and integrating (either internally or externally) all ICT services required for business processes. Service provider aims at delivering services portfolio with greatest revenue, taking into account consumer segments and territory.

Individual ICT services are mapped to other model objects in SPSPR model. By mapping to business processes or enterprise departments the service consumer (i.e. department or process) is determined. Mapping to ICT processes determines which ICT processes take part in service creation and delivery. Mapping to ICT applications determines by which applications the service is provided.

In SPSPR model the ICT services and their architecture represent the main communication tool for communication of business departments and ICT department. In this way the ICT services “hide” ICT processes and ICT resources (including application architecture) for business users. This situation brings following two significant benefits of SPSPR model:
- All technical details of ICT services provisioning, including specification of which application the functionality of information and application services is provided, are excluded from the interface between business and ICT department (see SLA structure in section 2.2). This problem is solved by ICT department and by its ICT strategy.

- Information, application and technological architectures of those ICT services, which are – based on sourcing decisions – delivered by external providers, need not be solved in detail in enterprise.

4.2 ICT services in TOGAF and ITIL

TOGAF (The Open Group Architecture Framework) [10] and ITIL (Information Technology Infrastructure Library) [7] are currently the most frequently used frameworks for Enterprise computing management. TOGAF is oriented towards design and implementation of ICT services as products for business goals. ITIL is mainly oriented towards delivery of these ICT services to users and customers. TOGAF is based on Enterprise Architecture (EA) repository, ITIL is using information storage in form of Configuration Management Database (CMDB).

There is lately and intention for interconnection of both frameworks. Braun and Winter in [2] declare, that “In case of EA being the central enterprise engineering concept and ITIL being the dominant operational model for IT, ITIL has to be sufficiently integrated into EA” and also propose interconnection of EA and ITIL meta-models (see Figure 2).

Although both frameworks (ITIL and TOGAF) include ICT services and their catalogue, as key meta-model element, they don’t mention ICT services architecture. However they deal with business, application, information and technological architectures.

There are different points of view towards ICT service architecture use in frameworks like TOGAF. By Hrabe [5] “If it possible to view enterprise as system of systems, than ICT services are not its subsystem (on the contrary to ICT as a whole), therefore it has no own architecture and it is not possible to describe and model this architecture”. “Services are used in enterprise in number of different types and categories and ICT services architecture is not possible without inclusion of links with number of objects from different areas of enterprise architecture. Therefore it is not necessary and makes no sense to search for neither specific (isolated) general services architecture nor ICT services architecture.

From our point of view the ICT services architecture inclusion in TOGAF could be beneficial. In this case two new phases i.e. “ICT services architecture design” and “Decision on ICT services sourcing” would be included between two existing TOGAF phases i.e. “Business architecture design” and “Information and application architecture design” (see Figure 3).

![Figure 2: EA and ITIL metamodels integration [2]](image-url)
Hamlett’s requirement [4] for inclusion of outsourced ICT services scope into enterprise architecture concept would also be solved by this modification.

4.3 The role of ICT service architecture in SPSPR model

The purpose of dividing business management into five layers (see Figure 1) is following:

- Clear identification of responsibilities of different levels of enterprise managers.
- Transparent way of decomposition of enterprise business goals, up to the layer of ICT management.
- Schema creation, which enables to create a set of metrics for success evaluation of individual process types and responsible managers. See places marked by “clock” in Figure 1.

Strategic business management is fully in competence of top-management. It is responsible for setting the business goals and priorities and for creating conditions and resources enabling achievement of these goals. It means that its tasks consist of setting products and services the organization will produce, core customers – those the business is orientated on, main business partners (esp. for finding one’s position in a value chain). It is also responsible for creating and sustaining resources (people, knowledge, finance, technology, etc.) necessary for achieving set goals.

Enterprise fulfills the business goals by means of core business processes. Design and management of business processes in such a way, that organization fulfills the strategic goals is the main task of second level – i.e. level of core and supporting processes. Main activities at this level are the following: a) definition and optimization of business processes, b) operational management of processes and capacities, c) processes monitoring d) process execution and e) sources management.

The manager responsible for the process definition and optimization is responsible for suggesting the process (individual activities, their sequences, etc. – as in [15]) in such a way that the process leads to the production of competitive product/service in the optimal time, volume, quality and at acceptable costs. The following metrics may be used to measure the efficiency: volume of sold production/service, profit from the sale of product/service, etc.

Now we are coming to the first important characteristics of the SPSPR model, which is the reaction on current trend in division of responsibilities between business and ICT managers [11]. A part of the process definition must also be the suggestion of ICT services that will optimally support the business process. This is, in fact, an explicitly described responsibility of a process manager (owner) for “ordered volume and ordered quality” of ICT services. The process manager has to calculate an acceptable (limit) cost of ordered ICT services. The cost of ICT services is one of the business process cost items and once it becomes too high, the final product/service would be no longer competitive at the market. This is one of the key points of the model. When it is not possible to ensure required ICT services for this limited cost, then it is crucial to adjust the main process and its requirements for ICT services (see Figure 4).

The process manager is buying the necessary ICT services from the ICT services manager(s). In the case of the centralized model of ICT management, the CIO is the one in charge of all ICT services. He also decides the form (internal / external / combination) of their assurance. However, in the case of the decentralized model, the Process manager can himself also approach the external providers of ICT services and buy the service from them. In each model, it is advantageous to apply the same ICT services definition and its structure for both, internal and external providers. Once we apply the same structure of the service definition, then it is relatively easy to decide whether to purchase the service from an internal or an external provider.

Having done this, we have managed to reach the third layer of business management – the layer of information services. ICT service definition should have the same structure for service provided internally as well as for service provided externally. In this case the consistent criteria set may be used for decision, whether we buy the given service (e.g. functionality of application for production logistics) internally or externally.

The ICT services manager is responsible for the delivery (operation) of the contracted services. In case the manager decides to purchase the ICT service from an external provider, the problem of information service management reduces to the contract making and control of its carrying out. The contract includes SLA for all contracted services. When the service is ensured by in-house provision, the CIO is obliged to ensure required ICT processes and provide required ICT resources.
The criterion of ICT services manager effectiveness and efficiency is not only the measure of fulfilling the service parameters as agreed within SLA, but also achieving such service costs that are lower or equal to the contracted price, and at the same time are comparable (by using benchmarking) with the prices of similar services on the IT market.

ICT service is produced by ICT processes (e.g. change management, incident management, etc.). These processes, managed by ICT process managers create the fourth model level. Importance of ICT processes quality increases especially with the following parameters of ICT services:

- Importance of business process, which is supported by given ICT service (critical business processes need services with high quality).
- Number of service users; the more users are using given service the more mature ICT service ought to be.
- Requirements on service quality (availability, response time, security etc.).
- Total number of ICT services (for increasing number of services also requirements on their integration as well as on corresponding processes and resources are increased).
- Total volume of ICT resources, which are consumed by ICT processes.

From above description it may be seen that the maturity of ICT services should grow with the number of internally provided ICT services and with the level of SLA parameters.

ICT resources management is the last management layer in SPSPR model. Resources include namely: technology infrastructure (hardware, network, and system software), application software, data, and material and ICT personnel. Managers on this level exercise classical ICT professions such as: application administrator, network administrator, database administrator, etc. Their responsibility is to operate and maintain the resource at acceptable costs. Activities belonging to the administration of technological resources are as follows: observation of resource utilization and its capacity changes consequent with changes in service requirements, observation of developing trends and planning of time – when the resource is going to be upgraded, etc. Human resources management deals with recruiting new employees with required qualifications, career development planning, retraining, etc. The criterion of resources manager effectiveness and efficiency is acquisition; maintenance and development of resource at the level that is, in the matter of quality, comparable with the quality available in the market, and in the matter of capacity, corresponding with the requirements of internally provided information services.

Responsibilities of ICT department towards business may be deduced from SPSPR model. From this point of view the main responsibilities are the following:
- Cooperation on business strategy.
- Cooperation with business managers, in order for them to use properly ICT potential for support of their business processes and business goals (by formulation of requirements for ICT services).
- Review of consistency and implementation ability of required services.
- Delivery of agreed upon services in agreed upon time, content, quality, volume and costs.
- Costs of internally provided services should be equal or lower than services market costs.

Secondary responsibilities include mainly:
- Proper choice of sourcing for ICT services, processes and resources.
- Quality (proper maturity) of ICT processes.
- Information system integrity.
- ICT costs should correlate with enterprise performance, e.g. volume of delivered ICT services should react on seasonal business changes.
- ICT flexibility towards changes in business requirements.

5. Conclusion
Possible approaches towards ICT services classification and architecture and their role in ICT – business management are proposed in this paper. Approaches used in our SPRPS model are described in greater detail as we feel they may be of general use. We are convinced that approaches described in this paper may bring the following benefits for enterprise computing management:
- Clear responsibility definition in relationship towards ICT for various levels of enterprise managers and specialists.
- Transparency of the way of enterprise business goals decomposition to the ICT operations management.
- Development of schema from which the metrics of success of individual process types and responsible managers may be deduced.
- All technical details of ICT services provisioning are excluded from the boundary between business and ICT department which makes business managers specification of ICT services requirements easier.
- Detailed information, application and technological architectures of those ICT services, which are on the basis of sourcing decisions delivered by external provider, need not be solved inside an enterprise.

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7. References