

# THE MODEL OF E-TECHNOLOGY UTILIZATION FOR SMEs

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## Abstract

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Today, small and medium-sized enterprises implement e-technology in order to improve business performance and competitiveness. As to achieve the maximum level of benefits from e-technology implementation, it is important to understand well to all suitable e-activities, their possibilities and also opportunity for business.

In this paper, the general model of e-technology utilization in the form of partial e-technologies is described. This general model was proposed for better understanding of the possibilities small and medium-sized enterprises can reach by usage of e-technologies.

Based on a synthesis of related literatures, an analysis of various data from reachable researches, surveys of enterprises and a qualitative study of referential business subjects, we identified several e-activities which are dominant specially for SMEs, external subjects connected to these activities (customers, suppliers, partners) and also groups of IS/ICT necessary to support identified e-activities. All these information were summarized and adopted in the general model.

The model provides basic platform for our research within e-technology and simple formal structure for analysis and comparison of real businesses in this scope. Although, in this paper the SME area is considered, the model itself is general.

e-technology, e-activities, small and medium-sized enterprises, e-technology utilization model, e-technology utilization index

The term e-technology is the shorthand for electronic technology or e-business technology. It covers especially complex technical support as hardware, software and communication infrastructure for enabling a lot of various electronic activities as e-commerce, e-invoicing, e-procurement, e-marketing and lot of other ones. In fact, this is the main reason why various e-technologies are implemented within enterprises.

Formal definitions of the term e-technology are offered by several authors.

Koh and Maquire (2009) define electronic-technology (e-technology) as a diverse range of IT, IS, IT/IS and ICT used with the network architecture support of the Internet, Intranet and/or Extranet to assist personal, business, organizational and institutional activities.

In the similar way, Stevens (2007) describes e-technologies as any product, device or mechanism

that creates and disseminates information about the business or facilitates transactions for the business by means of the world wide web, inter and intranets, e-mail, machine-readable and scanned information, hand-held and desk-top electronic devices and any other electronic means.

In fact, it seems to be clear that e-technology is closely related to the problem of business. Here, in this paper, the term e-technology is used for the information and communication technology and also information systems and software tools used as a platform for electronic business and its components according to simple but clarifying definition of e-technology proposed by Wei, De Boer and Chen (2009): *E-technology is defined as the architecture, technologies and components that enable and support e-business*.

However, e-business is wide concept which should be considered in details. Hence, component-

based description of the e-business brings a principle of dividing e-business into several e-activities as e-commerce, e-learning, e-marketing and other ones (Wenna, 2002).

But the level, possibilities and real state of using and applying e-business is not the same for all businesses. Simply, there are not the same conditions and needs for all businesses. From this point of view e-technology used within one business usually differs from other business, especially if we consider different size, sector, organization and many other characteristics.

The main motivation of our work is the need to find the way we can compare e-technology in businesses by the set of so called "e-technology models" for various groups of businesses. This paper is oriented to the part of our long-time work and the main objective is to propose the general model of the e-technology utilization for small and medium enterprises and equivalent businesses. In fact, this objective is one of main objectives in our research that we have been working on since 2009/2010 (Malo, 2010).

## METHODS AND RESOURCES

For our work and the SME e-technology model itself it is necessary to understand and adopt the formal relations between e-business, partial e-activities in the context of e-business and e-technology. This standalone problem is a part of the whole our research and was solved in the first phase of our project, which offers necessary theoretical background for exploring e-technology utilization (Malo, 2010).

The main assumptions adopted in this paper on the basis of the research are:

1. E-business is set of partial e-activities.
2. E-activities are supported by various e-technologies.
3. Each e-activity is aimed to different user type or subject type.
4. E-technology is a subset of enterprise IS/ICT.

These initial assumptions create basic conceptual schema for using e-technology and e-activities in businesses.

In this paper, we used information from several surveys and studies as the start point of our analysis. The main information resources used here are:

1. Own quantitative survey and qualitative study of using e-technologies within businesses.<sup>1</sup>
2. Information Technologies in Business (Czech Statistical Office, 2010).
3. Synthesis Report 2009/10: "ICT and e-Business for an Innovative and Sustainable Economy" (European Commission, 2010).
4. The European e-Business Report 2008 – The impact of ICT and e-business on firms, sectors and the economy (European Commission, 2008).
5. Eurostat Statistics for Information Society (European Commission, 2011).
6. Report Internet World (The Boston Consulting World, 2011).
7. Analytic Study about Using Information and Communication Technologies in Small Enterprises (European Projects & Management, 2010).

We aimed only to enterprises with number of employees from 10 up to 250. It covers the small and medium-sized enterprise with respect to the EU Commission Recommendation 2003/361/EC (European Commission; 2003). According to this recommendation the category of micro, small and medium-sized enterprises (signed as SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million (see Tab. I).<sup>2</sup>

In fact, we took only staff numbers into account, because information about turnovers or balance sheet total were not available in used information resources and researches.

As the next result of our analysis, we defined the base selection (mix) of e-activities and supporting e-technologies for e-business in the general way not targeted to branches, sectors or detail sizes of SMEs. Method for involving e-activities in the mix was based on the statistical results gained from used information resources and studies. We analyzed used e-activities within businesses and took the widely used e-activities into the account. Formally, the general mix of e-activities  $M$  was selected by the next formula.

I: Definition of SMEs

Enterprise	Staff number	Turnover	Balance sheet total
micro	< 10	≤ € 2 million	≤ € 2 million
small	< 50	≤ € 10 million	≤ € 10 million
medium-sized	< 250	≤ € 50 million	≤ € 43 million

1 Raw data of the quantitative survey were gained in diploma thesis (Machaníček, 2011). The qualitative study was processed in the 2010 with 7 participants from SME sector.

2 Micro businesses are not involved in this paper.

$$M = \{a \in A \mid \frac{\sum_{e \in E} S(e, a)}{|E|} \geq \delta\},$$

where

$A$  .....a set of researched e-activities

$E$  .....a set of researched enterprises

$S(f, a)$  .... support for e-activity  $a$  in the enterprise  $e$ :

0 – e-activity is supported

1 – e-activity is not supported

$\delta$  .....minimal rate of utilization,  $\delta \in (0, 1)$ .

As the last step we identified and specified e-technology components as a part of the general e-technology utilization model. The index of e-technology utilization was proposed too because of planned future work and the necessity to focus this model to various business branches and to compare enterprises within these segments.

The model should be understood as a conceptual framework which can be used for constructing partial models for strictly defined types of enterprises.

## RESULTS

### SMEs' mix of e-activities

We defined the mix of e-activities which suits the best for various SMEs. The mix definition came out of statistical data gained from various researches. The rate of utilization was approximated for data founded according to specified condition within analysed researches; results from the Czech Republic were prioritized. Minimal rate of utilization was estimated and set to 3 % (see Tab II).

E-communication, as the last e-activity, was added in the mix without approximating the rate of utilization because usage of various communication

tools is possible to include into other e-activities or e-business itself.

All enumerated e-activities are common and usual, thus no explanation and description is included in this paper. However, e-communication is e-activity covering all possible electronic communication channels with other enterprises, customers, employees or other subjects and e-cooperation is considered here as the e-activity enabling electronic collaboration with partners or employees.

The most used e-activities within businesses in SMEs are understood as a part of e-business.<sup>3</sup> It means that e-business creates basic platform for all partial e-activities (see Fig. 1). We accept this premise only in businesses because there are also e-activities that not belong to e-business domain not even to business sector (e.g. e-health, e-governance) in general.

According to the assumption three<sup>4</sup>, we defined also targeted subjects aiming by e-activities (see Tab. III). In fact, there are five possible interactions in selected e-activities and their context. E-activities in businesses interact with:

1. suppliers;
2. customers;
3. partners;
4. employees;
5. others (external subjects, public institutions, service providers).

Although the term partner is sometimes used also for suppliers or customers, here in the paper the group of partner contains only users not possible to be characterized as suppliers or customers. It means, for example, users joined in the affiliate partner programs or collaborating with business not on the knowledge level for gaining advantage from partnerships.<sup>5</sup>

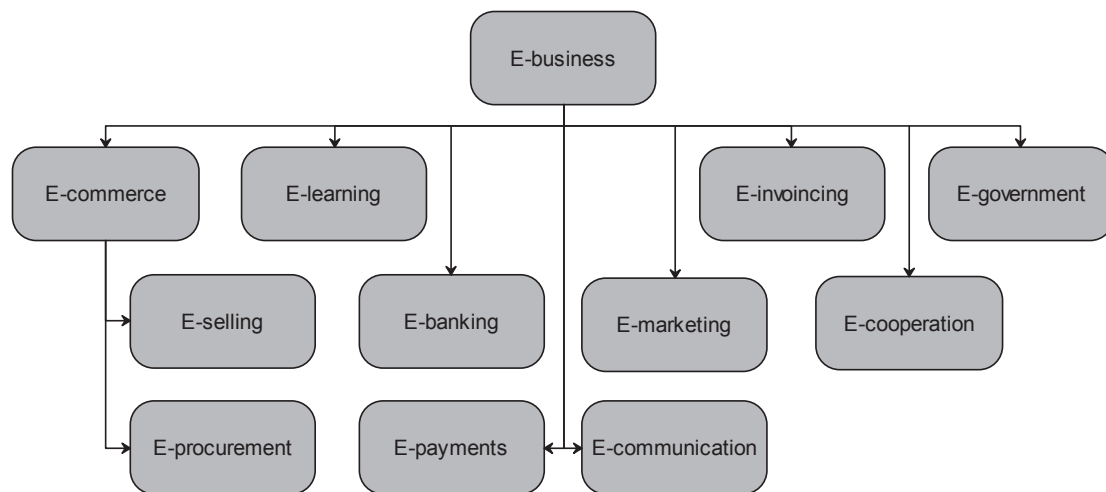
II: Utilization of e-activities

E-activity	Condition	Approximate rate of utilization (%)
E-banking	Using internet banking or alternative	85.57%
E-marketing	Engaging in at least one e-marketing tool	57.01%
E-government	Processing form for public institutions online or electronic tendering	54.80%
E-commerce (E-procurement)	Placing orders online	35.34%
E-learning	Using e-courses or e-tests	30.84%
E-cooperation	Integrating intranet or extranet system for support of employees or partners	28.14%
E-commerce (E-selling)	Selling goods or services online	19.87%
E-invoicing	Placing or accepting e-invoices	14.67%
E-payments	Providing possibility to pay online	4.04%

<sup>3</sup> See assumption one in the section Methods and Resources.

<sup>4</sup> See the section Methods and Resources.

<sup>5</sup> Also describe at [http://en.wikipedia.org/wiki/Business\\_partner](http://en.wikipedia.org/wiki/Business_partner).



1: The mix of e-activities for SMEs

III: Matrix of base interactions in e-activities

E-activity	Suppliers	Customers	Partners	Employees	Others
E-commerce	x	x			
E-selling		x			
E-procurement	x				
E-learning				x	
E-marketing		x	x		
E-invoicing	x	x			
E-government					x
E-banking					x
E-payments		x			
E-cooperation			x	x	
E-communication	x	x	x	x	x

### E-technology model and its components

Based on the definition of the mix of e-activities, necessary and applicable supporting e-technologies can be enumerated. As we defined above, e-technologies are represented by information and communication technology and also information systems and software tools. That is why we set a list of services, systems and tools enabling and supporting selected e-activities.

However, e-business as an embracing e-activity creates the main e-technology platform. Core e-business technologies are Internet and its services as web and email. Saturation of stated technologies is very high. The rate of using Internet is 93.7% for small enterprises and 98.3% for medium-sized enterprises. Today, the very important emerging technology for e-business is also mobile networks (Czech Statistical Office, 2010).

As more and more established organizations realize the need to interact with their customers, partners and suppliers over the Internet, integration with ERP systems is a critical issue, thus e-business is changing the definition of enterprise systems (Ash and Burn, 2001) (Wang and Nah, 2001).

It is clear because ERP and usually also CRM and SCM information systems need to implemented vendors and APIs to be able to support e-activities (Wang and Nah, 2001).

Broadly speaking, Internet with web and email services together with mobile networks are supported in primary enterprise systems (mainly ERP) because of necessity to e-business support. However, in various companies this basement is being extended by information systems and software tools from the scope of partial e-activities we defined in the mix. Possible systems, tools and services in SMEs listed in the Tab. IV are base components for the general model.

All enumerated e-technologies above were selected with respect to our analysis of cited information resources (research, surveys). However, not all e-technologies are usual in several groups of enterprises; small companies are not usually familiar with large information systems. On the other hand, partial technologies can be used, if it is useful. That is why the listed e-technologies, especially complex systems, can be in particular models replaced only by one or more alternative

IV: *Model components*<sup>6</sup>

<b>E-business (platform)</b>			
Using Internet	EIS (Enterprise Information Portal)	Web pages	e-ERP (Enterprise Resource Planning)
CMS (Content Management System)	EDI (Electronic Data Interchange)	DMS (Document Management System)	
<b>E-commerce (including e-selling and e-procurement)</b>			
e-CRM (Customer Relationship Management System)	E-marketplace (B2B)	E-procurement system	E-auctions
e-SCM (Supply Chain Management system)	E-shop (B2C)	Web catalog	
<b>E-learning (without communication tools)</b>			
LMS (Learning Management System)	LCMS (Learning Content Man. System)	VLE (Virtual Learning environment)	Automated testing
<b>E-marketing</b>			
Web analytics	Catalog links	Paid listings	SEO tools (Search Engine Optimization)
Banner and link exchange/ buying/selling	ORM (Online Reputation Management)	Social media	PR articles
E-mailing			
<b>E-banking, e-payments</b>			
Internet/Home banking	Card payments	Other online payments	
<b>E-government, e-invoicing</b>			
Public and government services	Digital signature	ESS (E-invoice Service System)	E-archive
<b>E-communication</b>			
Instant messaging	Email	Blog system	RSS
Discussion boards	IP telephony	Chat	Newsletters
E-conferences			
<b>E-cooperation</b>			
PRM (Partner Relationship Man.)	E-calendar (shared)	Task list	E-Groupware
Wiki	Intranet system		

functions of the system. For example, in small enterprises CMS can be represented by using simple visual editor (WYSIWYG), DMS by the file directory on the central server and ESS by sending invoices by emails. These modifications allow using the model nearly in all enterprises and demonstrating one of main principles adopted in our work.

Tab. IV represents a general list of basic e-technology components which should be modified when applying it to specific group of enterprises (e.g. small enterprises in logistic sector). Simply speaking, a set of e-technologies described above creates the general model of e-technology utilization (MUE). It means e-technologies which can be implemented within SME enterprises. The general model *MUE* is formally represented as a finite set of e-technology elements from e-technologies of the mix of e-activities  $T_m$ .

In fact, this conceptual model is a framework we are using now in our research for developing partial e-technology models. We are interesting only in defined components belonging to the mix of selected e-activities because of real possibility of partial model definition.

The principle of using the model is to describe what level of all e-technologies' utilization is reached within the one or the group of enterprises. It is necessary to classify each component of the model by the number from 0 to 100 (in per cents). In order to be able to do it, the suitable metric has to be set. In our framework, the e-technology utilization index was prepared as the metric for qualifying the level for any e-technology.

6 All e-technologies defined in the table are named and understood ordinarily. Prefix e- means adjective electronic.

### E-technology utilization index

In order to support possibility of comparing and measuring e-technology utilization within concrete type of enterprises, we proposed the e-technology utilization index as a base metric. The e-technology utilization index is defined as

$$EUI = \sum_{i=1}^n w_i \times A_i,$$

where

$EUI$ ...e-technology utilization index,  $EUI \in (0, 1)$

$w_i$  .....weight for  $A_i$  in percentage,  $\sum_{i=1}^n w_i = 1$   
 $A_i$ .....e-technology utilization index for e-activity  $i$ ,  
 $A_i \in (0, 1)$

$$A_i = \sum_{j=1}^m w_j \times T_{ij},$$

where

$w_j$ .....weight for  $T_{ij}$  in percentage,  $\sum_{j=1}^m w_j = 1$   
 $T_{ij}$  .....rate of using e-technology  $j$  in e-activity  $i$ ,  $T_{ij} \in (0, 1)$ .

E-technology utilization index for individual e-activities  $A_i$  can be counted in the same way as  $EUI$  so there is possibility to count only all e-technology utilization indexes for selected e-activities and compare them as separated values (in vector).

With the view of real usage of  $EUI$ , all weights have to be defined together with the rules for estimation of  $T_{ij}$  rates.<sup>7</sup>

### DISCUSSION

We analyzed and surveyed several information resources to be able to describe current state of

e-technology utilization within small and medium-sized enterprises. Our objective in this work was to prepare the general model of e-technology utilization in described sector and that is why we set a mix of e-activities usually adopted by explored enterprises.

The defined mix creates borders for finding relevant e-technologies, so in next steps of our work we was able to specify and found relevant information systems, software tools and services enabling selected e-activities. These e-technologies are components of the proposed general model.

However, the practical usage of the model is not possible because it is only conceptual framework for definition of particular models with the clear aiming to strict defined group (type) of businesses. It is possible to clearly defined needs and possibilities in such specified group. But preparation of particular models is entire part of our research, not this paper. Based upon particular e-technology models, we should be able to measure and compare various enterprises in several type groups.

In fact, the next very important question is how to process a relevant comparison of various enterprises in the scope of used e-technology. Simple e-technology matching in various subjects is not relevant.

In order to solve this problem, we proposed the new metric named e-technology utilization index. This index can be calculated for the e-technology as the complex or for particular groups of e-technologies. We assume grouping according to e-activity classification.

Generally, this paper describes principles of our research in the context of modeling e-technology utilization. Proposed general model will be used in our future work as the framework for developing particular models suiting various types of enterprises.

### SUMMARY

E-technologies as a part of modern information technologies supporting electronic business and its parts (electronic activities) are implemented within enterprises environment especially in order to increase efficiency and optimizing a lot of functions and to do enterprises more competitiveness too. However, there is a general problem with e-technology selection and implementation within business because of lack of information. No one knows what should help and what should or could be implemented.

In this paper, we propose the general model of e-technology utilization which was constructed upon the literature overview, own survey and analyses of various researches with data and information about small and medium-sized firms and their information technology utilization.

In the first phase, a mix of e-activities currently used within the sector of small and medium-sized enterprises was selected. E-technologies supporting these e-activities consist of various information and communication technologies, information systems and software tools and their implementation is a prerequisite for e-activity using. All possible e-technologies were analyzed and included into the

<sup>7</sup> Concrete values for weights and e-technology rates are not part of this paper.

general model of e-technology utilization. This general model doesn't take variability of enterprises (size, sector) into the account but realizes a basement for the definition of partial models. In order to be able to compare and measure the level of e-technology utilization in particular subjects, the index of e-technology utilization was also defined in this work.

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#### REFERENCES

- ASH, G. and BURN, J., 2002: E-ERP: A Comprehensive Approach to E-Business. In: *Enterprise Resource Planning: Solutions and Management*. IGI Global. ISBN 19-307-0836-X.
- CZECH STATISTICAL OFFICE, 2010: Využívání IT v podnicích – výsledky za leden 2010. [cit. 2011-10-24]. Cited from [http://www.czso.cz/csu/redakce.nsf/i/vyuzivani\\_it\\_v\\_podnicich\\_vysledky\\_za\\_leden\\_2010](http://www.czso.cz/csu/redakce.nsf/i/vyuzivani_it_v_podnicich_vysledky_za_leden_2010).
- EUROPEAN COMMISSION, 2003: Commission recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises [online]. In: *Official Journal of the European Union*. [cit. 2011-10-24]. Cited from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:124:0036:0041:en:PDF>.
- EUROPEAN COMMISSION, 2008: *The European e-Business Report 2008 – The impact of ICT and e-business on firms, sectors and the economy. 6th Synthesis Report of the Sectoral e-Business Watch*. [cit. 2011-10-25]. Luxembourg: Office for Official Publications of the European Communities. ISBN 978-92-79-09355-5. Cited from <http://ec.europa.eu/enterprise/archives/e-business-watch/key-reports/documents/EBR08.pdf>.
- EUROPEAN COMMISSION, 2010: *ICT and e-Business for an Innovative and Sustainable Economy – 7th Synthesis Report of the Sectoral e-Business Watch (2010)*. [cit. 2011-10-25]. Luxembourg: Office for Official Publications of the European Communities. ISBN 978-92-79-14682-4. Cited from <http://www.empirica.com/themen/ebusiness/documents/EBR09-10.pdf>.
- EUROPEAN COMMISSION, 2011: *Information Society*. Eurostat statistics database. [cit. 2011-10-25]. Cited from [http://epp.eurostat.ec.europa.eu/portal/page/portal/information\\_society/introduction](http://epp.eurostat.ec.europa.eu/portal/page/portal/information_society/introduction).
- EUROPEAN PROJECTS & MANAGEMENT, 2010: *Situační analýza – analytická studie o využívání informačních a komunikačních technologií malými firmami v kraji Vysočina pro potřeby projektu MAFIDIS+*. [cit. 2011-10-25]. Cited from [www.mafidis-plus.info/docs/z\\_mfd.pdf](http://www.mafidis-plus.info/docs/z_mfd.pdf).
- KOH, S.C. L. and MAGUIRE, S., 2009: Information and Communication Technologies Management in Turbulent Business Environments. IGI Global. ISBN 10: 160-56-6424-3.
- MACHANÍČEK, L. 2011: Možnosti uplatnění e-technologií v oblasti malých a středních firem. Diploma thesis. Mendel University in Brno.
- MALO, R., 2010: E-activities Based Business Model: The Case for E-technology Implementation. In: *Proceedings of the IADIS International Conference on e-Commerce*. Freiburg: IADIS Press, p. 173–176. ISBN 978-972-8939-24-3.
- STEVENS, Ch. 2007: Guidelines for the Use of E-technology in the CFC. United States Office of Personnel Management. Cited from [http://www.opm.gov/cfc/opmmemos/2006/E-Technology\\_Guidelines.pdf](http://www.opm.gov/cfc/opmmemos/2006/E-Technology_Guidelines.pdf).
- WANG, B. and NAH, F. H., 2002: ERP + E-Business = A New Vision of Enterprise System. In *Enterprise Resource Planning: Solutions and Management*. IGI Global. ISBN 19-307-0836-X.
- WEI, Y, DE BOER, S. J. and CHEN, J., 2001: Management of e-technology in China. In: *Management of Engineering and Technology*, 2001. Portland. [cit. 2011-10-26]. ISBN 1-890843-06-7. Cited from [http://doc.utwente.nl/55915/1/Management\\_e-technology\\_China\\_-\\_Yi\\_Wei.pdf](http://doc.utwente.nl/55915/1/Management_e-technology_China_-_Yi_Wei.pdf).
- WENNA, CH., 2002: *Strategic Issues of B2B E-business*. [cit. 2011-11-15]. Johannes Kepler University. Cited from [http://www.wenna.com/portals/ngb/text/article\\_cwenna.pdf](http://www.wenna.com/portals/ngb/text/article_cwenna.pdf).

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