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selected problems of IT application

Editor
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Editorial

The main purpose of this book is an attempt of knowledge and research results dissemination of IT application using English language. Many interesting researches and theoretical considerations conducted and published in Poland are completely unknown for foreigner readers because they are published in Polish only. Therefore, this volume is a collection of chosen problems in IT application in different areas of business activity.

There are economic, managerial and strictly technical considerations of IT application problems discussed in this book. Some authors discuss IT tools supporting information flows in stock exchange enterprises and risk management information for banking system especially. Some authors consider very technical researches as IT tools usage in the material fatigue strength determination.

IT tools application in logistics management and supply chain management is one of the most frequent topics considered in this volume. Interest in logistics and supply chain management, both in industry and academia, has grown rapidly over the past years. This trend is due to enormous potentials of logistics in improving business processes efficiency and this trend is caused by the development of information and communication systems that are able to provide access to comprehensive data from all components of the supply chain. Because of aforementioned reasons a few authors of this book consider information system, simulation or EDI problems appearing in the logistics, reverse logistics or supply chain management, following the trend in businesses.

IT tools selection and the barriers for its application are another crucial problems concerned in the papers of this volume. Also, problems of e-learning and knowledge models can be easily noticed. Balloon effect arising in the course of software upgrades seems to be quite interesting aspect for every readers. Multidimensional consideration on IT application is shown in Earned Value concept where business, technical and contracts aspects in IT project management are discussed.

The editor would like to thank the authors of the papers for their contribution. All papers submitted for publication in this volume have been subject to a refereeing process and I am grateful to the referees whose work was essential to ensure a high quality level of this book.

Janusz K. Grabara

November 2004

I. CHOSEN ASPECTS OF INFORMATION SUPPORTING FOR STOCK EXCHANGE COMPANIES

Helena KOŚCIELNIAK

Turbulently changing economy conditions, along with the appearing economic risk and especially the competition growth on a global scale, influence significantly the conditions of running the business, including realization of basic aims and the enterprise's mission. Considering economic changes that are happening, the achievement of the enterprise's aims, both the short-term and long-term, requires multi-aspect process of supporting its activity. Supporting means helping, aiding, mutual supporting and in foreign literature there are: gearing in UK and leverage in USA.

Supporting the enterprise means decision making process and performing the activities; it is assigned to the goal which strictly corresponds with the overall area of support and its selected elements. The process of supporting which is properly structured and properly implemented will enable to reduce the risk connected with the decision process and therefore will lift the level of its rationality.

Using certain criteria, one can point to different kinds of supporting and its features. The most important criteria for classification of supporting within the enterprise include:

- area of business activity
- influence strength,
- influence on the enterprise's economic results,
- interaction time,
- origins,
- performed functions,
- results of supporting
- realization tools,
- purpose of supporting according to the groups of interests (see Tab. 1)

The range of supporting tools is varied and determined by the enterprise's strategic aim which is defined as a maximization of the owners' profits seen as a total of paid dividends and the increase in the price of shares in the future. As it is underlined by J. Penc[1], the ideas, methods, motivation, specific knowledge and imagination is necessary for the management, but the information is undoubtedly the most important thing since it enables to identify changes happening in the environment and to adjust, as soon as possible, the potential and future opportunities. The experience of enterprises which operate in the market economy conditions shows that information systems can be a tool for supporting; they are assigned to three basic decision areas, common for all organizations; they include:

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[1] J. Penc, *Zarządzanie dla przyszłości. Twórcze kierowanie firmą*, Wydawnictwo Profesjonalnej Szkoły Biznesu, Kraków 1999, s. 106.

- investments,
- operation activity,
- sources of financing.

Table 1. Features and properties of enterprise's activity supporting

Criterion	Features and properties					
Supported area	Production and sale	Property and capital	Finance	marketing	Organizaton and management	Human resources
Influence strength	Significant/ strong	Significant	Substantial	Moderate/ insignificant	No influence	
Influence on economic and financial results of enterprise	Positive	Negative	Neutral			
	Ethics					
Interaction time	Short-term	Long-term				
		Operative	Strategic			
Function	Informative	Motivational	Controlling			
Measurement of the supporting results	Quantitative	According to the value	Qualitative			
		Absolute	Relative			
Realization tools	Assets	Liabilities				
Sources	Internal	External				
Supporting goal	Setting up and running the enterprise	Efficiency and effectiveness of enterprise's activities	Development and growth			

Source: self study

Fig 1 shows firm, mutual connection between all listed decision areas.

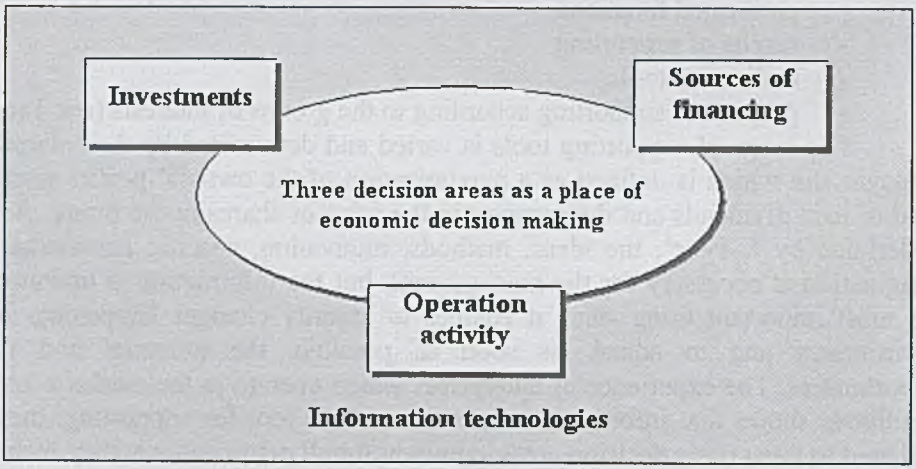

Fig. 1. Connections for decision areas
Source: Self-study on the basis of Erich A. Helfert, *Techniki analizy finansowej*, PWE, Warszawa 2004, p. 24.

Above mentioned decision areas, according to E. Helfert concern, in turn:

- the choice, realization and supervision for investments by use of proper strategies, economic analysis and effective management,
- performing a profitable operation activity thanks to right economic choices and effective use of possessed resources,
- guarantee, for the enterprise, a profitable form of financing through the reasonable assessment of expected profits as referring to the risk connected with different proportions of internal and external sources of capital.

The information used for the decision making in joint-stock companies are subject to multiple classification.

Table 2. Types of information for economic and financial analyses of joint-stock companies and their aims

Criterion	Type	Properties	Aims
Source of obtaining	Internal	Generated within own organization	Assessment of potential, conditions and rules for company's activity
	External	From company's environment	To inform about environment conditions of the activity as compared to the branch, competition, economic conditions; they point to the range of adjusting corrections
Way for obtaining	Primary	Obtained for the first time, not processed	Gathered for certain decision issues e.g. assessment of investing attractiveness (trend analysis, profit prognosis)
	Secondary	Obtained and processed by others	Enable to conduct analysis from the market perspective e.g. record history, market trends
Character of the decision	Operative	Connected with the recurrent short-term problems	Assessment of the effectiveness for the management
	Strategic	Connected with the decisions with the perspective longer than the operative one	Assessment of the investment attractiveness

Source: Self-study on the basis of: Z. Leszczyński, A. Skowronek-Mielczarek, *Analiza ekonomiczno-finansowa spółki*, PWE, Warszawa 2004, s. 33.

From analytical point of view following types of information seem to be the especially useful (see Fig. 2):

I. Basic financial accountancy:
   - balance and loss and profit account (F-02) – forms prepared once a year,
   - cash account and the breakdown for the changes in company capital,
   - quarterly report on income, costs and financial outcome (F-01),
   - additional information for the reports.

II. Remaining accountancy, prepared mainly for GUS.

III. Remaining primary sources concern individual areas of company's activity such as: lists of capital assets, depreciation, and breakdowns for reserves, sales, costs, organization, employment etc. The attention should be paid especially on the economic intelligence which is defined as the set of tasks connected with finding, processing and spreading (in order to further use) the information necessary for business units. J.F. Daigne underlines three fundamental functions of the economic intelligence within the enterprise, such as:
   - improving the scientific and technological output,
   - spotting the chances and threats in external environment,
   - decision on the influence strategy for the of civil services and competition enterprises[2]

IV. External information concerns company's environment and come from such sources as GUS and WUS investigations, publications in the professional press, results of conducted market analysis, legal regulations concerning taxes, payments, insurance, other companies' annual reports.

It is impossible in the market economy to make decision that concern: the enterprises aims, controlling it, flexible adjustment to changing external and internal conditions and managing the processes of realization for these aims, without the decision information. This part of the analysis consists in content-related and informative supporting the processes of financial decision preparations and it burdens it with the responsibility for actual quality of the decisions. The people who make the decisions within the companies have, at their disposal, some information that usually is not sufficient to make sure that decision being made is right. At the same time, there are some situations where there is much more information which could be used by the company.

New information technologies are the source of supporting effectiveness and the pace for joint-stock companies activities and they supply it with new methods of working. J. Brilman points at a few changes that have recently appeared. They include:

New forms of the organization and new methods of working,

- opportunities of commercial application for the nets of the Internet and the Intranet

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[2] T. Majcherek, *Cele i zadania oraz metody pracy komórek wywiadu gospodarczego*, Referat wygłoszony na Konferencji pt. „Wywiad gospodarczy. Teoria i praktyka, Warszawa 30.IX 1999.

- new opportunities for automation,
- opportunities of externalisation through the use of new information and communication technologies[3]

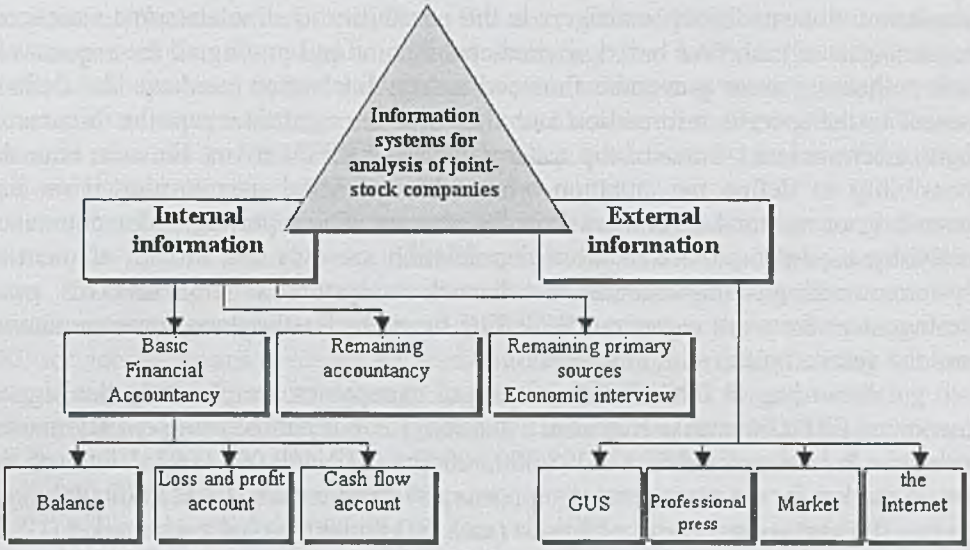

Fig. 2. Types of information for economic and financial analysis of joint-stock companies
Source: self-study.

Systems offered by the producers of the software can be divided into two following groups: smaller systems, mainly for reporting and accountancy purposes and the bigger ones, integrated, containing elements of decision supporting for management; these systems work mainly with the newest client-server technologies[4].

Smaller information and accountancy systems are designed mainly to inputting (printing) and recording the documents that contain the description of enterprise's business activity. Using input data, through the number of breakdowns and reports made accessible (with different criteria for information search), they enable the analysis of information on the economic activity results for the company and its financial status. Good systems of this class contain in-build generators of the reports which enable to define your own forms for breakdowns and analyses as well as printings for balances, tax returns, GUS reports. They also enable automation of some part of the work of financial and accounting departments e.g. automated accounting, generating of the documents such as: transfers, reminders, balance statements, interests notes. Such systems are usually characterized with clear philosophy, similar to accounting habits, and use of maintenance which does not require to be advanced user.

[3] J. Brilman, *Nowoczesne koncepcje i metody zarządzania*, PWE, Warszawa 2002, s. 155-156.
[4] A. Żmujdzin-Rozalska, *Systemy informatyczne*, Teleinfo nr 26/1998.

Bigger, integrated systems of supporting management are usually managed early, at the level of decision making, e.g. issuing/acceptance of the order, decision on issuing the transfer or advance payment. They enable the control of the full cycle for the document: management for purchase, sale, payments etc. Very important element for the managers is the possibility to simulate some situations, e.g. analysis of cash flow based on predicted income and putting all the expenses in order; these systems guarantee financial safety. Each user can have the defined access to the specific information and also have the right to accept the documents up to a certain level. Some of the systems such as e.g. PowerAms Finance, have the possibility to define the situation where the appointed user is alerted on e.g. overdraft, or minimal level of cash in the account. The reporting and accountancy activities as well as these of work depreciation are only the another element of system workings. Implementation of such a system usually involves prior arrangement for work organization, setting the rules for the documents circulation and the detailed plan of implementation.

According to IDC, Polish joint-stock companies are presently the biggest market of ERP (Enterprise Resource Plauniung) in our part of Europe; ERP market value in Poland amounted USD98,000,000 (ca. PLN400,000,000). Value of the world market for the management supporting systems equals USD23,500,000.

Poland is even ahead of Russia (ca. USD 80,000,000). Czech market (USD, 71,000,000) is third (in terms of size). Polish market has been dominated by two companies i.e. SAP (28%) and Oracle (23%). There are only two Polish companies in the lead – BPSC (3,6%) and Teta (3,5%).

Over the past three years the share of individual modules in sale of ERP systems has changed significantly. In 2000 they were usually of financial and accounting (45%) and sale and storage management (27%) type. Presently, the share increases for CRM, Business Intelligence and SCM (33%) modules and also for modules of human resources management (17%). According to IDC investigations, more than 58% of Polish companies with the income over PLN50,000,000 uses ERP systems.

In 2003, SAP company introduced the platform SAP NetWeaver into their offer; the platform enabled the data integration for different systems. It could be sold independently of mySAP systems and offered also for the customers who use competitive solutions of ERP. SAP NetWeaver includes application platform (Web Application Server), portal, data "wholesale warehouse" and the systems called Knowledge Management and Business Process Management.

The easiest way to gather the data is to download them from the Internet. It uses usually WWW or FTP servers. Very popular suppliers of the data from international markets are eSignal.com or Island.com. In Poland, quotations are distributed free by "Gazeta Giełdy PARKIET" at their website and Dom Maklerski BOŚ. Besides, almost all brokerage houses offer their customers, within account access services through the Internet, the quotations (in real time or insignificantly delayed). The quotations are also made accessible to their customers within the software for stock exchange investors, e.g. ABAKUS supplies data to their software for technical analysis GIEŁDA, and SKYNET to its program called

Portfel Inwestora ("investor portfolio") . The drawback of Internet solutions is necessity of continuous downloading of information on newest events. It can block the accessed net causing slowdown in its workings. Besides these facts, this solutions forces reliable and secure access to the quotations sources, which can be the point of "leakiness" of the system. Because of these problems, some methods have appeared for data supply without accessing the Internet (fact that these systems had appeared before the Internet became widespread to such a degree that it became an acceptable alternative, had considerable meaning to that). Classic example of it can be REUTERS which supplies quotations by means of encoded data which are spread by television channel.

The data are sent similarly to the teletext, but they do not have any format that can be read in a direct way. Therefore it is impossible to display any of the pages. To read them, one must have special decoder, together with the contract of data reception subscription (in Poland, REUTERS supplies the quotations, called RSP service, by means of CYFRA+ platform). Formally, it is not necessary to have even access to the Internet, although in practice, it is useful for e.g. updating the software or as a spare data source. In Poland, TSG system (for which the agents are the channels of public television) offers similar to REUTERS access; it concerns quotations from Stock Exchange in Warsaw.

Next basic means of supply of data required by the Law on Public Trading in Securities (Prawo o publicznym obrocie papierami wartościowymi), relating to the companies admitted to the public trading in securities, is Emitent; it makes use of electronic techniques. The basic participants here are issuers (companies in the stock exchange), Securities and Exchange Commission, Stock Exchange in Warsaw, Central Table of Offers and Polish Press Agency. Emitent system works in the environment of electronic mail, where participant join on the basis of workstations or mail centre. Integrated, with the mail, electronic forms enable to attribute standard structure to the sent reports, and automation of its further processing and distribution.

At the stage of arranging the gathered data, and making them useful, Excel or Access software is used. There are also more complicated tools, more time-consuming, but invaluable for creation of analysis with complicated algorithms, an example could be here the application of T-SQL or Visual Basic for STATISTICA.

For the process of technical analysis, MetaStock software by American company EQUIS is used. Besides this software (which is sold as a standard or professional version), there are a few thousands of software items designed for technical analysis. TradeStation and AdvancedGET should deserve peculiar attention here. The most powerful tool which has ever been created in our country is AAT software by ASHER.

Analysis of balance values for stock exchange companies and financial indexes counted on their basis are performed by Statistica software and spreadsheets of Notoria service.

RiskManager and CDO Manager are the software items developed to analyse the investment risk. Despite very good reputation of the foreign software, the biggest popularity in the area of the software for portfolio analysis in the stock

exchange investments has been won by the Kapitał software by Motte. Similarly to the world trends, Motte found in Kapital its own solutions. In the field of investment analysis, there is also Kondor software manufactured by Reuters.

In the process of finding, gathering, processing and flow of information, it is essential that the cost of their obtaining should be adequate to their significance and importance in order to secure effective joint-stock companies management[5].

Very important issue in the process of informative supporting of company's activity is to become involved in new technologies neither too early nor too late; therefore it is necessary to be up-to-date with the technologies and competition as well as to make use of benchmarking.

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II. COMPUTER SYSTEM TO DETERMINE FATIGUE STRENGTH OF MATERIALS UNDER COMPLEX LOADING

Krystian KALINOWSKI Ewa KALINOWSKA

Introduction

Modern industry and modern technologies need durable and reliable materials which guarantee safety of working machines and people, and at the same time protect natural environment. Therefore great emphasis is on testing the strength of materials. It is of particular significance in such fields as aviation, building engineering, extractive industry, sea and road transport.

Service loads of machines cause random complex stresses in their materials. That is why, the criteria of multiaxial random fatigue are of great importance in the algorithm of assessment of durability of materials. First studies in this domain were initiated by E. Macha [9, 10, 11].

Testing strength of materials is carried on stands testing fatigue, which use specially designed machines applying different loads to samples of materials. These stands are equipped with control systems which are to:

- generate assumed run of loads,
- transfer generated run on material system,
- measure and register loads and strains of the tested sample.

Computer control systems of these machines [5] have been prepared and programmed to fulfill control tasks, and to enable registration of loads of momentary measurements of stresses and strains, which constitute the data base and the basis for further tests.

The elaborated system, which determines fatigue stress of materials, is assigned to carry out tests which determine strength of materials on the basis of registered data in the bases of the afore-mentioned control systems.

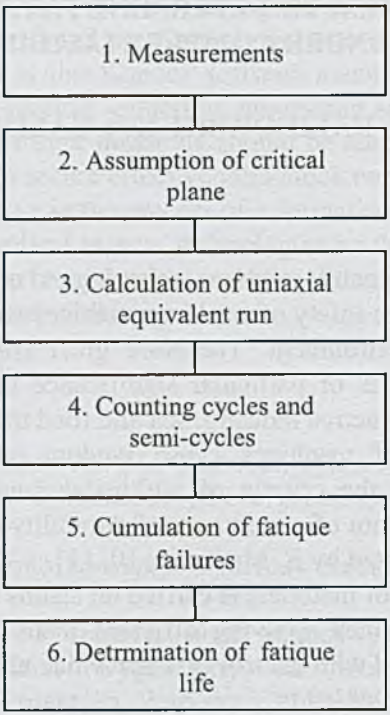

Fig. 1. General algorithm of determining fatigue life in complex state of loading.

Algorithm of assessment of material fatigue life in complex state of loading

Designating fatigue life of multiaxial loads is made through reduction of multiaxial stresses to equivalent state of uniaxial state by means of adequate criteria of fatigue effort. Equivalent runs obtained that way are analysed as in the case of uniaxial random fatigue [8]. Consecutive steps of procedure assessing fatigue life are presented on the block diagram of general algorithm (drawing 1) [8].

Block 1

Input data for calculations are: component runs of strains εij and stresses σij. These data can come from [8]:

- data base of control system,
- measurement of these magnitudes of real structural components in service conditions,
- obtained by calculations of designed or working structure by means of finite elements (MES), edge elements (MEB) or finite differences (MRS),
- computer generation of random sequences of formed probability characteristics corresponding with service or forecast conditions. This results in generation of random runs of normal distribution and requested distribution of spectral power density.

Block 2

Determining fatigue life it is important to determine correctly the expected position, i.e. critical plane [8] (fatigue scrap). Its position is determined by the state of strain and stress existing in the material. Its position is determined by giving values of direction cosines $I_n, m_n, n_n \ (n = \eta, s)$ of unit vectors η and s occurring in fatigue criteria, of which η is vertical and s is tangent to critical plane. Different criteria of determining expected position of the plane of fatigue scrap [8] can be applied:

- method of weight functions,
- method of defect cumulation,
- method of variance maximum.

The best results are achieved by the method of variance maximum [8]. In this method it is assumed that the planes, in which variance of equivalent stress reaches maximum, are critical for the material. The search for maximum variance [8] μ_{yeq} of the analysed state means a search for maximum of the expression:

$$\mu_{yeq} = \sum_{i=1}^{6}\sum_{j=1}^{6} a_i a_j \mu_{yij}$$

where: $a_i, a_j = f(I_n, m_n, n_n, c_k)$ are known non-linear functions of direction cosines, principal axis of stress or strain,

c_k - material constants.

Block 3

Calculation of uniaxial equivalent run is by means of proper criterion. There is a great number of different criteria, e.g. [8]:

- criterion of maximum total characteristic energy of normal and tangent strains

$$W_{eq}(t) = \frac{1}{2}\sigma_{ij}(t)\varepsilon_{ij}(t)\,\mathrm{sgn}[\sigma_{ij}(t), \varepsilon_{ij}(t)] \qquad (i, j = x, y, z)$$

- criterion of maximum characteristic energy of non-dilatational strains

$$W_{eq}(t) = \frac{1}{1+\nu}\sigma_{ij}(t)\varepsilon_{ij}(t)\,\mathrm{sgn}[\sigma_{ij}(t), \varepsilon_{ij}(t)] \quad (i \neq j, \quad i, j = x, y, z)$$

- criterion of maximum characteristic energy of normal strain in critical plane

$$W_{eq}(t) = \frac{1}{2}\sigma_{\eta}(t)\varepsilon_{\eta}(t)\,\mathrm{sgn}[\sigma_{\eta}(t), \varepsilon_{\eta}(t)]$$

Having assigned equivalent run, e.g. equivalent characteristic energy of strains $W_{eq}(t)$, counting of cycles and semi-cycles follows.

Block 4

There are many methods of counting cycles and semi-cycles:

- method of full cycles [8] neglects semi-cycles which results in overestimated fatigue life,
- pairs of ranges,
- hysteresis loop,
- rainflow [3].

Number of cycles and semi-cycles and their mean values can be determined by means of the last three methods. In the elaborated computer system the last method has been applied - rainflow.

Block 5

Having calculated cycles and semi-cycles, the cumulation of defects is determined. There are many hypotheses of defect cumulation [8]. The most often applied are the hypotheses of Palmgren-Miner [12] and Haibach [4]. Both hypotheses, in stress aspect, can be presented as follows [8]:

$$S(T_0) = \begin{cases} \sum_{i=1}^{j} \dfrac{n_i}{N_0(\sigma_{af}/\sigma_{ai})^m} & dla \quad \sigma_{ai} \geq \sigma_{af} \\ h\sum_{i=j+1}^{k} \dfrac{n}{N_0(\sigma_{af}/\sigma_{ai})^{(2m-1)}} & dla \quad \sigma_{ai} < \sigma_{af} \end{cases}$$

where:

$S(T_0)$ - degree of material damage in time T_0 according to Palmgren-Miner hypothesis ($h = 0$) or Haibach hypothesis ($a = h = 1$),

k - number of class intervals of amplitude histogram (j<k),

a - coefficient which allows us to take into consideration damages to amplitudes below σ_{af} in the cumulation process,

m - coefficient of Wöhler's curve inclination,

N_0 - number of cycles corresponding with the fatigue limit σ_{af},

σ_{af} - fatigue limit,

n_i - number of cycles of amplitude σ_{af}, where two identical cycles form one cycle.
In case of application of power engineering criteria for equivalent run, the formula of cumulation of fatigue failures has the form of [8]:

$$S(T_0) = \begin{cases} \sum_{i=1}^{j} \frac{n_i}{N_0 (W_{af} / W_{ai})^{m^*}} & dla \quad W_{ai} \geq aW_{af} \\ 0 \quad dla \quad W_{ai} < 0 \end{cases}$$

where:
W_{af} - fatigue limit is expressed in characteristic energy of strains,
a - coefficient which allows us to take into consideration amplitude damage below W_{af}, $(a = 0{,}25)$ in the cumulation process,
m^* - coefficient of fatigue curve inclination expressed in characteristic energy of strains,
N_0 - number of cycles corresponding with the fatigue limit W_{af},
n_i - number of cycles of amplitude W_{af}, where two identical semi-cycles create one cycle.

Block 6
Having determined the degree of damage in time T_O, fatigue life is calculated according to the formula:

$$T_{cal} = \frac{T_0}{S(T_0)}$$

Computer program of the system which determines fatigue strength of materials in complex state of loading

Assumptions

The following assumptions have been made to fulfill the system:
- collection of measurement data should be possible as a source of external data in the form of text file,
- the system should have criterial function editor, which shall have own function base with a possibility to insert new functions as well as the possibility to edit them,
- function registration should enable taking into consideration material, measurement and parametric data,

- possibility of selection of the run of material fatigue testing by choosing a search for minimum value of function, for 1, 2 or 3 variables or single testing at fixed decision variables (in the form of direction cosine angles),
- record of settings of the performed testing, as well as the later possibility to take the readings,
- graphical presentation of the results of uniaxial equivalent run,
- presentation of the results of amplitude damage cumulation and cycles of critical plane.

Algorithm of the program

To determine the position of the critical plane, it is necessary to determine nine variables $(l_1, l_2, l_3, m_1, m_2, m_3, n_1, n_2, n_3)$. There are six equality relations between these variables. The task to search the minimum meant defining optimal values of nine variables fulfilling six equality limitations. This problem was simplified by its reduction to a search for a function minimum of no more than three variables (a, b, c). Then the direction cosines have the following forms:

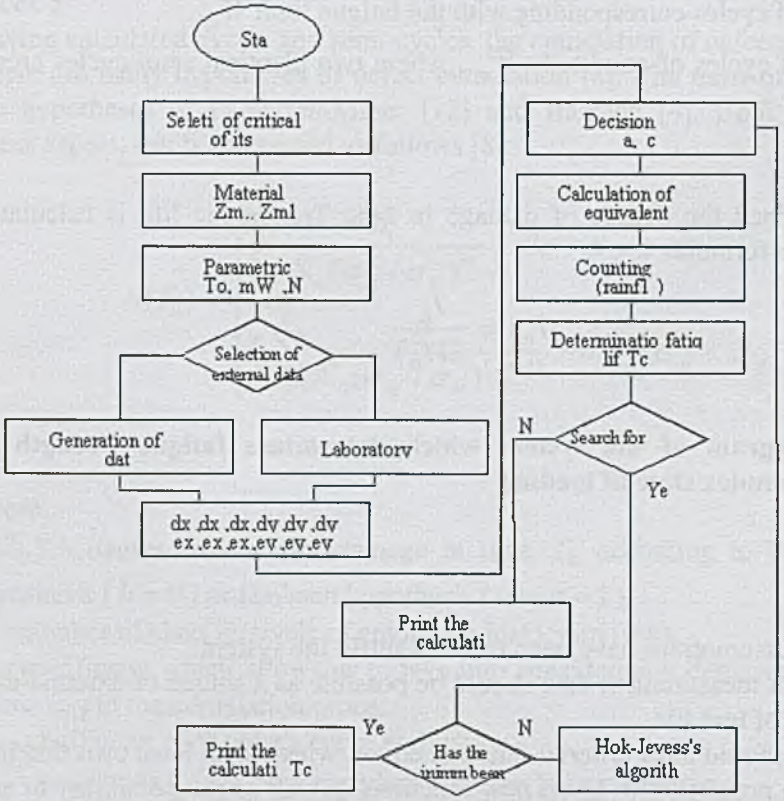

Fig. 2 presents a block diagram of algorithm used to determine material fatigue.

$$l_1 = \cos(c)\cos(b)$$
$$l_2 = \cos(c)\sin(b)\sin(a) - \sin(c)\cos(a)$$
$$l_3 = \cos 9c)\sin(b)\cos(a) + \sin(c)\sin(a)$$
$$m_1 = \sin(c)\cos(b)$$
$$m_2 = \cos(c)\cos(a) + \sin(c)\sin(b)\sin(a)$$
$$m_3 = \sin(c)\sin(b)\cos(a)\cos(c)\sin(a)$$
$$n_1 = -\sin(b)$$
$$n_2 = \cos(b)\sin(a)$$
$$n_3 = \cos(b)\cos(a)$$

The most important applied algorithms are:
- editor of criterial function,
- algorithm of rainflow,
- Hook-Jevess's algorithm.

Short description of the mentioned algorithms has been enclosed.

Editor of criterial function

Translator of algebraic expressions using reverse Polish notation and stack [6] has been applied to fulfill the editor of function.

Take syntactic unit (alphabetic character or a sequence of such characters, digit or number, algebraic action character) from an input sequence.

If it is an opening bracket, rewrite it into a stack.

If it is an operand rewrite it into an output sequence.

If it is an operator of algebraic action, then compare its priorities with operator's priority on top of the stack and take off, in turn, from the top of the stack into output sequence all these operators, which have higher or equal priority. If the operator's priority on top of the stack is smaller or the stack is empty, then enter the taken operator on top of the stack. If it is a closing bracket, then it is necessary to rewrite from the stack into output sequence everything to the opening bracket and simultaneously remove the opening bracket from the stack (without rewriting it into the output sequence).

If the input sequence is empty, then rewrite the contents of the stack into the output sequence. Algorithm determining the value of so transformed algebraic expressions is as follows: Syntactic unit of the output sequence is read and if it is an operand, then we place its value on top of the stack. If it is an operator, corresponding action is performed on one or two values on top of the stack and the result is entered in place of the operand, which was lower on the stack.

Rainflow Algorithm

Rainflow algorithm is to count cycles and semi-cycles which occurred during testing. The program uses rainflow algorithm worked out in Department of Structures and Material Strength of the Opole Technical University.

Hooke-Javess's Algorithm

To find function minimum, the Hook-Jevess's algorithm has been used. It is a non-gradient algorithm. This algorithm has been described in detail in the paper [1].The application of gradient algorithms in this problem is hindered because it is necessary to determine gradients, whose values can have significant mistakes due to the use of experimental data. As follows from the carried out tests, the durability function for the assumed variables in the form of direction cosines angles has got local extremes. It requires multiple calculations at different starting points.

Program of the system

Main menu consists of five categories [6]: function base, calculations, presentation, calculator and data about the authors of the program.
Function base

In function base the functions used during calculations are declared. Addition, modifying, deleting algebraic expressions of functions are possible. Each added new function is entered into the existing base. If addition or edition takes place on the existing function then an error occurs which will determine the display of adequate message. Writing to the function base occurs when the window is being closed. If the length of the function expression exceeds the visibility region, it is possible to display the whole pointing at the given region by the mouse. Function editor admits the following entries for the algebraic expression:

Operators: + (addition), - (subtraction), * (multiplication), / (division), ^ (power), % (modulo), (),[] (brackets),
Functions:

sin - (sine),
cos - (cosine),
tg, tan - (tangent),
ctg, ctan - (cotangent),
sqr - (square power),
sqrt - (square root),
pow - (power),
exp - (exponent),
pi - (3.14159265358979324),
ln - (common logarithm),

sign - (-1 for arguments<0, 0 for argument = 0, 1 for argument>0)

Material variables:

Zm1...Zm18

(up to 18 material constants can be inserted into criterial function expression),

External variables:

dxx, dxy, dxz, dyy,dyz, dzz,
exx, exy, exz, eyy, eyz, ezz

(Thus, 12 time sequences can be read from external files),

Angle variables of direction cosines (decision variables):

a - (angle a), b - (angle b), c-(angle c).

Calculations

When calculation option is selected, then all introduced functions are displayed. Having selected one of them, you can start to introduce material data (Zm1...Zm18), whose number cannot exceed 18. If there is any material data in the criterial function, its field is unlocked, otherwise the field is blank; thus no data can be entered into these fields. Only floating point numbers with one minus (pointing at negative value) can be entered into the material data field. If no value is entered into the unlocked field, the corresponding variable will have the value equal zero.

Having added values of material data, information referring to measurement data is given. If calculation is done on the basis of data achieved from tests performed on object in field or from laboratory, then the data can be taken from text file. This file should have *.txt extension. These data should have the following order: dxx, dxy, dxz, dyy, dyz, dzz, exx, exy, exz, eyz,ezz. The data should be separated by space character, comma or semicolon. Any other sign shall cause generation of error message. If some data does not occur in the pile, there is a possibility to mark this fact by deletion of data selection markers.

The system also enables calculations on testing data. To do it simply state the number of data and their type. These data shall be drawn from the range (0, 1). Having introduced the measurement data, it is necessary to introduce parametric data included in the formula for calculation of material fatigue life. These are: T_0 - duration of observation, a - defect coefficient, m - inclination coefficient, W_{af} - fatigue limit, N_0 - number of cycles corresponding with the fatigue limit W_{af}. Having determined the parametric data, the program to do calculations can be started. Calculation time depends on both the number of measurement data and the option: if calculations are done for accepted values of angles (a,b,c) or if a search for minimum fatigue life takes place. The program enables derivation of results in the form of a diagram for:

- uniaxial run (Fig. 3),
- durability of the function run of decision variable (angle of direction cosine) (Fig.4).

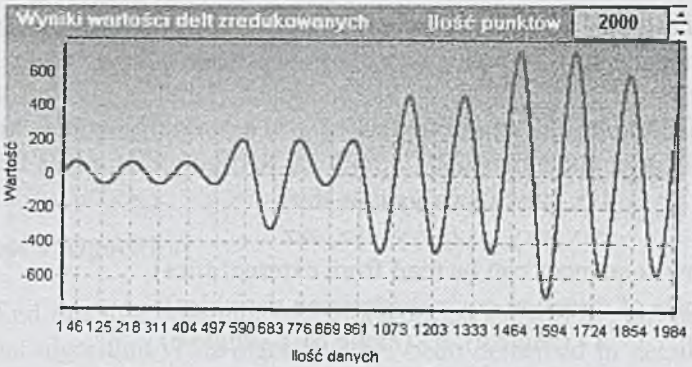

Fig.3. Diagram of uniaxial exemplary equivalent run.

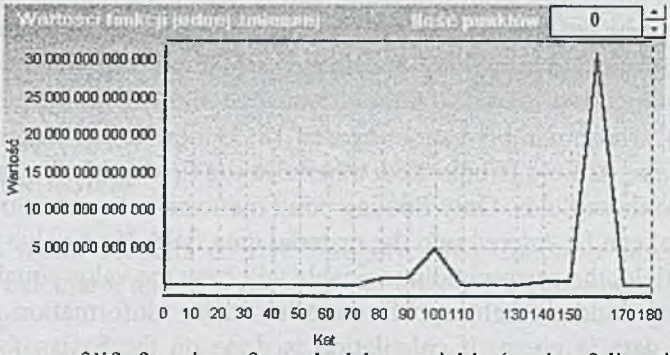

Fig. 4. Diagram of life function of one decision variable (angle of direction cosine)

It provides the result of life calculations at assumed angles of direction cosines, as well as the minimum value of fatigue life. To accelerate calculations it is possible to disable drawing diagrams and intermediate results.

Conclusion

Elaborated computer system, thanks to the worked out function editor based on ONP algorithm, becomes a universal testing tool used to determine material strength. It enables the use of criterial function base, and also enables creation of new ones according to the researcher's ideas.

The program cooperates with external data (data obtained from laboratory tests or carried out on the object in the field) and enables their configuration.

Determination of fatigue strength can be done in the following way:

- when searching for minimum of the function of single variable (at uniaxial strains),
- two variables (at biaxial strains),
- three variables (at triaxial strains).

The program is not a closed application; it enables addition of the next functions or algorithms searching minimum functions to the existing code.

However, calculation time can be very long and depends on the speed of the computer. The program will come up to one's expectations when installed on fast computer.

The elaborated computer system can be applied in research institutes dealing with testing fatigue strength of materials.

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III. COMPUTER-BASED SIMULATORS OF LOGISTIC SYSTEMS

Robert BUCKI, Franciszek MARECKI

Introduction

Modern production, transport and storing systems are subjected to logistic research [1,9,10,11,12,13]. They are automated and their control is computerized [8]. From a theoretical point of view there are complexes of logically, timely and spatially conditioned operations realized in them. Mathematical models, simulators and effective control algorithms need to be created to analyze such systems.

Mathematical models of logistic systems are presented in the form of logic-time equations of state. The number of states the system can find itself in is enormous. The system trajectory of states depends on control decisions. The control problem of a logistic system consists in determining such a sequence of decisions (strategies) for which the trajectory of states is optimal. Trajectories are assessed by different criteria [7].

Heuristic algorithms are used to control the logistic system to solve such a computationally complex problem. Algorithms provide rational solutions without guarantying its optimality. They are determined thanks to simulation [8]. Simulators allow for their effectiveness analyzing by means of statistical methods estimating simulation research results.

The paper formulates the control problem of a logistic production system introducing the example of the billet mill. Logic-time equations of state are derived for this process. On their basis, simulators may be built in order to carry out experiments examining effectiveness of control heuristic algorithms.

Control of complex production processes is based on mathematical modeling of such processes. Optimum algorithms or heuristic ones are used in these models. In case of heuristic algorithms, their efficiency is to be verified. Simulation experiments are carried out to verify efficiency of algorithms employed in complex production processes. Computer simulators are the research basis [2,4].

Assumptions have been made that the production line consists of parallel units. There are multi-functional tools in the units. They are subjected to wearing and tearing. The units are roll assemblies with passes in them as tools. Control of a production line is a decision-taking problem consisting in choosing certain products as well as replacing worn out assemblies. Product manufacturing must take into account material bounds and order limits. Moreover, the quantity of product series depends on the present state of tools through which the material is passed. Each product possesses its determined route – sequence of tools. A route is characterized by its flow capacity measured by the quantity of manufactured products. It is assumed that the production line is stopped in order to replace tools if each route flow capacity equals zero [3,5].

Production phases and tool replacement phases are distinguished in the process. A stage consists of phases. Many stages are necessary to manufacture all orders. The production process can be controlled optimally within each phase. The problem of replacing tools is a combinatory one [6,5]. Replacing tools influences the amount of production and its time. The production and replacement problem is a very complicated task which can be solved by means of assessment methods [14]. Production optimization within each stage does not guarantee the global optimum because the replacement of tools is carried out in a heuristic way. For this reason, production and replacement time scales can be sought for by means of random methods.

Production heuristic algorithms determine a product n which is consequently manufactured. Replacement heuristic algorithms assign an assembly of rolls i. The objective function remains to minimize the order manufacturing time. The paper presents general simulators of production and replacement control. They are based on recurrent state equations. Decisions about a manufactured product and a replaced tool are either random or based on the choice heuristic of a heuristic. In this way, better time scales may be obtained. Random optimization of time scaling consists in carrying out simulation research. The results of such research for a certain criterion generate a histogram approximated by a normal distribution. The best up-to-date time scale gives criterion index q. In case of a minimization problem, probability $P(t<q)$ can be expressed. It means further simulation experiments may let us obtain a better time scale, with index $t<q$. If the boundary value of this probability is given (e.g. 1%), it is the condition to finish the experiments.

1. Mathematical model

Let us take a rolling mill into consideration. It is assumed it consists of I assemblies and J_i passes in the ith assembly. The structure of the rolling mill can be presented in the matrix form: $E=\left\lfloor e_{i,j}\right\rfloor$, $i=1,...,I, j=1,...,J_i$, where: $J=\max_{1\le i\le I} J_i$.

Matrix E elements are defined in the following way:

$$e_{i,j}=\begin{cases} j, & for \quad 1\le j\le J_i, \\ -j, & for \quad J_i\le j\le J. \end{cases}$$

Consequently, matrix E elements are numbers of the passes. Non-existing passes are marked by negative numbers. A pass parameter is its life which equals the number of tons of material that can be passed through a new pass.

Let us assume the passes life matrix is given: $G=\left\lfloor g_{i,j}\right\rfloor$, $i=1,...,I, j=1,...,J_I$

Elements $g_{i,j}$ for $j\le J_i$ have practical meaning in the above shown matrix. Since for $e_{i,j}=-j$ there are non-existent adequate passes, it can be assumed that for such passes: $g_{i,j}=-j$. Rolling process consists in passing material through the passes of the successive assemblies.

There are routes given for manufacturing certain products written in the matrix form: $D = [d_{i,n}]$, n=1,...,N, i=1,...,I, where: $d_{i,n}$ - the ith assembly pass number, N - the number of products. A route can omit some assemblies in a general case. Should the nth route not include an ith assembly pass, then it is assumed that: d_{ij}= 0. A route consists of number of passes of the following assemblies from i=1 to i=I. Some routes are shorter, which means they do not include passes from certain assemblies. The last pass is the decisive one for the product type. Therefore, the maximal number of products can be the sum of all the passes in all assemblies.

Let us assume there are M types of materials (charges) from which N types of products can be manufactured. To allocate a charge to a product the allocation matrix is given: $A = [a_{m,n}]$, m=1,...,M, n=1,...,N, where:

$$a_{m,n} = \begin{cases} 1, & \textit{if the nth product can be manufactured from the mth charge,} \\ 0, & \textit{otherwise} \end{cases}$$

Let us also introduce the charge vector: $W = [w_m]$, m=1,...,M,

where: w_m – the number of tons of the mth charge type.

Let us introduce the rolling rate vector $V = [v_n]$, n=1,...,N, where: v_n - the number of the nth product tons manufactured in a time unit.

Let us introduce the order vector: $Z = [z_n]$, n=1,...,N,

where: z_n – the number of tons of the nth type product in state k-1.

The order vector changes after each decision about production (x_n^k):

$$z_n^k = \begin{cases} z_n^{k-1} - x_n^k, & \textit{if} \quad n = a \\ z_n^{k-1}, & \textit{if} \quad n \neq a \end{cases}$$

where: x_n^k - the number of tons of product a.

The billet mill state is defined as the matrix: $S = [s_{i,j}]$, i=1,...,I, j=1,...,J_i,

where: $s_{i,j}$ - the number of tons of material passed through the jth pass of the ith assembly, and for $J_i < j \le J$ we can write $s_{i,j} = -j$.

State matrix elements must satisfy the condition: $0 \le s_{i,j} \le g_{i,j}$, $1 \le j \le J_i$.

Initial state S^0 is given. The equation of state of the production line takes a general form: $S^k = f(S^{k-1}, x_n^k, b)$, where: b – the number of an assembly assigned to replacement.

The equation of state in case of production can be presented as follows:

$$s_{i,j}^{k} = \begin{cases} s_{i,j}^{k-1}, & \textit{if material is not passed through the jth pass} \\ & \textit{of the ith assembly of rolls,} \\ s_{i,j}^{k-1} + \min(p_a^{k-1}, z_n^{k-1}), & \textit{otherwise} \end{cases}$$

In case of the *b*th assembly replacement the equation of state takes the form:

$$s_{i,j}^{k} = \begin{cases} s_{i,j}^{k-1}, & \textit{if} \quad i \neq b \\ 0, & \textit{if} \quad i = b \end{cases}$$

Replacement brings about the opportunity for restarting production. To be able to carry out further calculations the pass matrix of the rolling mill is introduced: $P = \left[p_{i,j}\right]$, i=1,...,I, j=1,...,J_b, where: $p_{i,j} = g_{i,j} - s_{i,j}$, i=1,...,I, j=1,...,J_b; $p_{i,j} = -j$, $j = J_i + 1,...,J$.

Having finished the rolling stage the billet mill flow capacity is low. Most often, the route roll flow capacity of each product, where n=1,...,N, equals zero. To start the rolling stage the most worn out rolls are to be replaced by new ones. On the basis of state S^{k-1} the roll pass matrix can be calculated: $P^{k-1} = \left[p_{i,j}^{k-1}\right]$.

Residual pass of assemblies R_i will be calculated as shown: $R_i = \sum_{j=1}^{J_i} p_{i,j}$

According to the heuristic algorithm the *l*th assembly is to be replaced on condition that: $\exists_j \left(p_{l,j}^{k-1} = 0\right) \wedge \left(R_l = \min R_i\right)$.

During a rolling process, rolling time t_n is determined: $t_n = \frac{x_n}{v_n}$

Each assembly replacement time c_r is given as an element of the vector C.

Let us introduce the tolerance matrix: $H = \left[h_{i,j}\right]$, i=1,...,I, j=1,...,J,

where: $h_{i,j}$ - the tolerance of the *j*th pass of the *i*th assembly of rolls. In case of allowing for the tolerance matrix, the equation of state takes the form:

$$s_{i,j}^{k} = \begin{cases} s_{i,j}^{k}, & \textit{if} \quad (i \neq b) \wedge (p_{i,j}^{k-1} \geq h_{i,j}), \\ 0, & \textit{if} \quad (i = b) \wedge (p_{i,j}^{k-1} < h_{i,j}) \end{cases}$$

The assembly regeneration time coefficient ψ is introduced. It means how many units of the assembly flow capacity can be regenerated within the time unit. This can be written: $\psi = \frac{\max P_i}{\tau_i}$, i=1,...,I, where: τ_i - the *i*th assembly regeneration time.

2. Simulators

The above assumptions are taken into account. They are the basis for creating simulators. *Fig. 1.* presents a general simulator of production and replacement of rolls. The production process may be simulated in detail by means of a production simulator shown in *Fig. 2.* The replacement process itself will be checked by a simulation device built according to *Fig. 3.* Regeneration matters are graphically introduced in *Fig. 4.* and *5.* They are the frame of the regeneration simulator.

To built simulators the following data must be input: I, J, M, N, ψ, A, E, H, G, D, S^0, W, Z, V, C as well as the vector of optimization indexes Q and the allowable time of the order realization T.

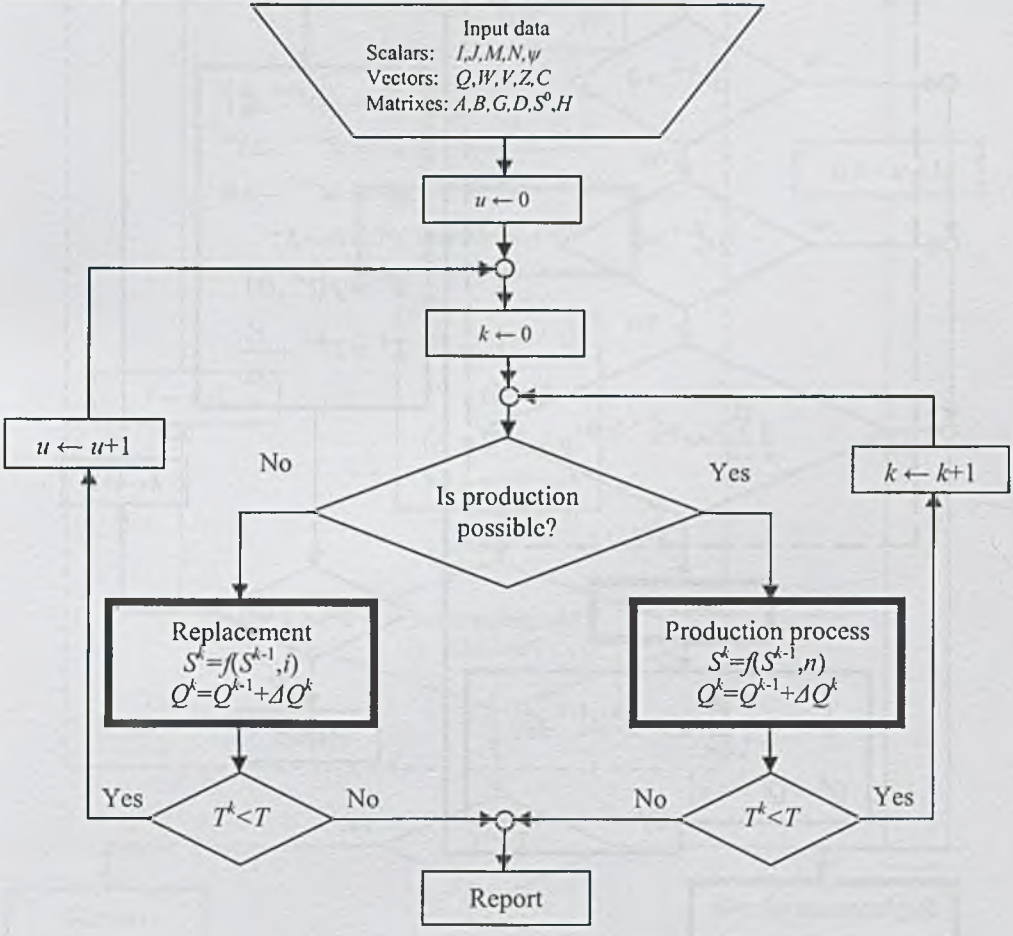

Fig.1. The block diagram of production and replacement.

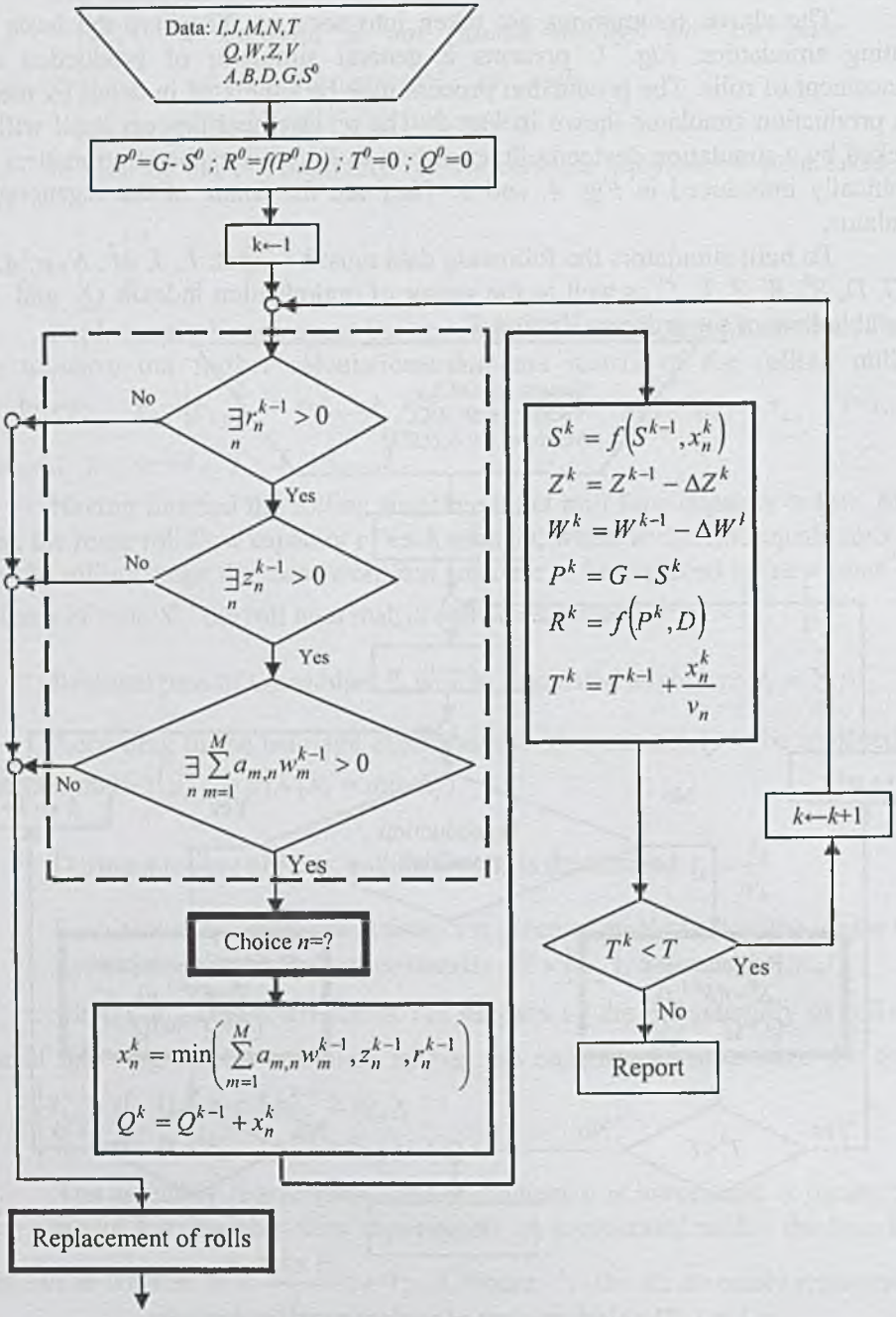

Fig. 2. The block diagram of the production process.

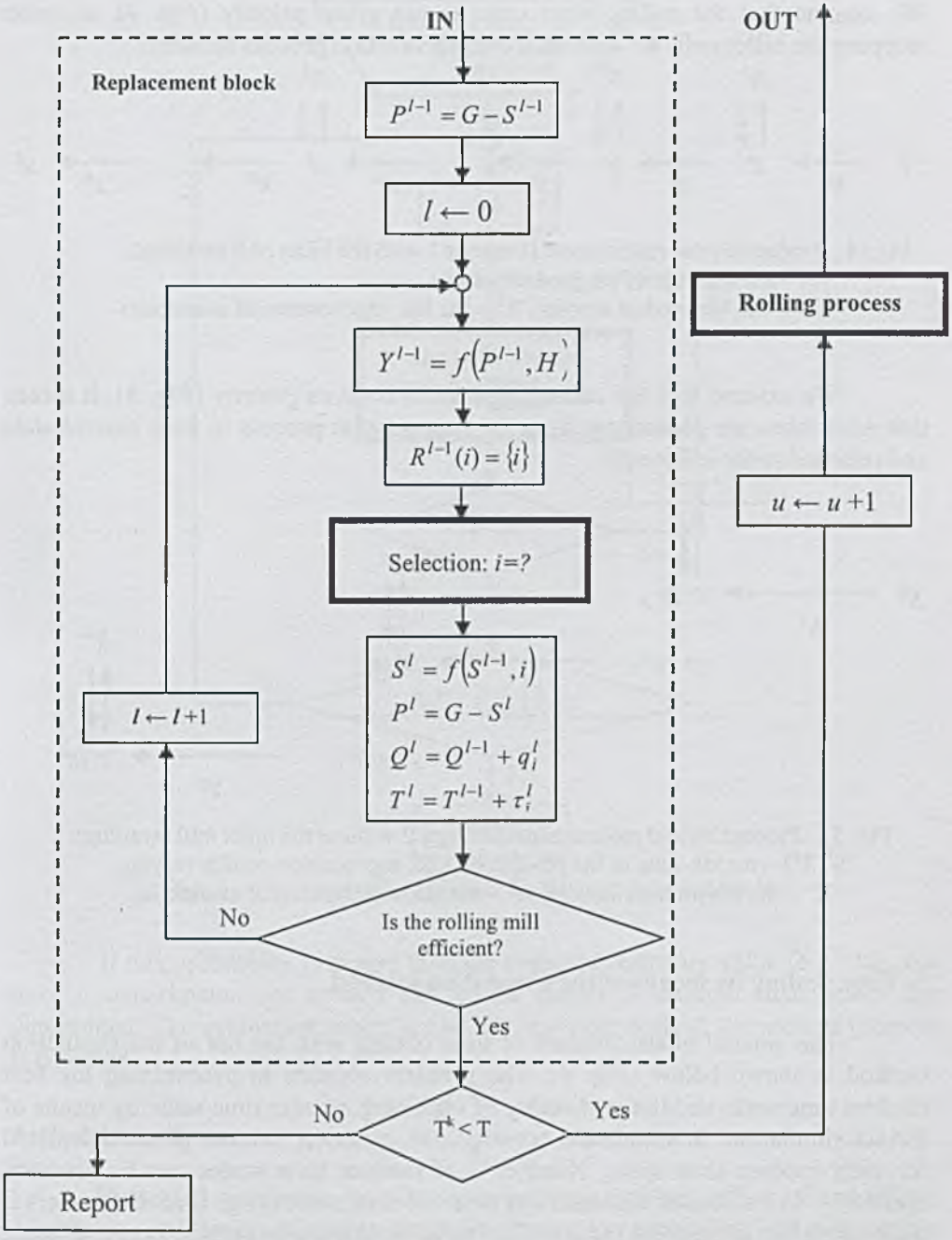

Fig. 3. The block diagram of the replacement process.

We assume that the rolling time scale is not given priority (*Fig. 4*), so, after stopping the billet mill, we wait until the regeneration process finishes.

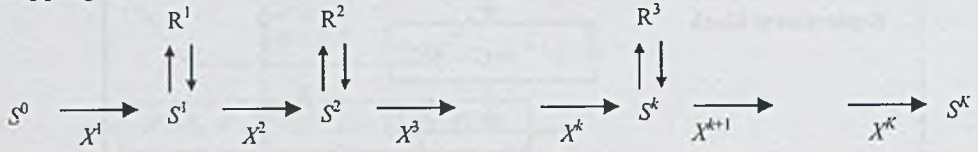

Fig. 4. Production and replacement (Strategy 1 with the billet mill awaiting):
S^k – the kth state of the production line,
X^k - the kth product amount, R^k - the kth regeneration of assemblies.

We assume that the rolling time scale is given priority (*Fig. 5*). It means that assemblies are phased out from the regeneration process in their current state and returned to the billet mill.

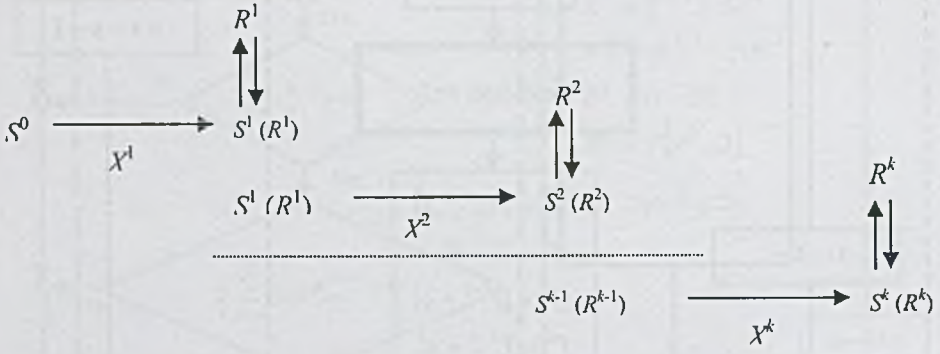

Fig. 5. Production and replacement (Strategy 2 without the billet mill awaiting):
$S^k(R^k)$ – the kth state of the production line, regeneration results-varying,
X^k - the kth product amount, R^k - the kth regeneration of assemblies.

3. Time scaling by means of the simulation method

The general block diagram of time scaling with the use of the simulation method is shown below (*Fig. 6*). The problem consists in determining the best random time scale and the probability of obtaining a better time scale by means of further simulation. In simulation consequence, criterion indexes Q^l are calculated for each random time scale. Number L of random time scales can be assumed optionally. For a chosen optimization index of time scales (e.g. time T of orders Z manufacturing) we can log indexes T^l of random time scales and the best time scale at the present moment which is characterized by T_{min}. After finishing L simulation experiments, a histogram is obtained (for indexes T^l) and the probability of obtaining a better time scale than presently the best available is calculated $P(T < T_{\min})$.

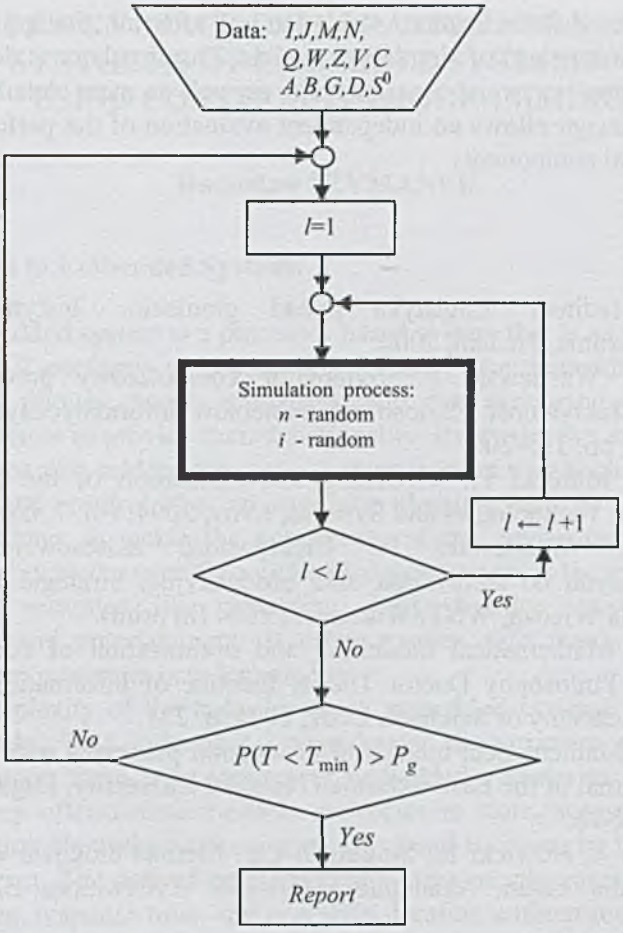

Fig.. 6. Experimental researches for the best tight schedule.

If this probability is bigger than the assumed boundary value (e.g. 1%), the next L experiments are carried out which means L random time scales are determined. The evaluation procedure of the best time scale at the present moment is repeated.

4. Conclusions

Presented simulators take into account the combined effect of variability, uncertainty and design of new methods for production scheduling and new supply chain configurations. Simulation is based on complex interdependencies between processes. Simulation models contribute more effectively to the experimental and computer supported research method. They can be divided typically into phases of model description providing a modeling formalism executable by software systems and experimental frame including several phases, which have to be executed by a

researcher for model verification, validation and after all the application (e.g. for explanation, forecasting) of simulation models. The simulator is designed to allow both a "screening" or worst-case analysis, as well as more detailed assessments. The modular design allows an independent evaluation of the performance of each of the individual components

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IV. DESIGN SPACE EXPLORATION FOR SYSTEM SYNTHESIS OF EMBEDDED SYSTEMS USING CONSTRAINT PROGRAMMING

Radosław SZYMANEK

1. Introduction to Embedded Systems

An embedded system is a processor based system that is an integral part of a larger system. It performs a specific functionality. The embedded systems are ubiquitous. Cell phones, house appliances, and cars are being equipped with embedded processors to provide their functionality. Every day we encounter many embedded systems. We seldom are aware that we interact with such systems. They often analyze and control the environment through sensors and actuators. Therefore, they have to tackle the complexity of the environment and present simple functionality to the user. The embedded system serves the user. It helps us with everyday activities like preparing food, laundry, shaving, distance communication, and entertainment. It often ensures safe manipulation of the environment given minimum user knowledge.

The complexity of the tasks in which embedded systems are helping us grows consistently. This influences tremendously the structure of the system. Nowadays, common trend is to implement embedded systems as multiprocessor systems [1]. They often access multiple memories to store, access, process, and present information about the environment. This trend is driven by the competitive force of the market. The user of an embedded system mostly cares about its cost, functionality, size, response time, and operation duration without recharging power source. These characteristics, especially low energy consumption and ever increasing functionality, can be satisfied by energy efficient architectures of multiple processing and memory units.

We can view an embedded system as a system consisting of multiple resources which used together provide the user with desired functionality. A set of constraints, which should be met by the system, can often be extracted from this functionality. The resources themselves are also sources of constraints. Therefore all important aspects of the design can be represented as constraints. This leads to a natural conclusion that a single framework which handles the functionality and resource constraints can be used to perform design space exploration. Below, we will briefly introduce the resources which are of interest to us. Each resource will be described in terms of the constraints it imposes on the design. This is followed by the description of the constraints which come from the specification of functionality.

An embedded system usually performs computation to process the data gathered from the sensors. This processing can be quite intensive, as in case of cell phones, where many different signal processing algorithms are executed. Therefore often heterogenous mix of processors and hardware units is used to execute these

algorithms. The constraints imposed by processing resources can be classified into three groups. The first group of constraints consists of assignment constraints. The assignment constraints specify how the functionality can be assigned to the processors, making sure that a processor is capable of computing the given task. The second group of constraints specify how much time is required to execute the given functionality on a certain resources. The third group of constraints, called resource constraints, ensure that none of the processors is overused.

The embedded system cannot work properly if the required data is not available to its processors. A multiprocessor architecture requires efficient communication resources such that all data can arrive on time. Similarly to the processing resources case, we also have three types of constraints. The assignment constraints make sure that data travels from the producer to the consumer respecting the communication architecture. The timing constraints reserve appropriate amount of time for each data transfer. The resource constraints make sure that at any time none of communication units have more traffic that they can handle.

Timing constraints are the most common specification constraints. The functionality description often contains latency, throughput, and real-time constraints. Since the processing, communication, and memory elements of an embedded system influence the execution time of an algorithm then the timing constraints will influence the implementation of the algorithm. Tight latency and throughput constraints can increase the cost of the architecture which can fulfill such tight constraints. On the other hand, the timing constraints may influence application execution or the order in which accesses to memory are performed. Each valid design needs to satisfy specification timing constraints, while fulfilling the timing constraints imposed by resources.

2. Constraint Programming

Constraint Programming (CP) is a relatively young and attractive approach for modeling many types of optimization problems. In this article, we will consider Constraint Programming over Finite Domains, CP(FD), which is suited for problems involving heterogeneous constraints and combinatorial search. The foundations for CP come from a number of fields such as, Artificial Intelligence, Programming Languages, Symbolic Computing, Operation Research, and Computational Logic. In CP the programming process consists of requirements (constraints) generation followed by search for a solution, using specialized constraint solvers. The solution supplied by the solver will satisfy all the constraints. Constraint programming has been successfully applied in numerous domains. Recent applications include computer graphics (to express geometric coherence in the case of scene analysis), intelligent agents (to play highly complex games), knowledge and information management, language processing for information retrieval, timetabling problems, molecular biology (DNA sequencing),

business applications (option trading), electrical engineering (to locate faults), circuit design (e.g. compute layouts).

The problems solved by Constraint Programming in these application areas are represented as a Constraint Satisfaction Problem (CSP). CSP consists of :

- a finite set of variables,
- a function which maps each variable to a domain,
- a finite set of constraints.

A variable is often called, in our work, a decision variable, a finite domain variable, or simply a variable. This variable is a decision variable since it describes the decision taken during design space exploration, such as task assignment, task start time, task duration, etc. It is also a finite domain variable since we employ CP(FD) solvers which use finite domain of integers to represent domains of variables.

A function which maps each variable to a domain is called a mapping function. This function specifies for each variable, the integers which can be assigned to this variable. If the mapping function changes then we observe a change of the variable domain. An important characteristics of any CP solver is that domain after change is a subset of the previous domain. In other words, the domain of any variable shrinks during exploration until it consists of only one element. The situation when mapping function maps a variable to an empty domain indicates non-valid (partial) solution.

A constraint is simply a relation among several variables, each taking a value in a given domain. A constraint thus restricts the possible values that variables can take; it represents some partial information about the variables of interest. An example of partial information is a partial ordering among application tasks. There are many different classifications of constraints. An example of constraint classes are primitive, global, linear, and nonlinear to name few of them.

All the constraints which describe CSP are stored in a constraint store. Each constraint restricts the combination of values that the set of variables may take simultaneously. The constraint in the constraint store can be in one of three states: satisfied, unsatisfied, unknown. The constraint is satisfied if its relation holds for any assignment of values to the constraint variables. A value assigned to a constraint variable must belong to its domain. On the other hand, if the relationship described by a constraint does not hold then the constraint is unsatisfied. The unknown state means that the constraint solver does not know yet if the constraint can be satisfied.

Each constraint has a number of consistency techniques. A consistency technique takes domain of any constraint variable and removes such values from the domain which will certainly put the constraint into unsatisfied state. In other words, if a value under consideration can lead to both satisfied or unsatisfied state then it cannot be removed from the domain. In such cases the consistency techniques indicate that constraint is in the unknown state. A constraint solver which allows a constraint to be in the unknown state is said to be incomplete. Any practical FD solver is an incomplete solver. The consistency techniques can

employ algorithms of different complexity and different reasoning strength. A consistency technique has more reasoning strength if for the same input domains it can deduce removal of more values from the initial domains.

3. System Synthesis

A synthesis process is generally understood as the translation from one representation into another more detailed representation. This synthesis process can be divided into three steps, as proposed by Specify-Explore-Refine (SER) paradigm [2]. In, the first step the system is specified. The exploration of different design decisions which are available to the designer and choice of the decisions which give good (optimal) design is performed in the second step. Finally, in the third step, the specification is extended to reflect the design choices previously made. This step, in particular, makes the specification more detailed.

There are an abundant number of decisions which need to be taken during synthesis. The complete exploration of such a huge design space in one step is impossible [3]. Therefore often the synthesis process is split into a number of smaller steps. Each small step specifies, explores, and refines the design. The design space under exploration, for each small step, is significantly reduced, which helps the exploration tools to examine it. As an
example, system level synthesis can be divided into an architecture selection, assignment, and scheduling steps.

Originally a digital system was described using transistor schematics. After a while, when the number of transistors available grew in thousands, then the gate-level schematics were used. This trend of increasing complexity has continued. It forced the designers to increase the abstraction level at which they conceptually describe the system. Currently, we start carrying out synthesis of the embedded system at system level. Specification, exploration, and refinement of the design at this level is mostly done manually. We concentrate on system level synthesis since we want to improve the tool support.

Constraint Programming framework can support designer during specification, exploration, and refinement. Good decisions at this level have the biggest impact on system quality [4, 5], therefore the design space should be carefully explored. Inadequate integration and bad reuse of IP cores at system level results in bandwidth problems and abundant power dissipation [6]. A right synthesis framework must excel in all steps of SER methodology to be of a significant value. A Constraint Programming framework possesses the required qualities to be a good candidate for such synthesis environment.

4. Design Space Exploration

Our work [7] supports the claim that CP gives good basis for design space exploration. We address design space exploration for problems such as architecture selection, task assignment, task scheduling, data assignment, and data access

scheduling. All articles included in [7] present constraint models and heuristics required to obtain a good exploration framework. This framework makes it possible to address resource trade-offs as well as optimization trade-offs.

An embedded system contains different resources. The importance of a particular resource has a tendency to change over time. Some designs are optimized in such a way that the silicon area is minimal. Some embedded systems have to meet tight timing constraints or provide the best performance possible, therefore the most effort goes into this direction. Another time, the focus is on creating a low power design. These different optimization criteria of the same embedded system can be represented in CP framework. Therefore, the design bottlenecks during the synthesis process can be properly addressed.

CP creates a solution in a constructive manner. Each step of the search heuristic constructs the solution by narrowing the domains of the decision variables. Every change in a domain of a decision variable will cause appropriate constraints to evaluate the change. This evaluation will often result in changing the domains of other decision variables. Since the cost function is represented as finite domain variable, the consistency techniques will also indicate what possible values the cost variable can take. This is an evaluation of the possible quality of the final result. If the reasoning techniques can deduce the cost of the solution based on a partial solution only then we often can reduce the search space quite significantly. We will simply stop the search in any part of the search space if our evaluation indicates that the best possible cost cannot match currently best solution.

Many of the research problems addressed in the synthesis of embedded systems are NP-hard. Any algorithm which performs full-search for these problems can run in exponential time. Therefore, different methods to explore only part of the search space are often a viable approach to reduce search time. However, instead of giving the heuristic the responsibility to reduce the search space we can employ special algorithms, easily developed in CP framework, which will reduce the search space before the heuristic even begins its search.

It is a common technique to divide the optimization problem into a sequence of simpler optimization problems. The optimal solution to each of the problems becomes a starting point for optimization in the subsequent problems. Therefore the exploration of the design space is divided into a sequence of the smaller problems of the design space exploration. Constraint Programming facilitates this divide and conquer design space exploration.

Each exploration phase is followed by a refinement stage. This stage reduces the search space based on the results of the exploration. The refinements add details to the original specification. An important advantage of the constraint framework is that all possible refinements can be expressed as constraints. A constraint model can be represented as an onion. At the core there are decision variables with their initial domains. Each layer adds new information.

First, the constraints of the model express the relationship between variables. This initial constraint specification already narrows the domains of the decision variables. However, model constraints do not fully specify the final design. There are still many decisions which need to be taken. Design space

exploration evaluates different alternatives and adds new layers of constraints so more and more is known. At any time, if we realize that the solution we have arrived at does not satisfy our needs, we can peel off some layers. After removing the layers which caused the problems we can continue the exploration.

The diversity of the possible refinements is enormous. First of all we can decide what is the value of a decision variable. Another type of refinement can specify a relation between values of decision variables. The specification is encoded by decision variables and constraints. Refinements can add decision variables and constraints to the model. In addition, the CP framework allows to create tailored constraints. Therefore, we can conclude that we can refine the design in many different ways. Moreover, we obtain more detailed specification which still satisfies the constraints imposed on the initial specification.

5. Multi-objective optimization

The embedded systems can be evaluated according to different criteria. We have concentrated on the performance measures, such as the length of the schedule, energy consumption, and architecture cost. Given multi-objective optimization function it is possible to have many Pareto-optimal designs. A Pareto-optimal design is such design which has at least a better value for one optimization criterion than other design. In other words, a design is Pareto-optimal if there is no other design which is better in all optimization criteria.

The set of Pareto-optimal solutions creates a Pareto diagram. A two dimensional Pareto diagram is presented in Figure 1. There are three solutions, namely A, B, and C. Solution B does not have overall optimal execution time or energy consumption, but still it is a Pareto-optimal solution. Neither solution A or C dominate solution B. Solution A has larger energy consumption and solution C has longer execution time. There are many possible approaches to perform multi-objective optimization. The first one is to merge several criteria into one criterion.

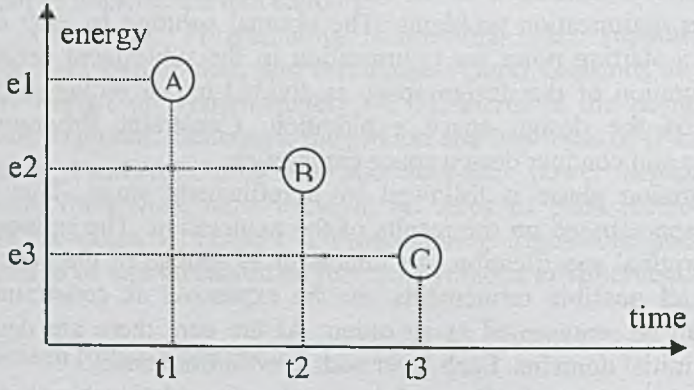

Figure 1 Pareto Diagram Example

This is obtained by using a new criterion which is a weighted function of all previous criteria. The quality of this approach is however very much dependent on the choice of the weights. Assume that solution A takes one time unit and three energy units. Solution B will need two time units and two energy units for its execution. Finally, solution C would need three time units and one energy unit. Therefore, if our new optimization criterion is a sum of time and energy we would obtain three optimal solutions with cost four. However, if time criterion has twice larger weight than energy criterion then we will obtain only one optimal solution, namely A. In general, the weighted function produces an arbitrary Pareto-optimal solution, which is not satisfactory from our point of view.

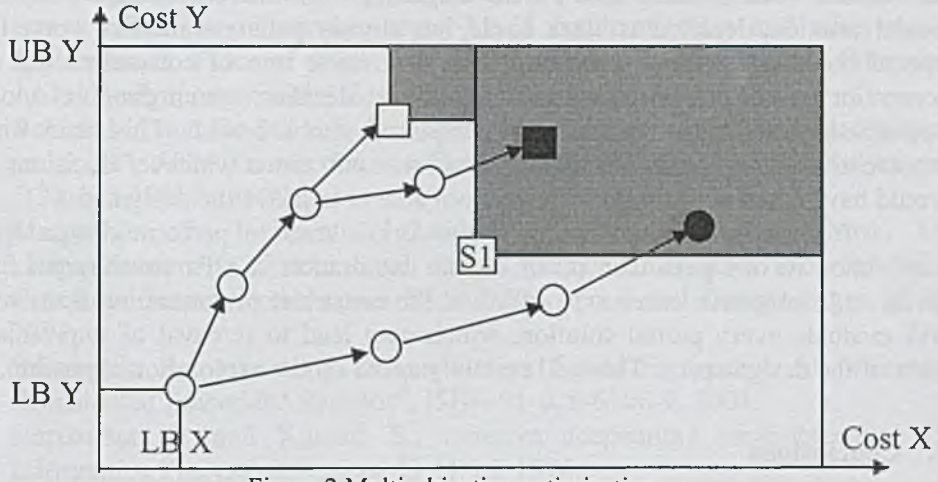

Figure 2 Multi-objective optimization.

The second approach is to execute several times single optimization algorithm. Each execution will use a different criterion. Clearly, executing one criterion optimizations twice would not create a Pareto diagram, as depicted in Figure 1. These two optimizations would not yield solution B. A better approach is proposed in [8]. The multi-objective optimization is solved as a sequence of single criterion optimizations with upper bounds on other criteria. The upper bounds are computed in previous optimization invocations. This approach however require subsequent exploration of the same design space.

A constraint programming framework makes it possible to create a general algorithm for multi-objective design space exploration. The exploration would be performed only once and a complete Pareto diagram will be produced. The general idea of constraint based multi-objective optimization is presented in Figure 2. In this particular case, there are two optimization criteria. The circles depict partial solutions. The design space exploration starts from the initial partial solution depicted by bottom left circle. The cost of this initial solution is equal to the lower bound for cost as computed by constraint framework based on initial specification. The design space is limited by the upperbounds for each of the cost metrics. Each

design decision is represented by an arrow. A final solution is represented by a rectangle. Between initial partial solution and any final solution there are number of other partial solutions. Most probably each of these solutions will have slightly different estimate of minimal achievable cost. Figure 2 presents an exploration walk in design space which had already one solution known. This solution is depicted by rectangle S1. All the solutions which lie within the biggest dashed rectangle will be dominated by solution S1. The first found solution, represented by the white rectangle, is a Pareto-optimal solution. It will increase the field of the forbidden area.

After finding first solution, the exploration process obtains next solution, represented by black rectangle, which is dominated by solution S1. We simply do not include such solution in a Pareto diagram. More interesting case is when a partial solution, depicted as black circle, has already both cost metrics worse than one of the already found solutions. This will cause one of constraints fail and constraint framework will backtrack to the last decision which does not violate optimization constraints and has an unexplored search branch. This black circle represents part of the design space which was cut, since whatever decisions we would have taken at this point, we were not able to improve the design cost.

A constraint programming framework allows to perform design space exploration in one pass. The result of this exploration is a Pareto diagram for a given multi-objective criteria. In addition, the constraint programming framework will evaluate every partial solution, which may lead to removal of unpromising parts of the design space. This will certainly speed up the exploration algorithm.

6. Conclusions

Embedded systems are used on every day life basis. They support us in many sophisticated tasks. During synthesis of such an embedded system a careful exploration of design options is required. There is no single architecture which is good for all applications. In addition, implementation of each application requires exploration of possible design architectures to obtain most efficient one.

Design space exploration of efficient architectures given heterogeneous constraints is not a trivial task. The Constraint Programming approach makes it possible to put all the heterogeneous constraints in one unified framework. All these constraints communicate with each other during design space exploration. This helps to identify wrong decisions faster, giving more time to explore those designs which have good quality.

Our Constraint Programming approach suits very well the Specify-Explore-Refine paradigm. Each exploration result can be expressed as constraints, which can be imposed at any time to enforce the result of the exploration. CP framework gives good basis for design space exploration and makes it possible to address resource trade-offs as well as optimization trade-offs.

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V. AN E-ACTIVITY PLANNING MODEL FOR SMALL AND MEDIUM-SIZED ENTERPRISES

Janusz K. GRABARA

Introduction

An electronic support of business activity is usually considered in very different ways. In wide scope, it can be assumed that the electronic support of business activity is an improvement and optimisation of enterprise activity during creation or operation on the e-market and value cha to achiever strategic and operational profits. IBM defines electronic activity as an organisation that using network techniques transform actions among customers, suppliers, trade partners and workers in order to improve efficiency and effectiveness. It should be notices that definition of e-activity is almost identical with definition of Supply Chain Management (SCM). Both functions are connected with management of links and interactions among trade entities (staff, positions, processes, organisation and markets). However Supply Chain Management is only one of the elements composing the e-activity[1]. CRM – Customer Relationship Management is another system concept of enabling creation and continuation of interactions with customers. Both concepts SCM and CRM are based on strong and integrated internal system of enterprise resources planning. It is stated that *integration of customer relations (front-end and back-end) with SCM systems can be done using techniques integrated with enterprise activity that is the fourth element of the e-activity*[2].

The e-activity planning

The planning is a process of effective knowledge creation beginning from data collection through understanding of present situation and scenario creation using suitable models, structure and data analysis elaboration, finishing with plan application and monitoring[3].

It is essential to consider features of strategic business planning and value chain analysis during concept of the e-activity creation. It is quite controversial that traditional methods are not suitable for brand new forms of activity strategic planning. There is an opinion that "*existing models and theories will be still used*

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[1] Tang N. At all: Development of an Electronic Business Planning Model for Small and Medium-sized Enterprises, International Journal of Logistics, Vol. 6, No 4 , Taylor & Francis, 2003.

[2] Robinson M.,Kalakota R. E-business Roadmap for Success , London, 2000

[3] J.Kisielnicki, J.Grabara, J.Nowak, Informatyka w Gospodarce Globalnej, WNT, Warszawa 2003.

even if perspective of new e-activity would be added for strategic planning process"[4]. It can be confirmed that competitive advantage may be achieved through the creation of specific value chain based on activity aims. Although in this expression, the Internet should be noticed as a chance not as an aim itself. It means that the Internet does not decline old planning methods, it rather points on their importance and necessity of the methods rigorous application. Based on those premises, Van Hooft and Stegwee[5] have proposed model that in details analyses planning process considering competitiveness analysis and ability of internal estimation using SWOT analyse (Strengths, Weakness, Opportunities, Threats); and using value chain method for the opportunities identification.

Making an assumption that strategic planning of the e-activity can be categorised vertically as an analytic planning and horizontally as a tactical planning. Vertical approach looks for definition of future situation as precise as possible with the purpose of cost estimation and whole budget preparation. Focusing on the numerical analysis is quite suitable for stable trade conditions those are used for forecasting of analysis and modelling results. Those features of the e-activity should be taken into account as a accidental and concentrated on the customer and fast activity process and create hazardous situation for planning approach.[6] "*Horizontal planning approach present vision that fast environment changes can be estimated by the staff of the first line, in the best way, whose are the first persons informed about changes. However rigorous adaptation of the horizontal planning can lead to shortages in planning where strategic decisions can be partial due to solving of urgent present problems then long perspective solutions*[7].

Connection of vertical and horizontal approaches allows for evolutional solution in searching the answer for the most important questions concerning goods and services types offered and sold on the e-market and integration chances of internal trade processes and also possibilities of relation improvement between external partners using new techniques and processes. Many Authors have provided with the answer but generally it can be stated that rise of profits, cost reduction, services personalization and following the SWOT analysis results are the most expected effects.

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[4] F. Van Hooft, R.Stegwee, E-business strategy: how to benefit from a hype, Logistics Information Management, 14, ½, 2001.

[5] F. Van Hooft, R.Stegwee, E-business strategy: how to benefit from a hype, Logistics Information Management, 14, ½, 2001

[6] Tang N. I inni Development of an Elektronic Business Planning Model for Small and Medium-sized Enterprises, International Journal of Logistics, Vol. 6, No 4 , Taylor & Francis, 2003

[7] Robinson M.,Kalakota R. E-business Roadmap for Success , London, 2000

New model of the e-activity planning

An advisory and a data collection from various internal and external sources and a presentation, how the data can be analyzed using set of defined tools of different business activity chosen for planned e-activity are the main importance in a new model. The model does not reflect all forms and applications of firm e-support – sometimes they are quite specific, however the model is a kind of algorithm in the area beginning from the strategy that is determined by a low trust level and finishing on the defining of particular e-activity realization. It is emphasized that the consciousness that necessity of engagement in the e-activity is a result of trade requirements, not a results of rising trends for IT development. Usage of IT without the clear needs is a reason of serious problems due to this integration of IT with present trade processes is the most important. The whole potential of the e-activity application can be implemented following the approach driven towards to the business activity. Model elaboration is based mainly on the implementation of planning aspect omitting technical one. The new model is based on three key analytic techniques: SWOT analysis, value chain analysis and the tool modeling usage of quality functions (QFD – Quality Function Deployment)[8].

The model presented by N. Tang[9] consists of four analysis levels. It can be presented as a process of intention's filtration, step by step, reducing information complexity and improving the accuracy of analysis on every levels (see figure 1). Initially, the model architecture is vertical moving from the opportunities' strategic estimation of the e-activity on the high the 1st level, finally it reaches choice of particular techniques of the e-activity on the 4th level. The model is composed of four main blocks those present main elements in the e-activity e.g. strategy, processes, staff,. technology. Exemplification of the e-activity planning structure and implementation of the communication tool necessary for planning process transparency are the model aims.

Strategic activity evaluation usually has following aims: appreciation of internal sources, recognition of firm ability and recognition of the competitive surroundings and its influence on the firm

The e-activity cannot be ignored because it is a threat to market position lost. The e-activity cannot be overvalued as well; nevertheless the e-activity can

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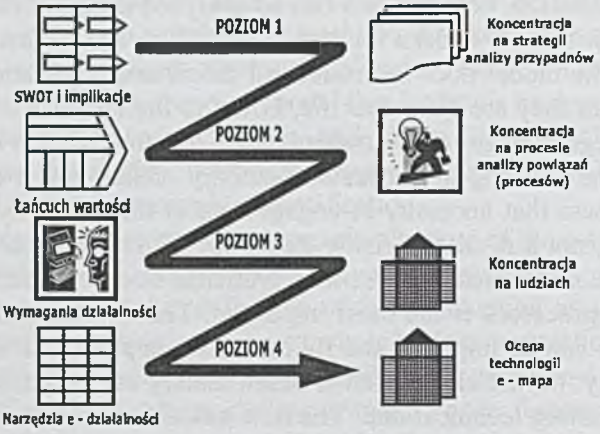
[8] Tang N. at all: Development of an Electronic Business Planning Model for Small and Medium-sized Enterprises, International Journal of Logistics, Vol. 6, No 4 , Taylor & Francis, 2003

[9] Tang N. at all: Development of an Electronic Business Planning Model for Small and Medium-sized Enterprises, International Journal of Logistics, Vol. 6, No 4 , Taylor & Francis, 2003

support every function and process in enterprise. SWOT analysis is a useful tool for firm market position evaluation[10].



SWOT and implications	Level 1	The concentration on strategy of case analysis
The value chain	Level 2	The concentration on process of linkages analysis (processes)
The activity support	Level 3	The concentration on people
The e-activity tool	Level 4	The technology evaluation e-map

Figure 1 The model of the e-activity planning process based on N.Tanga elaboration

Source: [2]

The experience shows that SWOT analysis is useful for strategic structural thinking because categorically divides information on the groups. SWOT analysis is often used in the form of the brainstorm. The information sources can be internal ones e.g. intelligent trade data experience and feelings of the staff and external ones, as well e.g. market reports, economy trends, and socio-demographic data.

[10] L.Bednarski, R.Borowiecki at all, Analiza Ekonomiczna Przedsiębiorstwa, Wyd. Akademii Ekonomicznej we Wrocławiu, Wrocław 1996.

SWOT analysis gives positive effects, only when helps to generate motivational actions coming from the strategic stress. Modification of traditional SWOT analysis is presented on the figure 2.

SWOT

Strengths	Weaknesses
Opportunities	Threats

SWOT - modification

	Opportunities	Threats
Strengths	Strengths utilization	Threats counteraction
Weaknesses	Strengths creation	Defense creation

Figure 2. Four genus strategies of SWOT analysis

Source: [6]

The internal sources and firm abilities are used as an environment influencing on the linkages of strengths and weaknesses with opportunities and threats. The strategic tool allowing for the connection can be divided on following strategies:

- proactive when strengths are linked with opportunities those can be used through its application in new market circumstances;
- reactive when weakness are linked with opportunities and threats or when strengths are linked with threats;
- defensive which searches the defense against usage of weaknesses by the environment for their own business.

Application of SWOT analysis in such a approach brings set of the e-activity areas.

Value chain analysis

SWOT analysis does not specify key areas of the e-activity those can be main sources of profits from the e-activity. Applying value chain concept elaborated by M. Porter, it is possible to understand the e-activity better and to change existing elements to realize strategic intentions. M. Porter has elaborated structure of trade operations in division on five basis logistics activities and four auxiliary activities. Considering size of organization using this analyze method, it is useful to divide every value chain element on principal operational processes and to estimate process's added value from the customer's point of view.

Relating to the Supply Chain Management, it should be pointed on the differences among various types of processes e.g. new supply source identification, ordering process, processes of material planning and offering processes.

The identification and distinguishing of the e-activity center that is crucial for strategy principle are achieved on this level. It is turned out that the application

useful for its analysis of linkages between activity and activity's groups from the operational perspective allows also for continuing of common relations.

"The e-activity should be noticed as an attempt of collaboration in purpose of specific operation improvement or engagement of all processes to concentrate the elements of the supply chain. The elements are customers, suppliers, staff, all people having their own expectations and ideas of the e-activity solutions. All the elements have to be identified and should be connected to the process of specification of suitable solution for firm e-activity"[11].

QFD (Quality Function Deployment) is the tool supporting engagement of the supply chain elements. Quality Function Deployment is the third analytical block composing the model and it is used for priorities evaluation and establishing for various e-activity opened for the firms those have made their strategy more powerful using SWOT analysis, value chain analysis and interviews with the supply chain elements.

The tool choice

Processes of the priorities' establishing are connected with availability of the e-activity tools and wages points those are used to pointing: How good is the particular e-activity tool in supporting the process. The processes replace the requirements and the QFD processes are replaced by the suitable e-activity tools e.g. e-value chain or chosen model of the e-activity. The indication on the e-activity tool the most suitable for organization effectiveness improvement is the results .

Summary

The proposal of the new e-activity planning model is a purpose of abovementioned elaboration. The model can be helpful for the e-activity application in small and medium-sized enterprises that can support and improved their general trade strategy. The model allow for priorities establishing that can assure the strategy and processes integration. The new model Application of the e-activity planning lead to clear distinguishing of three areas determining firm success. The areas are: effective leadership, permanent improvement, complete collaboration of the participants of the process on the all levels. Strong leadership consists of communication and determination that is necessary to assure established strategic aims and the activities leaded towards the aims. Permanent improvement is linked with attempt of reorganization. This tool should be used repeatedly on the various levels. Finally the most important thing is that the model is used by the process partici-

[11] Tang N. I inni Development of an Elektronic Business Planning Model for Small and Medium-sized Enterprises, International Journal of Logistics, Vol. 6, No 4 , Taylor & Francis, 2003

pants on the all levels in purpose of customer importance increase through ideas exchange using the e-activity.

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VI. EDI SYSTEM APPLICATION FOR REVERSE LOGISTICS

Iwona GRABARA, Joanna NOWAKOWSKA – GRUNT

1. Reverse logistics as a new trend in business logistics

Logistics processes taking place in the economy are more and more often supplemented with reverse logistics processes. It results mainly from the fact of increasing ecological awareness among enterprises, often boosted by current legal standards in a country, and sometimes just a fad of "being an ecological enterprise". The consequence of such an activity is looking for the solutions which enable efficient and quick goods returning within the confines of reverse logistics. It also grows in particular importance in case of activities in the area of information flow. In literature dealing with reverse logistics issues one can observe a twofold approach to the described issue. In German literature the reverse distribution is seen as an additional phase where goods flow in reverse direction occurs. The goods which are subject to reverse flow are the commodities and damaged materials, reused packaging, exchangeable units, recyclable materials etc. This phase is called the logistics of recycling processes.

In American literature return direction of the goods flow is identified with logistics system failure. It is often treated as a measure of efficiency of logistics systems. But such a reverse flow is no longer treated as a part of logistics system and it makes up completely separate system, called reverse logistic.

In enterprises' operation one can distinguish varied processes which can be ranked as reverse distribution processes. It is presented schematically in the Fig. 1. In reverse logistics processes one should take into consideration both activities connected with postproduction waste recycling processes and activities resulting from returns management and recycling processes. It causes some difficulties in proper organization of these processes, especially in such a flow that return way i.e. from the consumer to the manufacturer, should be economical and efficient. It is of particular importance in recycling processes since one of the main obstacles in recycling processes is lack of ordered system of reverse distribution and enormous costs of waste collection and disposal. American Paper Institute proves it by calculating that the main component of paper recycling costs (90%) is a distribution cost [3]. Within the conifers of common operation of businesses in EU market, one can see certain limitation in application of common policy. It mainly results from the fact of lack of such a common policy. Of course each EU country has certain procedures and standards in this area but they are, however, not standardized for all countries of the Fifteen.

In subject literature [4] four rules connected with reverse logistics can be distinguished; the rules have been ordered as regards their importance. They include:

- use of materials collected from recycling sources in production at the expense of new materials,

- application of ecological materials,
- reuse of recycling materials (mainly packaging)
- recycling of materials and worn-out goods

Such activities are often expensive and need additional activity done by enterprises, which is not welcome and very popular. Actually, requirements of re-management of waste products, first of all from cost criterion point of view should be taken into consideration. Following activities in the area of reverse logistics, there are certain consequences that result for all enterprise's activities in the area of manufacturing. In cases where life cycle of the finished goods is analysed, along with the influence of environmental factors on the production process, consumer use and disposal, the design of a product which will be easy to be disassembled and forwarded to recycling will be possible. The factories which manufacture goods will be forced to cooperate with suppliers and subcontractors in such a way that they supply materials and components which are suitable for being reused.

An example of possible application of system solutions could be the policy as regards packaging [2]. The issue is very important from reverse logistics point of view. Following the way of packaging from the point of the end of its basic function i.e. product protection, one can notice that the places of waste accumulation are dispersed and there are no specific rules which could point at the principles of their occurrence. This give rise to certain problems with their re-management, although the examples of certain solutions show that it is possible to be successful in this area. It so happens, e.g. in German „Grüne Punkt" system. In this case, the cost of goods disposal is included in the product price. The takings gained this way are allocated, by manufacturer, in the very moment of sale, for the activities connected with packaging collection and its processing. Hence, the end user pays for disposal of the packaging, and, using the system of selective collection in suitable containers, the initial selection occurs. Thanks to that, as the statistics show, almost 95-percent collection of material suitable to be reused can be observed.

2. Electronic data interchange for reverse distribution processes

Electronic data interchange (EDI) enables enterprises to interchange information electronically in a compact, concise and precise way. Because the operations are compact and have to follow some strict standards, when attempting to understand the language of the operations one should conduct detailed investigations.

The main task of the software for EDI (commonly called a converter) is to pick up the data from user applications and next to create the message in EDI standard and to send it to business partner. EDI converter realizes the process also in reverse direction.

The incoming message is converted to the data structure characteristic for the software used in the given company, such as e.g. sale service, accounting, delivery, warehouse management etc. The data interchange within EDI is essential

when the computer in one enterprise is connected, by means of telephone line, with the computer in the other one. In order to use the same language, the information have to be sent in standardized form, called "transaction set".

One of the best worked-out and offering the full spectrum of electronic data interchange service is EDI TRANSACTION SET ANSI ASC X12 [1]. EDI Transaction Set is a set of business documents, implemented by American National Standards Institute (ANSI). The documents can be transmitted by means of electronic data interchange. The group of documents have been divided according to the different issues. The issues include: communication, product data, row, materials and management, transport, purchase, finance, distribution and storage, communication and insurance.

Assuming that one enterprise (e.g. retailer) needs to send a message on the return of product to the other one (e.g. supplier), the information should be sent by means of structure included in "Transaction Set 180" which belongs to the group of distribution and storage.

Usually, in single process of data exchange connected with product returns, a few pieces of information should be sent (they are called "transaction set" within the EDI terminology) as a supplement to other information. All the messages that use the same transaction set are grouped together (in "functional groups"). The example is the table given below which shows how one could divide information sent if the retailer claims the return of two products and places four orders.

Tab 1. EDI operation structure.

Single messages (transaction set using „transaction set 180") information on return information on return	Functional group No 1
Single messages (transaction set using „transaction set 850") delivery order delivery order delivery order delivery order	Functional group No 2

Each operational set consists of numerous information pieces called "data segments". They are the code sequences and they are going to be under considerations of further part of the paper. Fortunately, the end user does not have to be interested in the above mentioned codes, since using proper software, the information concerning the supply order created by the retailer's system are translated into the EDI operations.

Data segments in operational set must conform to standard order which is presented in "operational set table". For example, the information on returns have to be consistent with the format found in the operational set 180 table. Not all the data segments have to be present but the data have to be always in given order.

The example of such a system, which can set an example for reverse logistics, can be the operational set EDI 180 of "Return Goods Authorization and Notification" designed to enable the businesses to exchange information on returns by means of EDI.

The set consists of many data elements which are common for other operational sets: the details on carrier, address information etc. Main data elements characteristic for operational set are contained by data segment RDR (Return Disposition Reason). RDR is used to indicate disposition of item return, reason for the return, problem description and the information if the item has been used. Data of element 1292 "return disposition code" indicate how to allocate the item in question. Possible dispositions for 1292 element are given in the Table 2

Tab. 2. Elements of Return Disposition Data – 1292.

CODE	MEANING
CR	Consumer Return to Vendor
DI	Dispose
KA	Keep with an Allowance
KR	Keep and Repair
MW	Manufacturer Warranty Service
RA	Return with Authorization Number
RD	Request Denied
RF	Return for Factory Repair
RN	Return without Authorization Number
RP	Return Authorization Pending
RT	Ship to Third Party
SD	Ship to Third Party for Disposal

Data element 1293 „Return request reason code" is used to indicate reasons for the return of item. Possible values for the element are given in the Table 3.

Tab 3. Elements of return request data – 1293.

CODE	MEANING
CO	Customer Ordering Error
CV	Colour Variance
DM	Defective Merchandise or Store Inspection
DP	Defective Packaging
DR	Defective Merchandise or Returned by Consumer
EI	Excess Inventory
EO	End of Season
EW	Excessive Wear
LP	Label Problem
NA	Not as Expected
OP	Outdated Packaging
PE	Price Error
PF	Poor Fit
PW	Poor Workmanship

SD	Short-Dated Product
SP	Shipped past Cancel Date
SR	Stock Reduction Agreement
ST	Style Problem
WG	Wrong Goods or Not Ordered

3. Integral table of transaction set EDI 180.

Any information concerning the return sent by EDI have to be adjusted the structure given in the operational set 180, which has been presented below, in the Table 4.

In each row, second column „Seg" contains identification of data segment, according to the name of the segment. The fourth column indicates if the segment is obligatory or optional. Fifth column (Max) indicates maximal number of data segments which can be present. The ending column (loop) indicates which segments can be repeatable.

For example, rows 120 to 160 all contain the information on the address and all have "1" in loop column.

This means that if the sender wants to add more than one address, all the lines can be included. "Loop Repeat – 200" over the line 120 indicates how many lines can be included into one operation.

Tab. 4. Operational set EDI 180 table

180 – segments „Authorisation and Notification on Return"

Pos	Seg	Name	Req	Max	Loop
TABELA 1					
010	ST	Transaction Set Header	M	1	
020	BGN	Beginning Segment	M	1	
030	RDR	Return Disposition Reason	O	1	
040	PRF	Purchase Order Reference	O	1	
050	DTM	Date/Time Reference	O	10	
060	N9	Reference Number	O	10	
070	PER	Administrative Communications Contact	O	2	
080	ITA	Allowance, Charge or Service	O	10	
090	PKG	Marking, Packaging, Loading	O	5	
100	TD1	Carrier Details (Quantity and Weight)	O	10	
110	TD5	Carrier Details (Routing Sequence/Transit Time)	O	10	
		Loop ID-N1 **Loop Repeat -200**			1
120	N1	Name	O	1	1
130	N2	Additional Name Information	O	2	1
140	N3	Address Information	O	2	1
150	N4	Geographic Location	O	1	

160	PER	Administrative Communications Contact	0	5	1
		Loop ID-LM **Loop Repeat -10**			
170	LM	Code Source Information	0	1	1
180	LQ	Industry Code	M	100	1
TABLE 2					
		Loop ID-BLI **Loop Repeat -500**			1
010	BLI	Baseline Item Data	0	1	1
011	N9	Reference Number	0	20	1
020	PID	Product/Item Description	0	5	1
030	RDR	Return Disposition Reason	0	1	1
040	ITA	Allowance, Charge or Service	0	10	1
050	PRF	Purchase Order Reference	0	1	1
051	AT	Financial Accounting	0	1	1
052	DTM	Data/Time Reference	0	15	1
053	DD	Demand Detail	0	100	1
054	GF	Furnished Goods and Services	0	1	1
055	TD5	Carrier Details (Routing Sequence/Transit Time)	0	5	1
		Loop ID-LM **Loop Repeat -10**			21
056	LM	Code Source Information	0	1	21
057	LQ	Industry Code	M	100	21
		Loop ID-N1 **Loop Repeat -200**			21
060	N1	Name	0	1	21
070	N2	Additional Name Information	0	2	21
080	N3	Address Information	0	2	21
090	N4	Geographic Location	0	1	21
100	PER	Administrative Communications Contact	0	5	21
		Loop ID-QTY **Pętla-Powtarzania-1**			21
110	QTY	Quantity	0	1	21
120	AMT	Monetary Amount	0	5	21
130	DTM	Date/Time Reference	0	10	21
140	N1	Name	0	1	21
		Loop ID-LM **Loop Repeat -10**			321
150	LM	Code Source Information	0	1	321
160	LQ	Industry Code	M	100	321

		Loop ID-LX	Loop Repeat -10			321
170	LX	Assigned Number		0	1	321
180	N9	Reference Number		0	1	321
190	DTM	Date/Time Reference		0	10	321
200	N1	Name		0	1	321
		Loop ID-LM	**Loop Repeat -10**			4321
170	LM	Code Source Information		0	1	4321
180	LQ	Industry Code		M	100	4321
190	SE	Transaction Set End		M	10	

Summary

Contrary to the fact that each retailer and manufacturer is potentially able to use the above operational set, it is not frequently used. One of the possible reasons for this state is that disposition and return reason codes are not sufficient to define all possible situations. Business triggers off newer and newer situations and demands for transaction sets, which results in continuous evolution in the EDI area, especially in such important areas as reverse distribution which is connected with recycling and ecology. It is possible to rate, among such additional codes: damage, damage supervised by video recording, alteration, processing, modification (of configuration products or products which can be modernized), repair, in-factory repair – return to manufacturer in order to repair, ordering error at agent's, internal ordering error, delivery error, transport claims and many others designed to full exchange of information.

List of transaction codes presented above is only the part of all codes for EDI, of which it is known that they are necessary to proper function of electronic data interchange in reverse logistics. Full set of procedures can be defined when reverse logistic procedures are implemented on a global scale and it is known what the needs in the global, regional and local scale are.

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VII. E-LEARNING AS A TOOL FOR IMPROVING AND EVALUATING SME EMPLOYEES' COMPETENCES IN E-MARKETING

Jerzy GOŁUCHOWSKI, Maria SMOLAREK, Ewa ZIEMBA

Introduction

Today, more and more organizations rely upon the competencies of their staffs. One reason for the increasing importance of competence is the rapid technological development in society and economy, e.g. Internet. An additional reason is that contemporary organizations are doing more knowledge and service work by means of the IT-based tools.

This increasing reliance on competence has triggered many entities to implement more effective learning and training processes in their organizations. It is no longer enough for organizations to hire people with the right diplomas. They have to get involved in active management and continuous development of competence. Issues relating to individual and organizational learning have been discussed extensively over the last ten years (e.g. [Rokita]).

It is well recognized that traditional methods of developing new competencies in organizations are not effective enough. It concerns all learning processes in small and middle enterprises (SMEs). In many cases people cannot leave their work with intention of going to school to learn in classrooms. The problem of SMEs in organizing better learning processes is that learning courses are too expensive. E-learning solutions overcome limitations of traditional teaching processes and reduce costs of competence acquisition in enterprises. E-learning systems guarantee employees' controlled access to indispensable knowledge in the most suitable time, either from work or from home. This form of training does not require employees to leave their workplace and, thus they are not excluded from everyday duties and decision-making processes. Moreover, e-learning trainings ensure individualization of teaching processes due to adjustment of the scope, intensity, pace, and level of the programme to the needs of the particular SME and their employees. In these situations e-learning is a better solution to improve competences, skills and knowledge.
This paper aims at showing e-learning possibilities that help improve and evaluate SME employees' competences in e-marketing.

Firstly, the paper presents notion of employees' competences and competence planning and developing in a modern organization. Moreover, it refers to the competence improving needs and expectations towards e-learning. Then, SME needs for developing e-marketing skills are discussed. Finally, the idea of a training system that would allow SME employees to improve their competences in implementation and coordination of e marketing was presented.

1. Employee competence as subject of planning and developing in a modern organization

„Competence thinking" has attracted more and more interest of personnel management specialists. One reason for this approach to organizational management, especially to personal development planning and knowledge of workers, is that it improves universal characteristics of employee performance better than other approaches. A "competency" reflects an important aspect of staff performance. Tasks are performed most effectively if the person doing them deploys skills, knowledge and behaviours (or attitudes) in combination.

There are two ways of understanding competencies. They have different origins (and, as eagle-eyed readers may have noticed, spellings, too – "competence" and "competences" versus "competency" and "competencies"). Different types of competencies can define each of these facets of performance.

Definitions of skills and knowledge types of competency are often called technical, functional, "hard" or job-related competences. These definitions aim at listing all the important tasks, skills and knowledge connected with a job that someone requires to perform effectively. Because they relate to the detailed "what" of a task or role, such lists of definitions tend to be long and complex. This usually means that each list is limited to one type of job or role or, perhaps, several related ones in a job family, rather than covering larger numbers of jobs or, indeed, the whole organization. On the other hand, competencies that define behaviours (or attitudes) can often be covered by shorter lists, because many jobs often require the same, or similar, approaches. For example, being concerned with customer care is a behavioural competency (it is a "how", not a "what", of a job), and this is an increasingly important aspect of an increasing number of jobs. So, it may be possible to create one definition of the competency of customer care that applies to many different jobs or roles. These types of competencies are often called behavioural or "soft" competencies, or personal behaviours or capabilities. This approach to defining performance at work was developed in the USA by David McClelland and taken further by Richard Boyatzis. Their work primarily involved defining the behaviours that successful managers demonstrated – not managers with barely acceptable performance [http://www.competencyandei.com/Definition-of-competency-] Whiddett and Hollyforde's define it in this way: "Competencies are behaviours that individuals demonstrate when undertaking job-relevant tasks effectively within a given organisational context." [Whiddett and Hollyforde].

One important group of behavioural competencies addresses how individuals manage their emotions. This subset of competencies is known collectively as "emotional intelligence". It covers such skills as not only being able to show empathy to understand other people (and, therefore, work more productively with them), but also being able to control their own reactions when put under pressure.

P. Hendler analysing different kind of competencies pointed out on core competencies and professional competencies [Hendler]. Core competencies are treated as emotional intelligence of a worker. These competencies are reflected by organizational culture. Group-work skills may serve as an example of core competencies. Professional competences are closely connected with workstation of an employee in an organization. Core competencies are considered as more important for effective realizations of organization mission and strategy. .

Key features of competencies are dynamics and possibility to develop needed skills, behaviours or attitudes. Measurement is another feature. Organization needs to measure actual competencies of every employee and team and identify required level of competencies [Filipowicz].

Identified competencies needed in an organization should be basis for planning personal development. According to these competencies all activities connected with development of competencies of the workers should be taken into consideration. Nowadays, these activities are supported by information and communication technologies, especially Internet-based learning. E-learning provides better tools to fit training courses to actual levels and ranges of individual needs and to manage processes of developing of personal competencies effectively.

2. Software tools in developing competences of employee

Fast growing demand for technologies that support e-learning has resulted in the dynamic development of products that support implementation of such systems. It concerns both solutions that provide a base for building e-teaching systems and tools that are necessary while preparing course materials. There are already systems that provide overall help for trainings. They aim at supporting course participants in the learning process, co-ordinating course participants' progress in the work with different materials, following course participants' grades and improving communication with instructors and other members of a group.

Software that creates a platform to build and initiate an e-learning system consists of three co-working components:

- Computer Mediated Communication (CMC) modules;
- Learning Management System (LMS) modules; and
- Learning Content Management System (LCMS) modules.

CMC systems are the Internet based electronic communication technologies that enable interactions both in the synchronic mode (i.e. in the real time) and in the asynchronic one. These systems include the following forms of communicating:

- e-mail;
- discussion group;
- text conference tools;

- Internet telephoning;
- tele and audio-conferences;
- graphic conference tools, shared white boards; and
- software for group-work.

Tools that support group-work enable to work on documents together and with no problems, and to co-share files and multimedia. Besides, these tools are equipped with systems that facilitate versioning of documents and workflow management. It is possible to manage authorities of particular task group participants. Due to implementation of the CMC systems in educational processes course participants can utilise the following forms of knowledge creation:

- learning in teams;
- interactive process of knowledge group building;
- active participation in generating and selecting of information; and
- building of knowledge in the context that results from other course participants' points of view.

It is an instructor's task to supervise any learning process, monitor work and provide tutorial guidance. Moreover, the systems in question frequently enable generation of the so-called virtual class and then provide the following options:

- shared whiteboard;
- hand up;
- follow me;
- on-line discussion;
- audio communication; and
- video communication.

Teaching technique in the virtual class mode is attractive. However, it requires expensive equipment and broad bandwidth.

The main task of the Learning Management Systems is to help in administering training activities and competences required for organisation of training. From the perspective of the end-user of LMS ensures an effective way to track individual skills and competences, simple methods of tracing learning activities and registering for courses. LMS manages access to on-line courses a participant is registered for, facilitates introducing, tracking, managing and reporting of learning activities. Currently there are many systems that help organise distance learning on the market. These systems particularly enable to:

- plan courses and manage trainings;
- manage users;
- design contents;
- design tests;
- trace progress and report; and
- evaluate.

Learning Content Management Systems (LCMS) make it easier to create, utilise, locate, deliver, manage and improve contents of trainings. Contents are usually managed in the centralised archive in form of small, self-describing identifiable elements or as training units that all satisfy one or more well defined training objects. LCMS can find and provide a final user with an individual training unit to satisfy their single claim or deliver elements of a larger course that is defined in the LMS system.

The main task of the LCMS is to create, process, locate, deliver, manage and improve the contents. In some cases it also involves gathering additional information and presenting information in an accessible way. LCMS does not deal with management of competences, does not have extra administrative functions and does not manage trainings or logistics. In advance systems LCMS controls user's interaction with learning objects and on the basis of this information provides a user with highly individualised course. LCMS provides supervising parties with clear and valuable reports that in the future might also be used to perfect training objects. Some of the leading LCMS systems enable co-operation and exchange of information with reference to training objects between course participants and teachers. This exchange is also recorded and made available to persons who prepare supplements to contents of trainings. LCMS and LMS systems differ in their functional scopes. However, they complement each other to reach optimal transfer of knowledge.

Users play a major role in both systems. No matter if it is a training object, on-line course, expert or other form of any training activity, both categories are characterised by one important common feature – providing users with resources in the most effective way. Typical LMS has a rich profile of each user including their function in their organisation, profession, preferences, competences, level of education, up to date participation in trainings and so on. Users expect that LMS will manage their competences, analyse level of their skills and register for courses that conforms to their already selected carer path. LCMS focuses on delivering contents that follow recipient's requirements exactly when it is required. Some LCMS systems can prepare contents on the basis of the user's profile or offering numerous opportunities of co-operation and knowledge exchange within training material. However, there is a key difference. LCMS takes all available information on the user into consideration in order to offer the best adjusted training object to the needs. On the other hand, LMS usually manages users' profiles and makes them available to the LCMS system.

LMS and LCMS share elements of content and user administration to a different degree. LMS usually offers user administration including users' profiles, competences, functions and place in their organisation – however this is only high level administration – and content tracking. Contrary to LMS, LCMS offers detailed administration and content tracking. LCMS devotes more attention to interactions between users and contents than to administration of the users themselves. Products of both categories have in-built mechanisms that administer contents and users.

Close integration of LMS and LCMS may facilitate a range of advance options that are unavailable while using one product only: LCMS may use information that is available in LMS - i.e. profiles, preferences, position, data concerning competences - in order to deliver a modified training track automatically. LCMS may also analyse trends by means of comparing users' preferences, chosen tracks and efficiency details of the tracks in question. Authors of particular training objects may use some trend analysis to verify training tracks in the real world. Gathered data enable adjustment to users' actual expectations. LCMS may – using collected information – forecast training tracks on the basis of the users' profiles.

It is worth paying some attention to the fact that entities that provide software within human resources management frequently enhance software functionality by adding modules that enable not only to determine career tracks, but also plan and manage employees' trainings (compare Table 1).

Table 1. Characteristics of selected modules that support competence management

Enterprise/ system/ module	Functionality within competence management
Baan IV Personnel management Personnel functions	Keeping records that collect information on employees' skills and predispositions, completed courses and trainings. Analyses that support recruitment processes, career planning and staff assessment. Management of trainings, courses, and vocational practices: planning, verification, assessment and evaluation of training companies.
Koma e-HR Personnel and human resources management	Employment analysis in different profiles. External and internal recruitment. Periodic staff assessment. Planning of trainings and courses and budgeting. Job description including indispensable qualifications and authorities, career track record.
MacroSoft Personnel and wage software KALI Staff assessment module ZZL	Supporting recruitment (possibility to define requirements individually). Generating demand on courses, lecturers' and organisers' competence assessment, evaluation of course results, verification of participants' qualifications. Personnel assessment.
MySAP Human Resources	Job descriptions. Information on employees: competences, qualifications, periodic assessments, completed trainings, vacancies, employment limits. Employee portal.
TETA_Personel Personnel	Employee portfolio: completed schools, obtained qualifications, foreign languages, participation in trainings, personality profile.

management	Training activity support: training planning, cost settling and monitoring, verification of acquired knowledge and qualifications. Job description and valuation, matching jobs with adequate pay class and scale, assessment of performed work. Job offers: keeping records of potential employees, examining candidates' profiles.

Source: Own on the basis of information materials

Polish market also offers autonomic IT system of competence management 'e-Kompetencje' developed by Www.praca.com Sp. z o.o. (Ltd.) Basic functions provided by this system include [Lakutowicz]:

- Assessment of employee's potential;
- Employee's verification;
- Designing of courses;
- Evaluation of training effectiveness – due to preliminary survey (carried out before trainings) and post-training survey it is possible to compare training effectiveness quickly;
- Designing individual tracks of employee's development – comparing required profiles with the actual ones; and
- Recruitment and selection customised for the very company.

The system enables to load basic personal data from the personnel system (if it is equipped with the function of data export to the text file). Ready competence profiles may be purchased together with the system. It is also possible to create profiles according to individual requirements of the system users.

3. SME needs for developing e-marketing competences and skills

Nowadays the Internet has become an attractive information tool of marketing [Brady 2002], [Chaffey], [Coupey], [Dann], [Reedy], [Sznajder]. Small and medium enterprises (SMEs) have to face difficulties while implementing and utilising Internet in marketing. Introducing e-marketing into company activities and combining off and on-line marketing campaigns is not an easy process[1]. This process makes employees

[1] Such a situation is reflected, inter alia, in the survey research conducted within TRIMAR Project. TRIMAR Project, i.e. On-Line Intelligent Training System for Internet Marketing by SMEs sector (UK/00/B/F/PP/129_110) was carried out under the auspices of the European Union within the Leonardo da Vinci programme. It was a three-year programme covering 2001-2003. The project team comprised of scientific partners as well as small and medium sized enterprises from Great Britain, Germany, Portugal, Slovakia and Poland. Among higher education institutions involved in the project there were: University of Luton, South Bank

and marketing specialists acquire new skills. The questionnaire[2] determined major barriers in implementation of the Internet marketing. Lack of relevant expertise, skills and experience is one of the biggest problems in using of the Internet. More than a half of employees evaluated their level of Internet marketing knowledge and skills as too low and insufficient. The survey results on the above issues are presented in the Figure 1.

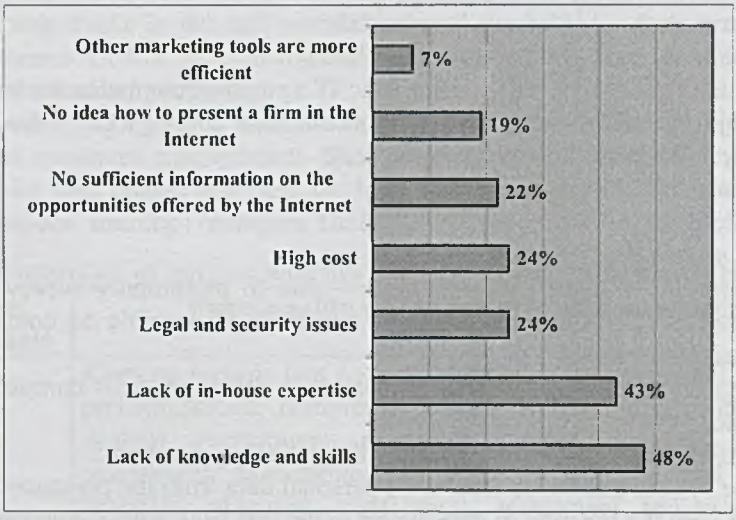

Figure 1. The major barriers to implementation of the Internet in marketing.
Source: Questionnaire.

University in London, Westfälische Wilhelms Universität in Munster, University of Economics in Katowice, Universidade Aberta in Lisbon, Technical University in Koszyce.

Leonardo da Vinci
European Training in the UK

More information about the project, its goals, stages and results achieved so far is available on the websites:

- http://www.ae.katowice.pl/trimar;
- ttp://www.cbusinesslearning.info/trimar

[2] 54 small and medium enterprises (SME) from Poland took part in the survey. 30% of them were represented by the IT sector. The majority of other SMEs dealt with printing, construction, consulting, finance and law, education, transport and tourism. The answers were mainly given by employees responsible for marketing at strategic and tactical levels of management.

Simultaneously, all the enterprises believe that training of their employees in Internet marketing could considerably contribute to their marketing success. As much as 93% of the sampled enterprises pointed out that such training was important or significant. Most of the companies in question are interested in the training system. 76% of companies indicated some demand for training within pre-selected subjects and levels. The suggested subjects and the demand for training courses as indicated by SMEs employees are presented in the Figure 2.

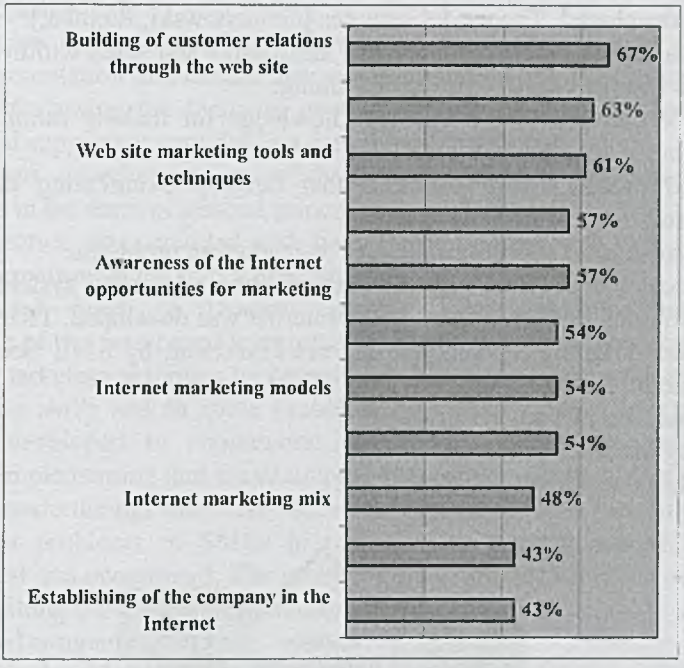

Figure 2. Training needs for small and medium enterprises in e-marketing.
Source: Questionnaire.

The sampled respondents are aware that their e-marketing knowledge is insufficient. They express some interest in training. Residential face-to-face training delivered by external expert and direct consultancy/guidance are equally desirable to most of the firms (38%) followed by web based self-training (15%). Self-study based on a CD-ROM is evaluated as interesting by the employees (14%). Analysis of the SMEs' demands leads to the conclusion that distance learning, and especially e-learning appears to be a good way of supporting employees in their e-marketing activities.

The survey shows that employees find asynchronic training very useful and their preferable training methods include:

- training in the form of a lecture; and
- training in the form of a presentation of case studies (44% SMEs) and model solutions (76% SMEs).

4. TRIMAR solution for developing of competences of SME workers in e-marketing fields

As a result of the research a model of e-marketing training for SMEs employees is developed. The model includes [Gołuchowski, Ziemba,]:

- tools that assess employees' level of knowledge and skills within e-marketing in order to choose a suitable level of training;
- a lecture that provides necessary knowledge for making rational e-marketing decisions;
- practical problems and solutions that develop e-marketing decision-making skills; and
- tools that support solving employees' e-marketing problems.

To meet the SME employees' expectations e-learning system in a form of asynchronic training delivered through the Internet was developed. TRIMAR – the On-Line Intelligent Training System for Internet Marketing by SME Sector consists of three major modules (Figure 3):

- Self Assessment Tool (SAT);
- Training Modules (TM); and
- Case-Based Reasoning System (CBR).

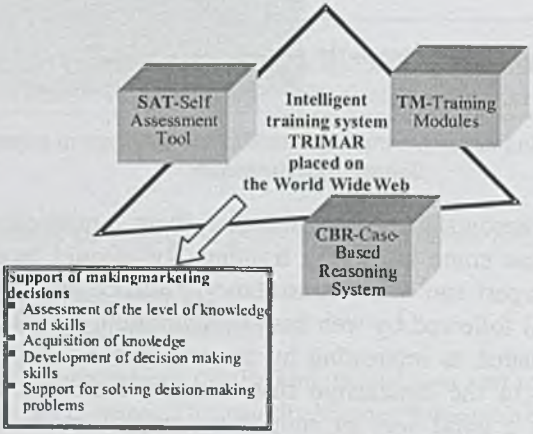

Figure 3. Architecture of TRIMAR training system.
Source: [Billewicz]

Basic function of the TM Module is to provide employees with theoretical and practical knowledge that refers to introduction and utilisation of e-marketing in business and - in particular - to knowledge that is indicated by surveyed enterprises (Figure 2). In TM module two levels of advancement on which knowledge acquisition takes place were devised: basic level and advanced level. On the basic level, lecture is used as a form of a lesson, which stimulates hypothetic-deductive thinking of trainees. Lectures are presented with division into themes that correspond with the needs signalled by SMEs (Figure 2). The main structure of the lecture was formulated into three parts [Kupisiewicz]:

- introduction – familiarisation with the subject of the lecture, description of terms, presentation of a lecture plan and potential questions to be answered;
- body – discussing the thematic content included in the plan, presentation of thesis and supportive material in a determined order; and
- conclusions – synthetic review of the content presented, emphasizing its crucial elements in the form of general principles.

Each lecture was provided with links to the Internet web sites that contained additional information on the issues presented.

Advanced level of lessons comprises case studies that allow for implementation of the case-based learning method and constitute practical examples of performing e-marketing activities by enterprises. The aim of case studies is to develop decision-making skills and to solve problems by reviewing appropriate cases. Case studies were developed in cooperation with SMEs that have already acquired experience in implementing and maintaining e-marketing activities. Such co-operation includes those undertakings that were successful as well as those that failed. Each case study describes problems of SMEs in reference to three levels of management: strategic, tactical and operational. The problems are formulated into five groups:

- Establishing the nature of a venture;
- Detailed company analysis;
- Strategic development planning;
- Business plan implementation; and
- Monitoring and controlling of performance.

In each group specific problems to be solved by the SME are identified. Each case study is summarised in a form of a Case Study Report and a Case Study Analysis. In a Case Study Report a company presents the character of its activity: Introduction, Challenge, Campaign, Problem, and Solution. Case Study Analysis constitutes some kind of a summary referring to Strategy, Challenge, Problem and Solution at specific levels of management and indicates final result of activities along with a verdict.

CBR Module collects knowledge acquired through the analysis of case studies. The module will provide the basis for analysis of experiences (successes and failures) of SMEs in e-marketing. Such experiences are extremely valuable for those companies that are now at the stage of implementing e-marketing. Employees have some

possibility to identify their company and all involved problems. To search through Case Studies base corresponding to given specification CBR makes use of the Nearest Neighbour Algorithm. The search is performed according to the basic parameters:

- Management Structure (Flat, Hierarchical);
- Company Category (Service Industry, IT Industry, Consultancy, Internet Sales, Retail Sales);
- Company Size (1-10 Employees, 11-50 Employees, 50 and more);
- Problem Category (Low Sales, Low Customer Satisfaction, Attracting New Customers, Expanding Market Range, Reducing Operated Costs, Low Company Visibility);
- Market Reach (Regional, National, International);
- Business Strategy (Low, Medium, Strong);
- Corporate Identity (Low, Medium, Strong); and
- Web Site Strategy (Low, Medium, Strong).

Introducing selected or all parameters employees are able to analyse similar problems and their solutions. Such an approach allows for resolving decision-making problems through adaptation of solutions that were implemented by other companies. First of all, CBR module enables developing decision making skills and supports employees in solving specific problems related to e-marketing activities.

Since control and self-assessment of knowledge and skills are one of the basic elements of learning, SAT module is designed to assess the knowledge of employees in the field of e-marketing. SAT module provides access to on-line tests, it facilitates passing subsequent stages of the training and enables tracking, managing and reporting on the SMEs' active contribution in self-assessment. Tests do not only evaluate students' knowledge. Information gathered while preparing and completing tests may also be utilised to acquire knowledge on SMEs themselves, to assess teachers and their teaching methods. As a result, such knowledge is crucial for personalisation of remote teaching processes. In order to increase effectiveness users should be given only information that will significantly enrich their knowledge. Providing users with personalised information requires, first of all, preliminary determination of their levels of knowledge on a selected topic. Then users are directed to an appropriate lesson on the appropriate level. And that is what SAT is responsible for within the TRIMAR system.

Tests in the SAT module use the single choice question and the complex multiple-choice questions. According to many experts this type of questions assess the knowledge of trainees in the most effective way.

After an employee has finished filling in the test, the system performs the point and percentage (share of good answers in relation to the overall number of answers) assessment of the answers to questions. Additionally, all questions together with answers marked by an employee and the correct answers appear in the screen. Thus, employees are able to compare their own answers with the correct ones. Depending on

the assessment result the employee can be directed to a suitable course and corresponding level of Training Modules in order to acquire necessary knowledge and skills. Tests in SAT module and lessons in TM module are divided into thematic groups in accordance with the needs signalled by SMEs (Figure 2).
TRIMAR training system should provide employees with support in the process of making decision in e-marketing. It may be used by SMEs employees in order to acquire and expand their theoretical and practical in e-marketing knowledge. The system enables developing competences and supports employees in solving specific problems related to e-marketing activities.

5. Conclusions and future works

It is possible to enumerate several benefits to be enjoyed while implementing e-learning in any training of employees. The most important benefits include [E-learning]:`

- Increase in cost and time effectiveness of any training. It is achieved by ensuring the same results at a lower price what is very important in the period of a slump in the economy when it is necessary to increase effectiveness having lower training budgets;
- Providing employees with just-in-time training solutions. This option is utilised when it is necessary to acquire knowledge in order to solve a particular problem that has emerged at a particular moment. There is no need for many weeks of a planning process of any training;
- Equalising of employees' knowledge levels before starting standard courses. Familiarising with knowledge and skills acquired by means of electronic trainings. It allows for more effective utilisation of traditional educational methods;
- Adjusting a development and didactic process to individual needs of every employee. It concerns not only requirements that results from employee's current competences and future challenges but also such elements like tempo of learning, the way something is remembered, etc.;
- Providing employees who cannot participate in traditional trainings because of the season or nature of their work with trainings and knowledge;
- Enabling employees' fast acquisition of new competences in case of a sudden change in the strategy, mergers, dramatic increases in the number of staff, etc.;
- Enabling fast accustoming of new employees to working in the conditions of a high turnover of staff;
- Generating a remarkable competitive advantage. It is commonly known that a wide access to knowledge and development of competences are a prerequisite for a competitive advantage and development; and

- Encouraging employees' motivation for self-developing and learning to make them show initiative on their own and use educational options offered by their companies actively;

SME's are faced with challenges of improving knowledge and competencies of their workers. E-learning delivers them effective means developing of competencies and knowledge of workers without leaving workstations. TRIMAR training system provide support to employees improving their competences in decision making. It may be used by SMEs employees in order to acquire and expand their theoretical and practical knowledge in the e-marketing fields.

However classical e-learning suffer form many constraints. Future work should be concentrated on blended methodology of learning (e-training) for SME's. We are interested also in developing feasibilities to group work during e-learning and to create feasibility of direct communication of learners and tutors.

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VIII. ELIMINATION OF BARRIERS FOR THE IMPLEMENTATION OF INTEGRATED SYSTEMS – PRELIMINARY CONCEPTS

Witold CHMIELARZ

1. Introduction

Empirical research shows that there is a simple relationship between the complexity and innovativeness of a project and the feasibility of its implementation. The more innovative and complex a project is, the more likely it is that its implementation will be delayed or even discontinued. In the case of integrated systems, this rule applies now to as many as 70% - 80% of the projects. Obviously, the implementation firms use their best efforts to prevent it, but most of their actions are focused on two main directions:

- improvement of tools supporting the process of automatic analysis, design and implementation of systems, mainly with the aim to use knowledge management tools in the process,
- improvement of interpersonal relations management as part of project management.

This paper is focused on the former group of issues and methods of preventing most frequent implementation problems.

The following diagram illustrates the relationship between the complexity of a project and the feasibility of its implementation.

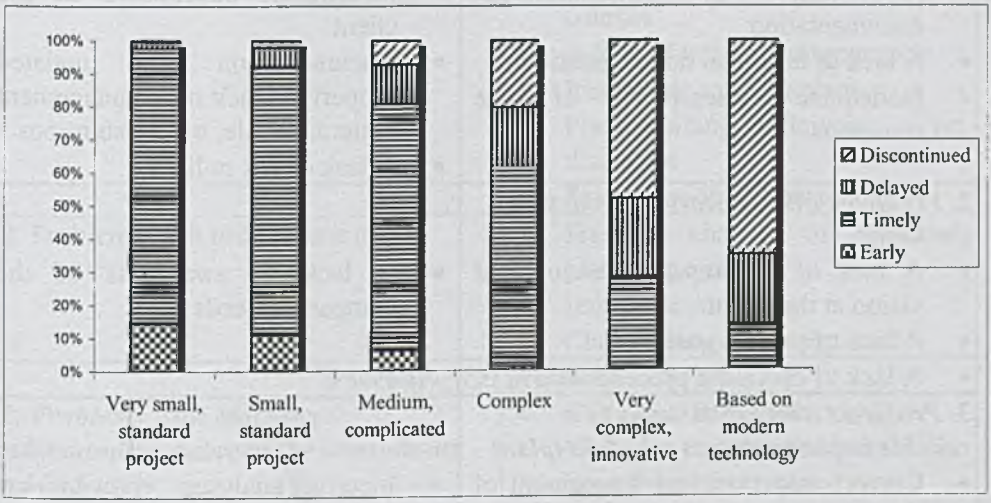

Fig. 1. Relationship between project complexity and success of its implementation
Source: Author

The following procedure can be followed in order to overcome barriers and threats to the implementation of an integrated system [1]:

- Undoubtedly, the first step to overcome implementation barriers is to identify the areas where such barriers appear, and the reasons why they appear.
- The second step is to define the methods of removing these barriers.
- The third step is to identify the barriers which can be eliminated or at least significantly reduced using the methods of knowledge management contained in the intelligent tools supporting the process of designing and changing the systems.
- The next step is to identify the tools and methods used to assist the designer and implementator in this respect.
- The last step is to create a concept of automation of the process of preventing barriers to integrated systems implementation.

The successive stages of this procedure are presented in the next sections of this paper.

2. Identification of the areas where implementation barriers appear

The following table summarises the most frequent implementation barriers, the reasons why they occur and the methods of their prevention [3].

Table 1. Problems and reasons why implementation barriers occur

Types of problems	Reasons
Organisational problems	
1. ***Problems with the correct assessment of a company's condition*** • A lack of organisational documentation • A lack of technical documentation • Inadequate assessment of the resources	• Insufficient information at the client • Documentation not updated properly, a lack of a management system, people, wrong solutions • A lack of HR policy
2. ***Problems with the correct analysis of the needs*** • A lack of a company development vision at the client • A lack of precise goals • A lack of operating procedures	• A lack of awareness of the company's needs
3. ***Problems with preparation of a reliable implementation schedule (plan)*** • Correct assessment of the amount of time necessary for the implementation	• Incorrect analyses • Excessive rush • Desire to win tender procedures
4. ***Problems with defining the necessary conditions of efficient implementation***	

Types of problems	Reasons
• Undefined or unfeasible requirements • A lack of methodology or procedures	• Incorrect analyses • Undefined requirements (including the working hours of end-users)
5. Problems with application of implementation methodology	• Unfamiliarity with the methodology • Deviations from the methodology
6. ***Problems with correct preparation of documentation***	• Poorly qualified staff • Problems with timely preparation of documentation • Frequent changes of the concept
7. ***Problems with users and their selection***	• A lack of substitute staff • Allocation of inadequate end-users • Late identification of a problem • Psychological barrier – a need to change the method of work
8. ***Problems with consultants and their selection***	• Shortage of consultants on the market • Inadequate company policy (no training) • Outflow abroad
9. Problems with training	• A lack of ready-made training courses • A lack of training programmes • Inadequate training plans • Poor training efficiency – no discipline • Savings on the project
10. Problems with project execution	• Frequent changes of execution plan, scope etc. • Imprecise contract • Changes among project staff
Psychological problems	
11. ***Problems with reaching understanding between the consultants and end-users***	• Cultural differences • Wrong composition of the implementation team • Clash of personalities • Conflicts within the client's team • A lack of division of responsibilities within the implementation team

Types of problems	Reasons
12. A lack of understanding of the implementation needs	• No information about the implementation objectives • No global vision – excessive focus on details
13. Hostile attitude of employees	• Fear of losing jobs • A lack of motivation • A lack of faith in the success of the project • Fear of the need to improve qualifications
Financial problems	
14. A lack of means	• Insufficient IT budget • Temporary problems on the market
15 . Pseudo-savings • Purchase of a limited version of the system • Purchase of an older version • Giving up training	• Misunderstanding of the needs • A lack of reserves
Technological problems	
16. Excessive customisation – tailoring of the system to the client's needs	• Misunderstanding of the system's logic • Wrong definition of the needs
17. A lack of security	• Disregard for safety

Source: Author

3. The role of I-CASE tools in solving implementation problems

CASE tools are useful in solving many of the problems presented above. Below we discuss the application of such tools in solving the aforementioned problems [2,3].

- Re: problem 1. Preliminary training of end-users in CASE methodology helps them understand the consultants' expectations as to the scope and quality of the required data.
- Re: 2. In-depth training of end-users in CASE methodology is recommended. Subsequently, the main procedures describing the elementary business processes at the client's company should be prepared by the client in cooperation with the consultants. Ideally, the client should develop such procedures using its own resources (as much as possible) with as little assistance from the consultants as possible. In this way, end-users are forced to get to know the tool well and, first and foremost, study the existing and planned procedures in depth. This approach has the following advantages:

involvement of the client in the implementation from the very beginning, understanding of the main ideas and assumptions of the implementation – a common platform of understanding, making the client partly responsible for the implementation and reduction of involvement of the consultants.

- Re: 3. CASE is used indirectly – the use of this tool for problems 1 and 2 has resulted in obtaining good quality „as is" and „to be" analyses and ensured compliance with the methodology.
- Re: 6. Problems with preparation of documentation – the application of CASE has measurable advantages – the whole processes are automatically documented as they are developed. All changes to the processes introduced during the implementation are also documented. Moreover, the tools of certain vendors allow automatic configuration of the system for end-users. As a result, a considerable part of the documentation is automated.
- Re: 8. The use of CASE allows significant reduction of the time needed for implementation and the time of work of the consultants. As a result, the existing resources (the consultants) are utilised better.
- Re: 9. Problems with training. In this case, the use of CASE tools may be the best solution. On the basis of the previously developed business processes (item 2), the training needs of the client are defined, and the end-user training is focused on the aforementioned processes only. In this case, it is sufficient to study the implementation plan and determine when end-users should be trained in the particular processes. Training is based on previously prepared (item 2) models of business processes. This approach allows elimination of unnecessary elements from training, thus increasing the absorption of the remaining material. As a result, training becomes more effective and can be shorter.
- Re: 11. Problems with understanding – end-users and other employees of the client involved in the implementation, including the management (items 1 and 2), obtain knowledge about the CASE tool used. Subsequently, a ready-made (predefined) solution is presented and discussed. In this way, the existing and modified business models containing all basic processes functioning at a given company become a platform of understanding.
- Re: 12. Presentation of processes subject to changes with the use of CASE helps the employees understand the objectives and needs of the implementation.
- Re: 13. If the implementation process becomes faster and more efficient, the results are achieved earlier, which has an encouraging effect and increases faith in success.
- Re: 16. Excessive customisation – presentation of the existing and planned business processes allows end-users to understand their nature and find the optimum solution, which increases the chances for avoiding unnecessary and costly customisations.

The analysis presented above shows that there are several important factors which allow elimination of problems occurring during system implementation.

The main one is the use of CASE tools, which is useful in 10 out of 17 cases. The second important element is the application of the remaining part of implementation methodology (which is often integrated with a CASE tool). The third factor concerns the HR issues to be considered during the implementation. The fourth one is finance.

4. Decision-making support model for implementation processes

Further research should focus on development of a model which would allow automatic reduction of the effect of barriers on the implementation process.

Collection of data for the management of such a process has been presented earlier in this paper. Identification of barriers on the one hand, and identification of the methods of eliminating them on the other suggest that plans of transformation of barriers into solutions for the individual, predefined cases should be developed in the next step. However, this process is extremely difficult for the following reasons:

- The amount of data in the implementations of integrated systems is now growing exponentially. A lot of such data must be stored for a long time, while masses of new data are added continuously (parameterisation of applications – the system cannot start until thousands of parameters are entered),
- Only a small portion of this data is subsequently used for making decisions,
- A growing amount of external information, which nowadays changes rapidly, has a significant impact on internal decisions,
- Data necessary for decision-making can be accumulated in different computer subsystems, databases, formats and languages (both programming and human),
- There are great many tools supporting data selection for management purposes,
- Security, quality and integrity of data in a system constitute a critical success factor for systems implementation in the economic reality.

One could expect that the application of knowledge management solutions would solve such problems related to automation of the solutions of identified problems with integrated system implementation. Transformation of data into knowledge, which is necessary to make decisions, can take very different forms. The following diagram shows a generalised method of transformation. Data is initially accumulated in a database. Subsequently, following preliminary processing, it is stored in data warehouses. In order to make the knowledge contained in such data available for management purposes, the data undergoes transformation to prepare it for a detailed analysis. This analysis is performed with the use of automatic search tools. The final transformation stage involves a comparison of data found with models (of behaviour, reactions) stored in intelligent systems, which allow interpretation of the obtained comparisons. The ultimate outcome of such comparisons is an assessment of usefulness of generalised information for management purposes and accumulation of such information, along with data, in the knowledge base.

The process of bringing out useful knowledge from mass data is called knowledge management. Knowledge management is the effective use of information-handling techniques by the user to improve the efficiency of organisation management processes.

The process of behavioural models development seems the most difficult step towards transformation of information into knowledge. In this case, it involves allocation of alternative solutions for every implementation barrier: on the one hand, solutions aimed at preventing barriers with the use of I-CASE tools, and on the other – social methods (management of the Company's human potential). Adding the interpretation of these solutions (putting them in a specified business context), and an assessment of their feasibility (or probability of success) in every analysed case leads directly towards automation of decisions made in the process, and indirectly – towards construction of a tool supporting this process. In a deterministic case (full identification) it can be based on creating cause-and-effect relations between the blackboards of barriers and methods of their prevention (or at least reduction of their effects); in a non-deterministic case – blackboard architecture based on diluted models [4]. The following diagram illustrates the former case.

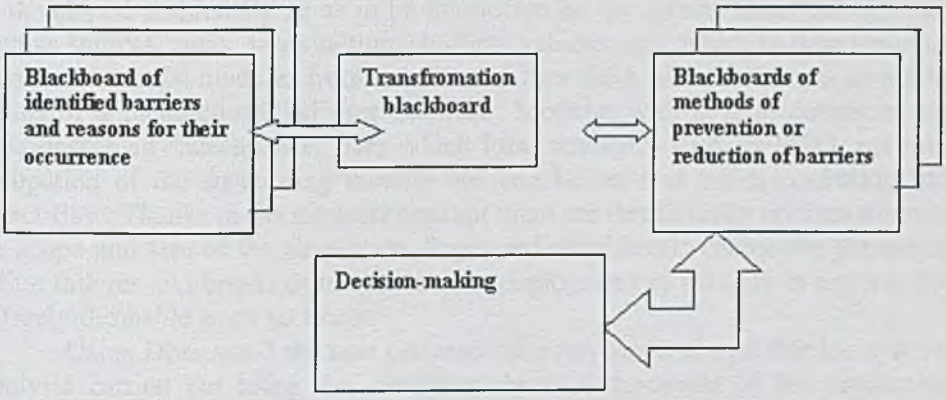

Fig. 2. The concept of a model of transformation of models into a knowledge base
Source: Author

Development of this concept will lead to construction of a tool supporting the decision-making process for the end-user and allowing automatic selection of a method minimising the limitations of the integrated systems implementation process.

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IX. SIMULATION OF GOODS FLOW IN THE SUPPLY CHAIN OF THE MILK COOPERATIVE X WITH THE APPLICATION OF THE DOSIMIS-3 PACKAGE

Sebastian KOT

Introduction

At present, simulation is the tool used quite often for logistics as well as other problems solution. In the paper the Author apply one of the simulation packages to solve the problems of goods flow in the supply chain. The tool in the researches was Dosimis-3. One of the well-known simulation packages used for material flow modeling and simulation is Dosimis-3, in the real circumstances and didactic process as well.

It is a modular-oriented simulation package developed by SDZ® GmbH. It is an interactive, objects, graphical simulator working with Windows 95/98/NT or UNIX. The simulator works event-discrete and allows for the simulation of possible time-discrete material flow systems. A simulated production process can be developed graphically so as to be interactive on the screen. Standard elements such as sources, sinks, work stations, buffers, vehicles etc., which in their structure represent essential modules from the material flow field, allow a rational layout by means of a menu-controlled user interface. Modules with several entrances and exits posses an 'intelligence' over which local strategies such as FIFO, minimal occupation of the succeeding module etc. can be realised when controlling the object flow. Thanks to the modular concept there are theoretically no limitations to the scope and size of the simulation. Super-ordinated levels enable the planner to define failures and breaks or to simulate the deployment of workers in any number of freely-definable work sections[1].

Using Dosismis-3 the user can research every stage of a production system. Analysis carried out using the simulator shows components of the production system where improvements may be necessary. In this way the user can[2]:

- Organize the effective internal transport system
- Find or avoid disturbances in transport process
- Improve internal transportation effectiveness
- Manage raw materials or semi-manufactured article supplies for particular work stations
- Establish the best parameters for production system operations
- Eliminate or reduce the interruption during the operations on the work stations

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- Minimize internal transportation costs, and production costs as a consequence

Applying Dosimis-3 the user can consider many alternatives for a production process in a short time and their respective influences on the effectiveness of the production system and, based on this, one can choose the most suitable alternative for the production schedule. The user can also optimize the number and type of transportation used, plan transportation routes or the speed of transportation. Dosimis-3 allows the evaluation of simulation results with a variety of tables and graphics. A dynamic presentation of the transport system behavior presented within the animation lets one better understand and manage the production mechanisms. The user also can resort to a variety of module values and simulator functions so that comprehensive, tailored control possibilities can be developed for any problem.

Model construction

The simulation experiment is based on the researches in chosen Milk Cooperatives X, and all necessary information available from Cooperative X logistics, production and distribution units. In model construction following assumptions are used and following parameters are adopted: the 22 raw milk supply routes (basis on the present routing) have been adopted as source modules. The raw milk supply is characterized with the following parameters: raw milk daily supply, supply number, average daily supply from a farm (table 1)

Table 1. Source modules – supply area and its parameters

Route	Route name	Daily supply (litres)	Supplier number	Average daily supply from a farm (litres)
1	MICHAŁOW	587	4	147
2	BORZYKOWA	7574	6	1262
3	MIECZYN	2991	188	16
4	JAZWINY	3958	2	1979
5	KRASOCIN	7663	352	22
6	OSIEK	722	6	120
7	LACHOW	7168	287	25
8	BEBELNO	8147	393	21
9	WŁOSZCZOWA	9331	282	33
10	SNOCHOWICE	6301	341	18
11	ŁOPUSZNO	2994	230	13
12	WÓLKA	8420	433	19
13	MNIN	9871	331	30
14	ZŁOTNIKI	9508	405	23
15	WĄGLESZYN	13580	569	24
16	CIERNO	9138	486	19
17	KLUCZEWSKO	9120	493	18
18	BORZYKOWA	6691	77	87

19	SŁUPIA	8781	94	93
20	ŻYTNO	7583	300	25
21	RADOSZEWNICA	8166	299	27
22	KONIECPOL	8550	349	24

Source: Authors elaboration based on the Milk Cooperatives X .

Among production modules of simulation model, following dairy articles' production processes have been distinguished (see table 2)

Table 2. Production modules and its parameters

Article	**kg/day**	Raw milk division used in article [%]
Yogurts and soured milk	19447	11.73
Curd cheese	9205	13.88
Yellow cheese	8345	34.22
Sour cream	7211	17.40
Cottage cheese	5967	5.76
Butter	1359	14.75
Melting cheese	625	2.26

Source: Authors elaboration based on the Milk Cooperatives X .

The delivered raw milk id divided for production needs according to data table 2. Because of model generalization, the butter production module has been shown on the simulation model screen, only. The others modules are presented in general form (compare figure 1).

Distribution modules are composed of four main groups of the customers with the sale volume and delivery cycle (table 3). Percentage share of whole distribution volume is adopted as the distribution modules parameter.

Table 3. Distribution modules and its parameters

	Share of whole distribution [%]	Delivery cycle [days]
Wholesalers	40.5	2
Dealers	27.3	1
Supermarkets	25.5	2
Details	6.7	1

Source: Authors elaboration based on the Milk Cooperatives X

There are two levels of distribution in case of wholesalers and dealers channels of distribution

After data collection and processes identification and recognition, the modules have been introduced to the Dosimis-3 model through the application quite similar to the Windows interface. The modules have been linked according to the processes sequence in the real supply chain. Achieved model is presented on the figure 1.

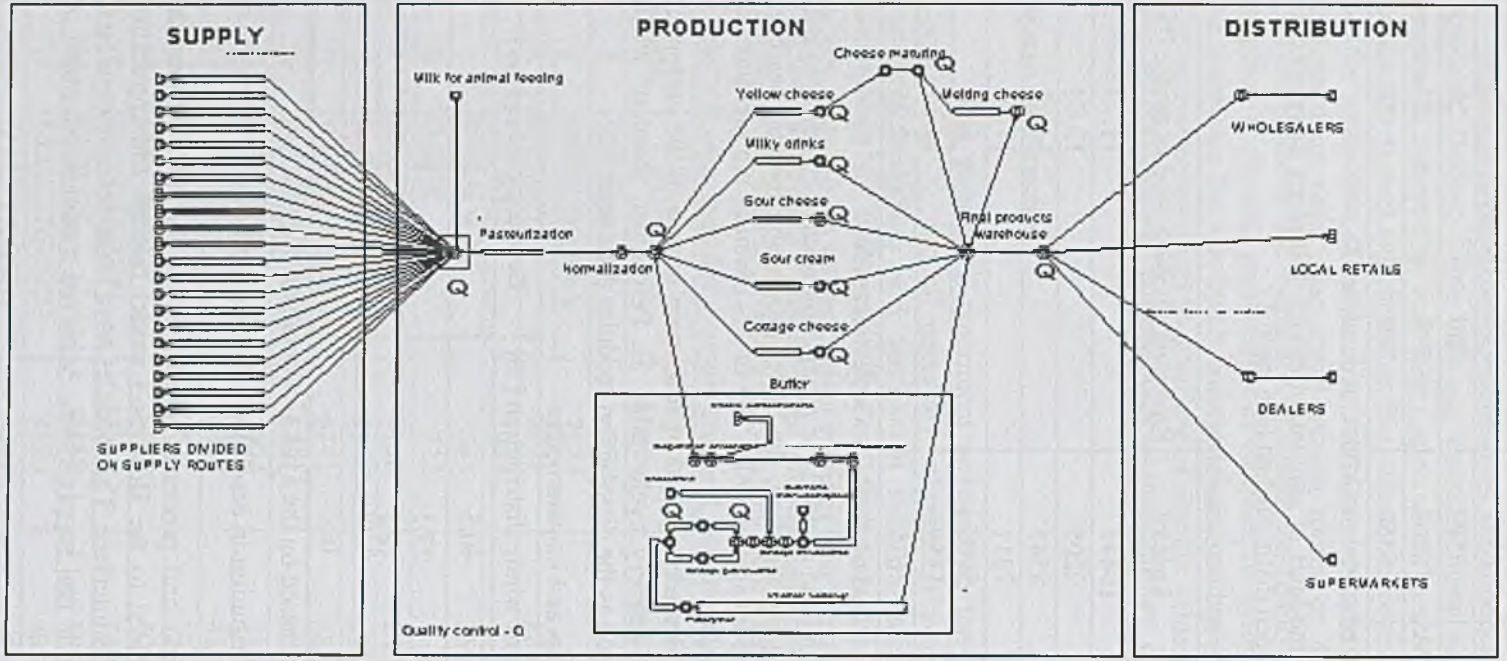

Figure 1. Dosimis-3 simulation model
Source: Author's elaboration

Model consists of 22 source modules, from the modules „raw milk" reach production area. In the beginning, there is raw milk quality control, where milk is segregated on the food milk and milk for the animals feeding (out of quality standards). Next raw milk is pasteurized and normalized according to defined constitution standards. After repeated quality control milk is divided on the particular articles production.

Detailed parameters of the production processes are based on the workstation output. The quality control station finishes every production module. In case of the yellow cheese there are storage module with characteristic parameters describing the maturing process and then quality control module. The yellow cheese fulfilling quality standards are supplied to the delivery and the cheese out of the standards are supplied to the melting cheese production. After packages and remarks control and documents addition, products are delivered to the above-mentioned groups of consumers.

Having designed the model, its correctness and completeness were checked with the help of internal procedures offered by the DOSIMIS-3 package. Next, the parameters of simulation were specified:

simulation time: 30 days

interval statistics: 1 hour

It was agreed that simulation with monthly time intervals would be conducted. This made it possible to carry out many simulation experiments together with the change of input parameters: the amount of raw milk production in supply areas corresponding to fluctuations in seasonal production. The average daily amount of raw milk supply for each month constituted then the input parameters. Simulation experiments assuming increase of raw milk supply to the level of 120% of the current supply were also carried out.

The conducted simulation experiments included changes in the parameters of composition of raw milk distribution for production of particular goods, and changes in the area of distribution comprising increase or decrease in the amount of distribution implemented through different channels.

Simulation results

After conducting consecutive experiments, statistical data describing the results of a simulation were checked. Special attention was paid to time monitoring statistics: occupancy, utilization, latency, and blockades.

The results of the series of simulation experiments conducted with the application of the model, give rise to the following conclusions:

- the time of carrying out supplies from the areas characterised by highly broken up production (average daily supply below 30 liters) delays considerably the time of successive processes.
- the efficiency of current stations of heat pretreatment (pasteurization) is unsatisfactory, causing blockades in 42% of time, which leads to the situation where anticipating units of particular goods show latency between 24% and

52% of time. The longest latency times occur in production units of ripening cheese, whose production technology requires gathering minimum amount of milk in order to begin production process.

- the time of utilization of individual production lines averaged respectively:
- canvassers are the most efficient channels of distribution due to the shortest latency time of products for distribution processes in simulation (34%), despite double-staged distribution process. The results of simulation have shown that the largest share in latency time occurs in case of supported wholesalers – latency time constitutes 69% of total time for this unit.
- increase in the amount of raw milk supply causes increase in the duration of blockades in pretreatment units.
- theoretically, if the efficiency of a pretreatment unit and the amount of supply is increased, then distribution components constitute a "bottleneck" in the flow of goods in a supply chain.

The results of simulation allow for the adoption of a policy of reorganization of processes of supply chain management aiming at:

- increasing the amount of daily supply and decreasing the number of suppliers in current areas of distribution
- changes in the production process, making it possible to increase the efficiency of milk pretreatment processes
- searching for new opportunities for extending distribution, specifically those ensuring faster flow of products (canvassers, wholesale-retail trade networks).

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X. INFORMATION ORIENTED CORPORATE LOGISTIC MANAGEMENT

Beata SKOWRON-GRABOWSKA

Introduction

Globalisation processes, occurring in many spheres of life, especially in information technology, allow us to use the expression "global information society"[1] in relation to many contemporary societies. In an "information" society, information technology establishes bases for new solutions in many different fields of life. One of those fields is management. Decision making is a very important task in management processes. Decisions made on the basis of complete information ensure effective management in all spheres of enterprise operation, especially in logistic management. Logistic management is understood as decision processes including a logical sequence of activities, creating a total concept of logistic actions in an enterprise. Logistic management is realised in properly shaped forms and with the use of steering and control systems.[2] A decision support system may improve the quality of information on which a decision is based. The system may suggest not only a single solution but also numerous solutions of logistics problems.

1. The logistics information system

The part of a corporate total information system applied to prepare logistic decisions and activities can be called a logistics information system. Figure 1 presents the system operation best.

The core of the system comprises three basic elements: input, output and data base. The first element - input - is the activity consisting in collecting data from different sources such as suppliers, customers, company internal records and any kind of data published in the media. The data on a number of suppliers (such as their ability to cooperate and the quality of their products) is essential to keep the balance between supply and production.

Through purchase processes, customers render different data needed for prognosis and decisions on operational level available. The data includes for example the following issues: sales volume, location of sales, etc. crucial for stability between production and sales.

Internal data comes mostly from different reports and concerns corporate costs and income. The data, which is closely connected with logistic activities is

[1] W.T. Kielecki, Informatyzacja zarządzania, PWE, Warszawa 2001, p. 9

[2] M. Sołtysik, Zarządzanie logistyczne, Wyd. Akademii Ekonomicznej w Katowicach, Katowice 2000, p.49

especially valuable. It is also selected by a logistic information system and processed for strategic decisions.

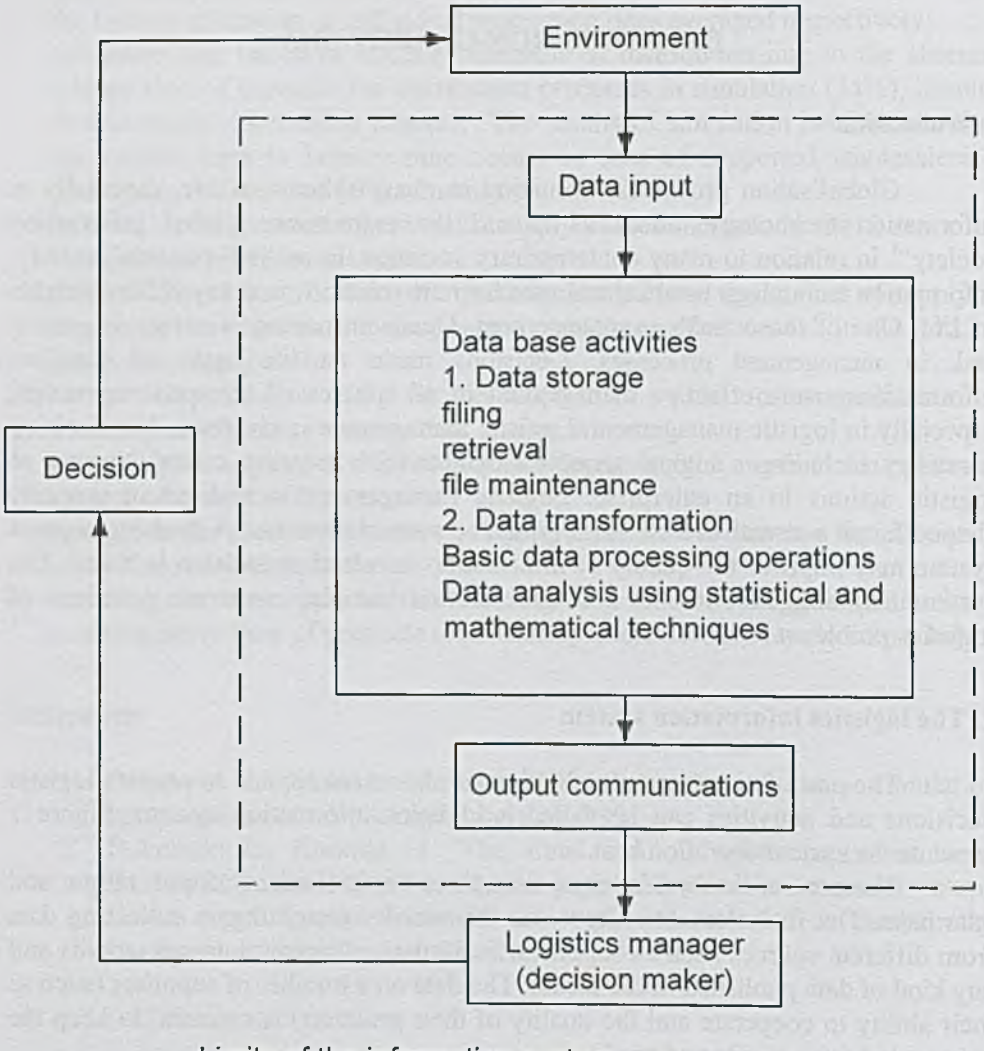

Figure 1 The Logistics Information System
Source: Balou p.150

Published data is a very important source of information for an enterprise. A company must be sensitive and react smoothly to the changes of the so collected information coming from the Internet as well as from other sources such as newspapers, different surveys, etc.

Database Management enables one to convert the data collected into useful information needed in decision making processes. The data significant for logisticians is selected and prepared in case it is needed. Preparation of such

documents as: purchase orders, invoices for customers or freight bills helps logisticians plan and control material flow.

The output are mostly summary reports, reports of inventories and exception reports that compare the desired performance with the actual performance and purchase or production orders.

This kind of a logistic information system does not exist on its own. Information systems are combined in the contemporary economy. Figure 2 shows how the situation has been changing from 1990.

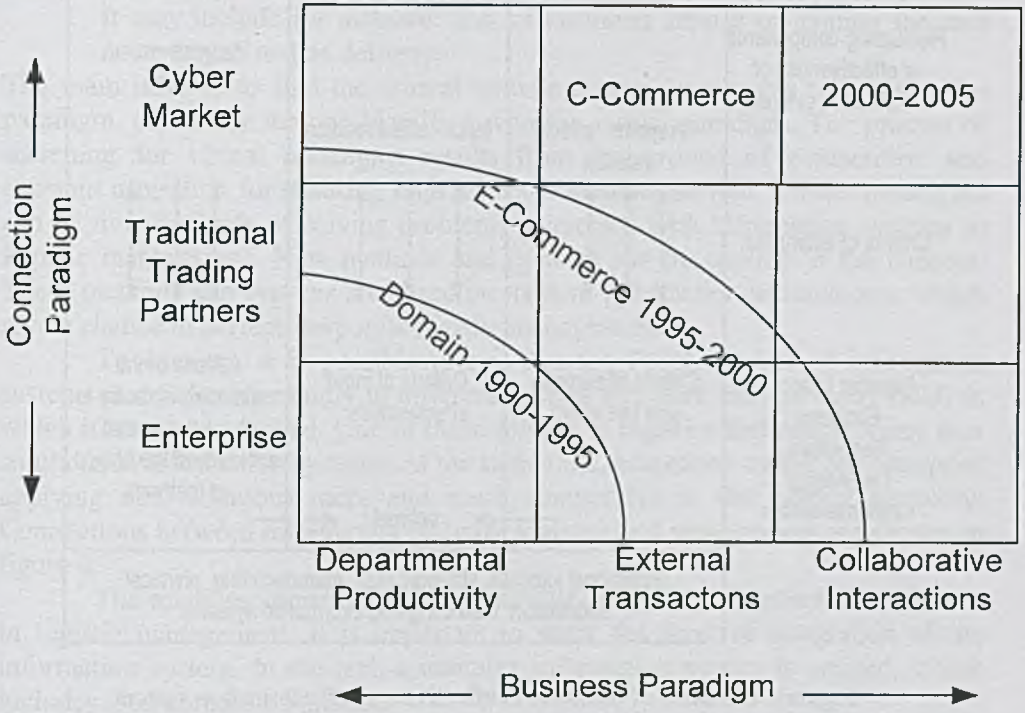

Figure 2 C-Commerce
Source: M. Szmit, Informatyka w zarządzaniu, Difin, Warszawa 2003, p.46

Wide application of the Internet and e-business technologies necessitates much closer cooperation between enterprises. This situation results in the fact that firms search for new solutions in information systems. Present standards of information systems can be classified as multi-service systems. They are able to serve more than one firm. One standard is needed to enable cooperation between companies and allow collaborative commerce to grow faster and more effectively.

2. Effectiveness of information systems and logistics

Processes of logistic information management integrate different functions and systems in an enterprise. Certain subsystems are no longer autonomic due to becoming partially integrated on the first stage. Completely integrated systems,

which cover all organizational units of an enterprise, are created on the second stage. The same integration processes take place in logistics subsystems. Information that is gained from different data bases such as supply, manufacturing, distribution, transport and storehouse of materials, products and used materials helps create complex information systems in enterprises. (Figure 3)

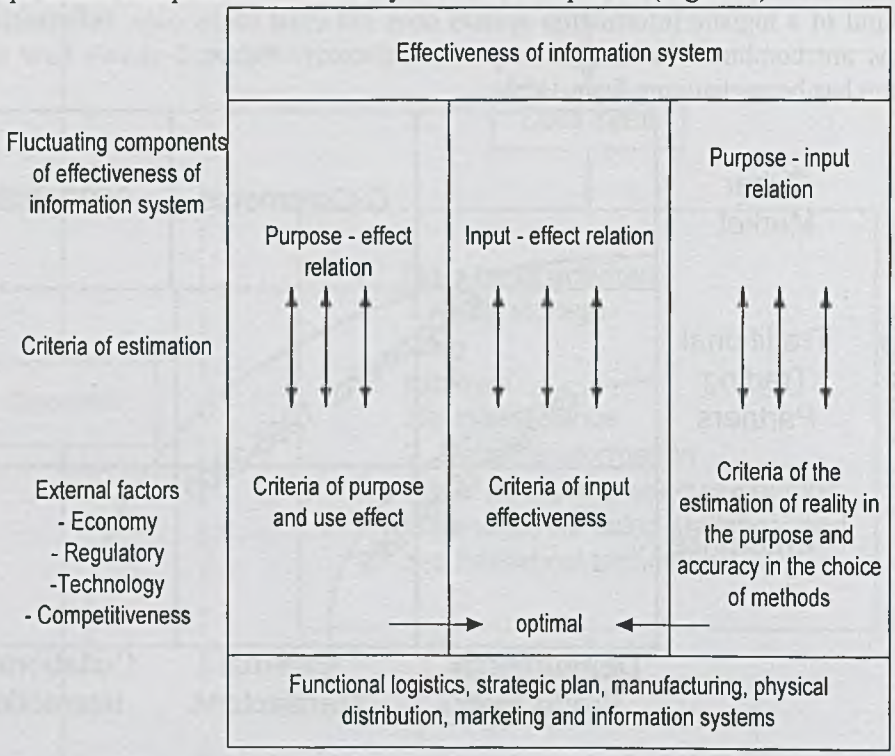

Figure 3 Elements of formulas in effectiveness of information system
Source : author's own study on the basis of P. Blaik, Effectiveness of Logistic Processes with Strategic Aspect, Conference Materials, Logistic Library, Poznań 1993; W. Copacino and D.B. Rosenfield, Analytic Tools for Strategic Planning, International Journal of Physical Distribution and Materials Management 15 No3 (1985) p. 48

Different criteria are chosen to show the effectiveness of an information system. The criteria are divided into three groups: purpose, input and the relation between purpose and input. Internal and external factors of an enterprise and its environment influence the selection of criteria. They are chosen so as to be optimum. The information flow between logistics, distribution and marketing sections, its quality and speed influence the effectiveness of the information system most.

Integration of information systems in logistics management results from competitive conditions of enterprise operation. These conditions necessitate one to develop the right corporate management strategy, concerning especially logistic management. Enterprise strategy should also take into consideration virtual paradigms.

It is possible to point out virtual paradigms in logistics information processes. A virtual paradigm becomes established when there is a set (conforming to epistemology and logic), which allows to formalize it and a weltanschauung that allows to create a relative paradigm if such a situation occurs. In this way, a virtual paradigm is a formalized weltanschauung. A virtual paradigm may become a new paradigm if the following conditions are fulfilled:

- adoption of strategic assumptions,
- determination of the critical volume in the sphere of logistic management. It may include for instance: cost of customer service or gaining the data necessary to realize delivery.

The main issue is to find the critical volume during the process of creating the paradigm, especially the one identified with the virtual paradigm. The process of searching for virtual paradigms results from the growth of competition and constant aspiration for ensuring high level of customer service. Virtual paradigms can be new methods of solving problems connected with information systems in logistic management. New methods and systems can be applied in the concept. These methods and systems are based on modern information technologies, which give a chance to perfect corporate logistic management.

To sum up, it is possible to say that the Polish market of information systems is developing rapidly in different spheres but there are still many fields in which it may be improved. One of these spheres is logistics that adapts many new solutions in information systems. At the same time, adaptation makes the enterprise applying new solutions more and more competitive in the market economy. Connections between information systems, logistics and management are shown on figure 4.

The relations shown on figure 4 indicate the role of an information system in logistic management. It is important to show the level of integration of the information system. In the end, a complex information system is created, which includes total corporate logistics.

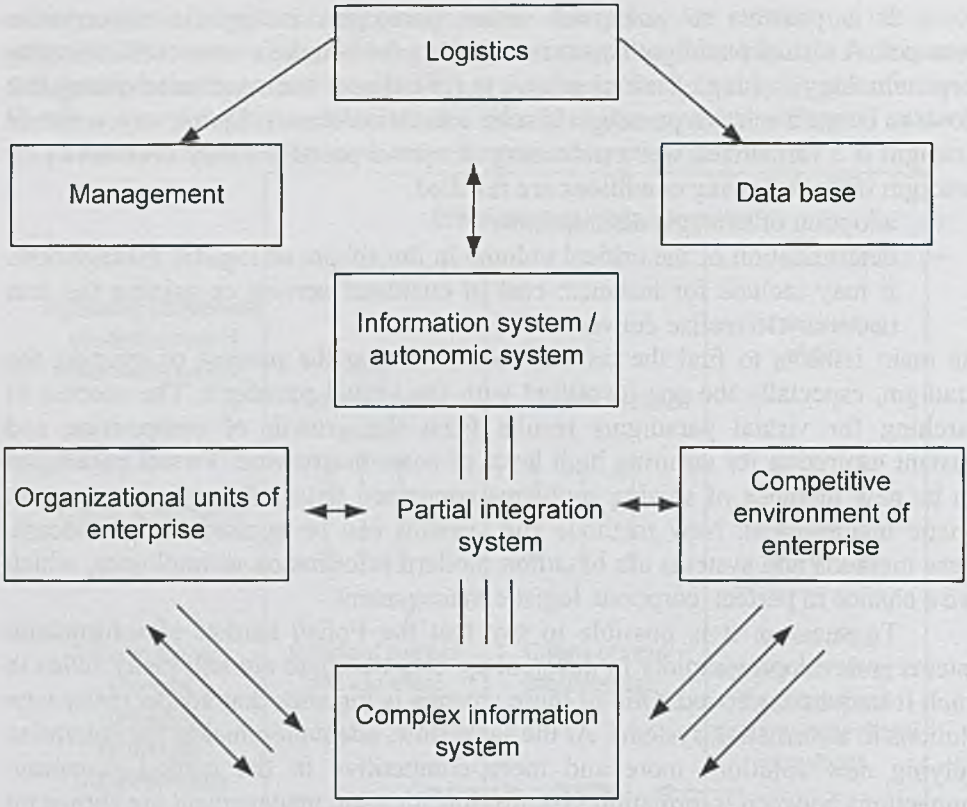

Figure 4 Integration processes of information systems in logistics management
Source: Author's own study

3. Practical aspects of applying information systems in logistics

Business practice shows possibilities of applying new techniques in solving logistics issues determined by information systems. A serious logistic problem is how to prepare sales properly. One of many possible solutions is the introduction of an algorithm of the sale process. In order to prepare such an algorithm, it is necessary to carry out certain analyses. They concern optimizing the transfer time of information on volume and structure of production from the production line and from storehouses to the sales department. It is necessary to:

- estimate the time of different activities in the above mentioned departments,
- determine the sequence of activities, which allows to minimize the time of information transfer while ensuring information credibility.

The sequence of activities is presented on figure 4 and in table 1
It is possible to introduce two methods of transferring information to the sales department. The first one is determined by points a,b.d,g,h and the second one by points a,b,c,e,f.

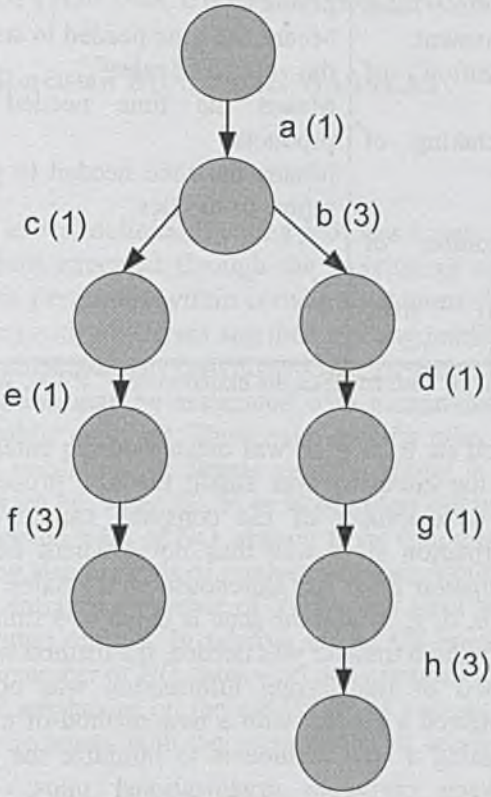

Figure 4 Two methods of transferring information from the storehouse to the sales department

Source: A. Nowicki " Informatyka dla ekonomistów" PWN, Warszawa 1998, p. 293

Both methods of transferring information are clearly shown on figure 4. Table 1 includes specification of activities undertaken in the enterprise on the way from the storehouse to the sales department.

Table 1 Activities in the processes

name of activity	meaning of activity	time unit
a) delivery of products to the storehouse	Means the time needed to take over ready products to the storehouse	1
b) creating a storehouse list	Means the time needed to update the situation in the storehouse	3
c) sending notification	Means the time needed to send a document concerning the volume of the last delivery to the storehouse	1
d) sending the storehouse list	Means the time needed to send an updated list of products in the storehouse	1
	Means the time needed to sell	3

	to the sales department	products Means the time needed to stocktaking	1 3
e)	realization of sales	the volume of sales Means the time needed to sell	
f)	stocktaking of sales	products Means the time needed to prepare a report from sales	
g)	realization of sales		
h)	report from sales		

Source: A. Nowicki " Informatyka dla ekonomistów" PWN, Warszawa 1998, p. 294

The method (a, b, d, g, h) was created during enterprise operation. At the beginning, when the company was small, the sale process did not need to be formalized. The development of the company caused increased demand for information. Information flow was thus not efficient enough. The method of transferring information from the storehouse to the sales department consists of five junctions (a, b, d, g, h) and the time is equal to 9 time units. Because higher efficiency of information transfer was needed, the method was changed.

The method of transferring information was observed by an outside company. They offered a project with a new method of transferring information. The aim of designing a new method is to optimize the process of transferring information between corporate organizational units. The new method of transferring information will consist of four junctions (a,c,e,f) and six time units. Figure 4 above presents both variants of the algorithm of transferring information from the storehouse to the sales department. The algorithm was chosen to present the problem due to its clarity. This algorithm is a good example of information processes of corporate logistic management.

Information systems can be recognized as basic fields that allow management and logistic processes to be more and more efficient. Globalization processes in economy result in greater complexity of information systems especially as far as logistic management is concerned. It is very important to mention the issues related with virtual paradigms and logistics. All the above discussed problems have also strategic aspects.

XI. INFORMATION SECURITY IN VOTING SYSTEMS

Roscislaw BUŃ, Janusz MARECKI

Introduction

According to a lexical definition, voting provides a way of choosing candidates for public functions executed through the election of certain individuals. Moreover, voting can be performed within certain institutions (board of directors, councils, assemblies etc.) with a different aim then electing public representatives.

Democracy requires constant calls for voting. In general one of many options is selected. An option may be associated with a candidate or a resolution. Voting may be either public or secret. There exist specific rules about the validity of voting and problem resolution. In classic systems voting is legitimized when there is a so-called quorum i.e. when ½ , ⅔ or ¾ of voters are present. Each voter can either: choose a decision YES or NO, abstain from voting or make an invalid vote. The result of voting also depends of established rules; Voting can be absolute or relative. In absolute voting the number of YES votes must be greater than the number of votes with other options. In relative voting the number of YES votes must be greater than the number of NO votes – all other options are passed over.

There is a great emphasize on the credibility of voting. The voting result should be accepted by the voters with the preservation of secrecy of each voter's choice.

1. Problem formulation

Can the voting committee announce the voting result without the possibility of identifying the YES and NO votes? Can the voters check the credibility of voting results? Can the voting be performed using the Internet? Will crypto-voting systems be used by councils and other institutions?

Let's consider a crypto-voting system for the Board of Shareholders (BS). Each voter can have a different number of votes depending on the number of shares he possesses. In general case a voter is not obliged to choose the same option on each of his votes, for example he can use some of his available votes for an option YES and the rest for NO. The set of authorized voters is known and so is their number of shares.

Assume the crypto-voting system should fulfill the following postulates:

- The voting process is secret, executed using special cards. A voter picks an option. This option is then sent to the Voting Committee is encoded form. Neither a voter nor the Voting Committee knows the secret voting code.
- The Voting Committee introduces the encoded data to the computer program provided by the Certification Institution (CI). CI knows the secret voting code.
- The Voting Committee receives the voting result from the CI in a BS decision form.

The above system guarantees the secrecy of voting. In addition it should resolve the following issues:

- The voting result can be presented with an adjustable level of voting details:
  - The number of valid votes
  - The number of votes for a chosen option
  - The number of votes for each option
  - The option choice for each voter.
- Each voter has a possibility to verify the authenticity of his choice by asking the CI.
- Each voter's claim about falsifying his vote can be rejected.
- A claim about falsifying the voting can be rejected.

The system which fulfills all these postulates is described below.

2. Voting system architecture

Let's consider the organizational rules of a local voting system (for a local computer). Analogous rules will be used for a network voting system (based on the Internet).

Suppose the number of shares S corresponds to the number of voting cards. Also, each voter can pick one option from the pool of N possible options. A draft of a voting card number Id is depicted in figure 1.

Option 1	*<option description>*	*<Secret integer* 1,Id >	Id (Card Id)
Option 2	*<option description>*	*<Secret integer* 2,Id >	Id (Card Id)
.....	.....	.....	.....
Option N	*<option description>*	*<Secret integer* N,Id>	Id (Card Id)

Figure 1 Voting card number "Id"

Voting card has a public description of every available option and a stub which incorporates the secret number of each option and the card Id number. The secret integers are generated by the CI before the voting and may be hidden by a cover. A voter after having chosen an option should rip off a secret part corresponding to it. Now, since all he has is a scrap with two hidden numbers he can scrape off the cover. If a voter is not suspicious about the authenticity of the voting system, he can give his scrap immediately to the Voting Committee. In other case he can remember these two integers for future verification. It is obvious that even if somebody secretly spots these numbers, he will not be able to draw a chosen option from them.

The organization of the voting process in a local system has the following course:

- The CI accepts a demand to make:
  - S voting cards with appropriate list of N options
  - A computer program to calculate the results of the voting

- The Voting Committee receives the voting cards and the computer program which can verify the authenticity of voting cards.
- Voting Committee randomly distributes voting cards to the Board of Shareholders proportionally to the number of shares they possess.
- Voters rip off a scrap of a voting card which corresponds to their chosen option. Suspicious voters can remember their card and option secret numbers. Next, each voter passes its scrap to the Voting Committee.
- The Voting Committee introduces the votes to the computer program which eliminates non-authorized and multi-choice votes matching them with its list of voting cards numbers.
- The computer program presents the voting result to the Voting Committee with a desired detail level.

Since the CI is the only institution which possesses a key to match vote secret numbers with corresponding options it can deal with more detailed accusations about the voting:

- A voter can check the correctness of his vote thanks to his voting card number.
- The CI can infer which option was chosen on each voting card. It can show these results to the voters, yet cannot match votes with voters.
- The CI can report the results of the voting with a desired level of details.

The mathematical bases of a crypto-voting system are as follows: the Certification Institution (CI) sets the table T of distinctive integers:

$$T = [\, t_{c,s} \,] \qquad \begin{matrix} c = 1, \ldots, C \\ s = 1, \ldots, S \end{matrix}$$

where:

S is the number of voting cards
C is the number of options for this voting.

After the voting the computer program checks the number of collected integers for each row c = 1, ..., C. Now the system knows how many votes were given to each option and can present the results with a desired detail level.

In case the system receives more than one number from the same column it means that somebody picked more than one option and the vote is discarded. If the system does not receive any integer for a column s it means that the vote number s was not given.

If a suspicious voter wants to check the correctness of his vote he should provide the CI with the number s of his voting card. The CI then looks at integers at the column s in the table T and tries to match them with some collected integer on a voting scrap. If such a match is found in row c than the suspicious voter receives an answer that he voted for the c^{th} option.

2.1 The completely secret voting system

When we look deeply into the crypto-voting model presented so far we can see that its biggest disadvantage lies in the fact that there is no way to present the relative results of the voting without knowing the number of votes for each option! In other words, given a voting with two options: YES / NO it is not possible to present the voting result without knowing the exact number of votes for YES and NO.

The crypto-voting system with complete secrecy constitutes a solution to this problem.

In a completely secret voting system there is also a Certifying Institution (CI), and a Voting Committee (VC). After a voting has finished neither of these institutions alone will know the results. Instead, a special conversational procedure between CI and VC will have to be put in place in order to let VC know the relative result of the voting. When this conversation will have finished, the voting results will still be unknown to the CI.

Assume the number of shares (and also the number of votes) is S and the number of shareholders is L. We will note s_i – the number of votes available for a shareholder i. With these assumptions, the formula below must hold:

$$s_1 + \ldots + s_2 + \ldots + s_L = S$$

We will focus only on a relative voting system with two available options: YES and NO. Before the voting takes place, CI has to prepare 2*S distinctive prime number divided equally into two sets S_Y and S_N:

$$S_Y = \{y_1, y_2, \ldots, y_S\} \qquad S_N = \{n_1, n_2, \ldots, n_S\}$$

Next, the CI calculates two values:

$$Y = y_1 * y_2 * \ldots * y_S \qquad N = n_1 * n_2 * \ldots * n_S$$

Finally, the CI creates S voting cards of the form depicted in figure 2.

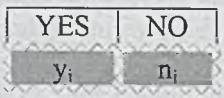

Figure 2 Complete security voting card number i

Fields y_i and n_i are covered and need to be scraped off to become visible. When the VC receives all voting cards from the CI, the voting can begin.

During the voting each voter "i" receives s_i voting cards. Then for each received card he rips off the covered number under YES or NO (according to his choice) and gives it to the VC. It is possible for the voter to have different choices for all his voting cards.

After the end of the voting, the VC collects all the votes from the pool and scraps the cover in order to see the hidden numbers. Although everyone can see the

number, nobody can guess what information is hidden in them. Neither the result of the voting nor even an individual vote is known.

Now, suppose the VC has S numbers: $g_1,..., g_s, ..., g_S$. Let's mark $p = \left\lfloor \frac{S}{2} \right\rfloor + 1$.

The following rule holds for the relative voting:

The result of the voting is YES if and only if among the numbers $g_1,..., g_s, ..., g_S$ there are p numbers representing a vote YES. (The similar rule applies to NO value)

The conversational procedure aimed at deriving the result of the voting is as follows:

1) VC creates all possible p-element subsets of the set $\{g_1,..., g_s, ..., g_S\}$. Let's mark them as $G_1, ..., G_p$.
2) For i = 1, 2, …, p do:
   - ☐ VC calculates $J_i = \prod_{g \in G_i} g$
   - ☐ VC **sends** J_i to CI
   - ☐ CI checks if J_i divides Y. If so, the result of the voting (YES) is **sent** to VC
   - ☐ CI checks if J_i divides N. If so, the result of the voting (NO) is **sent** to VC
3) If all sets G_i have been analyzed and no voting result was received it means that the result of the voting is a draw.

The correctness of this procedure can be proved in the following: if J_i divides Y then J_i is a multiplication of prime numbers from the set S_Y, hence J_i was created from the set of p prime numbers from the set S_Y. Consequently the voting pool had at least p votes YES, and the result of the voting must be YES.

The overall number of votes for YES and NO can be calculated only if VC sends the pool of votes to the CI.

3. Internet voting system

In Internet version of a crypto-voting system voting cards should be transmitted from the Voting Committee to each voter as encrypted e-mail messages. Option chosen by a voter should be sent back to the VC also as an encrypted e-mail. The exchange of information between the VC and a voter must ensure authenticity and confidentiality because:

- Each voter must be sure that his voting card (represented by an e-mail) was sent by the authentic Voting Committee. Only than the voter can chose an option and send it back to the Voting Committee.
- Each voter must be certain about the confidentiality of his choice i.e. the VC should not directly know the choice of the voter. In addition, the VC must be certain that it received a vote from an authorized voter.

Confidentiality and authenticity of transmitted information in a crypto-voting system can be achieved using a RSA secret code with asymmetric key. Thus, the Voting Committee should have its private key in addition to its public key. Similarly, each voter should have both private and public keys.

Transfer of information from the Voting Committee to the Voter follows the following schema:

- VC encodes the voting card using its private key (D_C).
- VC encodes the cryptogram using Voter's public key (E_V).
- Encoded information is sent to the Voter.
- The Voter decrypts the cryptogram using its private key D_V.
- The Voter decrypts the cryptogram using VC's public key E_C.

Transfer of information from the Voter to the Voting Committee follows the analogous schema:

- The Voter encrypts the information using its private key (D_V).
- The Voter encodes the cryptogram using VC's public key (E_C).
- Encoded information is sent to the VC.
- The VC decrypts the cryptogram using its private key D_C.
- The VC decrypts the cryptogram using Voter's public key E_V.

4. Final remarks

In the age of globalization of economic and social life there is a strong need for crypto-voting systems development. For the realization of this goal both information security and law legislation problems have to be taken under consideration.

Crypto-voting system based on a local computer must ensure the security of data (votes), computer program functionality and voting results backup. Internet based voting system must also provide solutions for authenticity and confidentiality during data transmission between the voting committee and a voter.

The specificity of crypto-voting systems consists in ensuring the secrecy of a voting i.e. presenting a voting result without knowing the individual choices of voters. In addition, such a system should ensure voting credibility through the Certifying Institution able to publish the voting results with a desired detail level.

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XII. INTEGRATED COMPUTER SYSTEMS SELECTION PRINCIPLES IN ORGANISATION

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Introduction

Successful implementation of a computer system into a company – whether for the first or subsequent times – is an organisational shock, which requires numerous direct and downright choices. They depend on the way taken, the so-called "informatisation" and the system development life cycle with it tightly connected. The choice is made in the first and all following phases, where there is still place for it or where there appears the necessity to introduce alterations, modifications or even reengineering. Never is the selection process simple and the considerable amount of "ready" information systems, which are available on the market, does not make it less difficult. It becomes far more complicated when a great deal of money comes into play like in the implementation of complex, integrated systems supporting MRP II/ ERP class management.

This paper purpose is to try and work out a formal and systematised methodology of computer system selection for complex systems, which could be used, at last partly, to solve the above presented problems. For this methodology practical use presentation systems Baan IV and R/ 3 data were taken. Described case was examined on medium size company.

In the course of "informatisation", at the very beginning, two points of view on the introduction of an information system into an organisation should be taken into consideration. The first one concerns the way "informatisation" is carried out. The existing base of software systems and software development methods used in a company determines it. Here we should consider three situations (3):

The first situation – it is possible for have a complex management information system constructed by specialised companies - system professionals (selected are: the company, methodology of system production and system itself),

The second situation - information systems built in the past by one or many different firms can be integrated (selected are: an integrator, method of integration, integration area),

The third situation: it is possible to have the already in place and previously constructed systems implemented (selected are: systems, methods of adjusting the systems to the organisation or adaptation) support system.

Due to organisational and legal reason there is the place for, at least, three possibilities:

The introduction of a ready, standard system for conventional information solutions (warehouses, wholesale firms, classic finance – account systems, human resources management systems, simple sales systems, unique systems for exceptional trades etc.) with the evasion of complicated tender procedures.

The system is applied to small firms, typical in their line of business, with no complicated external connections or to firms at the beginning of their activity. The initial selection is usually made on the basis of market analysis (press advertisement examination, information collecting from the trade community, situation analysis of alike local or foreign firms as well as systems and equipment exhibitions). The first choice is made mostly on the financial criteria basis or the individual, subjective opinions of competing or cooperating in the same line firms. The ultimate choice of a system is made after various systems presentations (at the firm or deliverer's headquarters) rarely by deep analysis of the existing base of software systems. This procedure has numerous advantages: quick choice, considerable simplicity of decision taking and reduction of selection costs to a minimum. A significant drawback is that it can be applied to the situation that had been previously recognised. There is also a high risk of the inaccurate selection of a system, which would demand great changes later on or even rejection of the system.

Simple tender procedures – applied to small firms and small and average size organisations with whom letters of enquiries are a must due to the in force law or customs (this touches both public and government institutions). The procedure scheme depends, in terms of money, on legal regulations. Preliminary analysis of requirements, characteristic for a given institution only, is done. Considered is the possibility to take advantage of the three previous presented situations.

System creation, integration, "ready" system implementation. The organisation, which introduces the information system, sends out letters of enquiries to the chosen prospective system deliverers (enclosing the analysis of specifications). The selection of the system is done on the basis of the replies to the letters of enquiries. In this method the precise letter of enquiries and clear selection criteria conditions the right choice of the system.

Complex tender procedures – used for medium or large-scale systems, either created or "ready" integrated systems. It is necessary to go through formal tender procedure of several stages because of the following reasons:

- High costs of the investment,
- Complicated functional requirements,
- Co-ordination of several project teams is necessary, as the system cannot be introduced by a small computer company,
- "Ready" integrated information systems on offer to clients require numerous modifications to meet their requirements,
- There is often the need for co-ordination of reengineering actions for the system implementation with the help of specific, indispensable tools supporting this process.

From the above discussion it becomes evident that decision taking, at the preliminary stage of optimal computer systems selection and implementation is in case of small and medium, typical systems frequently intuitive, based on experience of a team of specialists assigned to launch the project or other people's intuition, or it is random. Unfortunately, as the presentation of the typical situations in which the selection is done shows the choice of an information system made

right at the very beginning of the selection process has an enormous influence on the ultimate system selection. All decisions that follow result from this first one. The most complicated procedure accompanies the selection and implementation of great information systems into large organisations. The other systems are their simplified versions. Table 1 shows main stages of this procedure, its short characteristic, the description of selection possibilities, kind of criteria and possibilities of decision taking.

1. The requirements of a comparing method model

The so – far presented analysis show that the elaboration of information systems comparing and evaluation methodology model is necessary. Constructing the model the following criteria (the model features) should be taken into account:

- Advanced diversity, which makes the formation of the mathematical model difficult,
- Hierarchy, decisions taken at managerial level influence those at lower level,
- Considerable autonomy of particular criteria groups until the time of final decision taking,
- Time specification while counting validity criteria,
- Money criteria expressed in point scale,
- Preferences of prospective system customers,
- Degree of risk taking.

The ultimate results presented in point scale can be compared in their absolute or standard form (so that they could appear on a scale within the limit (0,1). It is suggested in some papers (1) that a given organisation should assign particular criteria a degree of importance so that employees' preferences could be reflected and compare them to other criteria of the same level.

The criteria evaluation is then the weighted mean of sub-criteria evaluation. Taking into consideration all the above suggestions it can be said that the model will make the compound of criteria weighted sum on particular levels. Comparing the total amount of points of particular criteria evaluation will make the choice of information system. If a point scale in criteria evaluation is regarded as restricting in information systems evaluation then the optimum criteria evaluation can be applied. It will allow for users preferences consideration, functional criteria maximisation, and costs minimisation.

Mixing up criteria is also possible followed by Pareto-optimum solution designation. In reality, however, the answers to the letters of enquiries are taken into consideration when it comes to decision taking. They are usually divided into the following criteria groups:

- functional (basic system functions, possibilities of reports writing etc.),
- information (interface, security, enter – exit data base),
- economic (financial and economic ratio, organisational ratio).

Table 1. Stages of information system selections – project execution

Procedure stages	Characteristics	Selection possibility	Types of criteria	Decision making
A time is to launch the	A team is appointed and so is its leader tasks are given Responsibility is assumed Methods of control are specified	The choice from among the employees Recruited are outside system professionals A mixed team consisting of both: the company's employees and outsiders is formed	Knowledge of information system Long period of work in a company Opinion about a consulting agency	A team – based evaluation of skills and abilities. An interview A contracting party opinion A qualifying test
A fast draft of the project's schedule is established	A plan of team's work is prepared	The order of tasks is decided upon Dead lines are set and so are simultaneous activities	The project is compared with its counterparts implemented into similar organisations at home or abroad experts' estimations	Manager's arbitrary decision The outcome of the team discussion Superior organs decision
The general outline of system development is prepared	The already in place computer system (its software, functions, hardware, networks) is analysed. The ultimate system main elements plus their connections are shown (the system functions its subsystems, and data base structure are presented, input/output characteristics control system specifications as well as defence system	A uniform description of selection possibilities (pattern) allowing for the comparison of different systems, with the application of the same criteria, is elaborated. The development model may concern: - repeated situations in a company - modification execution - restructuring or reengineering conclusion may be included in the letter of enquiries	The firms current situation in comparison with situation of similar structure organisations – self analysis Experts' insight into the situation Conclusions from mixed teams' analysis are drawn. At this supporting and informative stage data for further decision taking is collected	Decision concerning the direction of development (Deriving from a conceptual plan) is taken by the organisation executives after they have given team's conclusions careful consideration Attention; system requirements can be formulated so that they would suggest none of the three mentioned methods; decision is based solely and

	mechanisms are described)			entirely on the content of the answer to the letter of enquiries.
The analysis of the prospective providers and executors of the system	Selection of the best version from among existing integrated systems available. The prospective suppliers are short listed up to several dozen.	The analysis of newspaper advertisements and internet pages, opinion of scientific environment experts' opinion, participation in conferences, meetings and open displays opinions of the system current users. Conclusions are drawn on the basis of personal experience in the system use in some other organisations.	The basic selections criteria are as follows: - the sale of information systems - the sale of integration services - the rate of sale - the number of systems on the market - system maturity - specialisation in a given line of business - forms of technical support, technical and economic potential	Discussion within a team appointed to project execution. Particular system assessment is presented on point scale. Number of points gives a position on a scale – system of the least points is chosen. Arbitrary decision of the team's head Consultative body ranking Advisory offices ranking.

Procedure stages	Characteristics	Selection possibility	Types of criteria	Decision making
A letter of enquiries is written and sent out	Formal and legal requirements are worked upon Offers' evaluation procedure is prepared A letter of enquiries is written and sent out.	The letter should contain: Formal requirements description of the exiting computer system Assumptions for future system (range, size, algorithmic, narrow bottle neck, data conversion organisation changes, type of computer and telecommunication equipment). Assessment mechanism – highly univocal and universal	Types of criteria: -organisational (to what extend the system is used and taken advantage of by the staff, organisation is integrated: service support) -economic (programming, equipment, integration and training costs; organisational and economic effects, profit account – profitability rate, amount of profits earned -technological – precision reliability, safety, ability to be scaled, company existing platforms, graphic interface - psychological – degree of system acceptance by employees, system integration barriers, methods of system threats' elimination - functional – range of functions performed by the system.	All criteria can be grouped Quality and quantity criteria evaluation – not all criteria can be measured comparatively Criteria can be equal or preferential (the fundamental ones are of the greatest importance)
Offers are assessed and analysed	Replies to letters of enquiries are analysed according to the accepted criteria The number of suppliers is shot listed to 2-3 firms	The previously accepted mechanism allows for objective secondary selection of systems	Enumerated above	Conclusions are drawn at the team meeting Controversies arise when quantity evaluation of particular system shows similar results or when there

				is no uniform evaluation mechanism
Demonstrations and reference visits are arranged	Organisation employees are appointed to take responsibility for system modules assessment On the basis of formal requirements they prepare a list of questions for the suppliers to give answers to. A schedule of demonstrations is prepared, their place appointed	Managers of particular departments are appointed or people with the longest work experience or greatest familiarity of the organisation The presentation can take place at the organisation headquarters, the visit in an organisation of the closest possible profile	The criteria for presentation assessment are usually subjective: - evaluation are mainly communication means with the system user and the presenter's appearance - functionality and how to assure it. It is advisable to set the score for the position a given information system occupied during the presentation which will compare favourably with its valuation in a letter of enquiries	Reference visits make a further element in information system evaluation having considered the results of both the presentation and reference visit The ultimate choice of the company introducing the system should be done: Reassessment of the results, differences identification, the ultimate choice of the most preferable system. All criteria estimation results should be written in a final document.

Procedure stages	Characteristics	Selection possibility	Types of criteria	Decision making
The ultimate choice is made	A report is prepared by the project team A decision – taking organ consisting of the representatives of the board of directors, supervisory board, trade unions or „informatisation" commission is formed. These bodies are in the possession of funds and formulate the organisation policy.	Of primary importance in decision taking are the conclusions in the final document elaborated by the „informatisation" team. It may happen, however, that decisive bodies or their influenced members have their own preferences and will try to block decision – taking.	It is hard to enumerate any selection criteria as at this stage all possible criteria should have already been stated in a final report	The arbitrary decision is taken by the president or managing director or it is taken in an open vote or secret vote of the whole decisive body or by an appointed commission
Project execution for a contact Is signed a preliminary implementation Project is elaborated	Method systematic of project implementation, from the point of view of organisation, which is being computerised, is elaborated. (stock-	If they have not been considered so far, additional conditions, connected with signing the agreement, should be now paid attention to. These concern: - the kind of licence and method of its obtaining for	Any criteria of choice that show up at this stage concern additional requirements of system execution. Nevertheless they have an enormous effect on the costs of contract execution. Before signing an agreement it is necessary to	Successful negotiations (conducted skilfully) as well as good knowledge of the computer market may give extra discounts in contact execution. Similar actions can be taken at earlier stages (these should support

	taking, examining the possibility to adjust the suggested systems to the firm current situation, pointing out the firm's specific requirements necessary to meet .The methodology of data conversion is specified A plan of the system implementation procedure is prepared for optimal timing (the supporting role of Gantt's diagrams or Pert network plans) some of the activities can and should be carried out simultaneously.	the system and user programming - the possibility and procedure of system upgrading - the method, time and conditions of warranty and post warranty service - the procedure of possible system modifications introduction	come back, one more time, to the terms of payment presented in an offer as they are now precisely stated. Payment is spread over a period of time. Special attention should be paid to too low costs calculated that may result from outdated technology, a desire to enter the market at all costs and wish to monopolise market niche or make up for the lost position on the competitive market.	enquiries) in order to win when negotiating particular offers. It is essential to realise that large-case projects demand costs bearing which is necessary to assure the right quality of contact execution. Giving up some actions like for example training, will only do damage to the contact.

Source: Author on the basis of (3), (4), (5), (8)

2. The results of finance and accounting modules of BAANIV and R/3 systems comparison

Simplified outcomes of criteria assessment comparison are applied in existing information system validation. A full version of this comparison for finance – accounting subsystems of systems BAAN IV and R/3 is presented below. The assessment varied according to three gradation stages:

"0" - when a given feature is not present,

"0,5" - when the feature's requirements are met partially,

"1" - when given feature is fulfilled.

Eight basic finance-accounting modules can be distinguished in both systems: a general ledger, costs, liabilities and debts, assets, cash and bank, offers and orders, reporting and budgeting.

Assessment presented in points concerns particular function groups as well as functions differentiated in each group. All functions have been examined, only a few chosen functions will be presented below by way of example.

Table 2.Exemplary functional criteria of finance-accounting module assessment

CRITERIUM: GENERAL LEDGER	Baan IV	R/3
Chart accounts management	10,5	11
Chart of accounts structure may be defined by the user	1	1
Accounts that meet a given condition can be chosen	1	1
An full name of an account is written down on at least 50 signs	1	1
A contracted name of an account is used for the account identification and searching	1	1
The account can be assigned to particular groups of accounts	1	1
Balance, profit and loss, out of balance accounts	1	1
Synthetic, analytical accounts	1	1
Fiscal, non-fiscal accounts	1	1
Settlement, balance accounts, profit and loss accounts	0,5	1
Active, blocked accounts	1	1
Quality, quantity – quality, quantity accounts	1	1
Functional criteria in the entire finance-accounting module:	248	279

Source: Author

Below in Table 3 the results of assessments for computer criteria divided into 5 groups: input/output program mechanism service, database service, communication means, safety and technical means, are shown.

Table 3. Information criteria

Type of criteria	Baan IV	R/3
Input/output service	9	10
Data base service	7,5	7
Communication means	4	4
Safety criteria	7	7
Technical	4	4
Total	31,5	32

Source: Author

In table 4. economic criteria validation for both systems is presented. They slightly differ from the previously enumerated as there appeared the criteria of estimated costs among the wholly measurable criteria. They can be manipulated to a certain degree, so can be the time and certainly of system implementation.

Table 4. Economic and organisational criteria

Minute criterion	Baan IV	R/3
Approximate costs	Lower (1)	Higher (0)
Implementation time	6-18 months	3-36 months
Implementation certainly	Less (0)	More (1)
Warranty safeguard	1	1
Service	1	1
System modernisation	1	1
Phase implementation	1	1
Training providing	1	1
Precisely stated implementation schedule	1	1
Documentation in Polish language	1	1
Total	9	8
Points collected from all tables	288,5	319

Source: Author

The above comparison shows slight superiority of computer programming R/3 over Baan IV. It has to be remembered, however, that this refers only to the lower level of their assessment. Each fulfilled criterion is worth 1 here. Functional criteria, especially those with the greatest amount of minute criteria, clearly predominate. This may indicate that criteria connected with a given characteristic feature, which we least care about or which is of smallest importance, like for example, reporting, prevail in functional criteria. It is not unlikely that additional criteria and a specific situation in which a system would be implemented could ultimately change the situation. A considerate results standardisation could become the first step. Let's assume that the criteria presented in a functional criteria table will be treated as equal in importance with informative, economic and organisational criteria. The maximum points that can be collected we treat as one and we carry standardisation in each class of criteria, comparing the amount of points gathered by a given system with the maximum value. The results of

standardisation can be displaced onto the lower lever a carried out within criteria groups in particular criteria classes. This means that in each criteria group (total number of possibilities to fulfil equals 1) the same operation as before is being done and then all the results are summed up.

Table 5. Standardisation on particular levels

Criteria classes	Baan IV	R/3
Functional	6,94	7,48
A main book	0,92	0,98
Costs	0,75	1
Debts and Liabilities	0,98	0,98
Assets	0,96	1
Cash and bank	0,67	0,89
Offers and orders	1	1
Reporting	0,86	1
Budgeting	0,8	1
Information criteria	**4,76**	**4,79**
Enter/exit service	0.82	0,91
Data base service	0.94	0,88
Communication means	1	1
Safety criteria	1	1
Technical	1	1
Economic and organisational	**0,9**	**0,8**
Cost	0,1	0
Implementation time	0	0,1
Implementation certainty	0,1	0
Remaining economic	0,7	0,7
Total	**12,6**	**13,44**

Source: Author

The criteria however may not be of equal importance to us. The World Bank for instance, recommends that economic criteria should be assigned 33 % significance, the remaining go to other criteria. In Poland, as it is presumed, they range between 50-66 %, especially in of bank sphere. All the necessary calculations for every configuration show that the difference between the two systems is diminished to a considerable degree. Table 6 shows the calculations for all the enumerated variants.

Table 6. System measured with the presence of economic criteria

Criteria classes	Baan IV			R/3		
Economic criteria participation expressed in %	33%	50%	66%	33%	50%	66%
The remaining criteria (I variant)	1,17	0,89	0,59	1,25	0,95	0,63

The economic criteria (I variant)	0,26	0,40	0,53	0,26	0,40	0,53
Total	**1,43**	**1,29**	**1.12**	**1,54**	**1,35**	**1,16**
The remaining criteria (II variant)	7,46	5,65	3,73	8,34	6,32	4,17
The economic criteria (II variant)	0,30	0,45	0,59	0,26	0,40	0,53
Total	**7,76**	**6,10**	**4,32**	**8,24**	**6,72**	**4,70**

Source: Author

The above configuration will not look the same if we give the factors which are least in number (economic, informative, functional) the greatest importance. The example calculations are presented in table 7.

Table 7. Systems comparison measured with economic factors participation in 50%, informative in 30% and functional in 20 % presented by way of example. Economic and organisational criteria

Criteria classes		Baan IV	R/3
Economic criteria	(50%)	0,45	0,40
Informative criteria	(30%)	1,43	1,42
Functional criteria	(20%)	1,31	1,57
Total		**3,19**	**3,39**

Source: Author

The comparing indexes of systems can not only be standardised but also normalised when they range between 0 and 1 (0; 1). The simplest normalisation method is to refer them to the total amount of criteria at the lowest level of assessment. The results of this operation are shown in table 8. The whole range of criteria means here the fulfilment, by a system, of the possible criteria and not all fulfilled by a system. The last position in the table shows the range of criteria not fulfilled by a given system expressed in %.

Table 8. Comparing indications normalisation

Criteria classes	Baan IV	R/3
Economic criteria	0,76	0,86
Informative criteria	0,10	0,10
Functional criteria	0,03	0,02
Total	**0,12**	**0,02**

Source: Author

The presented assessment assumptions that help in a computer system selection in an organisation do not make the complete methodology of choice. Making up such a methodology would be extremely difficult due to a great amount of possibilities of firm computerisation. They are however, to severe as a helping hand for organisations seeking directions in how to approach the optimal variant. Example results were simultaneously presented to show that, depending on the

variant that has been accepted, it is possible to get different results for the some variant.

The second conclusion drown on the basis of the calculations is that there is a very little difference between the examined systems. This only proves the truthfulness of the opinion, widely shared by those dealing on the integrated systems market; about systems homogenisation (a new function that I have today is in the hands of my competitions tomorrow), which is the result of a strong, will to presence the position on the market.

The third conclusion is the conviction that despite the hardships (done to look for the greatest amount of functional minute criteria) subjectivism could not have been completely eliminated, for example, from the choice of the criteria.
The use of a scale of importance, touching the criteria groups or even particular criteria will not eliminate subjectivism entirely.

Normalisation, as well, only diminishes the range of criteria, that is it eases up the painful results but does not eliminate the cause of the situation.

It should also be taken into consideration that the above presented rules were tested out on two first on a list computer systems competing on our market and what is more, for the finance – accounting sub – system - the earliest to execute and the best to recognise (in details), as for as functions and needs are concerned.

For other systems and their modules the range of results acquired should be wider and thus guarantee a more clear answer to the nurturing question.

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XIII. MOBILE MULTIMEDIA: ON THE WAY TO BROADBAND

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Introduction

For the last three years or so the world has been moving to a new era of mobile communications – from plain mobile telephony and slow data transmission to full-blown mobile multimedia. Mobile multimedia services consist in creating and sharing multimedia content anywhere and anytime, with the use of applications implemented in mobile devices, and taking advantage of increasing possibilities offered by the underlying network technologies. Mobile multimedia market is mainly driven by the consumers' desire for information and entertainment, so the most prevalent media available on mobile phones today are games, music and news. However, the form in which these media are delivered to the mobile user depends very much on where he/she lives. The level of technology differs much in various parts of the world and different solutions are used to bring multimedia services closer to the demanding public.

Mobile multimedia were first implemented in messaging services. Improvements to Short Message Service (SMS), such as Nokia Smart Messaging (NSM) and 3GPP's Enhanced Message Service (EMS), added pictures, ringtones (melodies), screensavers and electronic business cards to plain text messaging. However, multimedia services, which are nothing new in the wireline part of global communication, put stringent requirements on the necessary bandwidth and quality of service in the mobile environment. For example, browsing Internet pages (usually filled with multimedia) on a mobile device is difficult due to numerous limitations of the device itself, as well as of the transmission capability of the mobile network. In order to overcome these limitations the Wireless Application Protocol (WAP) has been designed and standardized.

Another step forward in mobile multimedia was the Multimedia Message Service (MMS), standardized as a third generation service and offering various kinds of mobile media in the form of audio-visual presentations (including audio and video clips). From the very beginning WAP has been appointed the bearer technology for MMS. To extend the MMS possibilities of multimedia presentation control the W3C's Synchronized Multimedia Presentation Language (SMIL) has been implemented into MMS specification.

With the growth of customer demand for new mobile media applications and services (rich in near-live or live content), and the desire of mobile networks operators to quickly introduce such opportunities, the need for more and more bandwidth arises. Contrary to wireline systems, mobile networks always experienced problems in providing sufficient bandwidth due to the radio part limitations. Fortunately, technological progress in the field of radio transmission

techniques, which took place within the last five years, resulted in a number of enablers such as High Speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), Enhanced Data Rates for Global Evolution (EDGE), Wideband Code Division Multiple Access (WCDMA) and High Speed Downlink Packet Access (HSDPA). These techniques offer higher and higher radio bandwidth, introducing at the same time (starting from GPRS) the possibility of packet-switched radio transmission.

In the wireline world multimedia content is transferred from web servers to end-users' terminals using mainly the download technique. However, for mobile devices with the usual storage limitations streaming technique is more suitable in many cases. A 3GPP standard called Packet-switched Streaming Service (PSS) defines a framework for an interoperable streaming service in mobile networks. When combined with MMS and SMIL it can provide seamless multimedia playback on a mobile device.

The paper reviews the most important elements of the above mentioned mobile technologies, which enable delivery of multimedia content to mobile devices on the basis of wireless communication systems. Certain of these technologies are brought into focus, namely MMS, SMIL and PSS.

1 Mobile multimedia essential elements

When talking about mobile multimedia five essential elements (fields of mobile multimedia reality) have to be taken into account:

- media content,
- services,
- applications,
- devices,
- network technologies.

Examples of solutions and standards existing in each of these fields have been presented in Table 1.

From the point of view of standards these elements have to be supplemented with specification of:

- system architectures (end-to-end service definitions, system-level interface definitions, functional descriptions, etc.)
- protocols (for data transport, signalling and control),
- codecs[1] (for text, graphics, audio and video content),
- formats (message formats, file formats, etc.).

It is essential that open standards are used in implementation of various technological ecosystems, since this provides a natural evolution path for different

[1] Codec = Coder + Decoder

technologies, at the same time enabling backward compatibility and interoperability of implemented solutions. Hence, cooperation of standardization bodies, such as 3GPP, W3C, OMA and IETF, is essential for the development of mobile multimedia.

Table 1. Elements of mobile multimedia.

Mobile Multimedia Elements	Examples
Content	Static (e.g. text, still pictures), pre-stored dynamic (moving pictures, audio and video clips, etc.), live (videotelephony, videoconferencing, TV)
Services	On-demand media, multicasting, broadcasting, IM & presence, MMS, EMS, media portals, mobile games, ...
Applications	Media players, streaming servers, SIP clients/servers, content authoring tools, instant messaging, rich call, video telephony, ...
Devices	Mobile phones, imaging devices, PDAs, handhelds, laptops, recorders, media storage & playback devices, media servers & gateways, ...
Networks	2G, 2.5G, 2.75G, 3G, WLAN, ...

2 Demand for new mobile media services and applications

Mobile devices (cellular phones, personal digital assistants, handheld PCs) are becoming more and more versatile and common, providing an increasing range of services to both consumer and business users. Service demand is driven by the following evolving needs:

- anywhere, anytime access to information,
- access to corporate networks from any device,
- access to all messages (voice, email, multimedia, fax) from any single device,
- video and Web conferencing,
- access to specific types of information (financial, recreational),
- social contact (communities of interests),
- access to location-based information on demand.

Services are delivered through specific mobile applications, which provide the ability to communicate, interact and transact, regardless of the user's location or type of access terminal. Thanks to the development of speedy radio transmission technologies, such as HSCSD, GPRS, EDGE and WCDMA, mobile networks offer higher data rates, which can support a wide range of multimedia services. While 3G systems already provide data rates up to 2 Mbit/s, 4G mobile networks will support data rates up to 20 Mbit/s [1].

Increasing popularity of mobile wireless devices results in new mobile services being offered by network operators, which drives the creation of new mobile applications that should be scalable to the terminal capability and environment. Creation of these applications is based on a number of available technologies. Three of them, namely MMS, SMIL and PSS, are particularly suited to support mobile multimedia.

3 The need for bandwidth

Bandwidth availability is a crucial issue when talking of mobile multimedia development. Multimedia services generally base on two distinct techniques of content delivery: *download* and *streaming*.

Download technique consists in transmitting all multimedia content to a specific device and then replaying it. Streaming refers to the ability of an application to play a synchronized media stream in a continuous way, while this stream is being transmitted to the device over the network.

Various mobile media services place different demands on the mobile network as to the necessary bandwidth, and on the receiving terminal as to the required storage capacity and processing power. Table 2 shows the bandwidth-service relationship for several chosen types of multimedia services.

However, radio bandwidth is something that has always been in short supply in mobile environment. Since it is very difficult to allocate new spectrum to existing systems, technology research went in the direction of "squeezing out" as much as possible from the available radio resources. This means making the most efficient use of the radio channnels, usually by implementing different enhanced multiplexing and modulation techniques or by the change of radio access principles. This approach has led over the years to the successive development of radio technologies such as WAP, HSCSD, GPRS, EDGE, WCDMA and HSDPA.

Today, many of the media services defined as 3G ones are also supported on 2G or 2.5G networks, nevertheless their performance and quality characteristics may be very different. For example, downloading even a short video clip is rather difficult using a dial-up modem connection over an HSCSD network. Even if the connection is not broken, it takes a substantially long time to receive the complete file. With the MPEG-4 video streaming in packet mode on a 3G network it is reliable and can be done almost in real time. The "always on" feature, along with

bandwidth and real-time capabilities of 3G, open the door to seamless and cost effective mobile multimedia. Only with 3G technologies (such as WCDMA and the like) will the bandwidth supply satisfy the present and the future mobile multimedia services (cf. Table 3).

Table 2. Bandwidth demand for various mobile media services.

Bandwidth [kbit/s]	Service	Delivery technique
8-16	Voice/audio with text and images	Download Streaming
16-32	Slideshows with images and voice, animated graphics	Download Streaming
32-64	Music, news with video and voice	Download Streaming
64-128	Movie clips, music video	Download Streaming
128-256	Surveillance	Streaming
256-512	Sports events	Streaming
512-1024	TV	Streaming

Table 3. Maximum bandwidth available in various radio technologies.

Radio technology	Generation	Maximum bandwidth
WAP	2G	Does not increase available bandwidth, but enhances transmission by specific data processing
HSCSD	2.5G	115 kbit/s
GPRS	2.5G	160 kbit/s
EDGE	2.75G	470 kbit/s
WCDMA	3G	2 Mbit/s
HSDPA	3.5G	10 Mbit/s

4 Multimedia technology enablers

Throughout the recent years mobile media formats and the corresponding enabling technologies, specified by 3GPP and partner organizations, have been evolving in the direction of multimedia applications (Figure 1).

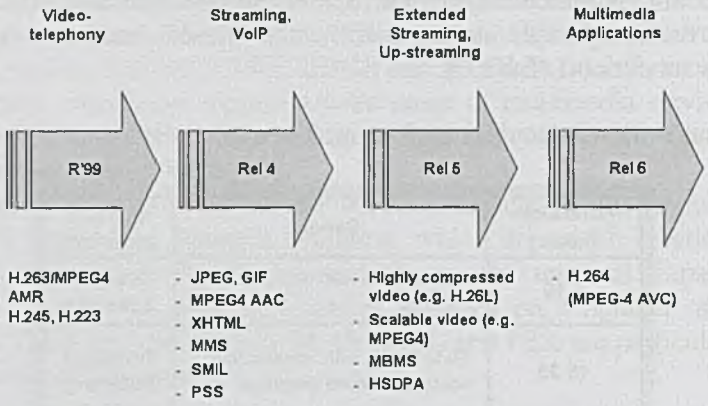

Figure 1. Various media formats and technologies used throughout 3GPP specifications releases.

However, there was always a difficulty in accessing multimedia content with the use of mobile devices, whose capabilities are much inferior to PC computers.

The first significant step forward in adjusting multimedia technology to the specific capabilities of mobile devices (small screen size, limited amount of available RAM, lower processing capabilities, slower transmission) was the creation of *Wireless Application Protocol (WAP)* version 1.0 by WAP Forum in 1998 [2]. WAP has been neatly designed as an open, global standard that enables wireless devices to easily access and interact with information and services instantly. WAP also introduces bearer and device independence, which promote interoperability. Hence, in 2002 the WAP Forum evolved into a new, global organization called the Open Mobile Alliance (OMA).

OMA addresses mainly the issue of mobile applications interoperability. It is the center for mobile service specification work, stimulating and contributing to the creation of interoperable services. OMA bases on several principles:

- products and services should be based on open, global standards, protocols and interfaces, and not locked to proprietary technologies,
- the applications layer should be bearer agnostic (which means independent of bearer technologies, such as TDMA, GSM, GPRS, EDGE, CDMA or WCDMA),
- the architecture framework and service enablers should be independent of operating systems,
- applications and platforms should be interoperable, providing seamless geographic and inter-generational roaming.

OMA has established cooperation with many external organizations and fora, including: 3GPP, 3GPP2, W3C, IETF, GSMA, ETSI and ITU-T. This cooperation influences to a great extent the specification and deployment of new interoperable technologies, such as those discussed in this section.

On the basis of WAP, *Multimedia Message Service (MMS)* was introduced in Release 4 of 3GPP specifications. MMS has been designed as a third generation service, but it is positioned now as a core enabling technology for multimedia service delivery over both 2.5G and 3G networks. It is built upon well-defined set of standards, which offer the potential to provide fully multimedia services to mobile users.

One of these standards is the *Synchronized Multimedia Integration Language (SMIL)*, a product of the World Wide Web Consortium (W3C)[2], which has been adopted as the basic presentation technology used in multimedia messaging. The adoption of SMIL allows for creation of fully dynamic multimedia presentations, in which various media, such as rich formatted text, audio and video, can be combined in a synchronized manner.

Another recently introduced standard is the 3GPP's *Packet Streaming Service (PSS)*, which opens up streaming technology for mobile applications. It provides for interworking with MMS, whereby streaming of the MMS message by the receiving client is enabled. In the following subsections the above mentioned 3GPP standards have been discussed. The mutual correlation of these standards has also been shown.

4.1 MMS

Multimedia Message Service is a third generation mobile service. 3GPP specifications define its general service aspects, functions of the MMS network and its building blocks, as well as the network architecture and interfaces [3-5]. However, from the very beginning of the standardization process the questions of application functionality, message structure and coding have been shifted to WAP Forum/OMA, since WAP has been chosen as the main bearer technology for MMS. This is why these aspects are covered by the WAP specifications rather than 3GPP [6-8].

MMS allows users to send and receive messages, exploiting the whole array of media types available today, namely:

- formatted text,
- graphics – plots, tables, diagrams, maps, sketches and plans,
- audio samples – short music or voice recordings, MP3 files,
- photographs – electronic postcards, illustrations to business projects,
- video – recorded with an in-built or attached camera (initially up to 30 s),

[2] The main purpose of W3C, which is a vendor-neutral forum, is to develop common protocols that promote the evolution of WWW and ensure its interoperability.

- multimedia presentations – synchronized sequences of text, voice, audio and video,
- streaming media – large volumes of video or sound.

Media have to be coded in an optimized manner (usually using compression to save on capacity and transmission times), so specific standard codecs are used. Table 4 presents media types and codecs, which are supported by the MMS specification.

The sequence of multimedia elements inside the message is not important if the SMIL presentation element is included. In this case the "Start" element in the multimedia message structure points to the presentation, which specifies the sequence and duration of the remaining elements. Otherwise, the message components are played on the device in a sequential manner.

Interoperability between multimedia devices, such as various types of mobile phones, handhelds or PDAs, can be looked upon from the point of view of the *mobile user profile*. The same user may want to access the subscribed services from a multitude of terminals possibly from different access networks. The user may have preferences on how to access the services regardless of the terminal capabilities. From this it follows that each user should have a personal profile that may dynamically change according to parameters such as: cost of the service, time of the day, instantaneous terminal capability (and possibly others).

To enable the user profile the following conditions have to be fulfilled:

- dynamic terminal capabilities negotiation should be possible between the terminal and the network,
- the user shall be able to define his/her preferences (personal service environment),
- the network shall be able to adapt the service delivery to the user preferences and to the terminal capabilities,
- the network shall be able to gather user information disseminated in different parts of the system.

Mobile devices differ in many aspects such as size of the display (screen), its resolution, number of colours used, available storage memory, etc. To provide for the correct presentation of a multimedia message on any MMS-enabled device, media format conversion and terminal capability negotiation have been introduced. The format to which the message will be converted stems from the *User Agent Profile (UAProf)*, defined in the OMA specification [9].

User Agent Profile describes the capabilities of the WAP Agent (WAP enabled device) and the preferences of the mobile user. It provides media content adaptation to a form, which can be best used by the receiving device. The MMS standard defines interfaces to user profile databases, as well as to servers performing media type and format conversion. The User Agent Profile is stored in the network for each MMS user device.

Table 4. Media types and codecs covered by the MMS specification.

Media type	Codec type	Description
Formatted text	XHTML Basic	Designed for web clients such as mobile phones, PDAs, pagers, etc.
Voice, telephony quality	AMR	Well suited to all voice and news clips (up to 4kHz)
Voice, high quality	AMR wideband	Well suited to all kinds of voice and audio clips (up to 8 kHz)
High quality audio	MPEG-4	Provides a range of bit rates and quality levels (up to CD-quality)
Photographic images	JPEG	Provides lossy compression with ratios 4:1 up to 30:1
Color raster images	GIF	Supports compression and simple animation sequences
Low bit rate video	H.263	Supports compression for video-conferencing, video-telephony and video-streaming
Low quality video	MPEG-4 visual	Supports increased error-resilience and video formats with max. frame rate of 15 Hz
Synchronized presentations	SMIL	Presents multimedia in a structured way, providing spatial and temporal relationship between components

The User Agent Profile is included in the WAP v1.2 specification, but its true significance will only become apparent as mobile technologies move towards convergence with the Web.

In the User Agent Profile the following elements may be included:

- hardware characteristics (screen size, colour capabilities, image capabilities, manufacturer, etc.),
- software characteristics (operating system vendor and version, list of audio and video encoders, etc.),
- application/user preferences (browser manufacturer and version, markup languages and versions supported, scripting languages supported, etc.),
- WAP characteristics (WMLScript libraries, WAP version, WML deck size, etc.),
- network characteristics (bearer characteristics such as latency and reliability, etc.).

The information about the user device's capabilities may be passed to the content server, so that application developers can tailor content accordingly. W3C predicts that, in the future, the majority of web content will be defined once, and the content adjustment according to the User Agent Profile will be carried out as a separate step.

The features present in the MMS standard make this service very well suited for a number of new, exciting mobile media applications. Straightforward examples include:

- exchange of photographs (e.g. vacation pictures),
- mobile postcards and birthday cards,
- news videoclips, sports videoclips,
- weather forecasts with maps,
- business cards exchange,
- multimedia games,
- simple melodies and music,
- mobile network games and gambling,
- location services with maps.

Some of these applications, such as exchange of photographs and viewcards, have already been enabled in mobile phones and made available to customers of mobile networks. These are, however, person-to-person applications, which still do not generate much wireless traffic in the field of multimedia messaging. The average number of MMS messages sent by a mobile user from an MMS-enabled device oscillates at around two per month [10]. This is mainly due to the lack of user-friendly interfaces aimed at creating MMS messages by mobile network subscribers. On the other hand, recent analyses estimate that significant portions of MMS traffic may be generated by machine-to-person applications. Wireless operators in southern European countries, such as Spain and Italy, have recently introduced an extensive range of MMS-based services, comprising different kinds of live information (news updates, tourist information, sport reports), as well as entertainment [10]. These services combine MMS with SMS and WAP to bring genuinely usable services to market.

To promote MMS application design the main mobile handset manufacturers offer free SDKs (Software Development Kits), along with emulators of MMS activity for the most popular phone types. They also publish useful hints on how to design applications. Finally, there are books available on MMS application development and the understanding of the main standards used in this technology [11].

4.2 SMIL

Multimedia content stored on a media server is usually placed in the context of a specific application. In the simplest case, this context is provided by a Web or WAP page, containing links to the media clips on the media server.

However, HTML and WML have limitations in dealing with continuous media types, such as audio and video. To enable application developers to express space and time relationships between media elements, as well as to add interactive browsing facilities, a specific *scene description language* has been developed.

Synchronized Multimedia Integration Language (SMIL) is a mark-up language, promoted by the World Wide Web Consortium (W3C). SMIL is based on Extensible Markup Language (XML) and allows for scheduling synchronized multimedia presentations where audio, video, text and graphics are combined in real-time. SMIL does not define any media format itself – instead, it integrates different formats in a synchronized presentation. The media elements are referred to in the SMIL code, but not included.

SMIL comes in two versions now. SMIL v.1.0 was released in 1998 [12] and describes the basic syntax of the language. A SMIL presentation consists of the following modules:

- Structure,
- Meta (who, what),
- Layout (where),
- Timing and Synchronization (when),
- Media Elements (what),
- Linking,
- Content Control.

In 2001 SMIL[3] v.2.0 specification was released [13]. In comparison with SMIL v.1.0, whose description contained only 30 pages, SMIL v.2.0 vastly extends the possibilities of the language (the description takes about 300 pages). Several new modules have been added, such as Animation, Time Manipulations and Transition Effects, and the Timing and Synchronization module has been much enhanced.

Linking with other documents is done similarly to ordinary HTML pages, but additionally the links may also contain references to other SMIL presentations.

SMIL v.2.0 gives the presentation designer a really powerful set of tools to create sophisticated audiovisual effects. However, the full power of this language may be appreciated only when viewing the effect on high-resolution large colour display devices such as the PCs and workstations. The smaller the device, the worse effect will be produced.

To improve this, SMIL v.2.0 brings also the concept of *SMIL profiles*. The profiles consist of combinations of SMIL v2.0 modules, which allow for different implementations of the language, adjusted to the capabilities of certain browsers. The SMIL v.2.0 Basic Profile has been especially designed for mobile devices. It works well on PDAs, but not on mobile phones. For this reason, a still narrower

[3] pronounced as "smile"

implementation of the language is used for mobile handsets, namely the MMS SMIL.

MMS SMIL requests that an MMS message consists of a "slide show", that is a succession of pages, each page containing at most two regions. One of the regions contains text, the other one contains an image. Each multimedia message is represented by one SMIL presentation. All the slides in the presentation have the same layout (Figure 2).

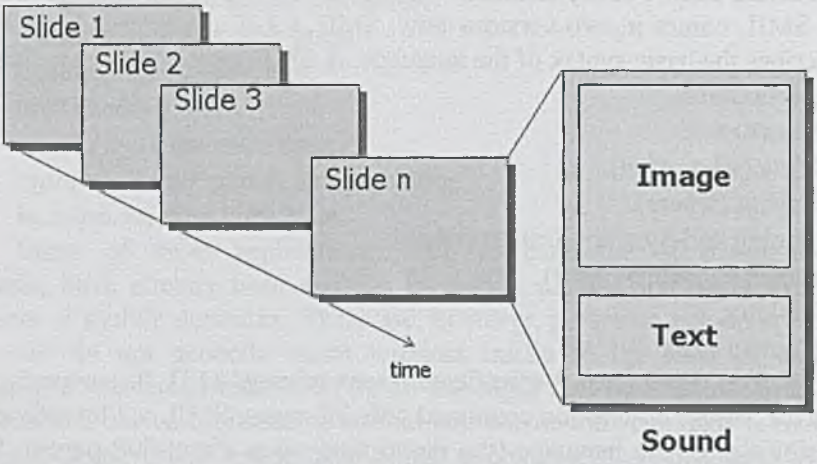

Figure 2. MMS SMIL presentation.

Audio material can be added to each slide in the AMR format, but this media type is not part of the minimum set.

At the moment, the tremendous potential of SMIL, of which only the basic features have been discussed in this section, can only be appreciated with the use of full-blown platforms equipped with relatively high processing power, sufficient memory and multimedia capabilities (large resolution colour display, high quality sound system).

For such platforms SMIL applications already exist in various fields, such as Internet TV/Radio, product information, user's guides, slideshows, etc. One of the most important fields where SMIL applications may be taken full advantage of is education. Multimedia presentations can be used in teaching, interactive learning and knowledge testing. Various other technologies can be combined with SMIL, such as SVG, XHTML, SQL, PHP (e.g. [14]).

As for handheld wireless devices and mobile phones, a range of simpler applications can be created, based on corresponding SMIL profiles. Wireless devices have now richer colour screens, improved processing power and can deliver enhanced multimedia functionality. They still fall short of the capabilities of desktop and laptop computers, but are now capable of displaying Web standard technologies such as XHTML, SMIL and SVG.

In addition to SMIL profiles, W3C has also introduced corresponding SVG profiles: SVG Tiny, aimed at multimedia capable cellphones such as the recently announced 3G units, and SVG Basic for handheld and palmtop computers [15]. This complements the set of tools, which can be used in the development of multimedia applications for mobile wireless devices.

In contrast to the PC world, where a number of SMIL editors and players are available (such as GRiNS, QuickTime, RealONE, SOJA or X-Smiles), there is still almost no such software for small mobile devices. However, also in this field substantial progress is being made. Centrum voor Wiskunde en Informatica (CWI) of the University of Amsterdam – one of the driving forces behind SMIL – released a new SMIL player called AMBULANT [16], which will support the full SMIL 2.0 recommendation and be free of charge. AMBULANT will provide a complete implementation of the various profiles defined or used with the SMIL language (including the major mobile and desktop ones in use), and will run on major platforms available (PDAs running WinCE, Tablet PCs running XP-Tablet, Desktop PCs running Linux).

4.3 PSS

Packet Streaming Service (PSS) is a 3GPP standard [17,18] which defines the basic framework for transparent end-to-end packet-switched streaming of data with real-time characteristics, so that the receiving device can start the presentation before the entire contents have been transmitted. Streaming involves the delivery of long, continuous media streams, and therefore requires predictable bandwidth, low delays and preferably no information loss. However, wireless channels are highly dynamic, which leads to unpredictable, time-varying bandwidth, delay and loss rates. This can be counteracted by stream scheduling, whereby packet transmission is a function of the estimated channel conditions and the client (device) feedback. The PSS framework is based on standards issued by other organizations, such as:

- IETF (in the field of protocols and payload formats),
- W3C (in the field of scene description),
- MPEG, ISO and ITU (in the field of codecs and media file format).

PSS is an application layer service and has been designed to work across different bearer networks (e.g. GPRS, EDGE, WCDMA). Applications that can use PSS may be classified as both on-demand and live delivery applications. They comprise news, music listening, video clips and live sports events.

The following streaming-related protocols, defined in IETF specifications, are used for PSS:

- *Real-time Transport Protocol (RTP)*, providing end-to-end network transport functions for real-time data applications (audio, video),
- *Real-time Control Protocol (RTCP)*, providing feedback on the quality of data distribution,
- *Real-time Streaming Protocol (RTSP)*, used to establish and control time-synchronized streams of continuous media,
- *Session Description Protocol (SDP)*, used to convey information about media streams in multimedia sessions.

The PSS defined codecs comprise a number of formats such as: AMR (narrowband and wideband) for speech, MPEG-4 for audio, SP-MIDI for synthetic audio, H.263 and MPEG-4 visual for video, JPEG and JFIF for still images, GIF 87a/89a and PNG for bitmap graphics, SVG Basic and SVG Tiny for vector graphics, XHTMLMP or SMIL "text" element for text and 3GP for timed text.

The new *3GPP file format (.3GP)* is used for timed multimedia in MMS and PSS. For MMS it is mandated to be used for continuous media along the entire delivery chain envisaged by the MMS, independent on whether the final delivery is done by streaming or download, thus enhancing interoperability. For PSS, the 3GPP file format is mandated to be used for timed text and it should be supported by PSS servers.

MMS supports streaming for the retrieval of multimedia message contents (one or more elements). The use of streaming for the retrieval of the message contents is independent of the message submission. Message contents may be either delivered as non-streaming elements, or made available for streaming retrieval.

Release 5 of the PSS specification introduces the concept of a *capability exchange*. Its functionality is defined as an extension to User Agent Profile (UAProf) mentioned already in Section 4.1. Capability exchange is an important component in the PSS. It enables PSS servers to provide a wide range of devices with content suitable for the particular device in question.

To enable server-side content negotiation for streaming, the PSS server needs to have access to a description of the specific capabilities of the mobile terminal. During the set-up of a streaming session the PSS server can use this description to provide the mobile terminal with the correct type of multimedia content. A PSS device capability profile is an instance of the UAProf. The device capability description contains a number of attributes. An example of an attribute has been shown in Figure 3.

PSS uses a subset of SMIL v.2.0 as a *scene description language*, although scene description is not required for all streaming sessions. For example, in the case of sessions consisting of one single continuous media or two media synchronised by using RTP timestamps, SMIL may not be needed. However, streams containing more media elements may be organized into synchronized

multimedia presentations using SMIL. Considering that many mobile devices may have limited software and hardware capabilities, the number of media to be played simultaneously should be limited. For example, many devices will not be able to handle more than one video sequence at the time.

Attribute name:	**RenderingScreenSize**
Attribute definition:	The rendering size of the device's screen in unit of pixels available for PSS media presentation. The horizontal size is given followed by the vertical size.
Component:	PssCommon
Type:	Dimension
Legal values:	Two integer values equal or greater than zero. A value equal "0x0"means that there exists no possibility to render visual PSS presentations.
Resolution rule:	Locked
EXAMPLE :	`<RenderingScreenSize>70x15</RenderingScreenSize>`

Figure 3. An example of an UAProf attribute.

The PSS technology has already been successfully implemented, for example in a project called Mobile Streaming Media Content Delivery Network (MSM-CDN), consisting of overlay media servers on top of the existing network, which perform content distribution and caching, streaming, resource monitoring, resource management and signalling. Streaming media clients were running on laptops and PDAsconnected over a WLAN. Interoperability has been demonstrated with 3GPP-compliant servers and with QuickTime, RealPlayer, and third-party 3GPP-compliant players.

5 New mobile devices

At the moment of introducing WAP the capabilities of wireless phones were very limited. The screen size was very small and only black and white images were supported. Data transfer rates over the radio interface in mobile networks were tremendously low (not exceeding several kbit/s) and there was no possibility of packet radio transmission.

Since that time many things changed. A multitude of wireless devices appeared, with improved processing capabilities, larger resolution colour displays and embedded various multimedia technologies. Premium mobile services allow delivery and download of rich media content directly to the wireless device. Mobile multimedia messaging, based on MMS technology, vastly increases these possibilities. On the other hand, icreasing availability of wireless Internet access, as well as the development of mobile gaming (based on Java programming, already

becoming a standard) open up further opportunities for the development of new mobile devices. Another important development stimmulating factor is the manufacturers' effort to reduce power consumption and increase the capacity of the device's battery, aimed at achieving longer operation times and providing wider independence of the user from the indoor environment.

All this, when combined with the constantly increasing radio transfer rates, offered by new bearer technologies (WAP v.2.0, HSCSD, GPRS, EDGE, WCDMA, HSDPA), leads to bridging the gap between the wired and the wireless worlds and increasing the pressure on making WWW applications directly available in the mobile device. Here, WAP version 2.0 (published in 2000) is a significant evolutionary step forward, offering new functions and features. The most important changes introduced in WAP 2.0 have been outlined below.

The language: XHTMLMP

At the Wireless Application Environment level WAP 2.0 introduces *eXtensible Hyper Text Markup Language Mobile Profile (XHTMLMP)* for page description. XHTML is an extension to HTML, published in 2000 by W3C. *Mobile Profile* means that only a specific subset of commands is implemented in the wireless device, plus some extensions designed specifically for this kind of environment (the XHTML standard allows to add such extensions). For compatibility reasons WML should still be understood by the browser.

The WAP Protocol Stack: Internet protocols

WAP 2.0 continues the support of WAP 1.x protocol stack (WSP, WTP, WTLS, WDP), which has been optimized for low-bandwidth bearer networks with relatively long latency. However, a key feature of the new standard is the introduction of Internet protocols into the WAP environment (HTTP, TLS, TCP, IP). This was motivated by the increased speed of wireless data transmission in 2.5G and 3G networks. These networks can offer IP support directly to mobile devices.

External Functionality Interface (EFI)

EFI specifies interface between WAE and external components or entities with applications that execute outside of WAE capabilities. This works in an analogous manner to a plug-in module, which extends the capabilities of browsers or other applications. EFI can be used to define the specific interfaces necessary for interworking with devices such as cameras, GPS receivers, smart card readers, etc.

Synchronization of diary and address book entries

The SyncML language has been adopted to enable data synchronization between wireless devices and server applications.

Support of unified representation of pictograms

This feature allows the use of tiny images (such as ☺, ⇨, ◷, 💻, 🖱, ✉), which can be used to quickly convey concepts using very small amount of space. This type of communication can overcome traditional language boundaries.

The new wireless handheld market is a large and rapidly growing industry. At present three basic products are expected to drive the development of this area [19]:

- smart phones,
- wireless personal digital assistents (WPDAs), and
- personal digital entertainment (PDE) systems.

The distinction of these three categories of mobile devices comes from their difference in form and functionality. In smart phones still the voice communication function is of primary interest and these are most widespread. WPDAs are usually larger and more computer-oriented. PDEs differ significantly from the other two categories in size and form, and in that they are devoted exclusively to entertainment, so they need large resolution (320×240) displays.

However, in the foreseeable future this division may become more diffuse, as new powerful technologies are on the horizon, which include:

- *Near-eye displays* – tiny screens positioned close to the eye that offer the appearance of being full-sized displays. Typically these may be included as part of a pair of eyeglasses, where one eye can focus on the display while the other is free to let the user see where he/she is going. By connecting a near-eye display to a handheld computer using Bluetooth, or some other form of wireless technology, an absolutely hands-free mobile computer can be obtained.
- *Virtual keyboards* – full-sized keyboards that take up no space. A virtual keyboard consists of a laser that projects an image of a keyboard onto a flat surface which can then be typed on as if it were actually there.
- *Fuel cells* – cells which create power by converting methanol into water. In fact, fuel cells produce significantly more power than an equivalent size battery, and will probably replace batteries in future mobile devices, providing for much longer operations periods.

6 Conclusions

Many simple mobile media services can be offered on the basis of applications created using only the possibilities of the WML language and the WAP standard. However, more sophisticated multimedia services will usually require capabilities contained in the MMS and SMIL technologies, or a combined approach.

If we look at the number of multimedia applications available to PC users and compare it with the number of such applications designed for mobile wireless devices, it becomes obvious that PCs still dominate in this area. Despite the constant growth of mobile device capabilities, the gap between the wireline and the wireless applications is still there.

Mobile multimedia application development is clearly influenced by two opposite groups of factors. On the one hand there are a number of technological obstacles, still existing in the mobile world. These include:

- a multitude of mobile device manufacturers, wireless infrastructure providers, mobile network operators and application developers, which create compatibility problems (proprietary technology solutions still exist on the market),
- limited capabilities of mobile wireless devices (small displays, limited amount of available RAM, lower processing capabilities),
- limited throughput of existing mobile data transmitting technologies (e.g. GPRS still does not provide its theoretical 160 kbit/s),
- lack of interoperability between applications and platforms coming from different vendors (even when based on a common standard).

On the other hand many positive influences of the standardization process can already be seen:

- cooperation of standardization bodies and organizations brings fruit in the form of stricter conformance & interoperability specifications,
- new UMTS networks, based on WCDMA radio access technology, start providing higher bitrates for mobile data transmission,
- more tools for application development appear, and possibilities of creating new applications are increasing,
- WAP provides device and bearer technology independence,
- MMS is pushing forward the convergence of the IT and telecom worlds (wireline and wireless networks) in terms of transport and software engineering technology,
- SMIL provides for lots of potential fields of application, and has a chance to become the main presentation technology used in future mobile devices.

Having all this in mind we can expect mobile multimedia services to be as ubiquitous in the near future as mobile devices today. Certainly, we are heading towards a multimedia-oriented era of mobile information and entertainment.

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XIV. ORGANIZATION IN THE PROJECT TEAM – HIERARCHICAL AND NETWORK APPROACH

Jerzy KISIELNICKI

Introducion; hypothesis and scope

Success and failure in information technology (IT) projects depend on many factors. Based on the analysis of literature as well as Author's research and experience, we can build a working hypothesis of a significant influence of the communication system on a final project outcome in the context of:

- Communication between the project team and the outside world (users, suppliers, other project teams, *etc.*)
- Communication within a project team.

In project management literature, communication occupies a significant position [J.Candle & D.Yeates (2003). H. Maylor (2003)]. Most research projects however, are focused on the analysis of communication between the project team and the outside world while communication within the project team seems to take a second place. From the literature dealing with building effective project teams, research carried out by L. Mullins (2001) deserves closer look. Mullins researched the key contradiction within a project team; he discovered that project leaders demand from their team members the willingness to compromise and subordination while at the same time they promote individualism and want to foster creativity. J. Chaffe (2001) on the other hand concluded that most people during their professional career loose both their creativity and individualism and prefer to conform to the existing standards. This is the very reason why some leaders prefer to build their teams from young people knowing that they lack experience. Another equally important factor in building effective project teams is selecting team members. J. Adair (1999) indicates three criteria that need to be taken into consideration while evaluation potential candidates: competence, motivation, and personal traits.

The subject of this paper is to prove the hypothesis that the communication system within the team significantly influences the its effectiveness. The key question that needs to be answered is: *what conditions the project leader needs to create in order to maximize the positive and minimize the negative effects of teamwork?*

While at the first glance this hypothesis might seem obvious, detailed analysis does not lead to decisive conclusions. While executing the project, teams could use different communication methods to both define the project tasks as well as evaluate results. The effectiveness of various communication methods can be very different therefore we want to prove the hypothesis that:

The network communication system provides the most effective framework for the management of the information technology projects

Network communication system is a system where communication between all team members is direct and cross divisional. In such system, the role of a project leader is not only to build the seamless flow of information between the team members but also to build trust between them. Simple network communication system is illustrated in diagram 1 below.

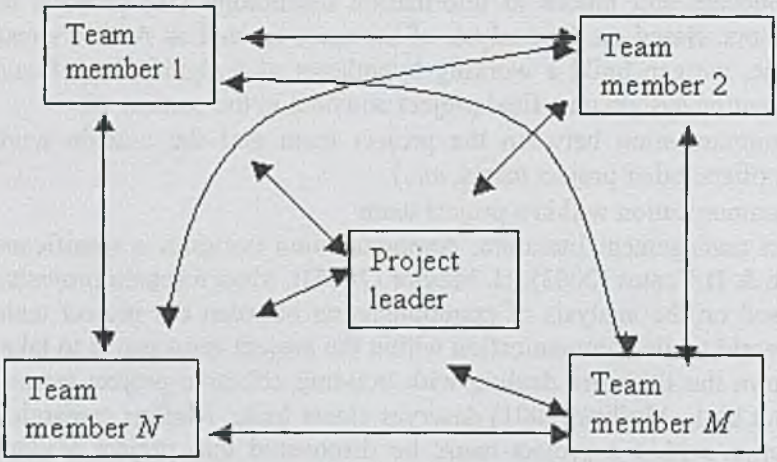

Diagram 1 Simple network communication system

During my professional career in IT, Author went through all steps of a corporate ladder; from system analyst to a senior project manager in charge of large software delivery projects. Author researched effectiveness of many IT projects but did not investigate large projects from other industries like, for example, construction. Despite that, the results of this research can be adapted to any other industry since the primary focus was on the internal project communication, which is generic rather than industry-specific.

The logic of this paper is as follows:

- Section one; covers the analysis of the communication systems and their elements.
- Section two; covers a brief description of two most common communication systems: traditional, hierarchical system and contemporary, network-based system; both systems can exist in different variations.
- Section three; describes the recommended version of the network communication system, its benefits and limitations.

Research description – analysis of communication

Systems

The analysis of communication systems was based on twenty two IT projects carried out between 1995 and 2002. The Author actively participated in twelve of these projects; the information about the remaining ten projects was based on project documentation as well as interviews with project participants. The main difficulty in the research is the fact that all projects are unique; (the ideal research would require an experiment where the same team would carry out the same projects at the same time with the only difference being the communication method). Therefore the conclusions of this research are based on estimates.

The majority of the projects included in the research targeted the business process improvement of the large organizations through the use of information technology. The project range was quite broad: implementation of IT in accounting for the major textile factory, improvement of the existing IT application in the insurance and pension institution, implementation of MRP II / ERP in a pharmaceutical company, application of IT in a municipality of a large municipality, strategic application of a new IT for a National Bank, application of IT to improve the management of a large top-security penitentiary, and application of IT for education (use of information technology program for senior executives) *etc.*

These projects represent a very diverse group of IT implementations; eighteen of these projects were business applications for various industries and four were for non-profit organizations. Success was defined based on schedule, cost, and scope; the project was considered successful if a variance at project completion for these three metrics was 10% or less. Despite the fact that fifteen of these projects were classified as success, during their implementation, the teams had to overcome significant problems.

The size of project teams in each of these projects was twenty people or more. The teams were cross-divisional; they included both IT personnel as well as industry specialists. The selection of such teams allowed the Author to research a group that both required at least a three-level communication and could not be managed by one person. In such a project team, level one consisted of system analysts designing a system, level two consisted of operational managers or team leaders, and level three was a project leader accountable for the entire project. To complement the standard communication channels, (i.e., project leader to team leader to system analyst) the Author researched communication channels between project leader and systems analyst and between system analysts themselves.

The Author searched for answers to the following questions:

1. How effective are main communication channels within a project team?
2. What project management methods would ensure a seamless information flow within a project team?
3. What communication system is recommended for implementation of IT projects?

In the context of this research, effective communication is measured by earlier defined project success criteria.

The method of research is asymmetrical; the focus is on identification of causes of failure while a success is treated as a given. The methods of analysis are:

- Review of project initial documentation (preliminary analysis, business case, application specifications etc.) and project progress documentation (schedule, budget, delivered scope).
- Questionnaires for both project managers and project team members.
- Author's notes from the project meetings where the team discussed project issues, risks, and solutions.

The information from the project meetings was the key source for the analysis while project documentation and questionnaires provided the necessary background and were used for further result verification and diagnosis. Project documents and questionnaire results indicated there was a problem while the discussions were a source of recommended solutions. In most cases, the discussions were within the project team with participation of specialists from other project teams or from user groups. Each significant deviation from budget, schedule, scope was presented and discussed. Project documents and questionnaire results would then help verify if decisions made by the group were effective. One of the key questions from the questionnaire was: *Would you like to work with the same team on the next project?*

Occasionally, the Author used the experiment where he would pass specific information to one team member or a group, and measure the time it would take for this information to reach all project members. In such an experiment, the Author would send and email and check when the email is read, monitor the usage of project database, and monitor the usage of Internet. The results showed that there are two categories of the roadblocks:

- Communication roadblocks caused by external factors like delay in supply of required technology, project financial issues, incomplete documentation supplied by users, change in regulations, strategic organization changes with the organization being on the receiving end of the project, unplanned absence of a team member, *etc.*
- Communication roadblocks caused by the internal factors like: insufficient communication, lack of knowledge and experience in carrying out the project, personal conflicts within the team, errors in project managements, *etc.*

While external factors listed above affect the project in general, internal factors were strongly related to the flow information within the team.

Communication system within the team was evaluated using the following criteria:

- How significant was cost, schedule, and scope variance at project completion?
- How effective was risk management process?
- How effective was a conflict resolution process?
- Were team members willing to cooperate and share knowledge?
- Were the team members willing to work together on the next project?

Considering the scope of this paper, the Author presents only the most important facets of the research.

Main communication systems and their elements

The research includes two communication systems used by project teams:

- Network-based system presented in its simplified form in diagram 1. In reality, the network system is more complex, since besides the project leader there are also team leaders accountable for delivery of portions of the overall solution. Fourteen projects selected for this research followed such structure and used the network-based communication method. The diagram depicting communication channels in such structure is presented in diagram 4.
- Traditional, hierarchical communication system depicted in its basic form in diagram 2. Eight projects selected for this research used the hierarchical communication system.

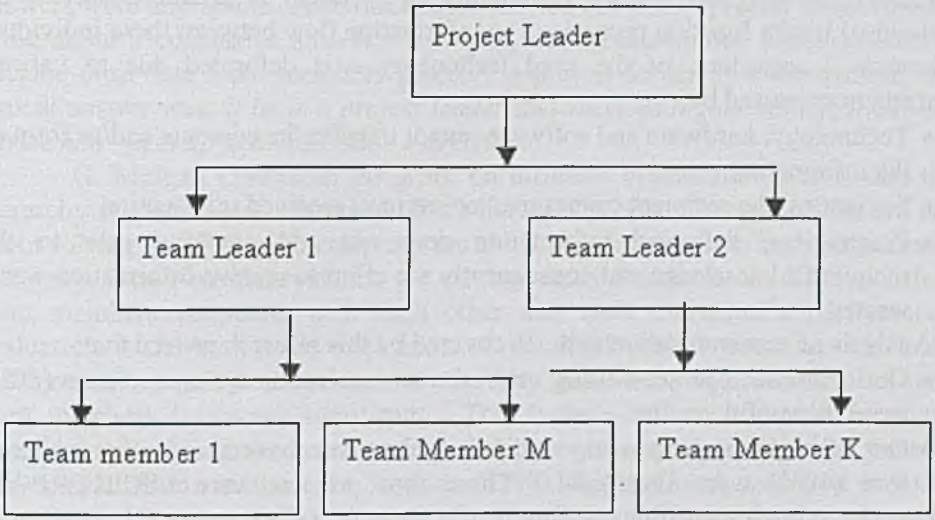

Diagram. 2 Traditional three-level communication system

Regardless of the communication method, all projects were using various aspects of information technology to provide a business solution: Computer Aided System Engineering (CASE), databases, Internet and email, or on-line cooperation. All communication systems within the project team include basic elements presented on diagram 3 below.

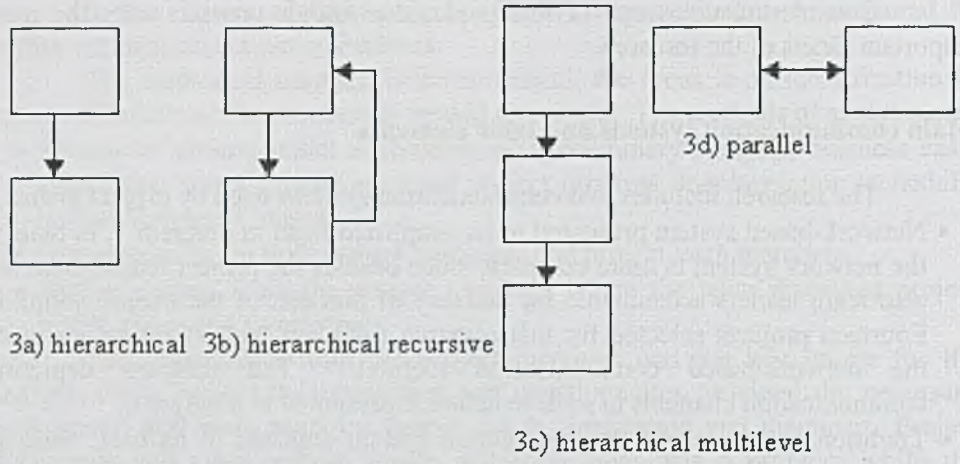

Diagram 3 Basic elements of communication systems.

Communication systems depicted on diagrams 1 and 2 consist of „bricks" presented on diagram 3. The communication system is effective only if all individual bricks function properly. The information flow between these individual elements – regardless of the used technology – is deformed due to various disturbances caused by:

- Technology; hardware and software cannot transfer the contents and/or form of the information.
- Semantics; the recipient cannot read or interpret received information.
- Pragmatism; delivered information does not add anything new to the recipient's knowledge and consequently the effort to receive information was a wasted.

Analysis of communication systems covered by this research proved that:

- Out of fourteen projects using network communication systems, eleven (80%) were successful.
- Out of eight projects using traditional hierarchical communication systems, four (50%) were successful. These four projects were MRPII/ERP-like package implementation projects.

As stated earlier, communication system is not the only project success factor. However, the answers to the question quoted earlier *Would you like to work with the same team on the next project?* were symptomatic.

- Amongst team members operating within the hierarchical communication system, between 60% and 70% of managers provided the positive answers while only 30% of system analysts provided a positive answer.
- Amongst the team members operating within the network communication system, between 70% and 80% provided a positive answer and there were no difference between the management team and systems analysts.

In addition, the number and magnitude of project issues were much smaller in project using the network communication as compared to the projects using the hierarchical communication.

The results of research on the speed of information flow proved that in the network system information flow was 30% faster than in the hierarchical systems. This research also proved the principles of management system design presented by M. Hammer in his business process re-engineering method. According to M. Hammer (1995), it is critical to eliminate the "middle man" in order to improve the effectiveness of communication. Other scientists also confirmed these principles in their research [J.Kisielnicki 2002].

Communication systems presented in diagrams 2, 3a and 3c are the least desirable and not recommended as in these systems a team member only receives directives. Such situation in reality cannot and does not exist; there is always an exchange of information where the team member at least informs a project manager about a progress of the project tasks. However, as stated in works [L.Grochowski, J.Kisielnicki 2000], in the hierarchical relationship team members reluctantly inform the project leaders about the project progress even though they consider it their duty. It seems that the reason of such behavior is psychological; when asked why team members withhold information from project managers, the answers were ambiguous. Also discussions carried out within project teams did not bring about a conclusive answer. However, during one-on-one conversations, it became clear that team members perceive a project leader as a competitor; the typical answer was: *If he is a project leader and receives higher salary, I will not advise him – it is up to him to make a decision.*

G. Morgan (1986), in his work on different organization writes that the hierarchy is a source of various conflicts between people. These conflicts are not about solving business problems; they are about people's position in organizational hierarchy. Based on observations, we can say that the situation is different when team members cooperate with each other and each individual's performance evaluation is driven by the evaluation of the final project outcome. In such environment cooperation becomes a necessity and knowledge transfer between team members is always significant. The leader's influence should focus on fostering, promoting, and demanding -when necessary - knowledge transfer between the team members. F. Savatera (1998) writes: *Greek preferred to solve issues with his equal rather than receive a solution from his Master; to make mistakes on his own behalf rather than to follow orders.* The Author believes that people carrying out IT project these days are such contemporary Greeks.

There are two categories of IT projects:

- Package implementation projects (for example, implementation of MRP II/ ERP) where creativity and individualism is not as important as following standards and proven procedures.
- Projects that deliver new and unique applications where team members need to use creativity to a certain degree.

Communication system presented in diagram 3b is effective in package implementation projects where it is critical that the system delivery procedures are followed. For projects delivering new applications, communication pattern presented in diagram 3d is more appropriate.

In a hierarchical communication system presented in diagram 2, the majority of elements is as presented in diagrams 3a, 3b, and 3c. In a network communication system, the majority of elements are as presented in diagram 3d.

Network communication system and its evolution; comparative analysis

In reality, the network communication system depicted in diagram 1 is used for project teams consisting of five to seven people. For larger teams, this model takes on a more complex form presented in diagram 4. This diagram represents a modification of the network communication system presented by Mintzberg (1999).

The network communication system (presented on diagram 4) is therefore recommended for implementation of complex IT systems. This system has been proven in several IT implementations projects; it was well received by the team members, and, what is the most important, it was proven effective.

The network communication structure presented in diagram 4 has the following key characteristics:

1. Division of the project team into smaller teams happens dynamically during the project using two techniques: PERT combined with the Critical Path Method (CPM) as well as Management by Objectives (MBO). These techniques are supplemented with the analysis of skills and personality traits of the individual team members; (team building methods will be a subject of a separate paper).
2. The network communication system is based on direct reports. The only person responsible for the entire project is a project leader. Team leaders have dual responsibility: they are both team leaders and team members (system analyst, business analyst, *etc*). During the project, after teams have completed their tasks, they were re-organized; the team leaders as well as team assignments would change. Colloquium on *Participant-Centered Learning* organized by Harvard Business School in 2002 followed a very similar pattern; during discussions on various case studies, both team leaders and team members would periodically change. During the entire session the Author was a team leader only once and every week he was working in a different team. All participants accepted this method as obvious and natural. Also in the researched IT projects the team accepted the changes in team leaders. These changes were introduced and explained at the beginning of the project. Financial aspect of the team leader position was such that the position of a leader required additional effort as well as different skills, and was considered recognition. However, it did not trigger additional compensation. While changes in the team leader assignments worked well, reassignments to different teams were not. The reasons were two-fold:
   - Schedule; different teams finished their deliverables in different times.
   - Personal relationships created during the project between the individual team members. This was the significant element supporting a strong communication within the individual team.

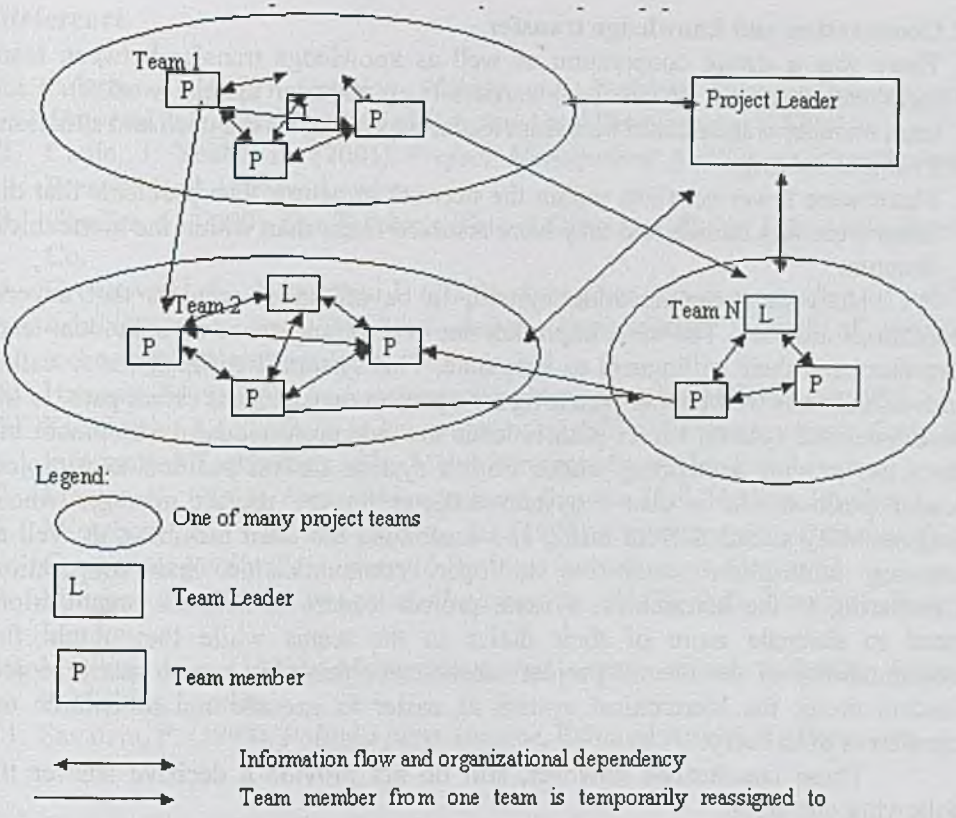

Diagram 4 Organizational structure and communication flow in a network-based project team.

3. Participation of team members from one team in achieving tasks of other team. For example, selected group of more experienced team members would spend 20% to 30 % of their time assisting in completion tasks from other group. This arrangement builds the relationship between the project participants and facilitates the flow of information as well as knowledge transfer. Methods PERT/CPM as well as (MBO) help decide which teams should share resources in this manner.

Conclusion

Research on effectiveness of both communication systems indicates that the network communication systems are superior to the hierarchical system in the following aspects:

1. **Progress monitoring**
   Possible deviations from scope, schedule and budget were communicated earlier in the network system than in a hierarchical system thus allowing for earlier intervention.

2. **Cooperation and knowledge transfer.**
   There was a strong cooperation as well as knowledge transfer between team members; there we no artificial barriers (*i.e.*, manager against worker). Each team member was or could be a team leader depending on the need and situation.
3. **Problem solving**
   There were fewer conflicts within the network structure. The problems that did occur were less intense and they were resolved faster than within the hierarchical structure.

Network communication system, to be effective, requires that several conditions are met. The most important one is the competence of individual team members and their willingness to cooperate. This system is difficult for so called individualists as well people preparing for a project management career path. In the recommended system, career path is leads towards professional development but does not provide a stepping stones from a system analyst position to a project leader position. It is also a system difficult for the project manager whose responsibility stretches from hiring and organizing the team members, as well as creating atmosphere conducive to open communication and cooperation. Comparing to the hierarchical system, project leaders of network organizations need to delegate more of their duties to the teams while they retain full accountability of the overall project success. For this very reason many project leaders prefer the hierarchical system as easier to execute and to enforce the timeliness of delivery.

These conclusions however, still do not provide a decisive answer the following questions:

- Which of these two systems is effective for all IT projects?
- What is the efficiency of replacing the hierarchical system with a network system?

Each business process needs to be both effective and efficient and an information system delivery process is no exception. There are many contributing factors that influence both its efficiency and effectiveness. Therefore in conclusion the Author would like to point out that the communication system, however critical to project success, is only one of these factors. Additional influence comes from the team makeup and as well as motivation techniques. The hiring and team building has been briefly discussed already. The effective motivation system, while critical to the overall communication strategy within the project team, is a separate topic. Effective motivation system also depends on the organizational culture, overall state of economy (the job market in particular) as well as the country itself; different motivation system will be effective in India, Great Britain, Poland, or United States. Communication system remains a key component in building effective teams since it is independent from team make-up and utilized motivation techniques.

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XV. RISK MANAGEMENT INFORMATION SYSTEM (RMIS) AS A SUPPORT OF RISK MANAGEMENT PROCESS

Alfreda ZACHOROWSKA

Theoretical Aspects of Risk Management Process in Project Management

Minimizing of the risk considered as the process is in fact the risk management[1]. Risk management is the term commonly used in the investment practice. In business activity including investment activity, risk management usually relies on the identification of events that can be threats for the economic result and on the planning of the protections reducing the negative influence of the risk. However, investors use micromanagement towards the individual risk exposures, rather than apply global management in this area because of high cost[2]. The center decision problem in the risk management is the evaluation and selection of the alternative techniques, strategies, projects and means of risk reduction. Every time risk should be possibly early identified, analyzed and systematically controlled. At the same time, it's necessary to verify the methods and instruments of risk reduction conformably to changes in environment[3]. This is ex-ante process that includes recognizing and

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[1] Risk management as the branch of knowledge dealing with the methods of risk treatment is of the interdisciplinary nature. It refers to economy, technology, marketing, management, law and psychology etc. Risk management means the safe business management under uncertainty. Compare with: H. Braun: Risikomanagement. Eine spezifische Controllingaufgabe. Toeche Mittler, Darmstadt 1984; B. Bruhwiler: Risk Management-eine Aufgabe der Unternehmenfuhrung, Paul Haust Verlag, Bern, Stuttgart 1980; K. Jędralska: Zachowania przedsiębiorstwa w warunkach niepewnych i ryzykownych. Katowice 1992; W. Tarczyński , M. Mojsiewicz: Zarzadzanie ryzykiem: podstawowe zagadnienia. PWE, Warszawa 2001.
In the risk management it is important all participants of investment process to have awareness of this phenomenon and its consequences. Compare with: P. Hommelhoff , D. Mattheus: Gesetzliche Grundlagen – Deutschland und international, [in:] Praxis des Risikomanagements – Grundlagen, Kategorien, branchenspezifische und strukturelle Aspekte. Hrsg. D. Dörner, P. Horváth, H. Kagermann. Schäffer-Poeschel Verlag, Stuttgart 2000: 8; E.J. Conrad: Society, Technology and Risk Assessment. London-New York 1980.

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[3] Compare with S.E. Schmid: Entwicklung einer entscheidungsunterstützenden Methode für das Risikomanagement. [in:] Verläßlichkeit von Mensch-Maschine-Systemen - 1. Hrsg. H.P. Willumeit, H. Kolrep, TU-Berlin, Berlin 1995: 239; M. Fally: Von der Idee zur Risikopolitik. Der Weg der STEWEAG/ Energie STEIERMARK zum angewandten, betrieblichen Risk-

preventing the negative influence of risk factors or relies on the utilization of the factors that positively affect the investment project realization[4]. The same process, but oriented on the absorption of the negative results occurring because of deviations from the expected state, is the ex-post action. In both cases the point is to minimize the negative results of the risk.

The literature presents the narrow and wide meaning of the risk management process[5]. The wide understanding of the risk management process involves all kinds of actions aimed at eliminating or reducing of every risk that occurs or may occur in the future. The narrow understanding consists of the actions averting the risk occurrence or reducing possible, negative results of the precisely specified risk. Thus the risk management process should be planned and oriented on achieving the goals. It means, all actions should be systematically conducted and have long-term character. Moreover, their purpose is the maximal reduction of the risk and the protection against the negative results of the risk. Generally, three stages of the risk management process are distinguished[6]:

Management. [in:] Betriebliches Risikomanagement. Hrsg. H. Hinterhuber, E. Sauerwein, Ch. Fohler-Norek, Berlin 1998: 220.

[4] K. Marcinek presented the wide analysis of the investment process risk including risk management in Ryzyko projektów inwestycyjnych. Prace naukowe, AE Katowice, 2000. Compare with: Z. Zawadzka: Zarządzanie ryzykiem w banku komercyjnym. Poltex, Warszawa 1999; D. Dziawgo: Zarządzanie ryzykiem w banku komercyjnym.[W:] Bankowość. Podręcznik dla studentów. Praca zbiorowa pod red. J. Głuchowskiego, J. Szambelańczyka, Wydawnictwo Wyższej Szkoły Bankowej, Poznań 1999: 354; R.K. Corie: Project Evaluation. Thomas Telford, London 1991: 80 and subsequent pages; W.L. Jaworski: Banki polskie u progu XXI wieku. Poltex, Warszawa 1999: 189 and subsequent pages.

[5] Compare with: M. Rajczyk: Podstawy bankowości komercyjnej. Fundacja Banku Śląskiego, Bielsko-Biała 1997: 94.

[6] Literature generally defines the risk management as the process consisted of presented stages. K. Marcinek exposes the additional stage – planning risk management as the first stage of this process. K. Marcinek: Zarządzanie ryzykiem projektów inwestycyjnych – wybrane problemy metodyczne.[W:] H. Henzel: Ekonomika inwestowania. Aspekty finansowe i ekologiczne. Katowice 2000: 27 and subsequent pages. Similar understanding of the project risk management, as the complex and multiphase process exists in the literature in English. Compare with: A Guide to the Project Management Body of Knowledge. Project Management Institute, Upper Darby 1966: 111 and subsequent pages; J.R. Turner: The Handbook of Project-Based Management - Improving the Processes for Achieving Strategic Objectives. McGraw-Hill, Maidenhead, Berkshire 1993: 237 and subsequent pages. The most composite (process consists of 9 stages) and integrated risk management system is presented by Ch. Chapman, S. Ward in Processes, Techniques and Insights. Wiley, Chichester 1997. In the polish literature the full risk management process is presented by: D. Dziawgo: Zarządzanie ryzykiem w banku komercyjnym.[W:] Bankowość. Podręcznik dla studentów. Praca zbiorowa pod red. J. Głuchowskiego, J. Szambelańczyka, Wydawnictwo Wyższej Szkoły Bankowej, Poznań

- identifying and quantifying the risk,
- treating the risk,
- control of the risk.

Independently of particular solutions, these stages create the standard risk management model.

The first stage is of informative and prognostic nature and involves the identification of the risk by combing its level, type, estimates of the likelihood and potential consequences. According to the systematic risk management process, the identification of the risk should be carried out continuously across all areas of threats. Correct identification and accurate evaluation of the risk depend in great part on the scope, completeness and quality of the necessary information. The risk identification allows selecting the appropriate techniques of its assessment. After the identification of the risk sources[7], it's possible to perform the evaluation of every risk type and the impact of all risk types on the realization of investment project. Quantification of the risk is considered as a very difficult stage of risk management process. Many techniques are incorporated in order to accomplish the appraisal stage and their selection is influenced by both subjective and objective factors. Objective factors include: type and size of the investment project, scope and validity of aggregated information, time-consumption, cost dimension of risk analyses and risk evaluation, the experience and the skills of analysts[8]. Subjective factors involve among others the economic potential and performance of investors.

The quantification of the risk has the great importance for risk management process.

The risk assessment is followed by the second stage of risk management process - the treatment of the risk. During this stage the practical responses to each significant risk are developed, selected and implemented. Risk treatment options leading to risk reduction can be categorized in two groups: active and passive strategies of the risk minimizing. The range of risk treatment options is presented in the figure 1.

1999:354; Z. Zawadzka: Zarządzanie ryzykiem w banku komercyjnym. Poltex, Warszawa 1999.

[7] Identification of the risk relies on the recognition of these risk types that are most likely to affect the project realization. Compare with: A Guide to the Project Management Body of Knowledge. Project Management Institute, Upper Darby 1966: 111; W.L. Jaworski, Z. Zawadzaka: Bankowość. Poltex, Warszawa 2001: 607; Z. Krzyżkiewicz: Podręcznik do nauki bankowości. Biblioteka Bankowca i Menedżera, Warszawa 2002: 69, 610.

[8] K. Marcinek presents the wider analysis of these factors in Ryzyko projektów inwestycyjnych. Prace naukowe, AE Katowice, 2000. Compare with P.A. Thompson, J.G. Perry, Engineering Construction Risks. A guide to project risk analysis and risk management. Thomas Telford, London 1992: 17 and subsequent pages.

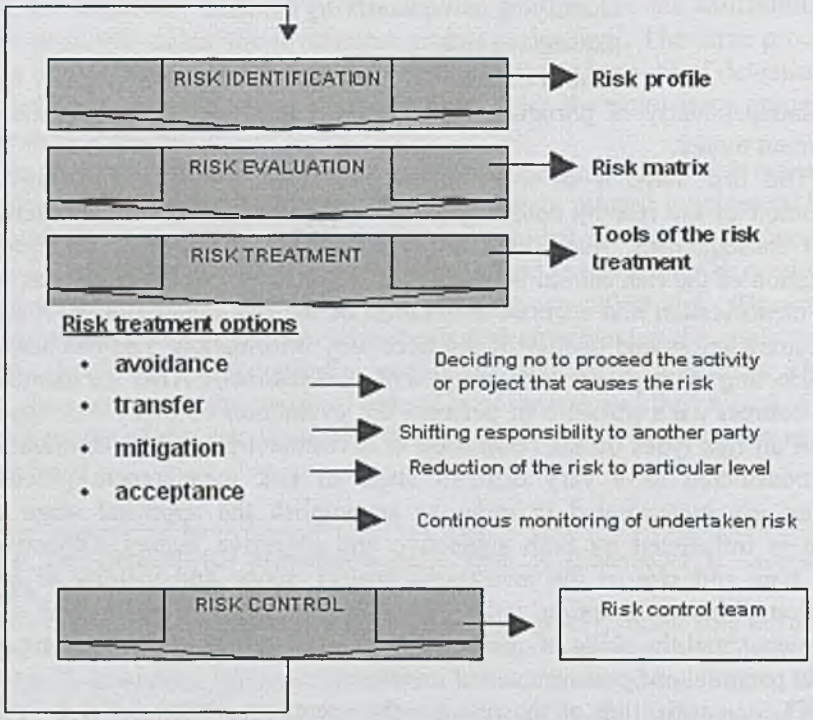

Figure 1. Risk treatment options in the risk management process.
Source: Prepared on the base K. Hornung, T. Reichmann, M. Diederichs: Risikomanagement - Teil I: Konzeptionelle Ansätze zur pragmatischen Realisierung gesetzlicher Anforderungen. „Controlling" 1999, Heft 7, s. 321.

Few risks remain static. Consequently, during the last stage of risk management process, it's necessary to identify new and changing risks and monitor the effectiveness of the implemented risk management strategies and tools. Control of the risk can be divided in two main areas: physical risk control and financial risk control[9]. The former involves taking action to eliminate the likelihood of loss (risk avoidance or preventing losses occurrence) or to reduce significantly the extent of loss (by the use of measures referring to frequency and severity of the risk). Financial risk control embraces all actions and instruments providing the finance in the event the loss

[9] Compare with: W. Tarczyński , M. Mojsiewicz: Zarzadzanie ryzykiem: podstawowe zagadnienia. PWE, Warszawa 2001: 37 and subsequent pages; D. Dziawgo: Zarządzanie ryzykiem w banku komercyjnym.[W:] Bankowość. Podręcznik dla studentów, praca zbiorowa pod red. J. Głuchowskiego, J. Szambelańczyka, Wydawnictwo Wyższej Szkoły Bankowej, Poznań 1999: 355 and subsequent pages; K. Krzakiewicz: Ryzyko w zarządzaniu przedsiębiorstwem. TNOiK, Poznań 1990: 40 and subsequent pages.

occurring. The most important techniques dealing with this aspect is risk retention and risk transfer. Concluding, control system enables to evaluate the efficiency of risk reduction actions. It should be mentioned, there is no procedure of the risk management that can be useful for each investor and under all circumstances. These procedures ought to be created with the regard of the specific nature of the particular investment project.

The risk management plays central role in financial services. For that reason it is considered as the integral part of the banking activity and important objective of all financial institutions[10]. Risk management is both the process and the utilization of relevant tools and techniques that are necessary to implement bank strategy. The literature clearly distinguishes two kinds of management: asset and liability management. Asset and liability management in banking is focused on the liquidity risk and interest rate risk at the level of balance sheet. It can be regarded as the sub-group of the risk management.

The risk management involves various risks that are critical for banking, including credit risk[11]. Considering the efficiency of the credit activity, the correct evaluation of the risk has got great weight at the time of credit decision-making. The credit risk is positively related to the credit duration and additionally it depends on the type of undertaking financed by the credit, quality of the collateral, credibility of debtor etc[12]. Thus, in order to enhance the safety of the credit operations, banks and other financial institutions introduce the appropriate procedures and mechanisms of the credit risk management. The wide understanding of this term involves all kinds of actions aimed at the elimination or reducing every possible or occurring risk. These are therefore preventing actions resulting in decrease of the overall risk level. Narrow

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[10] According to Meridian Research, over 400 biggest international banks and insurance institutions spend 2.063 million U.S. dollars on technologies associated with implementation of the risk assessment tools. Compare with: D. Williams: Risk Technology Spending: an Update. Risk Management Research Brief, Meridian Research, June 1999: 1 and subsequent pages; C. Merton: On the application of the continuous-time theory of finance to financial intermediation and insurance. The Geneva Papers on Risk and Insurance, 1989: 225 and subsequent pages.

[11] Main areas of asset/liability management embrace: assessment and monitoring liquidity risk and interest rate risk, controlling the balance sheet and the system protection against the liquidity risk and the interest rate risk. Compare with: J.W. Bitner, R.A. Goddard: Successful Bank Asset/Liability Management. John Wiley & Sons, 1992: 83; J. Bessis: Risk Management in Banking. John Wiley & Sons, 1998: 23 and subsequent pages.

[12] Compare with: M. Wiatr: Ryzyko kredytowe. [W:] Współczesny bank, praca zbiorowa pod red. W.L. Jaworskiego. Poltex, Warszawa 2000: 309; A. Zachorowska, S. Stachera-Włodarczyk: Ryzyko kredytowe w działalności banku. "Zeszyty Naukowe" WSB w Poznaniu 2003, nr 4.

meaning of this term refers to all actions towards the definite type of risk, carrying out in the purpose to prevent its occurrence or reduce its potential consequences[13].

In case of investment processes, risk management should be employed in each phase of the investment cycle. The implementation of risk management in the earliest stages of investment cycle brings the positive effects, although it is of rather strategic than practical nature because of limited scope of vested information. During these phases it is possible to improve the technical and financial documentation of the project, and verify the project solutions, what finally leads to reduction of the risk[14]. According to this aspect, notice should be taken of the last phase of the pre-investment stage – the phase of creating the detailed technical concept of the investment project. In this phase the programme is constructed, the investor is provided with additional analysis (for example results of preliminary simulation studies, likelihood analysis etc.) referring to the areas of the project with the greatest uncertainty. These added studies can have significant importance for the optimizing process conducted during scrupulous projecting. They can support the introducing of potential changes in the project by investor. From the 'uncertainty and risk' point of view, project manager should prepare the risk management plan in last phase of the pre-investment stage i.e. the phase of creating the detailed technical concept of the investment project[15]. On the one hand, such plan would indicate what contract strategy (contracts with suppliers and service providers at the stage of project realization) should be applied, on the other

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[13] Compare with: W.L. Jaworski, Z. Zawadzaka: Bankowość. Poltex, Warszawa 2001: 632; M. Rajczyk: Podstawy bankowości komercyjnej. Fundacja Banku Śląskiego, Bielsko-Biała 1997: 94. In opinion of some authors, the main objective of risk management in bank is risk quantification conducted to monitor and control the risk. J. Bessis: Risk Management in Banking. John Wiley & Sons, 1998: 23; C. Merton: On the application of the continuous-time theory of finance to financial intermediation and insurance. The Geneva Papers on Risk and Insurance, 1989: 225 and subsequent pages.

[14] Early risk identification can lead in some cases to the change of the ways to realize the project investment objectives. This problem is considered in greater scale by K. Marcinek in Ryzyko projektów inwestycyjnych. Prace naukowe, AE Katowice, 2000: 97 and subsequent pages. Compare with: Ch. Chapman, S. Ward in Processes, Techniques and Insights. Wiley, Chichester 1997: 247 and subsequent pages; P.A. Thompson, J.G. Perry, Engineering Construction Risks. A guide to project risk analysis and risk management. Thomas Telford, London 1992: 9 and subsequent pages.

[15] It must be stressed, that the uncertainty problem increases in the succeeding phases of the investment cycle (however the authors are not unanimous). It is impossible to construe on the base of historical data something more than trends to predict the future. For that reason it is extremely important to accurately evaluate the validity data and assumptions in the investment project. This fact is underlined by many authors. Compare with K. Marcinek: Wybrane zagadnienia ryzyka i niepewności w działalności inwestycyjnej przedsiębiorstw [W:] Inwestycje przedsiębiorstw w warunkach gospodarki rynkowej. Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice 1994.

hand – it would facilitate to select the most suitable types of contracts[16]. Risk management plan should help to make decision associated with the correlation between technical projecting, project realization and subsequent exploitation in the light of the assigned areas of responsibility and the risk allocation among the participants of investment cycle[17]. The appropriate evaluation level and sources of the risk allows specifying the measures of the threat reduction and minimizing potential losses.

All risk elements and possible ways of risk control should be taken into consideration during the investment decision-making process. Established financial reserves providing the risk protection can significantly affect the profitability of the investment project and in marginal cases influence the shape of realization decisions. The investment project should be constructed in accordance with the investment strategy accepted by investor and at the same time it should identify possible strategies of the risk control.

To avoid the unexpected increase in risk level, it is crucial to analyze the ways of risk undertaking and implied methods of risk reduction separately[18]. Additionally it is required to accomplish the investment risk analysis with relation to the overall risk of corporation and risk of corporation's businesses and the continuous monitoring of the risk treatment instruments.

It should be mentioned, that the achievement of relatively valid and full information about the risk level and the types of threats has the positive effect on limiting the scope of the investment risk[19]. The useful tools in this field are the risk matrixes and the matrixes of investment attractiveness.

The lack of information increases the risk, especially in case of beginning investors. For that reason, it is important to identify the level of the information validity of the data and assumptions in the investment project with the indication of the data sources, and precise description and explanation all assumptions made. Moreover all aspects, the investment and financial decisions are based on, should be scrupulously examined. In this way, the uncertainty over the validity of the project data set and assumptions is minimized to some extent. After meeting these fundamental

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[16] Compare with R.K. Corie: Project Evaluation. Thomas Telford, London 1991: 80.

[17] The example of the contracts aimed to diversify the investment risk are: contract with the building company to bear the losses associated with the potential delay of the building realization, compensation contract with the project manager or long-term contract with future customers (in case of some investment projects).

[18] K. Hornung, T. Reichmann, M. Diederichs: Risikomanagement -Teil I: Konzeptionelle Ansätze zur pragmatischen Realisierung gesetzlicher Anforderungen. „Controlling" 1999, Heft 7: 319.

[19] It is accented by many authors. Compare with: P. Scharpf: Die Sorgfaltspflichten des Geschäftsführers einer GmbH – Pflicht zur Einrichtung eines Risikomanagementund Überwachungssystems aufgrund der geplanten Änderung des AktG auch für den GmbH-Geschäftsführer. „ Der Betrieb"1997, Heft 15: 739.

requirements, it is possible to initiate the risk analysis of the projected investment. In this aspect, the continuous improvement of information flow is essential[20], what depends mainly on the creation of relevant database. The accurate and up-to-date database affects positively the reduction of uncertainty because it is the source of information needed for the risk analysis that is the base to build the risk management concept. The use of credit agency reports providing the information about given companies can also support the risk reduction.

It must be stressed that there is no way of the full elimination of the risk, but it is possible to reduce considerably its level. Depending on the threat level, the investor can use various methods and forms to reduce the risk. If the risk likelihood is insignificant, investor can bear the risk in advance to its acceptation. But if the risk analysis indicates high likelihood of risk that can result in great losses, investor should possibly early avoid, reduce or transfer the risk[21]. The selection of the methods to reduce the investment risk should be carried out in regard to the nature of the problem, time needed to solve it, the cost of chosen strategy and capital capacity of the investor.

In every case, the selection of methods and form of the protection against the investment risk depends on the level and type of the risk, definite situation of the investor and the specific conditions of the investment.

Risk Management Information System (RMIS)

The management of risk data and information is the key to the success of any risk management effort regardless of an organization's size or industry sector. Risk management information systems (RMIS) are typically computerized systems that assist in consolidating property values, claims, policy, and exposure information and provide the tracking and management reporting capabilities to enable to monitor and control overall cost of risk. Additionally risk management information systems (RMIS) professionals provide expert advice and information management solutions for organization at each stage of the risk management process.

The most successful systems have been those where the solution matched the need.

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[20] Compare with: Arbeitsgemeinschaft der Bau-Berufsgenossenschaften: Arbeitssicherheit und Gesundheitsschutz als Führungsaufgabe in der Bauwirtschaft Informationen und Ratschläge für Unternehmer. Wiesbaden 2000: 36-37; H. Braun: Risikomanagement. Eine spezifische Controllingaufgabe. Toeche Mittler, Darmstadt 1984: 65; K. Jędralska: Zachowania przedsiębiorstwa w warunkach nieopewnych i ryzykownych. Katowice 1992.

[21] Risks categorized as „medium" require special analysis and examination referring to methods of risk treatment. This category includes among others: risks that result in great losses but are unlikely to arise or risks that cause small losses, but are very likely to occur. H. Schierenbeck: Risk-Controlling in der Praxis: rechtliche Rahmen bedingung und geschäftspolitische Konzeptionen in Banken, Versicherungen und Industrie. Stuttgart 2000: 329.

An enterprise-based risk management information system should aim to:

- provide a means for uniform record-keeping in key areas of risk management, such as hazard identification, risk assessment, incident recording, claims management and corrective actions,
- provide easy access for all stakeholders to information recording, reporting and analysis tools,
- report to management on a range of key performance indicators that measure the performance of all those with risk management responsibilities,
- ensure that no issue is overlooked or forgotten, through the use of an effective corrective action, and follow-up and escalation system,
- meet and maintain statutory licensing or audit requirements,
- offer tangible evidence of the management to meeting the organization's obligation.

When implementing an RMIS, the whole business process should be considered and reviewed rather than taking it as a given. Only when the business process is considered as a whole can the maximum productivity be achieved by the RMIS.

Perhaps the most important aspect of an RMIS implementation is to devote planning and project management resources to the process because putting in an RMIS involves capital investment and changes in working practices. A fundamental part of the planning process is to ensure that all aspects of the RMIS and its application support the corporate strategy and vision. The hardware, software, people resources, processes and procedures should reinforce the corporate vision and enhance the organization's ability to fulfill it's goals.

There are five basic steps which should be addressed when planning and managing the implementation of an RMIS:

Selection of project team;

Implementation of an RMIS requires a multi-disciplinary team taking in providers and users of data as well as systems technicians. It is critical that the risk manager takes the leadership role in the project team since the RMIS will primarily be his or her responsibility and tool.

System needs analysis

The objective of the system needs analysis is to establish the features of the RMIS which will be required in order to fulfill the vision. In broad terms the system needs analysis looks at three areas: data capture, software features and hardware issues.

Resource needs analysis

Besides the computing aspects there are other resources which need to be provided in order to operate an RMIS for example skills and people resources existing in the company, possibility to obtain hiring or training budget.

Customization

Customization may refer to complete design of an RMIS from scratch or alteration of an existing system to suit the specific needs. Whether customization starts from a blank piece of paper or builds on an existing system, there are three phases to go through:

– definition

Definition consists of developing the system needs analysis within the context of the corporate vision and the process evaluation (to avoid the productivity paradox) so that a sufficiently detailed framework is established for system specifications to be established.

– specification

Detailed system specifications are drawn up using the combined resources of technical specialists and system users.

– programming

Finally the programmers can produce the code which delivers the RMIS specified in the definition and specification phases of customization.

Transition

It must be recognized that implementation of an RMIS involves a transition phase. It is unlikely that one day the new system will be put in place and immediately provides all the information, the analysis and the efficiency gains which are anticipated.

The introduction of a new system and new procedures means that there is a learning curve for personnel to go through. In fact there may also be new staff that may need time to learn not only the system and procedures associated with the RMIS but also the organization's way of operating. Since a computer system always needs to be tested, the old system - paper or otherwise - will likely be run in parallel with the RMIS for a period of time until the RMIS is fully tested, the output is verified and a comfort level has been established. The risk management department will therefore find itself with more competing demands on its staff.

Monitoring

As with any management process, monitoring is also part of the implementation project and then the ongoing operation of the system. The internal environment should be monitored to ensure that the RMIS continues to support and further corporate objectives and that its structure and format remains relevant. The external environment should also be monitored from two perspectives. Computer hardware and software is constantly developing, new possibilities are emerging all the time which may enhance the operation of the RMIS. The operating environment for the organization may change either through legislation or acceptable standards of practice or new knowledge.

Implementation of efficient Risk Management Information System can constitute value in the following dimensions (more or less in order of significance):

– compliance and prevention (avoid crises in own organization, avoid crises in other organizations, comply with corporate governance standards, avoid personal liability failure)

– operating performance (understand full range of risk facing the organization, evaluate business strategy risks, achieve best practices)

– corporate reputation (protection of corporate reputation)

– shareholder value enhancement (enhance capital allocation, improve returns through Value Based Management)

Through a combination of industry needs and technology change, the Risk Management Information System has come of age. Future use of the internet to further devolve the risk management process to all of the stakeholders, and to enhance the quality of information that is available, will ensure that the RMIS occupies a central position in support of every corporate risk management program.

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19. K. Marcinek: Zarządzanie ryzykiem projektów inwestycyjnych – wybrane problemy metodyczne.[W:] H. Henzel: Ekonomika inwestowania. Aspekty finansowe i ekologiczne. Katowice 2000.
20. C. Merton: On the application of the continuous-time theory of finance to financial intermediation and insurance. The Geneva Papers on Risk and Insurance, 1989.
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XVI. SUPPLY CHAIN SIMULATION USING "ARENA"

GRABARA Janusz, KOT Sebastian

Introduction

The overall aim of the is to develop a step-by-step approach to elaborate, model and evaluate Supply Chain (SC). Therefore, to complete the approach, the contribution of this paper is: to develop an approach to model SC and a method to evaluate SC quantitatively and qualitatively to determine a best practice SC scenario.

In order to evaluate the impact of SC scenarios on the SC performance, relevant aspects and mechanisms of the SC should be modelled. Therefore, when building a simulation model of a real system, we must pass through several stages or levels of modelling.

1,Define a modelling framework

1. Define a modelling framework

Starting with the real system, we first form a conceptual model of the system that contains the elements of the real system that we believe should be included in the model[1]. That is, one should identify all facilities, equipment, events, operating rules and descriptions of behaviour, state variables, decision variables, measures of performance, and so on, that will be part of the model. Other authors use other terms. Van Hee[2] refer to *ontology,* defined as a system of clearly defined concepts describing a certain knowledge domain. Wilson[3] refers to the *world view* or *Weltanschauung*, i.e. that view of the world which enables each observer to attribute meaning to what is observed.

Consecutively, we must identify the relationships between the elements identified. From the conceptualisation of the system a *logical model* (or flow chart model) is formed that contains the classification of and logical relationships among the elements of the system, as well as the exogenous variables that affect the system. A modelling framework is defined as a set of basic modelling constructs and their possible relationships required to model the behaviour of the SC completely.

2. Devise a set of symbolic objects

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[1] Hoover, S.V., Perry, R.F. (1989), *Simulation; a problem-solving approac*h, Reading MA: Addison-Westley
Checkland, P.B., Scholes, J. (1990), *Soft systems methodology in actio*n, Wiley & Sons

[2] Hee, K.M. van (1994), *Information systems engineering - a formal approac*h, Cambridge University Press

[3] Wilson, B.W. (1993), *Systems: concepts, methodologies and applications*, Second edition, John Wiley & Sons

The next step is to devise a set of corresponding symbolic (i.e. formal) objects that can be used to represent the foregoing modelling constructs[4]. This includes identifying the integrity rules that go along with those formal objects (i.e. how to use the objects).

3. Building the simulation model

Using the modelling framework and the symbolic objects defined we develop a *computer model*, in a specified simulation language, which will execute the logic described. Which aspects of the SC are modelled depends on the *demarcation of the SC*. The decision on how much of the real system should be included in the conceptual model to bring about a valid representation of the real system must be jointly agreed upon by the simulation analyst and the decision-makers.

Developing a simulation model is an iterative process with successive refinements at each stage. The basis for iterating between the different models is the success or failure we have when verifying and validating each of the models.

2.Supply Chain modelling in Arena using SIMAN language

SIMAN (SIMulation ANalysis) is a simulation language developed by Dennis Pegden in 1982 and distributed by Systems Modeling Corporation. It allows for building a process-oriented model, an event-oriented model, or a combination of both[5]. Arena is a graphical user interface based on SIMAN providing animation possibilities.

A SIMAN process simulation model is broken into two distinct parts, a model frame and an experimental frame, which are kept in separate files[6]. In this way, a particular model structure may be employed using many different sets of data without re-compiling the model code.

- In the *model frame*, modelling constructs called *blocks* are used to describe the logic by which the model's entities and resources interact dynamically. Each block has a corresponding pictorial representation, and these symbols can be combined into a linear top-down block diagram, which graphically describes the flow of entities through the system. Table 1 lists the main SIMAN blocks. A complete overview of SIMAN blocks can be found in Kelton et al.[7].
- In the *experimental frame*, modelling constructs called *elements* are used to specify the particular parameter values (e.g. mean service time) for the present simulation run(s), to define resource types and quantities, and to

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[4] Date, C.J. (2000), *An introduction to Database Systems*, 7th Edition, Reading (MA): Addison-Westley

[5] Law, A.M., Kelton, W.D. (1991), *Simulation modelling and analysis*, second edition, McGraw-Hill

[6] op. cit.

[7] Kelton, W.D., Sadowski, R.P., Sadowski, D.A. (1998), *Simulation with Arena*, Boston, Massachusetts: WCB/McGraw-Hill

delineate the output statistics desired. For example, the element RESOURCES specifies the capacity of resources. A TALLY collects statistics such as the mean, standard deviation, maximum value, and minimum value on a designated output variable.[8]

Table 1 Overview of the main SIMAN building blocks

SIMAN building block	*Description*
ASSIGN	Assigns values to attribute and variable
BRANCH	Controls flow of entities through code
CREATE	Creates entities
DELAY	Delays processing of entities
DISPOSE	Disposes of an entity
RELEASE	Releases a resource from an entity
ROUTE	Transfers an entity between stations
SEARCH	Searches a queue for an entity
SEIZE	Lets an entity capture a resource
SIGNAL	Signals WAIT to release entities
STATION	Defines a location in the model or the beginning of a submodel (series of blocks) which represent logic to be replicated in more than one place
QUEUE	Queues up entities before a business process
WAIT	Holds entities until signalled

Źródło: Kelton, W.D., Sadowski, R.P., Sadowski, D.A. (1998), *Simulation with Arena*, Boston, Massachusetts: WCB/McGraw-Hill

The separation of model and experiment allows one to make two distinct runs of the model, perhaps only differing in some parameter value, without recompiling the model frame. The SIMAN Output Processor allows one to perform certain statistical procedures such as confidence intervals and hypothesis tests on the output data produced by simulation runs from the same or different system configurations. The analyst can also choose the desired output data treatments after the simulation runs have been made.

The world view assumed is that of entities flowing through the blocks, which define system components. The blocks may alter the nature or the flow of entities, or both. Entities may represent a wide variety of animate or inanimate objects: for example, patients in a clinic, customers in a bank, cars in a tollbooth queue, manufactured parts in a production facility, or parts in an inventory system. Each block in SIMAN has an identifying flow chart symbol.

When the flow of entities is described using these symbols, converting the flow chart to computer code for the model frame of SIMAN is simply a matter of

[8] Hoover, S.V., Perry, R.F. (1989), *Simulation; a problem-solving approach*, Reading MA: Addison-Westley

recording the corresponding statement for each symbol. A simulation model written in SIMAN can be thought of as a collection of entities, described by attributes, flowing through a piece of simulation code. Entities can be created and disposed of. They can be sent to other pieces of code by conditional branch statements. Code that is restricted to one physical location can be assigned to a STATION. Entities may be routed between stations and stations may contain queue/resource combinations that act on items.

3.The Arena interface

The Arena environment includes menu-driven point-and-click procedures for constructing the SIMAN V model and experiment; animation; the Input Processor that assists in fitting distributions to data; and the Output Processor that can be used to obtain confidence intervals, histograms, and so on.

Arena provides alternative and interchangeable templates of graphical simulation modelling-and analysis modules that one can combine to build a fairly wide variety of simulation models. For ease of display and organisation, Arena has grouped the modules into panels to compose a template. By switching templates, one gains access to a whole different set of simulation modelling constructs and capabilities. At any time, one can pull in modules from the SIMAN template and gain access to simulation-language flexibility if one needs to. For specialised needs, like complex decision algorithms, one can write pieces of the model in a procedural language like Visual Basic, FORTRAN or C/C++. All of this takes place in the same consistent graphical user interface.[9]

Arena's specific characteristics are the following[10]:

- *Entities* can be grouped into new entities, but all the original entities remain in the model and keep their specific characteristics.
- *Attributes* are characteristics of ALL entities, but with a specific value that can differ from one entity to another. For example, all types of attributes of the entity 'Order' are also assigned to 'Delivery' and vice versa. The data type of an attribute is always numerical.
- Entities often compete with each other for service from *resources* that represent things like personnel, equipment, or space in a storage area of limited size. A process can only start when an entity succeeds in seizing a resource and releases the resources when finished. Resources are explicitly modelled in Arena. The resource availability is determined by a *schedule.* There are three possibilities to deal with breakdowns during resource utilisation (Ignore, Wait or Pre-empt).
- In Arena, *queues* can also be explicitly modelled; they have names and can also have capacities to represent, for instance, limited floor space for a

[9] Kelton, W.D., Sadowski, R.P., Sadowski, D.A. (1998), *Simulation with Arena*, Boston, Massachusetts: WCB/McGraw-Hill

[10] op. cit.

buffer. In the queue, entities are ordered by means of a predefined procedure (e.g. FIFO, LIFO, etc.).

- . *Global variables* are (numerical) pieces of information that reflect some characteristic of the total system, regardless of how many or what kinds of entities might be around (for example, inventory level or simulation time).
- . As the simulation proceeds, Arena keeps track of *statistical variables* to calculate the output performance measures. A *Dstat* measures the value of attributes continuously (for example, inventory levels). A *tally* measures the value of an attribute as an event occurs (for example, the total amount of no-sales) and a *counter* counts the number of times a certain event occurs (for example, the number of stock outs).

4. Model validation

Experimenting with a simulation model is a surrogate for actually experimenting with an existing or proposed system. Hence, one of the most important aspects in simulation studies is the validation of the model. If the model is not valid, then any conclusions derived from the model will be of doubtful value. Law and Kelton[11] refer to Balci and Sargent[12], who give a comprehensive bibliography on model validation. Three words play a central role in model validation: verification, validation and credibility:

- *Verification* is determining that a simulation computer program performs as intended, i.e., debugging the computer program. Verification checks the translation of the conceptual simulation model (the process models and assumptions) into a correctly working program.
- *Validation* is concerned with determining whether the conceptual simulation model (i.e. the modelling framework) is an accurate representation of the system under study.
- When a simulation model and its results are accepted by the problem owners as being valid, and are used as an aid in making decisions, the model is *credible*.

Law and Kelton present two basic thoughts in model validation that is adhered to.[13]

First, it is extremely important for the modeller to *interact with the problem owner(s) on a regular basis throughout the course of the simulation study.* The model is more credible when the manager understands and accepts the model's assumptions. Another important idea for validity/credibility enhancement is for the

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[11] Law, A.M., Kelton, W.D. (1991), *Simulation modelling and analysis*, second edition, McGraw-Hill

[12] Balci, O., Sargent, R.G. (1984), A bibliography on the credibility assessment and validation of
simulation and mathematical models, *Simuletter* 15, 15-27

[13] Law, A.M., Kelton, W.D. (1991), *Simulation modelling and analysis*, second edition, McGraw-Hill

modellers *to perform a structured walk-through of the conceptual model (prior to the beginning of coding) before an audience of all key people.*
This meeting helps ensure that the model's assumptions are correct, complete and consistent (i.e. that 'local' information obtained from difference people is not contradictory).

They specified these thoughts in a three-step approach for developing valid and credible simulation models:

1. Develop a model with high face validity, i.e. a model that, on the surface, seems reasonable to people who are knowledgeable about the system under study. Use conversations with system 'experts' in multiple layers of the organisation, observations of the system and collections of empirical data, existing theory, relevant results from similar simulation models and your own experience/intuition.
2. Test the assumptions of the model by sensitivity analysis.
3. Determine how representative the simulation output data are.

If the decisions to be made with a simulation model are of particularly great importance, *field tests* can be used to obtain system output data from a version of the proposed system (or a subsystem) for validation purposes. According to Law and Kelton the most definitive test of a simulation model's validity is establishing that its output data closely resemble the output data that would be expected from the actual (proposed) system. If the two sets of data compare 'favourably', then the model is considered 'valid'. But how one defines correspondence and determines if it is sufficient is not universally agreed upon. After the model is developed we observe the system for a period of time, collecting data for all exogenous variables and performance measures. The exogenous variables are then used as model inputs, which yield performance measures from the model. A decision on model validity is based on the degree to which the performance measures produced by the model and those observed in the system are similar.

It is generally impossible to perform a statistical validation between model output data and the corresponding system output data (if it exists), due to the nature of these data. The output processes of almost all real-world systems and simulations are non-stationary (the distributions of the successive observations change over time) and autocorrelated (the observations in the process are correlated with each other). Law and Kelton[14] believe that it is most useful to ask whether or not the differences between the system and the model are considerable enough to affect any conclusions derived from the model. They also recommend that the system and model be compared by driving the model with historical system input data (e.g. actual observed consumer demand data and service times) without the use of a formal statistical procedure. Thus the system and the model experience exactly the same observations from the input (random) variables.

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[14] Law, A.M., Kelton, W.D. (1991), *Simulation modelling and analysis*, second edition, McGraw-Hill

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XVII. SYSTEM OF INFORMATION IN THE WHOLESALE AGRI-FOOD INDUSTRY

Joanna NOWAKOWSKA-GRUNT

1. Characteristics of transformation in Polish agri-food industry

Nowadays, Polish agri-food industry undergoes considerable changes. It is mostly caused by the present situation of the market characterized by a few factors determining the development of the agri-food branch. The factors have emerged due to both internal economic and social changes as well as changes in world trends in the economy and technology. The liberalization in international trade has also been of great importance. Market changes in the a rea of agri-food produce seem to exert influence on two groups of factors: supply factors and the factors of the demand type. Following are the most important supply factors[1]:

- investments in agriculture and food industry
- concentration and specialization of production
- development and strengthening of small and middle businesses,
- processes of integration with Western Europe economy,
- implementation of new technologies and know-how into organization, management and marketing

Demand factors include:

- income level in the society,
- adopting, by the consumers, certain lifestyle where key factor is a way to spend their free time or some market behaviour,
- adopting some patterns of western mass consumption,
- demographic changes,

Taking the demand factors into consideration one should mostly point to changes in food consumption, resulting mainly from the changes in personal income of people. Some investigations[2] show the increase, in 1996 – 2000, of real value of individual consumption coming from the personal income, along with a trend pointing to the transition in the spending structure. The share of the expenditures on food decrease while share of expenditures on non-food goods and the remaining services increases, which is characteristic of the highly developed countries.

Next element that illustrates changes in food industry are the data on wholesale and retail sale. As the investigations show, the share of food in retail sale is higher than in wholesale. It is mainly caused by all the tendencies for the Polish agri-food processing industry; it points to high levels of sale of fresh food

[1] B. Słomińska, *Uwarunkowania zmian w systemie sprzedaży żywności,* [w:] „Wiadomości Statystyczne" Wyd. GUS i PTS, nr 7/2002, s.50

[2] B. Słomińska, *Uwarunkowania zmian ...*, op.cit. s.50 -59

and heightened activity, of both production businesses and the trade enterprises, to expand sales level but with except wholesale. Such tendencies are not very useful for forming the distribution networks, but they have been observed over the past few years.

2. Wholesale in Poland

Despite unfavourable tendencies being observed for wholesale market in Poland, its activity seems to be essential for proper flow of goods in the logistic chain in agri-food industry. The most significant functions of wholesale include:

- organizing goods exchange,
- purchase and sale of goods,
- stocking up the goods and reserves,
- logistic activity connected with goods stocking, standardization, package, processing and creation of trade assortment,
- quality acceptance for deliveries,
- organizing the deliveries on the basis of long-term contracts,
- keeping goods traffic records.

However, nowadays, the market economy limits such activities, and creation of value added for the customer seems to be a proper task for the wholesale market and it could be achieved through additional activities, such as storage, package, standardization for the pallets of stored goods etc. Logistic activities are therefore very welcome here since they give the customer the possibility to have the market goods available.

Creation of database for information about size, structure and changes in supply, demand an the prices of the goods sold there. The information database which is fed with such an information enables prediction which helps the market participants to make decisions on the production range and the trade. Information obtained from the wholesale market are available for all the entities that exist in the agri-food market i.e. both producers, traders, processing businesses and central institutions, which enables to prepare reports and market prognosis. Therefore, the wholesale market plays very important role for the creation of information databases which enable to facilitate the process of good and information flow; it happens because the wholesale market is a link which generates the information, very quickly and easily, for all the links in the supply chain within the area of agri-food processing.

3. System of information in the wholesale market for Wielkopolska Gildia Rolno-Ogrodnicza S.A, Poznan, Poland (WGRO)[3]

According to the sources, the guild supplies about 500 enterprises, mostly localized in the area of middle-west and north Poland and its annual turnover reaches the level of PLN400-500M. Considering the entities which the guild includes, some links can be distinguished as it is illustrated in the Fig. 1. The most significant entity in the organization is the centre for logistics and distribution which deals with organization and coordination for supplies of bigger and standardized goods batches of agri-gardening goods for recipients.

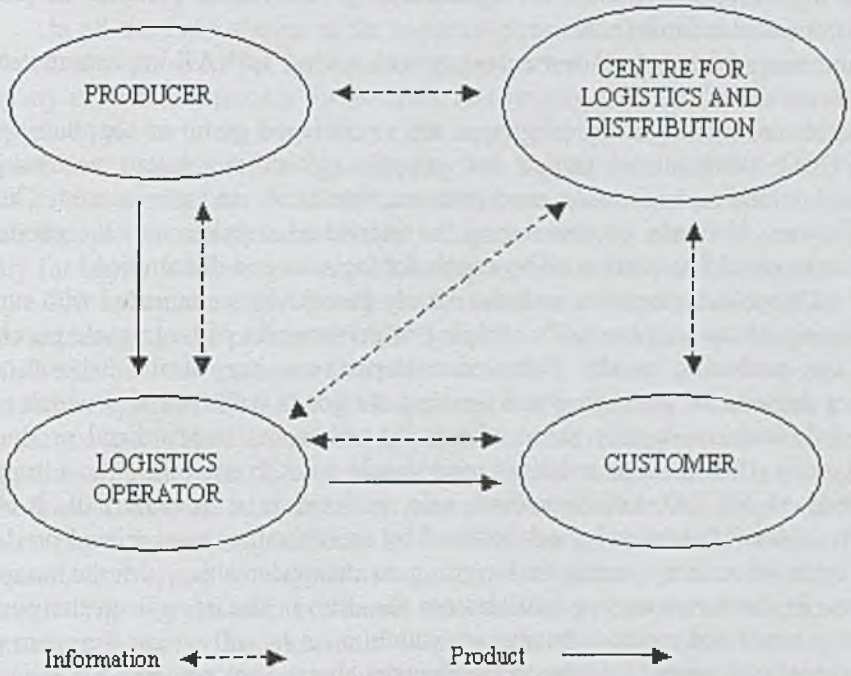

Fig.1 Logistics system scheme in the market of WGRO S.A.
Source: I. Fechner: Cebula i ziemniaki w kilobajtach (cz.1), [w:] „Logistyka" nr 3/20001, p. 6

The guild, as a business entity, is characterized by two basic phases for goods flow (connected with the information flow) i.e. delivery phase, and distribution phase.

For the delivery phase, the physical flow of good and information concern mainly the suppliers, both individual and organized in groups. They usually include individual producers of agri-food goods and also producers goods and specialized

[3] the analysis for system of information has been conducted on the basis of I. Fecher's article „Cebula i ziemniaki w kilobajtach", published in „Logistyka", No 3/2001 and 4/2001, and also on a basis of the Internet information at http/sir.ilim.poznan.pl, and http/wgro.com.pl

processing enterprises. From the flow effectiveness point of view, the most profitable suppliers are the producers' groups since they deliver larger supplies at a time, usually of high quality. Following the thesis for the bill designed for producers' groups[4], they arise in order to:

- facilitate the deliveries and the market for agricultural producers in accordance with competition rules,
- enable to apply for the preferential loans through realization of the common property designed to be the loan repayment guarantee. Producers' groups can apply for the state subventions for organization,
- common settlement of accounts for agricultural production in case of decision on high levels of quotas for agricultural production in prospect of meeting European standards in this area,
- common settlement of cost accounts with a view to VAT implementation for farmers

In this case, the producers' groups are a privileged group of suppliers and, in WGRO, professional advice and supplies of all assortment necessary for production (such as seeds, seed potatoes, fertilizers etc.) are secured. The task of taking initiative in associating the individual supplier into the producers' groups should be performed by centre for logistics and distribution.

Distribution logistics includes mainly the activities connected with supplies completing of the supplies and supplying large networks of large-scale purchasers with agri-gardening goods. Completion department has, at its disposal, many modern devices for packaging and marking the goods with barcodes which causes the goods undergoing this phase of activity to become standardized products of high quality. Besides such solutions, one should point to one of the most important activities of WGRO, i.e. immediate sale, realized in a modern hall. It relates usually to small batches of goods, offered by individual, non-associated producers. This form of activity seems to be going to disappear since, despite temporary increase in the turnover, one can observe the drop in the interest on the purchase made by small and medium businesses which, even recently, were the main group of the guild customers. It is due to the changes observed as compared to the market agents. They buy, more and more often, big trade networks and the agents of cash & carry type, but, on the other hand, the number of purchases realized by small groups of traders is decreasing; the traders provide themselves rather at wholesalers such as before mentioned cash & carry. Because of this, the big trade networks, being more and more significant recipient of the goods offered by WGRO, demand not only high quality of the goods, but also proper packaging and marking according to the EAN system, and also realization of the supplies at the right place and at the right time, according to Just-in-Time system. Such demands can not be satisfied by the individual suppliers.

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[4] Materials from the seminar: „Ustawa o grupach producenckich" Min. Roln. I Gosp. Żywn. Warszawa 1998, s.19

As it comes to the distribution within WGRO, the significant part is played by the marketing and sales department. The tasks of the marketing department concentrate on influencing the customers to popularize the exchange and to propagate modern forms of wholesale and to promote Polish products. Sales department's task is to be efficient in finding new recipients. The department cooperate closely, on the information exchange, with centre for logistics and distribution, which, in turn, delivers information necessary to contact the recipients and to match them with the recipients who offer the goods. The offer is worked out by the sales department and then publicized in the Internet so all entities get the access to it; not only the entities which are located in the area of the exchange activity.

In all the links shown in the logistics chain, one of the element which has not been characterized yet is the activity performed by logistics operator. Paker company is such an operator for WGRO, and its role is to render the services on: acceptance of the deliveries from the suppliers, sorting, short-term storage, common and individual package, forming the logistics units and delivery of the goods to the consumers. The activities of the service enterprise lead therefore to enrich the products with new, attractive usage qualities since the are attractive mostly for big network recipients such as hypermarkets and retail networks.

The information flow is of great importance to the chain of supplies for the goods exchange. In the presented WGRO, the flow follows in a specific way. Since the full offer of the exchange is made accessible in the Internet as an Market Information System (SIR – System Informacji Rynkowej) the information gathered from the producers should reach the Internet. Because of the fact that availability of this carrier of information is very poor among the farmers, the guild is being helped by the local commune administration as well as agriculture advising centres. The farmers can fill in the documents in form of the questionnaire, which is then processed, and typed to the electronic form which is made accessible in the electronic file, by trained commune and advising centres' workers. Further information flows in an electronic way, while the information given by the producers flows to the database which is administrated by Centre for Logistics and Distribution of WGRO S.A. The system of information exchange by means of the Internet is supplemented by the system of information and training meetings, where the producers get the information on the opportunities and rules for the cooperation with WGRO S.A. and also on many essential issues.

Information system for the information flow from food producers to the analyzed unit and the flow within WGRO S.A. have a twofold meaning. While the information within guild flows efficiently and quickly, thanks to use of the information system (for connection of units), the information from producers have to contain two phases of forwarding information: first in a paper form to the local commune authorities and then in an electronic form forwarded by means of the Internet and reach the database in Centre for Logistics and Distribution. This kind of system is imperfect, however, as the accessibility to the Internet grows, there is a chance that the information flow will be improved.

Strict connection, by means of computer system, between Centre for Logistic and Distribution with Logistics Operator is a very important factor for the information flow. Thanks to very quick and efficient information, both entities can cooperate closely, which is of considerable importance to realization of almost immediate supplies for the recipients, which, of course, in case of goods subject to the exchange at the guild (i.e. vegetables, fruit and flowers), is a precondition to ensure the fresh products and therefore basic feature of the high quality.

4. Summary

Presented analysis of logistics system and wholesale information system, being one of the most important cells of agri-food processing industry, points to significant transformations happening in functioning of this unit. Goods guild, colloquially, is a place where suppliers and recipients meet in order to perform purchase and sales activities. Such an approach, as compared to the presented analysis, is too much simplified. The wholesale market, which can be exemplified by Wielkopolska Gildia Rolno – Ogrodnicza S.A. (WGRO) is beginning to play more and more important role in the delivery chain. First of all, it encourages the market for the suppliers by promoting and awarding useful (from delivery chain management point of view) solutions such as producers' groups. The distribution environment in the goods guild is very modern and it makes use of logistics operators who render complex services on logistics, which, in turn, help to add usage value to the goods which undergo the turnover at the exchange. Considering information flow, the exchange initiates the activities to enable access to itself, despite certain difficulties in realizing pre-set flow (very poor accessibility to the Internet observed among agricultural goods producers). All these activities cause the guild, as a link for turnover between the suppliers and recipients of agri-food goods, to be a specific logistics centre which is very significant link for the supply chain in agri-food industry.

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XVIII. THE BALLOON EFFECT IN REAL-TIME SYSTEMS

Grzegorz BLIŹNIUK

Introduction

Concurrent software is manufactured in an extremely complicated and diversified process, its complexity evident on all levels - from human management and the choice of production method and tools, to project management, production control, production auditing and product testing. There is also talk of introducing configuration checks throughout the production process. One of the configuration elements (besides various customised applications and documentation on the software environment) is a software product built to function according to pre-set rules.

An important phase of the production process is quality testing. The work behind IT system projects (personnel management, surveying, analysis, blueprints, startup documentation) is frequently subjected to such tests, as is the software itself.

In the present article we will concentrate on software quality. First here are post-production tests carried out by the manufacturer, then follow similar tests by the buyer. Only after the completion of such tests do producer and buyer sit down to discuss prices, startup details, etc.

Given today's software engineering knowledge there appears to be no alternative to the above procedure. This, however, does not mean it is flawless. The author of the present article (which perforce handles the issue only superficially), based his conclusions on the matter on the following observations:

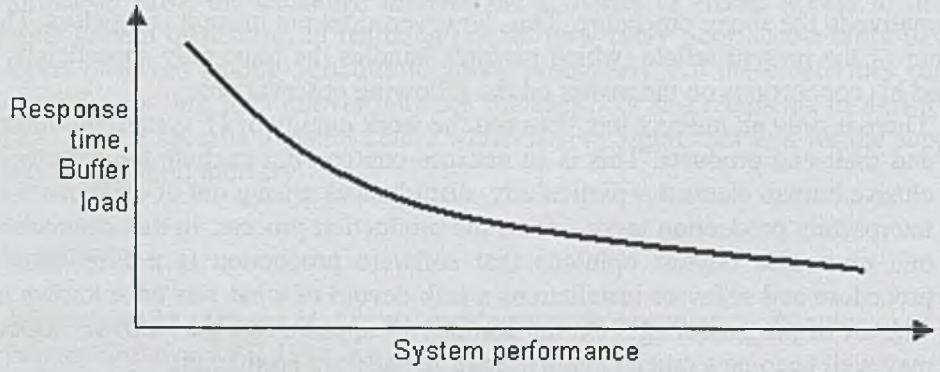
- There is only an indirect link between the work quality of IT system producers and their end products. This is so because one can not exclude the extremely elusive human element – particularly disturbances arising out of differences in interpreting production tasks – from the production process. In this connection one must also contest opinions that software production is a fully closed procedure and software installations a task devoid of what was once known as "the art of programming". On the contrary, it appears that the "artistic" aspect may well become a crucial quality factor in software production.
- One can never be sure that the tests carried out on software were really all-embracing. This is why all attempts at expanding the scope of software tests and verification are valuable and welcome.
- Errors discovered in the test or exploitation phase are much more expensive to remove than those pinpointed in earlier production stages. For this reason it is important to develop testing methods enabling quality checks earlier on in the production process. Such tests may prove incomparably cheaper than removing errors from untested software.
- Current software science provides no generally acceptable software quality testing method.

In light of the above it appears reasonable to supplement current quality tests with new testing methods (this article's author has also come out with proposals in this respect, presented in point [1]). The tests in question would allow quality checks on concurrent software already in the design phase and not, as now, on the ready product. Tests on selected software components would be possible even earlier, basing solely on pre-design blueprints.

Work on the testing methods outlined in [1] resulted in a number of interesting observations regarding some software types, one of which is this article's main topic. The phenomenon in question only appears in certain kinds of software but can have a large bearing on its functioning. Its appearance can be independent of the software's design and its discovery, if at all possible, is difficult.

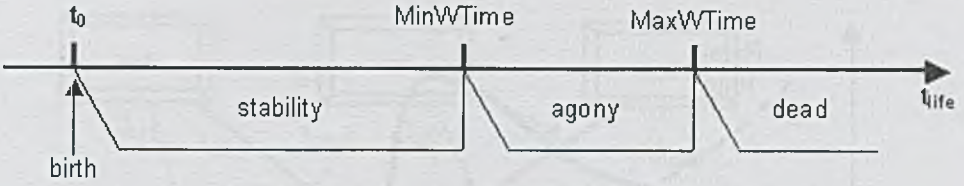
1. What is the balloon effect?

For users software quality depends both on design and effectiveness. Users frequently complain that while software may be functionally sufficient, it tends to be too slow. The most widespread method of speeding up software - besides re-designing, re-installation or re-configuration – is to activate it on a more powerful system in the assumption that stronger hardware will boost software. In this case the only feasible quality measure is the software's response time. In the case of message-relaying software it appears self-evident that a bigger system will cut down buffer load and thus shorten the time needed for messages to come through. The phenomenon is graphically displayed in picture 2.1.



Picture. 2.1. The influence of system performance on software response and buffer load

It appears, however, that this rule does not always work in the same way. This is particularly true in the case of software in which message lifespan is regulated as in picture 2.2.



Picture 2.2. Message lifespan parameters

The basic parameters for which software is tuned base on the assumption that messages are generated in moment **to**, their safe and stable relay then taking place within the timephase **(MinWTime – to)**. Moment **(to + MinWTime)** is followed by the message's agony phase, which takes place in the timephase **(MaxWTime – MinWTime)**, during which message stability is temporarily lost. This timephase is also the software's last chance to process the message if it is to be relayed within the given time limit. Relaying messages in their agony phase is generally considered risky (instable). Moment **(to + MaxWTime)** is followed by the messages death, meaning it can no loner wait for relaying and has to be debuffered.

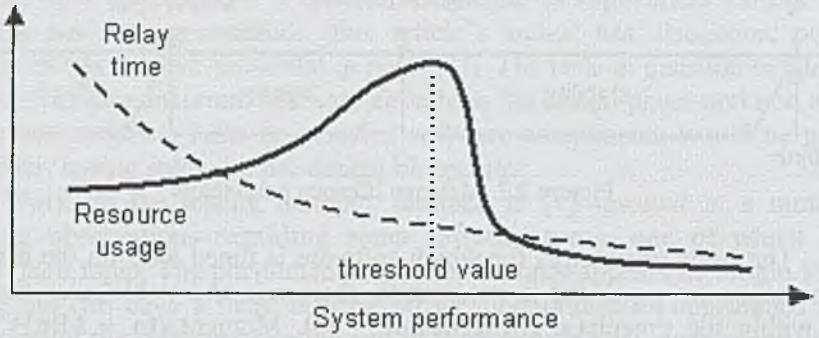
As the above shows, message lifespan understood as the time a message spends inside software, is perforce limited. What, then, should be done in cases where too many messages are relayed or when the relaying is instable? One way out is to reinstall the software. If this is not possible, it is best to upgrade the whole system until the desired software follow-up is achieved.

As I intend to show on a selected example, gradual upgrades on limited-lifespan (or impatient) message relaying software can give rise to a phenomenon which we may call the *balloon effect*.

The **balloon effect** arises in the course of software upgrades, which while helping to boost follow-up time, paradoxically also cause the message relaying system's buffer load to rise until the software achieves a certain performance level, after which it begins to sink again in rapid, irregular leaps. Once this threshold is crossed any attempts at boosting software will cut down buffer load.

The term "balloon effect" arose from the phenomenon's similarity to inflating a balloon. Balloons are made of stretching materials, which means that the more gas we put into them the larger their volume. This, however, is only be true up to the time when the gas pressure inside the balloon is sufficient to tear it apart. When the ballon bursts, its volume shrinks drastically - and irreversibly.

Some may find this analogy somewhat far-fetched, nonetheless I believe one can imagine our "balloon" as a bufferload of "impatient" messages waiting to be relayed, and system upgrades as "gas pressure". The balloon effect illustration in diagram 2.3. was based on concurrent software quality tests described in [1] and could be proof in favour of the above comparison (cf. the solid line in picture 2.3.).



Picture 2.3. The balloon effect illustration

Further research quoted herein shows that changes in the system's response time to impatient messages run according to the general principles outlined in picture 2.1. Experimenters have noticed that in such cases raised system efficiency and software response time are in reverse proportion to each other (picture 2.3., broken line[1]).

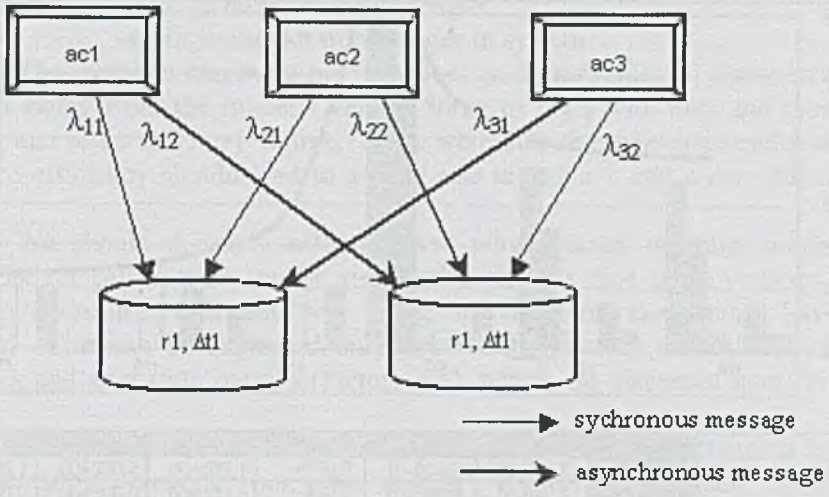
3. Research

3.1. A model illustration example schema

One experiment involved a concurrent software model consisting of three active components (**ac1**, **ac2**, **ac3**) and two resources (**r1**, **r2**) [1] (cf. picture 3.1.). The active components sent out synchronous and asynchronous messages to the resources, which were to relay them on. The software in question had Poisson distribution and fixed relay times [2, 3].

The parameters presented in Table 3.1 show clearly that the tests were conducted with parameter □ designating the intensity of random message-to-resources traffic constant for all d*i i=0..6* variants. Also constant were *MinWTime* and *MaxWTime*. What did change were parameters □t1 and □t2, proving that the resources had fixed message-relaying times. These parameters then rose with subsequent versions of the model in a process that can be called controlled resource efficiency growth.

[1] In reality the initial phase of the broken line's downward curve is less smooth than in diagram 2.3. This, however, in no way undermines the present discussion's relevance and actuality.



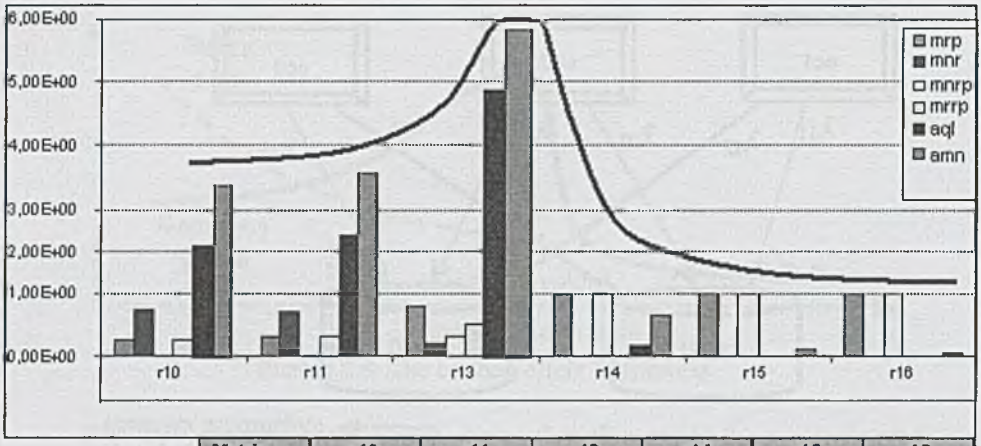
Picture 3.1. The illustration example schema

Table 3.1. Model Parameter Values

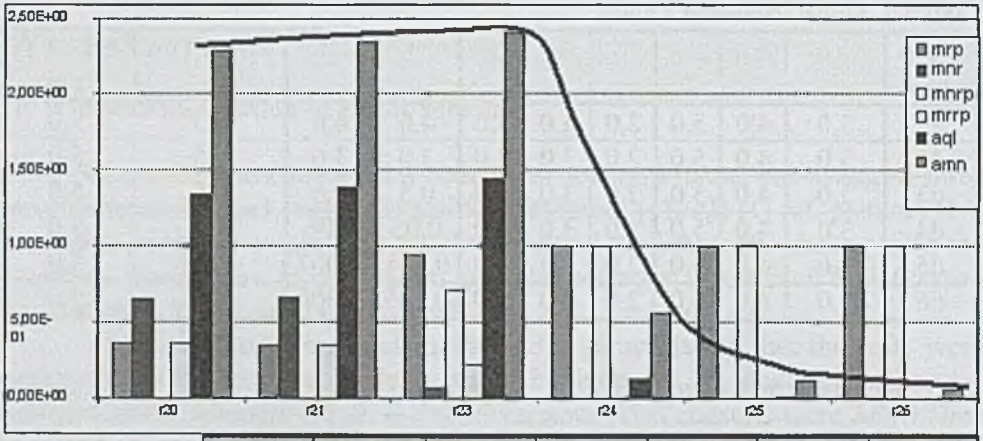
Signa -ture	□11	□21	□31	□12	□22	□32	□t1	□t2	MinWTim e	MaxWTi me
d0	3,0	4,0	5,0	2,0	3,0	4,0	4,0	4,0	2,5	5,0
d1	3,0	4,0	5,0	2,0	3,0	4,0	3,0	3,6	2,5	5,0
d3	3,0	4,0	5,0	2,0	3,0	4,0	0,5	0,6	2,5	5,0
d4	3,0	4,0	5,0	2,0	3,0	4,0	0,05	0,06	2,5	5,0
d5	3,0	4,0	5,0	2,0	3,0	4,0	0,001	0,002	2,5	5,0
d6	3,0	4,0	5,0	2,0	3,0	4,0	0,005	0,006	2,5	5,0

3.2. Observing the balloon effect

The model underwent simulation tests [2, 3, 4] in a specially-built simulator allowing overview over a broad range of concurrent software quality features, including resource usage, deadlock, starvation, jamming and relay load. The results were achieved by processing simulator-generated number sequences into maximum and average software parameters. Buffer length was assumed as unlimited (non-priority FIFO queues). After the elapse of lifespan *MaxWTime* the message was removed from the system, which meant its death (Picture 2.1.). The system did not relay messages still in the agony phase whose relay time promised to extend beyond its lifespan, the resources in such cases considered to have insufficient followup.



Metric	r10	r11	r13	r14	r15	r16
mrp	2,66E-01	3,02E-01	8,07E-	1,00E+00	1,00E+00	1,00E+00
mnr	7,34E-01	6,98E-01	1,93E-	0,00E+00	0,00E+00	0,00E+00
mnrp	0,00E+00	0,00E+00	9,16E-	9,99E-01	1,00E+00	1,00E+00
mrrp	2,66E-01	3,02E-01	8,90E-	7,05E-04	2,90E-04	1,20E-04
aql	1,75E+00	1,89E+00	4,87E+00	1,70E-01	5,82E-03	1,49E-03
amn	2,71E+00	2,85E+00	5,82E+00	6,50E-01	1,18E-01	5,87E-02



Metric	r20	r21	r23	r24	r25	r26
mrp	3,54E-01	3,39E-01	9,36E-01	1,00E+00	1,00E+00	1,00E+00
mnr	6,46E-01	6,61E-01	6,37E-02	2,76E-05	1,93E-05	0,00E+00
mnrp	0,00E+00	0,00E+00	7,16E-01	9,98E-01	9,98E-01	9,99E-01
mrrp	3,54E-01	3,39E-01	2,20E-01	2,23E-03	1,66E-03	1,45E-03
aql	1,34E+00	1,39E+00	1,44E+00	1,27E-01	4,89E-03	1,20E-03
amn	2,29E+00	2,35E+00	2,40E+00	5,61E-01	1,07E-01	5,33E-02

Picture 3.2. Responce characteristic for resources r1 and r2

The graphic charts shown in Picture 3.2 show simulated results for the following quality factors:

- *mrp* - maximum message relay probability
- *mnr* - maximum non-relay probability
- *mnrp* - maximum normal relay probability (stability phase, Picture 2)
- *mrrp* - maximum risky relay probability (agony phase, Picture 2)

- *aql* -average message queue length
- *amn* -average number of messages in system

The dynamic reactivity metric values in Picture 3.2. [1] show an evident upward swing from the model's version three to four, with *mrp* and *mnr* rising rapidly and *mnrp* and *mrrp* falling. These were also the expected results as rising resource efficiency should lead to a *mrp)* rise to value 1 and a *mnr* fall towards zero.

We should therefore ask ourselves why average message number and queue length values were on the rise in the model's first three versions. If the software's resource efficency was going up, shouldn't they rather have been sinking? This can be explained only after further studies on research-obtained interlock and starvation metrics (Picture 3.5), which are discussed later on in this article.

During tests the model's first three versions suffered permanent interlock and starvation, versions four, five and six displaying no such troubles. In permanent interlock and starvation cases access demands are debuffered and considered unrelayed. This is called message death (Picture 2.2.). As the software resources gain power permanent interlock and starvation become temporary, more messages are also relayed in the stability phase (see Example). There are now also fewer rejected messages so more are buffered, the increase in buffer length in this case a side effect of raised resource performance (but insufficient to totally eradicate software wear and resulting message deaths).

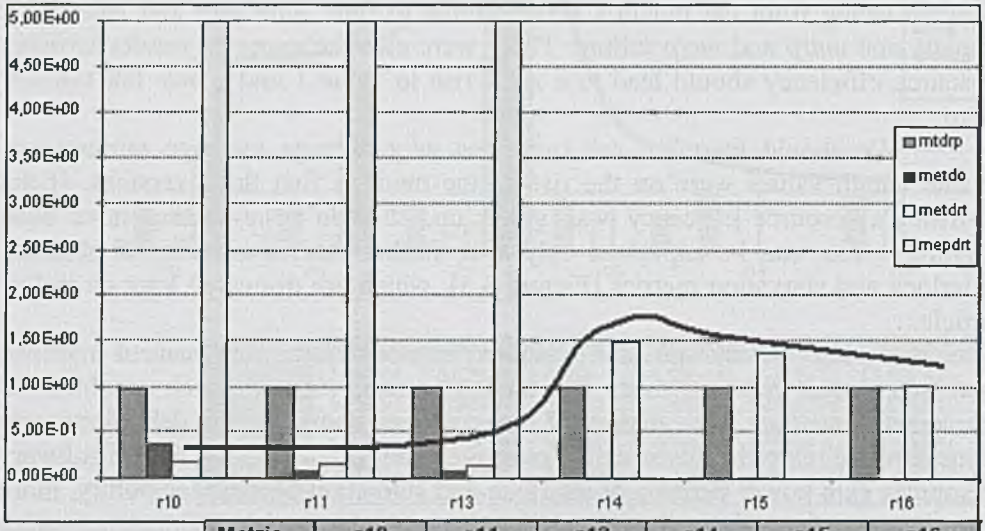
Increased buffer length as a result of resource upgrades is what we call the *balloon effect.*

The ballon effect disappears when resource efficiency is sufficient to eradicate permanent interlock and starvation. Having crossed this threshold, average message number and average queue length values (*amn, aql*) start to fall as expected, relaying now efficient enough to keep the buffers from overloading.
Diagram 3.3 shows the dynamic metrics for deadlocks appearing in the Illustration Example Schema. Examined were the following values:

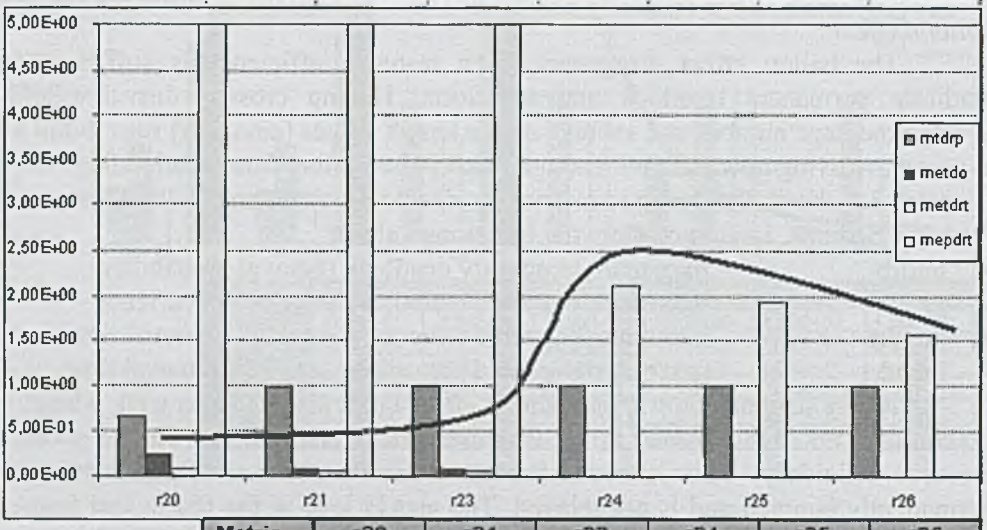
- mtdrp - maximum temporary deadlock removal probability
- metdo - maximum expected temporary deadlock occurrence
- metdrt - maximum expected temporary deadlock removal time
- mepdrt - maximum expected permanent deadlock removal time

As the diagram shows, the balloon effect takes place here as well, whereby it should be noted that *metdrt* in the first three trial runs is lowest despite poorest resource efficiency. This is because a considerable number of messages gets permanently jammed and is not relayed. The *metdrt* leap in the fourth and further runs is the result of upgraded software killing off permanent hang-ups (at this stage messages are mostly threatened by temporary jams which the software can deal with). The result is a rise in average hangup removal time. The table under Picture 3.2 shows that estimated maximum hangup removal probability equals 1 only in the fourth and further trials.

The above experiments also showed visible changes in permanent starvation removal. As with deadlocks, the threshold here appeared between the third and fourth trials on the second model. For more details on starvation see [1].



Metric	r10	r11	r13	r14	r15	r16
mtdrp	9,81E-01	9,87E-01	9,96E-01	1,00E+00	1,00E+00	1,00E+00
metdo	3,65E-01	6,67E-02	6,84E-02	0,00E+00	0,00E+00	0,00E+00
metdrt	1,65E-01	1,38E-01	1,25E-01	1,48E+00	1,37E+00	1,01E+00
mepdrt	5,00E+00	5,00E+00	5,00E+00	0,00E+00	0,00E+00	0,00E+00



Metric	r20	r21	r23	r24	r25	r26
mtdrp	6,68E-01	9,76E-01	9,99E-01	1,00E+00	1,00E+00	1,00E+00
metdo	2,40E-01	7,20E-02	7,18E-02	0,00E+00	0,00E+00	0,00E+00
metdrt	7,44E-02	5,56E-02	4,87E-02	2,10E+00	1,94E+00	1,57E+00
mepdrt	5,00E+00	5,00E+00	5,00E+00	0,00E+00	0,00E+00	0,00E+00

Rys.3.3. Deadlock characteristic for resource r1 and r2

4. Summary

The balloon effect's occurrence in real limited-lifespan message relaying software may entail unnecessary costs and the best remedy here is to upgrade hard- and software beyond the danger point. This, however, will not work with smaller systems, where buffer load analysis alone may prove too expensive. On the other hand, however, I believe that in large systems with data banks measured in giga- and terabytes any buffer load rise that is not clearly justified by data bank size could be a threat to the operator's budget. In such cases it may be better to spend larger sums on upgrading the system's computing power instead of merely raising data carrier size.

The above cost analysis is geared more to dispersed than centralised systems, the first being better adapted to communicate between distant elements. It can, however, be of some use to centralized networks, which also occasionally relay limited-timespan messages and are therefore threatened with the balloon effect.

The above conclusions do not apply to software relaying unlimited-lifespan – or patient – messages, where rising software performance is directly proportionate to falling buffer load.

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XIX. THE POSSIBILITIES OF EARNED VALUE CONCEPT APPLICATION IN IT PROJECT MANAGEMENT SYSTEM

Mirosław DYCZKOWSKI

Introduction

This paper presents findings referring to the application of the Earned Value (EV) concept in IT projects (see section 3). EV was applied while the project had already been partially implemented, since it had occurred that the existing project management system hadn't given satisfactory answers to many important questions. The conclusions presented in this article should be taken into consideration both by IT project managers and the companies implementing such projects. There are some reasons for that:

- serious hindrances to effective IT project management, especially in terms of cost and time management, and those associated with insufficiency of early warning signal systems tracking deviations from drawn up schedules and budgets (the problem is typical not only for Poland, see The Standish Group reports [CHAOS, 1995; 2001; 2003]),
- necessity of putting into the Polish practice tools, which are world-wide recognized as efficient methods of improving project's effectiveness, particularly in case of high-risk projects where the managers are facing growing competition (see [Dudycz and Dyczkowski, 2001a; Dyczkowski, 2001; Szyjewski, 2004]).

The author's intention was also to gain experience and collect information, which could be useful in his scientific researches and academic work.

1.The concept of earned value project management

Before the application of EV is described, the idea of this approach should be recalled. For further details the author recommends the available literature (see [Christensen, 1998; Fleming and Koppelman, 1998; 2000; 2001a; 2001b; Kezsbom and Edward, 2001; Lientz and Rea, 2002; Olson, 2001; PMBOK®, 2000; Wake, 1998 or Wilkens, 1999] and Project Management Journal) as well as Web-pages of well-known project management associations such as: AACE Int. (http://www.aacei.org), PMWebRing (http://www.pmforum.org), PMI (http://www.pmi.org), or SEI (http://www.sei.cmu.org) or software firms e.g.: ABT Corporation (http://www.abtcorp.org), AMS (http://www.amsusa.org), CAI (http://www.cai.org), Microsoft (http://www.microsoft.org), or Primavera (http://www.primavera.org).

Earned Value is a method used in a project management, which combines resources management, task schedules, budget and requirements in implementation's efficiency. The EV method is based on evaluation and

monitoring of work progress in terms of costs, time and performance. Obtained figures are compared with a scope of a project, having been determined at a project's definition stage. Thus, an integration of particular objectives (related to the main dimensions of a project such as: scope, costs and time) and creation of a system assessing efficiency of their achieving, can be guaranteed (see [Fleming and Koppelman, 1998, p.1; Kezsbom and Edward, 2001, p.330; PMBOK®, 2000, ch.4]).

The idea of Earned Value is explained on fig.1, 2 and 3, presenting the main differences between EV and the "traditional" methods of controlling and evaluating work progress being based on comparison of budgets with actual expenses incurred (the broken lines on fig.1). Nevertheless, such an analysis does not provide all necessary information about the stage and the progress of a project.

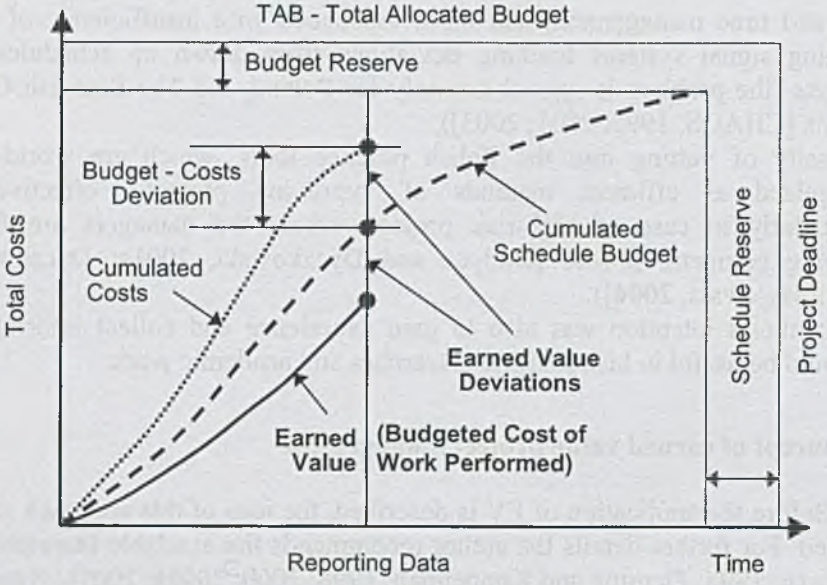

Fig. 1. Earned Value concept

In order to have the above-mentioned data obtained, Earned Value (understood as all the total value of tasks completed so far during project's implementation) needs to be monitored (the solid line on fig.1) and compared with a schedule budget and costs incurred. Such a procedure enables to track project's performance and to estimate consequences of time and cost deviations, arising on the way, more precisely (fig. 3).

The application of EV to monitor a completion of work does not require any preliminary activities from managing teams, which would considerably exceed typical tasks realized in initial and planning stages in the majority of project

management's approaches (see the list of ten earned value "musts" defined by Fleming and Koppelman [Fleming and Koppelman, 1998, pp. 5-9]). The analysis is based on formal structural plans, commonly used by project managers (e.g. WBS – Work Breakdown Structure, OBS – Organization Breakdown Structure, RAM – Responsibility Assignment Matrix, CBS – Cost Breakdown Structure), budgets, schedules and tools used for collecting data about consumption of allocated resources to complete measurable work packages defined in a project. Project managers have to decompose each task into work packages and define their attributes: scope, progress measure, relevant elements of WBS, budget, assignment of responsibilities according to RAM as well as start and end dates. Having completed that, critical processes (including defined scope), schedule and estimated resources are being integrated into a bottom-up plan consisting of detailed measurement cells called CAP – Control Account Plan.

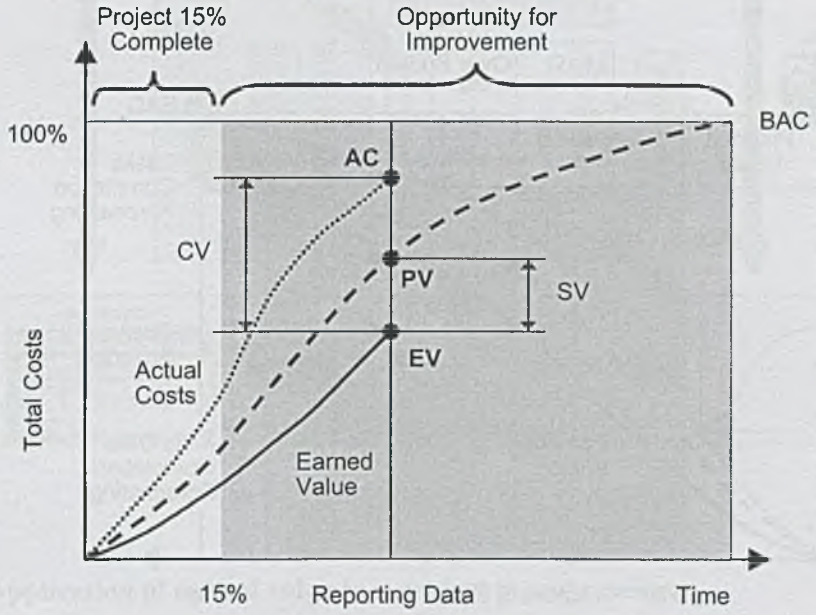

Fig. 2. The idea of using EV for project's monitoring

Consequently, basic parameters of a project, used in EV, can be tracked (see fig. 2) e.g.: PV – Planned Value (the synonyms are PC – Planned Cost or BCWS – Budgeted Cost of Work Scheduled), AC – Actual Cost (the synonym is ACWP – Actual Cost of Work Performed), EV – Earned Value (the synonym is BCWP – Budgeted Cost of Work Performed) for completely or partially performed work packages. On the basis of PV, AC and EV project managers can calculate Cost Variance (CV=EV-AC) and Schedule Variance (SV=EV-PV).

Having estimated CV and SV, basic conclusions concerning the stage of a project can be drawn and indexes, crucial for predicting an efficiency of a project's further development calculated, i.e.: CPI (Cost Performance Index) and SPI (Schedule Performance Index). The first one (the formula CPI=EV/AC) informs about cost efficiency (i.e. compares a value of work performed to resources consumed). The latter (the formula SPI=EV/PV) describes schedule efficiency (i.e. delay or advance). These indexes stabilize shortly after the beginning of a project; the reports show that SPI and CPI fix just after 15%-completion of projects [Fleming and Koppelman, 1998, pp.1-2]. The efficiency indexes are used to calculate the following measures: ETC – Estimate To Complete, EAC – Estimate At Completion and TCPI – To Complete Performance Index (the formulas are presented in the tab. 2). They enable to obtain information about observed trends in a project (see fig. 3) and therefore to influence its further development.

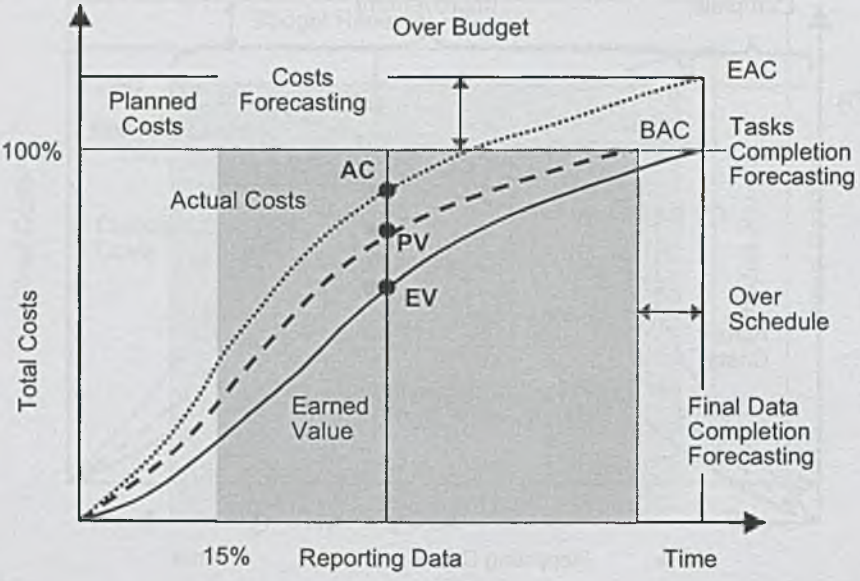

Fig. 3. The idea of using EV for project's estimation

The unquestionable advantage of EV is its easily understandable and applicable concept, what is being proved in the next part of this article. From the IT project managers' point of view the usefulness of EV increases if EV is implemented in project management applications such as ABT, MS Project or Primavera (see [Dudycz and Dyczkowski, 2001b]).

The presentation of the EV method should be concluded with a remark, that its implementation in IT project management has to comply with certain principles. The first group of these refers to organizational activities and a

realization integrated within a process of designing the environment, which enables to apply the EVA/EVM standards (Earned Value Analysis/Earned Value Management) in a certain projects. The other group is related with an utilization of already implemented solutions, that is with running a system called EVPM (Earned Value Project Management). The basic objects, which the EVPM system is composed of and the relations between them are illustrated by the fig. 4. The detailed description can be also found in [Dyczkowski, 2003].

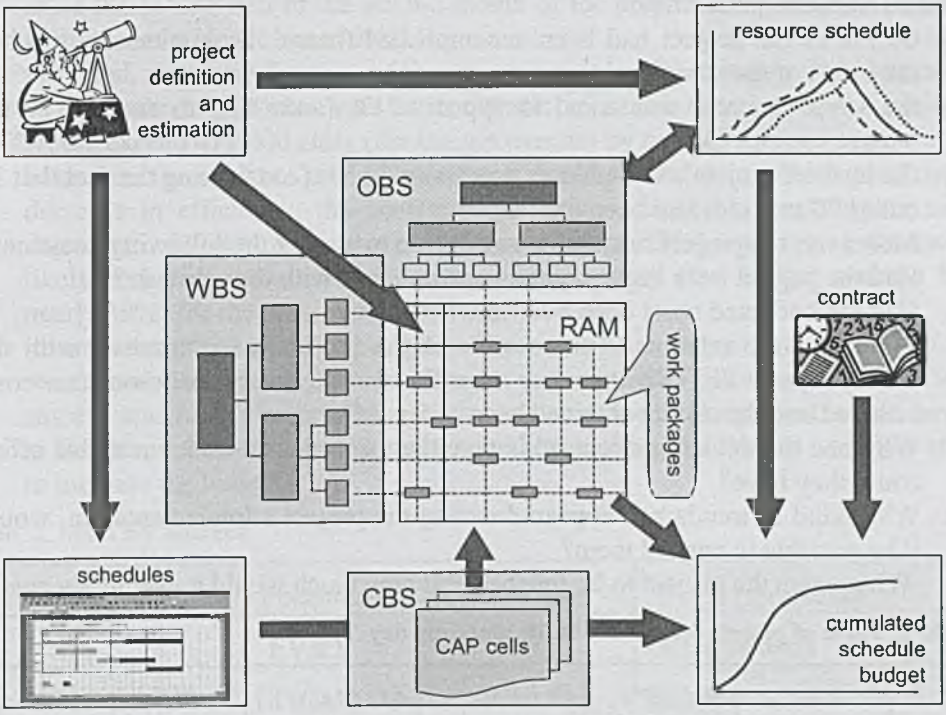

Fig. 4. The main objects of the EVPM system

2.Application of earned value in e-project management

The project (see [Dyczkowski, 2002]), in which EV as an assessment tool has been applied, aimed at the implementation of an Internet-based e-commerce system (A2A, B2B and partially B2C electronic transactions) with elements of e-SCM and e-CRM solutions in a large, multioperational Polish enterprise (from the second half of the top-hundred Polish companies).

The project, because of an inaccurate definition of its functional areas, was based on Optional Scope Contract (OSC). The system was partially built on modification of standard business application (with an extension of its functionality and an adjustment to the specific features of the client's line of business) and partially by designing interfaces to existing standard ERP-type software, which had

been used in the firm for two years. In general, 4 subsystems containing 30, 20, 18 and 2 modules respectively were to be created within 12-month period of time. The budget of this project was equal to 350,000 zloty.

The stage of the project at the reporting day was as follows. The implementation had already taken 8 months. 36 out of 70 modules had been completed (22 out of 30, 10 out of 20, 6 out of 18 and 0 out of 2 respectively). The costs incurred had amounted to 248,300 zloty. Three completely different assessments of the project's progress had been presented at the periodical meeting of the Executive committee:

1) 66,7% of the project had been accomplished (hence the implementation had taken 2/3 of the scheduled time),
2) the work progress was equal to approx. 71% (according to the part of the budget spent to date),
3) the level of project's completion was about 51.5% (considering the fact that 36 out of 70 modules had been implemented).

Moreover, the project manager was not able to answer the following questions:

1. Had the project been implemented in accordance with the schedule?
2. Had the budgeted costs been overrun?
3. What was the relation of the results of the project in comparison with the money spent and whether any significant differences between the costs incurred and the results obtained been observed?
4. Why had the deviations occurred, were they significant, what a possible effect could they have?
5. What kind of trends had appeared during the project's implementation, would it be possible to control them?
6. When were the project to be finished and how much would it eventually cost?

Tab. 1. Value of project parameters at the reporting day

Subsystem	BAC	PC (PV, BCWS)	EV (BCWP)	AC (ACWP)	SV	CV
A	150,000 zl	150,000 zl	112,500 zl	130,000 zl	–37,500 zl	–17,500 zl
B	100,000 zl	50,000 zl	50,000 zl	50,000 zl	0 zl	0 zl
C	90,000 zl	45,000 zl	29,700 zl	45,000 zl	–15,300 zl	–15,300 zl
D	10,000 zl	3,300 zl	0 zl	4,000 zl	–3,300 zl	–4,000 zl
Total	350,000 zl	248,300 zl	192,200 zl	229,000 zl	–56,100 zl	–36,800 zl

At that stage independent experts, using EV method, prepared a breakdown of basic parameters (tab. 1 and 2) of the project and presented the following assessments:

1) in general, the project was delayed and its implementation had cost more than expected (71% of the budget had been spent but the work completed had amounted only to 55% of the overall cost of the entire system; the current 39-day delay was equal to 16% of the scheduled time),
2) the efficiency indexes were low (SPI=0.77, CPI=0.84) and they had been stable since the second half of the second month of the project's implementation (the fluctuations were within ±10%),
3) provided, that the efficiency of the remaining part of the project would remain at the same level (what was an optimistic scenario) the cost of the project would exceed 417,000 zloty (the budget overrun by over 19%),
4) basing on the statistics available in the EV-related literature, which predicts a decrease in efficiency, the costs of the project would be much higher and amount to: 420,000 zloty (the budget exceeded by 20%) considering the most likely scenario or even reach almost 472,000 zloty (the budget overrun by nearly 39%) for the pessimistic version,
5) in order not to exceed the budget, efficiency of the project's implementation would have to increase considerably, for the required TCPI was equal to 1.30; since it was hardly imaginable, much smaller scope of the project would have to be accepted or the contract renegotiated (to prolong the time to complete and to increase the budget).

Tab. 2. Main EV indexes

Index	Formula	Value	Comments
SPI	EV/PV	0.77	Delay of work
CPI	EV/AC	0.84	The cost exceeds the value of work
ETC	(BAC-EV)/CPI	188,013.53 zl	Provided that the current value of CPI is maintained
EAC (estimated)	BAC/CPI	417,01353 zl	Provided that the current value of CPI is maintained
EAC (optimistic)	AC+ETC	417,013.53 zl	Statistically the most optimistic scenario
EAC (statistically the most likely)	$\frac{AC+(BAC-EV)}{0,8*CPI+0,2*SPI}$	419,982.49 zl	Statistically the most likely scenario

EAC (pessimistic)	AC+(BAC-EV) / (CPI*SPI)	471,891.57 zł	Statistically the most pessimistic scenario
TCPI (calculated for budget)	(BAC-EV)/(BAC-AC)	1.30	The required value of the efficiency index, which enables not to overrun the scheduled budget
TCPI (calculated for estimated budget)	(BAC-EV)/(EAC-AC)	1.20	The required value of the efficiency index, which enables not to overrun the estimated budget

The presented information enabled e.g. to:

a) obtain the complete assessment of the current stage of the project and necessary actions to be taken in future,
b) make decisions related to an increase of efficiency of work,
c) make decisions concerning the implementation of EV as an important tool improving management of other projects in the company, particularly as a key element of an early warning system tracking deviations of incurred expenses within a particular period of time from results obtained.

3.Conclusion

The example, presented in the previous section, proves the usefulness of EV in IT project management. This method enables to derive the following benefits (see [Christensen, 1998]):

1. EV integrates work, schedule and cost using formal structural plans such as WBS, OBS, RAM and CBS and creates a single management control system providing reliable data.
2. The cumulative cost performance index (CPI) and the schedule performance index (SPI) act as early warning signals.
3. EV uses an index-based approach to forecast the final cost and the end-day of the project (the CPI is a predicator for the cost and the SPI is a predicator for the final date).
4. The "to-complete" performance indexes allow evaluation of the forecasted final cost and the forecasted final date.
5. The periodic (e.g. weekly or monthly) CPI and SPI are the benchmarks.
6. EV is based on the management by exception principle so that information overload can be reduced.
7. The associated databases of completed projects are very useful for comparative analysis.

8. EVPM system databases collect a lot of detailed characteristics, scenarios, parameters, metrics etc. describe current and closed projects and processes. Therefore EVPM's implementation is a very good start-point to create a knowledge based project management system.

The Earned Value method is focused on costs, time, scope and implementation's efficiency. It combines three basic areas of project management: business management (covering economic – mainly financial – aspects), technical management (related mostly to assuring compatibility of project's results with technical specifications in all phases of its life cycle) and contract management (referring to the contracts drawn up between all the participants involved in a project) and enables to create a complex and uniform evaluation system. Its popularization should help to improve efficiency of investments in IT and communication technologies. According to the author, the method ought to be implemented as one of the tools of auditing IT projects financed from public funds just like it has been adopted e.g. in the USA in acquisitions of new systems by US government agencies.

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XX. PROCESS OF BUILDING THE PROBABILISTIC KNOWLEDGE MODEL[1]

Marek A. VALENTA, Anna ZYGMUNT

Introduction

Acknowledged direction for using the acquired domain knowledge is creating the model of that knowledge. Such model could be then used by the inference process in the expert systems. There are many types of the knowledge models and connected with them inference methods. Each of that models and inference engines could be responsible for the different demands of such systems goals.

Expert systems quality decidedly depends on the knowledge stored in their knowledge bases. To the needs of this discussion, knowledge management can be understood as the process of the knowledge acquisition, building appropriate knowledge model and selecting the inference method. Such process should be strictly relevant to the goals of the final system and validation of that knowledge.
In that process one can distinguish two cases: knowledge acquisition in the traditional manner from experts and literature sources (interview techniques, etc) and the automatic process (or semi-automatic), in which machine learning methods are used.

Within the framework of studies making by the authors in Department of Computer Science, AGH University of Science and Technology [5, 18], many knowledge models and prototypes of medical expert systems have been built, supporting the decision making connected with the problem of occurring relatively many nosocomial infection cases. Problem has wide range and decision support in reality can concern many aspects of treatment. First natural step in developing such kind of systems is making use of traditional knowledge acquisition methods. Both for the expert doctors and variety of domain literature the natural knowledge representation is describing the considered problems as the dependent or independent events. It isn't, of course, the only way of presenting the medical knowledge, but this way is simple platform of agreement between experts and knowledge engineers.

Taking into consideration the probabilistic knowledge model, as the basis of developing such expert systems, than, in the actual state of storing the data about process treatment, these data can become the valuable knowledge sources. Valuable, because after selecting proper data sources we can obtain from them fully reliable knowledge.

Describing earlier research, are based upon two kind of knowledge models: probabilistic one enable inferring on the basis of bayes theorem and more complex

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model in the form of bayesian network. In research very interesting is aspect of the automatic knowledge acquisition from existing databases, recognizing the range of application different methods and tools. The final goal of these research is recognizing the conditions of applicability research methods and developing methodology of specific kind of systems realization.

1. Nosocomial infections – problem and system foundation

Nosocomial infections appearance has been chosen as a research area. They are the significant problem in hospitals in all world. Nosocomial infections are evolving during staying sick person in the hospital or after his returning home, but always, its origin is staying in the hospital and making there treatment. Nosocomial infections have become heavy medical-economic problem and are considered to be more meaningful then infective diseases incidence.

Apart from the progress and development of medicine, in every hospital, some percentage of patients are become infected during applied there medical treatment. Reasons of the nosocomial infections arising are very complex and problem significant, especially that for some infected patients, nosocomial infections become the proximate cause of the death [39]. In such situation decision supporting in the range of therapeutic process management of the patients in the hospital become often the necessity. In the information technology development age, supporting these processes by the intelligent computer systems with built-in domain knowledge bases seem to be the best solution.

The most important problem of such systems development (after solving the technical problems) is the knowledge acquisition, building the appropriate knowledge model and matching for that model the intelligent advisory methods (inference). A large majority of these problems can be treated as a knowledge management problem [17].

Detailed analysis the knowledge in domain of therapy processes and their impact on nosocomial infections arising had brought to the logical structure developing of that knowledge [14]. Facts, which we are working with during the treatment process, one can describe as factors which have an affect of the risk degrees of the nosocomial infection incidence. More accurate analysis of these factors (considering their genesis) indicates the necessity of defining among them three different groups: factors which are dependent on the general state of patient health; factors, which are dependent on the selected diagnostic-therapeutic procedure and the factors dependent on hospitals conditions, which are connected with their infrastructure and organizational procedures.

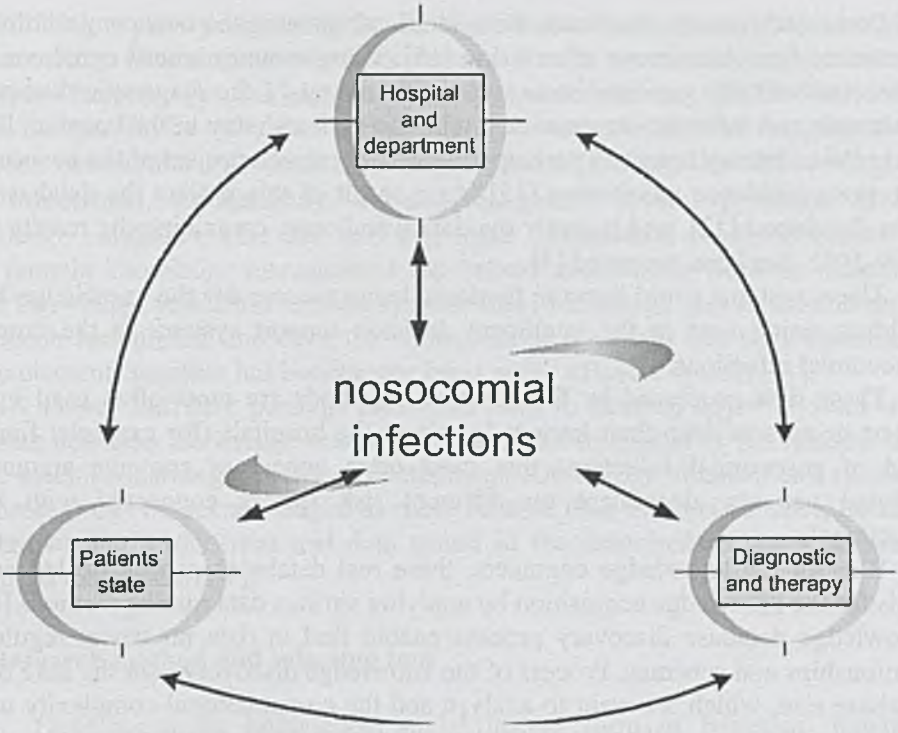

Figure 1. Knowledge structure – nosocomial infections risk factors

General goal of the decision support systems in the range of the presented earlier problems is supporting – in specific situation – the size of risk of the nosocomial infection incidence and indicating the risk factors having the most significant influence on the nosocomial infections incidence. More ambitious goals are the direct determining the optimum conditions and therapeutic processes minimizing the nosocomial infection risks, are not the subject of our research.

2. Available data sources for nosocomial infections

Both in the all domains and in the case of nosocomial infections, the basic and natural knowledge source for the developing systems are expert doctors and the domain literature. However, generally known are problems with acquisition the knowledge from such sources and that knowledge validation. Therefore, the new knowledge sources are looking for not only by the doctors but also by the knowledge engineers building domain knowledge bases for the new expert systems. For the knowledge engineers, who don't possess the domain knowledge, one of the most important thing is that the alternative sources of that knowledge should be fully reliable, and using methods of that knowledge acquisition allow run this process without knowing the domain. Naturally such trends are desirable, although their whole realization seems to be practically impossible [1, 7].

Fortunately, in the hospitals, the systems monitoring the nosocomial infection incidences have been more often using [15]. These systems record numerous data connected with the patients' state, type and amount of the diagnostic-therapeutic treatments and information connected with the patients' stay in the hospital. There are in Poland many hospitals participating in the research project of the nosocomial infections incidence monitoring [15]. As a result of this project the database has been developed [12], and recently the data warehouse, containing the results from 1999-2001, has been proposed [4].

These systems could become the knowledge sources for the knowledge bases building, using next in the intelligent decision support systems in the range of nosocomial infections.

These data processed by the statistical methods are most often used by the expert doctors to deep their knowledge about the hospitals (for example: find the kind of nosocomial infections that most often appear or compute amount of infected patients, dependent on different risk factors connected with these infections).

But, for the knowledge engineers, these real databases can be treated as the basis for the knowledge acquisition by applying various data mining methods [6]. Knowledge database discovery process enable find in data nontrivial regularity, relationships and schemes. Process of the knowledge discovery - for the sake of the database size, which we want to analyze and the computational complexity of the used algorithms – is realized with the help of different advanced computer methods and tools [3].

3. Domain of study and problem resolving conception

On the one hand, we have at our disposal specialized databases and - following from this - the possibility of presenting knowledge as events (facts connected with patients and treatments). But, on the other hand, expert doctors relatively easily make use of domain knowledge, defining the dependences between different risk factors in the form of probability of the conditional events. In this situation natural approach for selecting the knowledge models and inference methods seems to be the probability models. Taking into account various conditions of knowledge probabilistic models building and inference processes defining one can generally find the practicability two kind of these models. Much more simpler models are based on the conditional events probability and make assumption about the different risk factors independence. During the inference process bayes theorem is directly used in these models [14]. Building more complex knowledge base, that use probabilistic knowledge, enable bayesian networks technology [8, 9, 10].

In our research in building intelligent decision support systems with built-in nosocomial infections knowledge bases these two models have been used. First model is based on the probabilistic expert systems shell BayEx [14]. Second model, taking advantage of the bayesian networks, is built on the basis of the BN Power Software package [19].

Building expert system using BayEx shell is the classic example of managing the knowledge obtaining directly from experts. Several tests have been carried and expert system prototype has been built. But then one found out, that the knowledge model built-in BayEx was relatively too simple, to make the correct mapping of the complex nosocomial infections domain (in spite of limiting domain to surgical site infections). Concurrently, experts recognized several problems in the knowledge validation. One can find that these fundamental problems connected with domain knowledge management has caused undertaking work in computer-aided knowledge validation in such system. Brief foredesign and functional range have been formulated, and even the validation methodology has been determine. These elements together has become the basis of the xBayEx system [11].

BN Power Software package allow not only to develop expert system with bayesian networks knowledge base model, but it can be treated as the valuable tool of the machine learning processes development. Knowledge obtained as a result of that process can be acknowledged as more reliable than in previous case, because that knowledge arises from real data stored in the described earlier nosocomial infections databases [8, 9].

4. Research method and selecting tool

Developing the knowledge model in the form of bayesian networks requires two consecutive steps performance: net structure determining, that is defining the nodes (representing events) and relationships between them, and determining, in the second step, the value of these relationships. Receiving model, after testing, can become the basis of decision support systems developing. In case of BN Power Software, such model is called as classifier. Process of this task realization and BN Power Software system modules are presented on the fig. 2.

BN Power Software [2, 19] system received very good opinion by the knowledge data discovery experts during the KDD Cup 2001 (Data Mining Competition) [20]. It gave the best prediction accuracy.

BN Power Software possesses important feature exploiting in the automatic machine learning algorithm: bayesian networks generation, predefining by the experts selected elements of the building knowledge model.

System has built-in automatic procedures extended support that allow to indicate the desirable logic relations and their character. One can indicate data where different types of relationships must be excluded, or data where such relationships may exist. One can even point data character, taking into consideration their place in the network structure (root and leaf nodes).

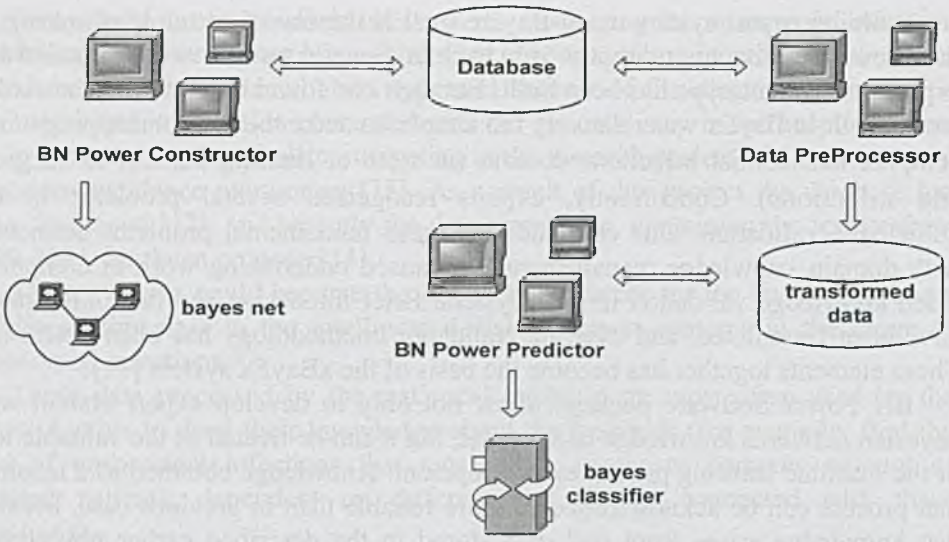

Figure 2. BN Power Software modules

Advanced tool for the model building allow to select for the analysis the subset of available data (usually tremendous size), and for the continuous values allow to select the discretisation methods. Input data can be received from several different sources, especially from databases compatible with MS SQL Server format.

BN Power Software consists of three independent modules (fig.2). Dividing BN Power Software into modules reflects its fundamental usable functions. And so, Data PreProcessor allow to make the preliminary selection of the input data and their conversion to the form making easy additional processing (net generation and learning). BN Power Constructor is a module realizing the complete generation of the domain knowledge model in the form of bayesian networks. This generation is made on the basis of input data and user-defined selected features of that net. The most technological advanced module in the BN Power Software System is BN Power Predictor. This module allow not only to generate the bayesian networks structure for the corresponding field of knowledge, but this module is able to generate bayes classifier on the basis of selected input data. These classifiers can realize the intelligent support decision functions in the domain of implemented knowledge.

5. Experiments description

For testing the possibility of fully automatic generating knowledge from the nosocomial infections databases [12], several steps described by this technology have been realized [5]. First of theses steps was the appropriate data preparation, which contains:

- selecting only these records attributes, which are interested to traces in the data mining process;
- defining acceptable data samples – one and a half millions records are analyzed very long, therefore it is very difficult to make comparative simulations for different algorithms parameters;
- selecting the training and testing data test.

Attribute selection was necessary, because the input data are the tremendous set more than one and a half millions records of hospital treatments cases. Authors decided to select only some, the most interesting aspects connected with nosocomial infections. First step was converting the part of data to the form required by the BN Power Software algorithms (for example data discretisation). Second step was selecting and grouping the attributes which can be considered as the most significant from the data mining viewpoint. Taking into consideration the research methodology data was divided into training data set and testing data set in accordance with generally accepted principles, that ¾ of data would be the training data set, and ¼ - data set testing effectiveness of receiving classifiers.

Six groups of data were determined with data attributes connected with: operations, patient's state, departments and hospitals characteristics. For more detailed analysis data groups of infected patients were selected.

Automatic design the bayesian network on the basis of each data group allow to generate several bayesian network structure, which then allow to find interesting relationships in data. This way authors received enough detailed knowledge, which was a fragment of the greater whole, containing the total knowledge about nosocomial infections problem. Such fragmentary knowledge is significant easier to its verification not only for knowledge engineers, but for expert doctors.

Threshold is an important algorithm parameter, which has a great impact on controlling the obtaining knowledge significance. Controlling the value of this parameter enable changing the quantity and degree of discovered relationships. And so: low parameter values (below 1) allow to discover even weak relationships, but the algorithm execution time is very long. Otherwise, high values of the threshold (above 1) cause only strong relationships finding. Within a framework of experiment one has generated the bayesian network both for low and high value of the threshold. This way the one tested the bayesian network generation program sensitivity to different values of this parameter. There was made an experiment in matching the values of threshold to different models. Exemplary bayesian network generated by BN Power Constructor module are shown on figure 3 and 4.

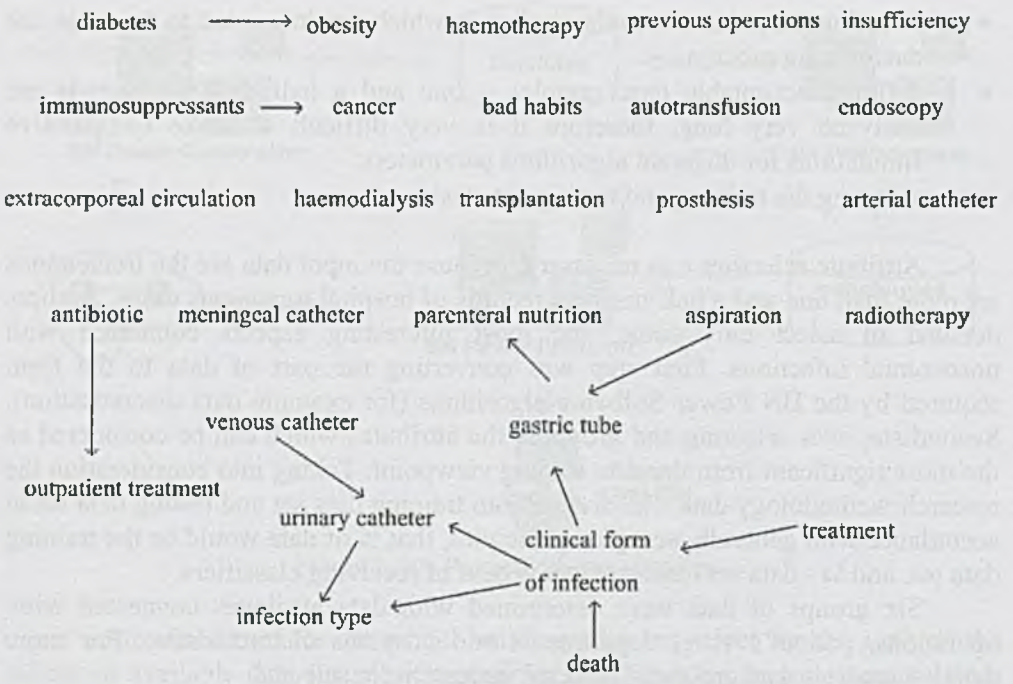

Figure 3. Network generated for relationship nosocomial_infections_risk_factors and clicinical_form_of_infections, threshold = 1.0 [5]

These figures represent the different impact factors on the type of nosocomial infections. Similar experiments were made on the data describing the details of operations and their results in the form of nosocomial infections and their consequences. Results of these experiments have reached an interesting conclusion, quite often inconsistent with generally accepted relationships defined by the expert doctors. And so, for example the operation time turned out to be conditionally independent from the infection type, anaesthesia, treatment and analgesic profile, but it is conditionally dependent from the field of operation cleanness, drainage and the operation site. Similarly, the kind of infection (infected system) is conditionally dependent on the wound class and operation site, but conditionally independent from many others factors. Interesting, but controversial, is the conditional dependence of the patient death. In receiving model it depends on the kind of infection, treatment, field of operation cleanness and operation site but is independent from the operating technique and duration of the operation.

As it's shown, the generally described method provides many materials for analyses and the possibility of the threshold value setting provides additional control over the theoretical significance discovered knowledge. Theoretical, because there exists the absolute necessity to discuss discovered knowledge with experts. Purpose of this discussion on the one hand is to initiate the experts to verify their present knowledge with the discovered relationships. On the other hand

– to verify these parts of the discovered knowledge which are inconsistent with these experts experience.

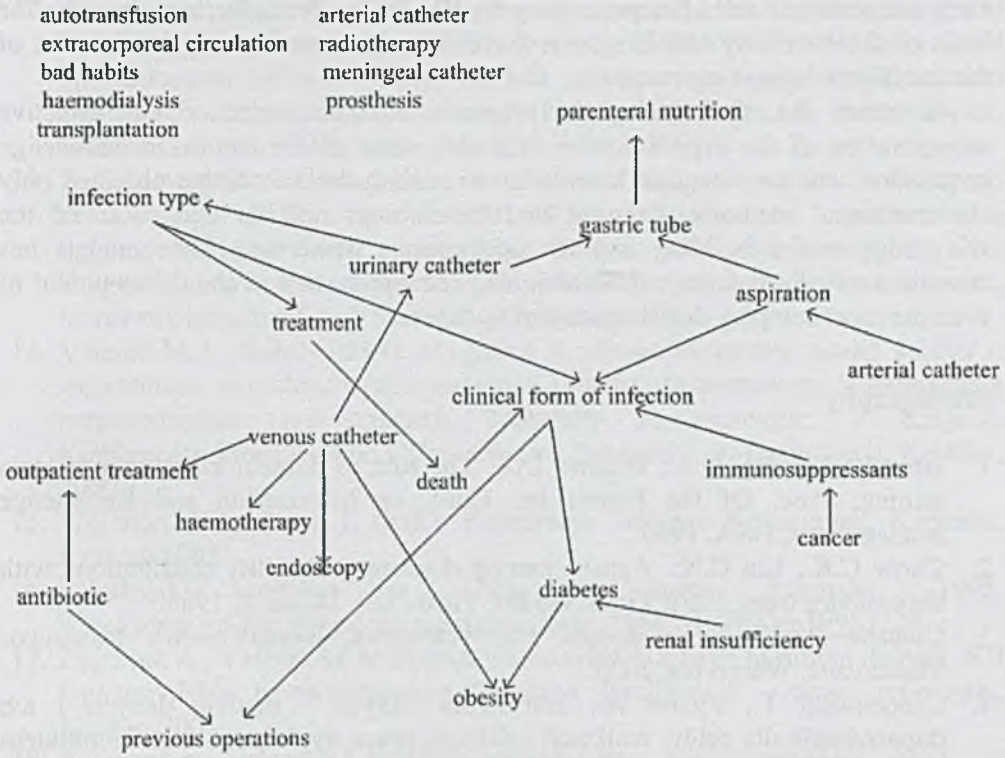

Figure 4. Network generated for relationship between nosocomial_infections_risk_factors and clicinical_form_of_infections, threshold = 0.5 [5]

6. Conclusions

One should ask a question, why basically correct research methods could lead to the generation of the knowledge inconsistent with the current knowledge. Such case analyses come to the conclusion, that one of the most significant reasons for receiving false knowledge is wrong matching of the input data to the goal of the analysis. Existence of even the most tremendous databases which play a positive role in the transaction systems (hospital, patient records management, etc.) is not always a sufficient condition for extracting data and obtaining useful knowledge for implementing an intelligent decision support system.

An extremely significant finding is, among other things, the conclusion, that developing data stored systems, we should – knowing the above experiment results – design these systems in such a manner, that in the future they could be fully valuable sources for automatic knowledge acquisition.

Upon analysis the BN Power Software system usability one may find that, discussion about the automatically discovered knowledge can cause an almost manual intervention in the elements of the discovered knowledge. The model, after such interventions and after processing by BN Power Predictor, may become the basis of the extremely usable system (bayes classifier) performing the function of the intelligent supporting system.

It comes out, that having the proper data source selection and effective incorporation of the experts in the following steps of the automatic knowledge acquisition, one may acquire knowledge exceeding the knowledge obtained only via traditional methods. Existing and developing methods and tools of the knowledge model building and the applications which use these models has become a more and more comfortable and reliable partner in the development of even the most complex decision support systems.

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