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Pannon Management Review

Pannon Management Review contributes to bridging scholarly management research and management practitioner thinking worldwide. In particular, *Pannon Management Review* broadens the existing links between Hungarian scholars and practitioners, on the one hand, and the wider international academic and business communities, on the other—the journal acts as an overall Central and Eastern European catalyst for the dissemination of international thinking, both scholarly and managerial. To this end, the articles published in *Pannon Management Review* reflect the extensive variety of interests, backgrounds, and levels of experience and expertise of its contributors, both scholars and practitioners—and seek to balance academic rigour with practical relevance in addressing issues of current managerial interest. The journal also encourages the publication of articles outside the often narrow disciplinary constraints of traditional academic journals, and offers young scholars publication opportunities in a supportive, nurturing editorial environment.

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Contents

ZOLTÁN VERES

EDITORIAL: MULTIDISCIPLINARITY – BREAKING OUT OF THE DISCIPLINARY SILOS

Dear Reader,

The first issue in 2014 of Pannon Management Review you are holding in your hand shows its familiar face but, at the same time, it has set a renewal as an aim. Since the publication of the previous issue a new editor has been appointed, which is inevitably reflected in the spirit of the selected papers you can read here. We are planning to shift the content of the Pannon Management Review in two directions. On the one hand, in line with mainstream sources, we intend to increase the scientific methodological value of papers on management, and on the other, we follow a selection concept that can organise the content of particular issues around a specific leitmotif. In the current issue this leitmotif is: multidisciplinarity.

In today's corporate practice, a functional approach is more and more substituted by integrated, interfunctional teamwork. Problems in managers' decision-making cannot be understood through the narrow lenses of particular functions (i.e. subject groups). Conventional structures do not take these into consideration at all.

Consequently, young professionals today are only able to think in terms of functional "boxes". Thus when approaching problems they try to find the answer to the question "In which subject did we learn about this?" although this is highly unusual in the practice of – especially - small enterprises. A typical example of this can be taken from quality management. The operationalisation of the European quality model called EFQM is only possible in a multidisciplinary approach. In corporate practice this means that marketers, designers, quality managers, human resource managers etc. are only able to implement a comprehensive quality control together. Thus managers need an extensive material of knowledge rather than traditionally deep specialization.

In modern business life creative managers are needed instead of masters of analysis. A creative manager possesses the skill to know how to approach a business problem of any kind, he or she is self-confident in recognizing the problem and can communicate persuasively both orally and in writing. Analysis is the responsibility of the executive level; the management "only" has to be

able to judge whether the documents for decision-making and analysis preparation are reliable or not. But the leaders of micro and small enterprises cannot do without an analytical thinking either. Therefore, both groups have to be developed even though their expectations are totally different from one another.

Apart from multidisciplinary skills – or even together with them – intercultural affinity is also a key competence in the modern, global management. In order to understand the intercultural phenomena of an internationalising management it is important to know the underlying reasons as well. To this we can have recourse to an already classical approach of cultural anthropology. Serpell's Culture's Influence on Behaviour from 1976 claims that cultural explanatory models can be used well in those areas where people need to go through quick adaptation processes. These explanatory models also include such behavioural and cognitive processes as decision, planning and logical thinking. Several experiments have justified the decisive role of the cultural environment – especially in childhood – in later problem-solving preferences. Let us call it local determination, which includes such factors as:

- The rules of interpersonal behaviour. This concerns the local determination of the spoken language in particular but the norms of performance in a workgroup can have important differences as well. Based on the works of Ishii and Bruneau, Hidasi (1999) presents an interesting feature of linguistic behaviour, namely the different role of unspoken messages. This means that silence during speech can carry entirely different meanings in different languages.
- Social and behavioural norms transmitted by educational institutions.
- Accepted level of performance orientation.
- The role of individuality vs. taking joint responsibilities. In this respect, for example, there is a typical difference between American and Chinese local determination.
- The role of creativity in problem solving.
- Approaching problems systematically vs. through details.
- Perception of visual representation. This, for instance, is a dimension that is imprinted in childhood strongly and its cultural differences are significant.

The above detailed principles are reflected in the selection contained in this issue. The article by Richard Kása and his fellow researchers under the title of *The concept of perception driven service process reengineeering by entropy reduction* identifies the theoretical links between services marketing, production economics, operations management and service quality management. Based on

the dominant process character of service transactions well-known models of operations management can be applied in reengineering of service processes. The argumentation of the authors is clear and there is no doubt that in this case their multidisciplinary approach is a must.

Teresa Shuk-Ching Poon from Hong Kong in her article *Upgrading the information communication and technology industry in China: a global value chain analysis* offers to the Reader a really sophisticated scientific analysis on the crossroad of infocommunication technology, technology development, R&D management and international economics. The core message of the article comes however from the international / regional / intercultural dimension. It is extraordinarily exciting to read about the industrial environment of a huge country from the BRICS group. Yes, it is exciting and holds plenty of lessons for managers in the global economy. Briefly do not miss, dear Reader, to read it.

Following the PMR traditions – publishing portraits of companies and individuals whose performance is illustrative of management achievement – in this issue, we feature an interview with the leader of a renowned company. Now we spoke to dr. Márta Hoffmann, CEO of TNS-Hoffmann Market Research Agency about the exciting connections between building up a company and a personal career, and the Hungarian market and multinational corporate philosophy. With the casualness of spoken language and in a very enjoyable style, the interview shows management dilemmas and a continuous balancing between the "multi" and "artisan" methods applied in a narrow and small market. Looking back at her company's many years of development, dr. Márta Hoffmann discusses the issues of global networking, the international business development and the intercultural corporate management that constitute everyday tasks for today's executives.

And true to the mission of the Review, we offer a publication opportunity to a young researcher in this issue – and from now in each issue in the future - as well. The first big challenge in a person's scientific career is to obtain a doctoral degree. When this multi-annual process begins, the candidate does not know yet what to expect. How many pitfalls, how many dead ends, and many of those moments when there seems to be no solution? Or maybe the multitude of possible solutions seems daunting. A decision must be taken on the focus and the main direction of the research. In this respect, colleagues and university research workshops can provide a helpful environment that promotes the doctoral activity on the planned road. Somewhat paradoxically, the scientific value of PhD dissertations is determined by what further research achievements they encourage from the part of a "young" researcher. Here the word "young" does not refer to the researcher's age but is meant to show that the former

doctoral candidate has already joined the club of qualified researchers. During their shorter or longer PhD studies, they have acquired the skills in research methodology that are needed to undertake effective research. And of course, they have become committed for life to scientific work and are now a part of a community, Hungarian and international academic life where they can find fellow researchers with similar interests. This time, we have chosen Ferenc Bognár's paper entitled *The impact of organisational culture and maintenance strategies in organisational business processes* in which he summarises the findings of his doctoral research. In line with the message of this issue, Ferenc Bognár presents the complexity of management through the intersection of quality management, production economics, human resource management, maintenance management and engineering.

The journal has a new editor, but we will preserve PMR's values and strive to continuously improve the quality of the review. Invariably, our goals include providing a platform for research-based articles with practical relevance, offering actionable managerial advice and publishing interesting articles having the potential to enhance our knowledge and understanding. We hope that by publishing this issue, we can show the colourful world of management science as well as encourage other researchers to present themselves in our journal.

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Zoltán Veres was born in Hungary. He received his university degrees from the Technical University of Budapest (Masters degree in Electrical Engineering) and the Budapest University of Economic Sciences (Masters degree in International Business). He obtained his Ph.D. in economics, at the Hungarian Academy of Sciences. More recently, he obtained his habilitation degree at University of Szeged, Faculty of Economics and Business Administration.

He worked as project manager of numerous international industrial projects in the Mediterranean region (e.g. Greece, Middle East, North Africa) between 1977 and '90.

Since 1990, he actively participates in the higher education In 2011 he was appointed professor of Marketing at the Budapest Business School (BBS), Hungary and in addition he was also Head of Research Centre at BBS until now. He is actually Head of Marketing Department of the University of Pannonia, Veszprém, Hungary.

He has had consultancy practice and conducted numerous research projects on services marketing and project marketing. In 2001 and 2002 he was Head of Service Research Department at the multinational GfK Market Research Agency.

He has more than 200 scientific publications, including the books of Introduction to Market Research and Foundations of Services Marketing. He has been editor of series to Academy Publishing House (Wolters Kluwer Group), Budapest. He has been editor of journals Revista Internacional de Marketing Público y No Lucrativo, Spain, and Marketing & Menedzsment, Hungary. He is a member of the Committee of Marketing Sciences at the Hungarian Academy of Sciences.

RICHARD KÁSA - ÁKOS GUBÁN - MIKLÓS GUBÁN - SON HUA NAM - LÁSZLÓ MOLNÁR

THE CONCEPT OF PERCEPTION DRIVEN SERVICE PROCESS REENGINEERING BY ENTROPY REDUCTION

Abstract

The topic of rethinking, reorganizing or reengineering dysfunctional business processes has been approached from many aspects. However, methods and techniques are greatly diverse. Service processes do not get as much attention as their importance would deserve. One reason is the usage of production oriented methods for service processes. The other reason is the complexity of stochastic service processes. In these processes, it is usually hard to give strict and consistent parameters, indicators and even object functions. In our research, we offer a unified, heuristic mapping and simulation methodology for process simulation and improvement. In this paper, this problem is analysed from a very new aspect as the observed processes of the system are not considered as an essential argument of the examination. Instead the main elements are the nodes of the system, transactions and transformations. The second important aspect of the methodology is the quality and efficiency perceptions of internal and external users of the processes. Thirdly, not only cost efficiency and lead-times are applied in the object function, but also the reduction of process entropy. Based on empirical and literature researches, the basic conceptual framework is also presented. Examples would be such as the full mathematical model and a possible solution of the computational model with Mealy automatons.

Introduction

The domination of the service sector keeps growing in the world's largest economies as global statistics show in OECD and World Bank databases. Eichengreen and Gupta (2013) argue this as well. More than 63% of world GDP is produced by service sector (CIA, 2013) and this ratio is even greater in countries with higher GDP (more than 75%). This increasing importance has led us to examine recent business process amelioration methods. We also examine their usability and customization for service processes. This topic of business process improvement or re-engineering has a long history in business literature. The discussion topic has been present on the academic side and among managers. There is a lot of confusion and debate on this topic. The reengineering topic has not lost its actuality.

The concept of reorganizing dysfunctional business processes still exists even in the twenty-first century. Usually this is with new, more sophisticated tools and methodologies. Yet, it is still based on old principals. The narrowing

markets, increasing competition and the recent economic crisis all stimulate companies towards continuous rationalization, cost reduction and increased efficiency. All of this is in order to gain some kind of comparative advantage which creates a basis for the development of methodologies of process improvement.

We found that these business process amelioration (BPA) methods and techniques are not clearly adoptable to service processes (Gubán & Kása, 2013). Despite the large number of BPA technologies and tools, efforts have tended to emphasize manufacturing applications over service operations. By now it has become apparent that the economies of even the most industrialized countries are becoming increasingly dominated by services. However, producing consistently high quality and efficient services has not received as much attention as in manufacturing firms (Mefford, 1993). The differences in the characteristics of manufacturing and services have led many managers to believe that successful BPA methods used in manufacturing are not applicable in service organizations. There is a lot of evidence, though, of using BPA tools tailored clearly for the service sector (see e.g.: Brahe, 2007; Sánchez-Rodríguez et al., 2006; Wüllenweber & Weitzel, 2007). Due to the lack of service standards, there is general success in the services. This makes the customer-focused approach of BPI inherently attractive for a service organisation. Hence, BPI methodologies have been widely disseminated and adopted, especially in the financial services and healthcare areas (Hammer & Goding, 2001; Hoerl, 2004).

The reason is not only the lack of tools, but also the specifications of services. Human intervention is common practice in services which results in a lot of hidden factors. Thus, the success of BPA in service organizations depends very much on the fit among interdependence. Also, the success depends on the strategy's content and process (Gubán & Kása, 2013).

Literature review

Before starting to elaborate a new technique for process amelioration (or just laying its fundamentals) basic techniques, methods and trends should be reviewed. We have analysed the current literature available in leading international scientific and academic journals. The sample of journals consists of Engineering and Process Economics, Engineering Costs and Production Economics, Journal of Operations Management, International Journal of Production Economics, European Management Journal, Journal of Management, Journal of Supply Chain Management and Production and Operations Management. In these journals, we inspected 1151 papers (between 1978 and 2013) that could be associated with process improvement, reengineering,

rightsizing or management. Upon a closer look at the papers, we found 55 that can be associated with business process amelioration. In most cases, these papers show a case when one or more kinds of process reengineering tools were used. We also found many publications on methods and methodologies of process improving and reengineering. Also, a relatively high performance number of the tools and performance change due to this improvement. There is a relatively low number of papers in relevant journals on applications and theory. This might be because of the tendency towards a narrowing development of new tools.

Table 1: Relevant publications on BPA in the most influential journals

Application	Case	Methodology	Performance	Theory	Tools
- Clark & Hammond, 1997; - Jones, Noble, & Crowe, 1997; - Macintosh, 1997; - Williams, Tang, & Gong, 2000	- Arnold & Floyd, 1997; - Choi & Hong, 2002; - Currie, Michell, & Abanishe, 2008; - Done, Voss, & Rytter, 2011; - French & Laforge, 2006; - Houghton & Portougal, 1997; - McFadden & Hosmane, 2001; - Purwadi, Tanaka, & Ota, 1999; - Saccani, Johansson, & Perona, 2007; - Sarkis, Presley, & Liles, 1997; - Shivappa & Babu, 1997 - Ojanen, Piippo, & Tuominen, 2002	- Berry & Cooper, 1999; - Hill et al., 2002; - Perrone, Roma, & Lo Nigro, 2010; - Rolfe & Armistead, 1995; - Seidmann & Sundararajan, 1997; - Simons Jr., Wicker, Garrity, & Kraus, 1999; - Terziovski, Fitzpatrick, & O'Neill, 2003; - Tomlinson & Fai, 2013; - Upton & Kim, 1998; - Wagner & Neshat, 2010; - Weng & Parlar, 2005	- Da Silveira, 2005; - Das & Joshi, 2007; - Droge, Vickery, & Jacobs, 2012; - Goel & Chen, 2008; - Hegde, Kekre, Rajiv, & Tadikamalla, 2005; - Hendry, 1995; Jacobs & Swink, 2011; - Launonen & Kess, 2002; - Stahl & Zimmerer, 1983; - Kim & Jang, 2002	- Chan & Choi, 1997; - Edwards & Peppard, 1994; - Heineke & Davis, 2007 - A. V. Hill et al., 2002	- De Bruyn & Gelders, 1997; - Flynn, 1987; Karvonen, 1998; - Lillrank, Holopainen, & Paavola, 2002; - Lockamy & Smith, 1997; - Neiger, Rotaru, & Churilov, 2009

As we look at the temporal distribution of these publications, two trends seem to dominate. The first one is associated with the total number of publications on this topic. There was a major growth in 1990 after Michael Hammer published his article in the Harvard Business Review. He claimed that the major challenge for managers was to obliterate forms of work that do not add value rather than using technology for automation. (Hammer, 1990). This launched an avalanche in major journals. The number of papers is still growing after a peak in 1995 when the U.S. created Frankenstein Economy was implemented (Janszen, 1996). There was also major growth after the global financial crisis started to expand. The second trend seemed to begin in 1997. A great number of process improvement applications and tools were developed.

These were a product or summation of the strong interest in this topic in 1995 (Ettlie, 1997).

Temporal Evolution and the Development of Process Orientation of BPA Techniques and Methods

There is no doubt about the importance of the continuous amelioration of business processes. The driving forces of these radical changes can be interpreted as the extension of Porter's competitive advantages (Porter, 1980, 1985, 1990) summarized by Hammer and Champy (1993) and confirmed by O'Neill and Sohal (1999):

- customers who can now be very diverse, segmented, and are expectant of consultation,
- competition that has intensified to meet the needs of customers in every niche,
- change that has become pervasive, persistent, faster and in some markets a pre-requisite.

The evolution of BPA dates back to the first appearance of rudimentary process orientation between 1750-1970 with the beginning of the industrial period. The main focus of this embryonic process improvement phase was on labour division, cost reduction and productivity with technologies. Examples of these technologies were mechanisation, standardization and depth records. Their main tools were PDCA improvement cycle and financial modelling. Rightsizing and restructuring were also used for achieving changes in formal structural relationships. Their focus on business processes was pretty low (Grover & Malhotra, 1997). Their orientation is mainly functional, the improvement goals are usually incremental, and the frequency of application is isolated in time (Grover & Malhotra, 1997).

The next generation of process improvement is the first phase of information period dated from 1970-90. This is the era of quality management and work efficiency with such technologies as material requirements planning (MRP) and management information systems (MIS). The main tools of this period were computer automation and statistical process control. These tools refer to the typical application of technologies. The application focuses mainly on automating existing procedures without questioning their appropriateness or legitimacy (Grover & Malhotra, 1997).

The third generation is the second phase of the information period with business process improvement (BPI) dating back to the '90s. This is the era of process innovation and best practices with such slogans like "better, faster and

cheaper". At this time, technologies such as ERP, CRM, supply chain models and enterprise architecture models were introduced. New tools were developed and used like Six Sigma, TQM, BPR and Best Practice Benchmarking (BPB). These tools and techniques have their focus on processes, and bottom-up improvements in many places with continuous and incremental scope.

The fourth generation is the third phase of information period with business process management (BPM) dating from the 2000s. The main focus of this era was on continuous transformation, flexibility and modularity. Enterprise application integration (EAI), service oriented architecture (SOA) and semantic object model (SOM), performance management systems (PMS) and BPM systems are the major technologies of this era. Tools also vary from customization to BPM procedures like integrated design-build framework (IDBF), benchmarking-oriented process reengineering (BOPR), business process standardization (BPS) and event-condition-action (ECA) computation. Some of these tools have a very intensive service orientation (especially SOA and ECA) while others tend to be adapted to services with general success (see Gubán & Kása, 2013 for more details).

This literature review suggests that numerous techniques and methods are available for business process amelioration. All of them are based on the concept of BPR. This concept is the creation of a blueprint of the process structure. Then, significant changes are made to reach better performance and a more harmonized process structure. In our terms, BPA means something different which can be described by *process logistification*.

Globalized Service Models affecting our research

Manufacturing and service companies differ mainly in the communication and interaction with customers. This results in a new approach because in production firms, corporate activity produces tangible, clearly identifiable and manifested goods (Réthi & Illés, 2012). Also, very often service companies are trying to establish cultures based on frequent interactions. As a consequence of this attitude, 'moment of truth' experiences multiply and front office employees will face substantial conflicts (Heidrich, 2006; Veres, 1998).

The global market expansion of standardization is called McDonaldization, based on Ritzer (Ritzer, 1993). The system in this case follows the work organization principles of Fordism and Taylorism. The company acquires competitive advantage from the productivity cost-benefits. The service providers standardize their processes so the output of the service is constant and always equal to the consumers' expectations. In this case, the higher volume of sales is

crucial to reduce costs. This provides comparative advantage for the company. Consumers have pretty much accurate information on the standard service due to advertisements. Also, the information is based upon their own and their acquaintances' experiences. McDonaldized business processes can be repeated. Due to this, problems and errors arising in business activity can be effectively solved. However the reparability assumes the existence of trust, meaning that the provider will not commit an error again. The operating logic of McDonaldization as a system is basically divided into four dimensions: efficiency, predictability, reliability and control by technology (Heidrich, 2008; Ritzer, 2004; Veres, 2009).

Through the extremes of standardization of service processes, McDonaldized companies are getting increasingly similar to production-like companies. In the early 80s, the production approach related to the classical and neoclassical economic theories was dominant in the organization of work and corporate marketing. According to this dominant approach, the value is located in the material and generated through the manufacturing process (value added, utility, exchange value). Therefore goods and products should be considered as a standardized output (Réthi & Illés, 2012; Vargo & Lusch, 2004).

Customization is the exact opposite of McDonaldization. It is based on the foundations of marketing and service management. The user of the service expects to receive adequate service that meets his or her demands. The main difference from McDonaldization is that its objective is to satisfy the requirements and quality need of customers as accurately as possible. However, this needs special knowledge. In most of the cases, at the beginning of the process there are no known patterns to fulfil such requirements. Neither the provider nor the customer knows which solution will lead to the desired result. As the consumer does not have a certain idea about the service's output, he will simply accept the service process as a result. A further difference is that the methodology of the customization is based on special knowledge and high professional qualifications.

Workaround for the above mentioned two opposite approaches is the modularization (Sundbo, 2002). In this case, the firm that provides the service combines standardization and customization methods. Namely, products are manufactured and sold in large quantities, and on a fairly high price. The viability of the system requires that the company's process shall be build up by standard modules and these small changes create a sense of personal, customized service to consumers (Heidrich, 2008; Veres, 2009, 310-322). These services are in fact only partially tailored. Their preparation is standardized and becomes personalized only when consumer enters into the process. This model greatly relies on the evolving information technologies which allow the perfect

functioning of the system. Apparently Disneyalization (Bryman, 2004) is the opposite of McDonaldization. However, the productivity-based service providers increasingly place their services at a physical and human environment resulting in a unique perceived consumption. The challenge of organizational operation and management is to make the service unique while productivity-based economic logic also can be observed. Disneyalization is not based on the principles of customization, but rather on the above-mentioned modularization. It re-packs such standardized service modules with some peripheral service combinations, which has low unit costs due to frequent use, thus providing a sense of customization (Heidrich, 2008).

A Disneyalized service gives the impression of uniqueness to the consumers. Thus it combines the features of a productivity-based economic activity and customization. With the rethinking of traditional products, the company can sell successfully in new industries. Also, this is true with low unit costs of the extra activities due to frequent usage. The performance of such complete services, though, requires a highly qualified workforce. This is in contrast to McDonaldization.

Research preliminaries and framework

The processes of economic systems, depending on their location in the system, may be different both in structure and in operating characteristics. Processes according to their location in the organization can be either production processes or logistical, information technology, information, business, management or marketing processes, and so on. However, they seem to show very large differences. In fact they have one fundamental thing in common: at least one object flows through each of the processes or sections of processes consuming partially or entirely the resources of the processes (Hammer & Champy, 1993; Lepmets, McBride, & Ras, 2012).

During our examinations, it was noticed that the efficiency of a process is exclusively determined by the object flowing in it and not by the functional department which it partly or fully incorporates. (Gubán & Kása, 2013; Kása & Gubán, 2013) It has been recognized that in many cases the explored processes of a system are not featured by the internal characteristics of the system, rather by earlier inheritances or bad habits which makes them dysfunctional and ineffective. A system works optimally when it involves only necessary and real processes and get rid of redundant, unnecessary elements (Buavaraporn, 2010). If these unnecessary elements could be "carved" from the system – like in sculptures- a really effective process system will arise which will be controlled and determined by the flowing elements of the system.

The hereby outlined research of effective system reorganization was started at the beginning of 2013 and a research team was formed with the name of LOST (Logistification and Simulation Technologies) in Services. The scope of this recent paper is the conceptualization of our findings on internal and external customers' perception driven research framework. This is in regards to business process amelioration (BPA).

Methodology and conceptualization

Perception driven processes

The very first task of our research is to clarify the key terms of the concept. For this, the notion of business process should be specified as it forms the basis of the research. As it is specially used in our research, the definition will be built up in several stages.

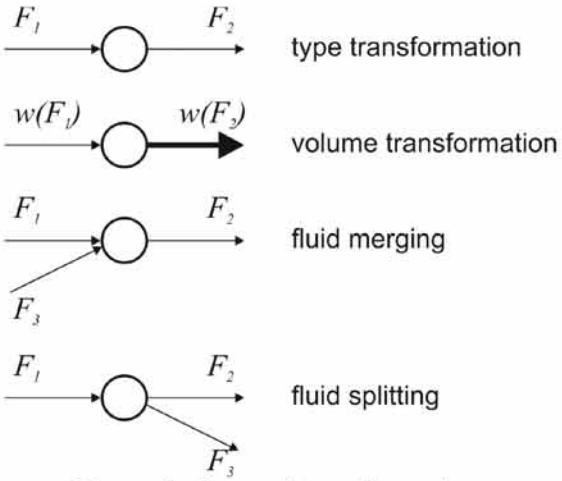

Figure 1. Types of transformations

Definition 1: A **node** is such an object of a system which is able to store *data* on any kind of transformation (input-output transformation or type transformation such as information → data) of any element. Also, a node is able to perform actions on related *functions* and *procedures* (creation of new elements, merging and even separating elements and eliminating). Hereinafter, these abilities are called node **transformation** (I/O transformation, new element, storage, merging, separating, eliminating). Such transformation where the type of input element and output element is different is called **type-transformation**. These possible transformations are shown in figure 1 below.

Definition 2: **Fluid** is such a tangible or intangible object which may *flow* between two not necessarily adjacent nodes of a system or may *develop* or *perish* (expire) on a node. Or, it may undergo a quantitative and/or qualitative *transformation*.

Definition 3: **Fluid flow** is a finite set of examined fluids that includes a determined *node sequence* (where the end-node of a fluid is a start-node of another fluid) in a specified *time interval*, the sequence of node transformations, the entry and exit type-transformations and the time structure together. A fluid flow in $[t_s; t_f]$ time interval can be described by the following sequence:

$$F(d;\tau;w)_{[t_s;t_f]} = \langle (c_{i_0 j_0}; \tau_0; w_0; t_{s0}; t_{o0}); (c_{i_1 j_1}; \tau_1; w_1; t_{s1}; t_{o1}); \dots; (c_{i_m j_m}; \tau_m; w_m t_{s1}; t_{o1}) \rangle \quad (1)$$

where $(c_{i_l j_l}; t_{sl}; t_{ol}): l = 1; \dots; m+1$ means that the fluid entered into the $c_{i_l j_l}$ node of a certain process with τ and τ_{l-1} status and with the type's w and w_{l-1} weight value. The outgoing fluid has τ_l type and w_l weigh. The other two parameters represents the time of node entry and exit, where $t_{sl} \leq t_{ol} \in [t_s; t_f]$ as well as $t_{ol} \leq t_{sl+1}$. Obviously in sequence $\check{C}(F) = \langle c_{i_0 j_0}; c_{i_1 j_1}; \dots; c_{i_m j_m} \rangle$ a certain node may appear several times, however as a connotation of definition 3 the sequence of nodes is finite. Thus $|\check{C}(F)|$ refers to the number of nodes in the sequence.

By means of the above definitions the relevant (business) processes can be described. (Hereinafter the term process will be used instead of business process. It is not ambiguous, since process is used only in this sense.)

Definition 4: **Process** is a batch of a fluid flow with its interconnections that is arbitrarily and/or intentionally treated as a single unit by a business organization. Process is an abstract notion in all cases which includes a model showing the structure of the process. This model will be the subject of examination in our research.

Definition 5: A **process item** is real series of activities implemented on the basis of real demands.

The above definition for process items fits in our framework, but seems to be too general. The reason is that business organizations develop their processes by some kind of management methodology techniques. This is also true for

production, logistics, and even financial and accounting processes. Our previous studies have proved that every process is guided by users' perceptions. Whether external or internal users, their requirements guide processes in every node of the system. Similarly, there is a (not necessarily human) user in any node (like a robot on the assembly line) whose needs, "orders" must be satisfied on the input side and provides different outputs.

Definition 6: **User** is an entity who may establish a claim to a process or a process section even from outside, either from inside of a system.

Users in the system cannot be considered simply as a regular customer. These users (which may be either machines, or robots) like to be influenced by their perceptions determined by their characteristics in their requests and orders. Obviously the interpretation of costumers' perceptions is necessary here whereas the concept of the notion of social perceptions is too rough for us.

Definition 7: A **users' perception** is a collective system of (potential) customers' feelings about knowledge (data and information) that is or may be derived from internal processes of the company and has an impact on their (future) demands, orders and preferences.

The term itself seems to be fairly subjective and follows from the fact that customers also have their own abilities. These have significant influences on the quantity and quality of information absorbed from the process. They make interdependencies with preliminary knowledge and capabilities. (E.g. an elderly woman and a young guy have different perceptions on smartphone's and analogue telephone's service.)

Question arises whether the perceptions of customers of a system count in developing and operating its processes. Especially when the inside feelings say everything is all right. Obviously, inner perspectives are narrow and process items produce many internal uncertainty. Thus, the operation of the system cannot provide the required optimum.

Definition 8: Processes whose operation are much affected by intra- and inter-perceptions shall be called **perception driven processes (PDP).**

Hereinafter, processes identified in a system will be examined and such process attributes are given. Fluid flow can be constructed by further process examinations.

Let:

- $n \in N^+$ be the number of processes discovered in a system and P_i $(0 < i \leq n)$ be a single process of this system.
- D denote a finite set of fluids (such generalized above) of this system; if the fluid in a certain point of time belongs to process P_i than in case of $d \in D$, $d \uparrow P_i$ notation shall be used.
- τ denote fluid type set occurring in the system, or the role that it entrusts in a certain test section, for example a document on the input of a process, a data on a certain node or it can be a waiting element as well. Typesets has general elements as well as specific components regarding the system or subsystems of the processes.

Furthermore let:

- $[t_s; t_f]$ be the system test time intervals
- $R[r_{ij}]$ hyper-matrix shows, that P_i process somehow supplies fluids to P_j process $(0 < i, j \leq n)$. Then $r_{ij} := \{((d; T)|d \in D; T \in \tau)\}$ is a fluid relationship set. (Obviously the matrix is non-symmetric.)

It is important to define inputs, outputs and interfaces of the processes as well as all significant flow features.

- $I(P_i) = \{(d; T; t)|d \in D; T \in \tau; t \in [t_s; t_f]\}$ is an input fluid set of a process (meta-process) where the input fluid, type and time of appearance on the input (which may be sub-intervals as well) are noted
- $O(P_i) = \{(d; T; t)|d \in D; T \in \tau; t \in [t_s; t_f]\}$ is an output fluid set of a process (meta-process) where the input fluid, type and time of appearance on the output (which may be sub-intervals as well) are noted
- $C(P_{ij}) = \{(d; T; t)|d \in D; T \in \tau; t \in [t_s; t_f]\}$ is fluid set of the j^{th} interface of a process where the fluid, type and time of appearance (which may be sub-intervals as well) are noted. There may be such specific fluids here like 'waiting for … time', 'connection without waiting', etc…
- $(T_i; T_j)_d$ is the transformation on fluid d, which may happen in the process or on a node as well. (However, transformations on processes can be omitted. If a transformation happens during a flow, then a virtual node should be created in this process and transformation should be assigned to this node.)

- T_d means a possible typeset of fluid d $(0 < i; j \leq |T_d|)$. (Hereinafter for the sake of simplicity, the transformations are denoted by $\hat{T}$, and $\hat{\emptyset}$ means blank transformation when no type change occurred.)

Logistification

In the previous chapter, those terms were prepared and organized. They will be used in deeper understanding of results of process examination. The technique of logistification will be used as a modelling and analysing tool for processes. Appellation comes from the well-defined, well-modelled logistics and supply chain processes. All other kinds of processes can be considered as logistical process because of the flowing fluids. Thus, a unified process analysis can be performed at the whole process system of business organizations.

Definition 9: **Logistification** is the modelling and analysis in terms of efficiency, sensitivity and optimality. Logistification is based on the temporal and spatial changes in related data of the processes of any kind of systems by means of fluids flowing in processes.

The explored processes of the system shall be examined in a flow perspective. Then the entry (input in flow aspect) and exit (output in flow aspect) nodes should be found in order to explore how processes are connected to each other and to identify the types and characteristics of these interfaces. The system may include only a finite number of processes. Otherwise, if possible, a finite number of the most important processes in terms of the investigation should be selected. Models carried out as a result from this type of analysis can be skeletonized about confusing and not relevant items supplied by the economic environment.

In term of flow, the fluid-flow can be divided into two groups: it can be either nodal flow or continuous flow. In case of nodal flow, the fluid transformation is visible/measurable and has effect only on process nodes. In cases of continuous flow, the effect of fluid transformation can be realized and measured at any point of the process. In terms of our investigation, nodal flows will be important and give an overview of this kind of flow as we prepare to carry out simulation of service processes

Let $d \in D$ be a fluid (where D is a finite set), and let P_0 be the process at t_0 initial time of fluid analysis (observation) whose input involves the fluid and be the initial type of the fluid T_0.
Then $(d, T_0, t_0) \in P_0 \cup I(P_0)$.

The flow of this fluid can be described at $[t_s; t_f]$ period of time with the following sequence:

$$F(d)_{[t_s;t_f]} = \langle \hat{T}_0; (c_{i_0 j_0}; t_{s0}; t_{o0}); \hat{T}_1; (c_{i_1 j_1}; t_{s1}; t_{o1}); \dots; \hat{T}_m; (c_{i_m j_m}; t_{sm}; t_{om}); \hat{T}_{m+1} \rangle \quad (2)$$

where

$$\hat{T}_l \in \left\{ (T_i; T_j)_d \right\} \cup \{\hat{\emptyset}\}: l = 1; \dots; m+1 \quad (3)$$

and in equation (3) $(c_{i_l j_l}; t_{sl}; t_{ol}): l = 1; \dots; m+1; c_{i_l j_l}$ is node; $t_{sl} \leq t_{ol} \in [t_s; t_f]$ and $t_{ol} \leq t_{sl+1}$.
t_{sl} represents the time of node entry and t_{ol} represents the exit time. The total duration of fluid flow in $[t_s; t_f]$ interval is $[t_{s0}; t_{om}]$.
Comment: Obviously in sequence

$$\check{C}(F) = \langle c_{i_0 j_0}; c_{i_1 j_1}; \dots; c_{i_m j_m} \rangle \quad (4)$$

a certain node may appear several times, however the sequence of nodes is finite (as follows from the definition).

The fluid flow is homogenous if $F(d)_{[t_s;t_f]}$ is a fluid flow and $\hat{T}_l = \hat{\emptyset}: l = 1; \dots; m+1$.
For proper classification of fluid flow, the fluid weight function is introduced. Since this value can vary along the process, it should be incorporated in the transformation.

Let $(T_i; T_j)_d$ be a type transformation and $w(T): T \in \tau$ be a weight function which is assigned to fluid type. This measure can be positive or negative sign as well. Negative measure refers to opposite direction of flow.

Then a transformation is:

$$\hat{T}_{ij} = \left((T_i; w_i); (T_j; w_j) \right)_d \quad (5)$$

where weights are assigned to the actual type of fluid. This solution allows quantitative and qualitative changes in fluids in case of materials.

Since the typeset may include values with discrete and continuous types (the definition does not contain any restrictions on this issue). Therefore, a discrete material flow can be handled just like a continuous information flow as the amount of information can change. This can be compared to the change of the size (amount/dimensions) of material during elaboration.

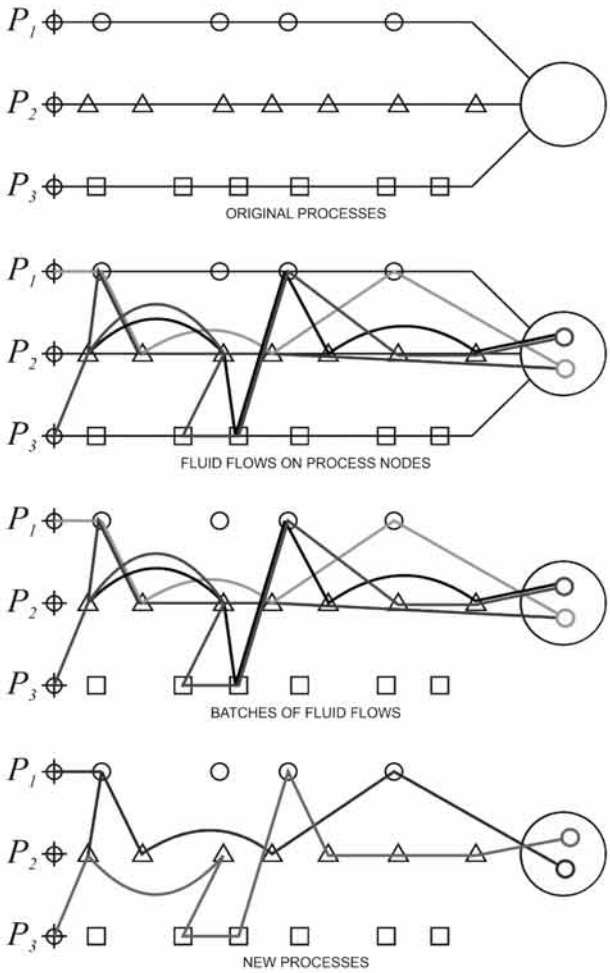

Fig. 2: Logistification of processes.

The extended nodal flow of fluids in $[t_s; t_f]$ time interval is amended as follows:

$$F(d)_{[t_s;t_f]} = \langle \hat{T}_0; (c_{i_0 j_0}; t_{s0}; t_{o0}); \hat{T}_1; (c_{i_1 j_1}; t_{s1}; t_{o1}); \dots; \hat{T}_m; (c_{i_m j_m}; t_{sm}; t_{om}); \hat{T}_{m+1} \rangle \quad (6)$$

sequence, where

$$\hat{T}_l \in \left\{\left((T_i; w_i); (T_j; w_j)\right)_d\right\} \cup \{\widehat{\emptyset}\}: l = 1; \ldots; m+1 \tag{7}$$

and $((c_{i_l j_l}; t_l): l = 1; \ldots; m+1; c_{i_l j_l}$ interface; $t_l \in [t_s; t_f]$.

Further processes associated with the fluid can be discovered for the explored processes of the above detailed fluid flow system. These processes are much more informative than the initial ones.

Let there be $F_1 = F(d_1)_{[t_{s1}; t_{f1}]}; F_2 = F(d_2)_{[t_{s2}; t_{f2}]}$ two process flow. It is said, that $F_1 \leq F_2$ or F_1 is a process section of F_2 when $[t_{s1}; t_{f1}] \subseteq [t_{s2}; t_{f2}]$ and $\check{C}(F_1) \subset \check{C}(F_2)$ viz. subsequence. This definition can be refined if we do not expect the whole series to be part of the other series $\left(\check{C}(F_1) \subseteq \check{C}(F_2)\right)$.

Logistification is illustrated in figure 2.

Entropy of fluid flows

It is very interesting to examine how uncertainty aroused and increased in the system of fluid flow by intra-users (internal customers) or inter-users (external customers). Is there any rate of reliability of fluid-systems? If so, is it possible to add limits to this measure? These issues suggest that a kind of entropy concept should be introduced. The entropy of fluid flow can be compared the most to the Shannon's entropy (Kannappan, 1972a) and can be inspected from several aspects:

1. External (inter) users' perspective
2. Aspect of the real internal uncertainty of the system

Economic systems are always open systems, so their uncertainty (reliability) is highly influenced by external world and internal users. It is equally true that an economic system has no demand for its products or services, and no apparent activities. Despite these facts, it should keep contact with the social, legal, etc. aspects of the economic environment. Consequently, they have both inter- and intra-users (customers) with their demands. This is true even in this special case. Examples also include economic systems, tax authorities, reporting requirements and accountability.

Accordingly, these passive systems can be treated as the active ones. So it can be stated that there is an impact of increasing external uncertainty in all of the studied systems. On the other hand, the level of uncertainty can be also increased by the demands and outputs of intra-users in nodes. The effect of these two influences should be complied to create a degree of reliability for process systems.

Nodal entropy

In business literature can hardly be any evidence found for process entropy. However Shannon in his works has laid its fundamentals (Moore, 1956; Shannon, 1948). These studies were followed by some supplements and critics (Asl, Khalilzadeh, Youshanlouei, & Mood, 2012; Kannappan, 1972b). Managerial entropy was also introduced and discussed by many authors (Peiyu, Zhang, & Yong, 2009; Shiyou & Yu, 2009; Wanhua, 2002; Yao & Yu, 2008) but they cannot face with such issues we need to develop our model.

Jung et al. also dealt with this issue (Jung, Chin, & Cardoso, 2011). Although in our interpretation, multiple nodes may provide and accept fluids or some nodes may be ignored. On the other hand, the importance of fluids is not necessarily proportional to its likelihood. The work of Jing (2012) cannot form the basis of our concept of entropy. Neither nodal nor process entropy can be inferred from Jing's entropy definition.

To define perceptional entropy, the first step should be the drafting of the actual (real) entropy of the fluid system. Let c be a node and the set of fluids entering this node be $D_I(c) = \{d|d \in D; d \in \text{input}(c)\}$ and $D_O(c) = \{d|d \in D; d \in \text{output}(c)\}$. Let $D_c(d)$ be a fluid set determined by a given $d \in D_O(c)$ output fluid on the c node and let $n_d = |D_c(d)|$. Let the probability of a d fluid to appear on node c in an appropriate manner (type, value and time) be $P_{Oc}(d)$. This probability is determined by arrival probabilities of dominant input fluids and the probability of node transformation. Our investigations show that this probability which means internal uncertainty depends on the uncertainty of input fluids. Let $P_I(d_j)$ be the probability that d output fluid determined by $d_j \in D_c(d)$ $(j = 1; 2; \dots; n_d)$ input fluid adequately (entirely and timely) enters into a node. As input fluids differently affect the adequate appearance of output fluids, therefore probability of input fluids has also different weights on outputs.

Accordingly, the impact probability of input fluids can be described by

$$P_i(d) = \sum_{j=1}^{n_d} \lambda_j P(d_j) \tag{9}$$

equation, where

$$\sum_{j=1}^{n_d} \lambda_j = 1$$

and λ_j is the influencing factor of the input fluid.

Let $A_j\ (j = 1; 2; \dots; n_d)$ be an event when the $d_j \in D_c(d)$ input fluid adequately enters. It is not sure that the fluid is entirely received, but is sufficient in processing terms, In other words, the output fluid meets the completeness axiom to a node. Accordingly, the probability of nodal uncertainty can be introduced and described (i.e. what is the probability that the node does not make an A_d mistake) by:

$$P_c(d) = P\left(A_d \middle| A_1 \cdot \dots \cdot A_{n_d}\right). \tag{10}$$

Consequently, the completeness probability that an output fluid leaves the examined node can be specified with the following equation:

$$P_{Oc}(d) = P_i(d)P_c(d). \tag{11}$$

So as the entropy of an output fluid of a node:

$$H(c_d) = -\log_2 P_{Oc}(d), \tag{12}$$

and accordingly, the nodal entropy can be interpreted in several ways. It may be weighted- similar to impact probability as the significance of a fluid may be important. Since it is not easy to pre-measure, it will be interpreted on the "weakest" output fluid of the node:

$$H(c) = -\log_2 \min\{P_{Oc}(d_k) | k = 1 \dots m\}. \tag{13}$$

where m is the number of output fluids of a node.

Process entropy

Theoretically process entropy is readily determined using nodal entropy. The conception here is that fluids appear in process inputs flowing through the nodes of the process. An output fluid appears in one or more nodal inputs with the same completeness probability as it was at the output. So let the c_i node provides the d fluid to the c_k node. In this case $P_{Oc_i}(d) = P_{Ic_k}(d)$ will be satisfied.

Let P be an explored process of a system. Let us take the $I(P)$ set of input fluids. Than process entropy is determined by a constructive way.

Step 1:

Let us denote identified nodal fluid that one, whose nodal completeness probability is known. Their set is denoted by $E(P)$. Initially $E(P) = I(P)$.

Step 2:

Let us take those nodes leaving output fluids, which are clearly, defined by $E(P)$ fluids and their completeness probability can be determined by input fluids and nodes. Their set is denoted by $T(P)$.

Step 3:

$$E(P) := E(P) \cup T(P). \tag{14}$$

Step 4:

Examine that the completeness probability is determined or not for all output fluids:

$$O(P) \subset E(P)? \tag{15}$$

If this condition is not satisfied, get back to step 2.

Step 5:

Every completeness probability for all output fluids are determined. This enables us to express the process entropy with the following equation:

$$H(P) = -\log_2 \min\{P_{Oc}(d) | d \in O(P)\} \tag{16}$$

Intra-user entropy

Users do not necessarily experience the real entropy of a process, but rather they have very different perceptions of the process. Intra-users (internal users and customers) are situated in a node and manage and/or execute transactions. They have some kind of knowledge on input fluids that are important to them due to their perceptions. They determine the complete probability of these fluids. This probability cannot be 0, since in this case transformation wouldn't be started in the node and it cannot be part of the process. So in the case of perceptional entropy the impossible event does not cause a 0 entropy.

Let $D_c(u)$ be the set of input fluids used by an intra-user and let $n_u = |D_c(u)|$. Furthermore let $d \in D_c(u)$ be the completeness perception of fluid (the completeness probability perceived by the intra-user, i.e. how likely they feel that fluid arrived accurately, in the right quality and the right quantity), and the perceptional entropy of the intra-user is:

$$H(c) = -\log_2 \sum_{j=1}^{n_u} \lambda_j P(d_j) \left(d_j \in D_c(u)\right)$$

(17)

where

$$\sum_{j=1}^{n_u} \lambda_j = 1$$

and λ_j is the perceptional influencing factor of input fluid.

Inter-user entropy

The uncertainty of an inter-user always depends on user demands. For instance, a demand for fulfilling a production system deadline, a quality demand or the reliability of a user (simple parameters). Variations with any of these priorities are also included (complex parameters). The uncertainty of a system for an inter-user is determined by the collected data from system feedback information. Uncertainty can be terminated either by the system or by the users (e.g. on the occasion of the completion of the process) with a definite answer on the output (termination) of the process. In any other time uncertainty depends on inter-user's perceptions.

So the less the inter-user knows the processes of the system, the less they will be able to make safe decisions. Thus there is a high degree of uncertainty. As the process system of a business organization is stochastic, the demands of other users, the performance limitations of the system and the internal structure of processes also influence the uncertainty.

From this aspect, inter-user uncertainty is determined by the rate of information on the system. On the other hand, is determined by the perceptions of the users. So it does not make much sense to the users if they get complete information on processes and they are not able to detect or interpret it via their perceptions. Therefore, the concept of inter-user entropy will be composed of these two features. More specifically, the inter-user entropy is the perceptional distortion of Shannon's entropy (Moore, 1956). To define it, the fluid flow provided set of information should be specified as a Shannon's sample space (Shannon, 1949).

Let p be a parameter (simple or complex) whose value is relevant for an inter-user in time t_d.

Let the actual time be $t_0 (< t_d)$ and let $t \in [t_0; t_d[$. Furthermore let all the fluid flow sets be known according to eq. (6): $\Phi_{[t_0;t_d]} = \{F(d)_{[t_0;t_d]}\}$. A fluid flow is characterized by its fluids, types, weights, transformations, etc. Let c be a virtual node where there is a certain inter-user. Fluids necessary for them are the input fluids of this node. Thus, the inter-user entropy is the perceptional distortion of

Shannon's entropy (or shortly perceptional entropy) in accordance with eq. (17) is:

$$H_u = H(c) \tag{18}$$

which is denoted as the uncertainty measure of the fluid flow system.

At all other times, the uncertainty is at a minimum value which is adjusted by the user according to their system-related perceptions (obviously this is greatly influenced by their experiences).

Discussion

Empirical research

In order to get some impression of the modelling issues, objectives and conditions in a two-step empirical research were implemented in November 2013. Primarily, four focus group interviews were performed among the population to have some insights on service process perceptions. Secondarily, 12 in-depth interviews were performed among experts of service companies. This was to have some impressions of the special characteristics of financial service providers' nodes and processes. These initial empirical researches are resulted in a complete questionnaire which is to capture users' perceptions of financial service processes. Also, the questionnaire results form the basis of a future experimental model. This empirical framework is illustrated in Figure 3.

During the *focus group interviews,* consumers above 18 were asked of their relationship with financial institutions and they can provide us useful answers to our questions. During the research, we carried out 4 focus group interviews that means altogether 30 people were asked (7-8 persons/interview). The youngest respondent was 18 years old while the oldest one was 59 years old. Furthermore, all the "age groups" were represented during the interviews from the youth and middle-aged through the mature, experienced age group. Composition according to the occupation of the participants also shows considerable heterogeneity There were university students, lecturers, blue collars, white collars, managers, entrepreneurs as well as job seekers. First, two interviews were carried out at the MIM Research Student Office at the University of Miskolc. The other two interviews were carried out in the Focus Laboratory of the Budapest Business School Research Centre. The interviews were done in the interval between 13th and 21st of November 2013. They were documented by video record and reports were made on the given issues. This served as a basis for the research results.

During the *in-depth interviews,* experts working for commercial banks were asked for a good overview of their own company's business processes and to

provide us with valuable information. Twelve persons were asked throughout the in-depth interviews. Interviews were made – after asking for appointment on phone, email – at the location and date assigned by the respondent. After asking permission, conversations were documented by sound recording and on the basis of the provided information. Reports were made that also served as a basis of the research.

Results of focus group interviews

During the focus group interviews, we were interested in the services respondents buy during their everyday life. When answering this question we discovered that respondents use many kinds of services. These include public utility services (electricity, water, gas), community travel, catering (café, pub, restaurant), post, telecommunication services (phone, internet), banking services, healthcare, education, sport, cultural services (cinema, theatre, concert) and personal services (hairdresser, beautician, masseur). We have to remark that commerce and insurance are not considered as services.

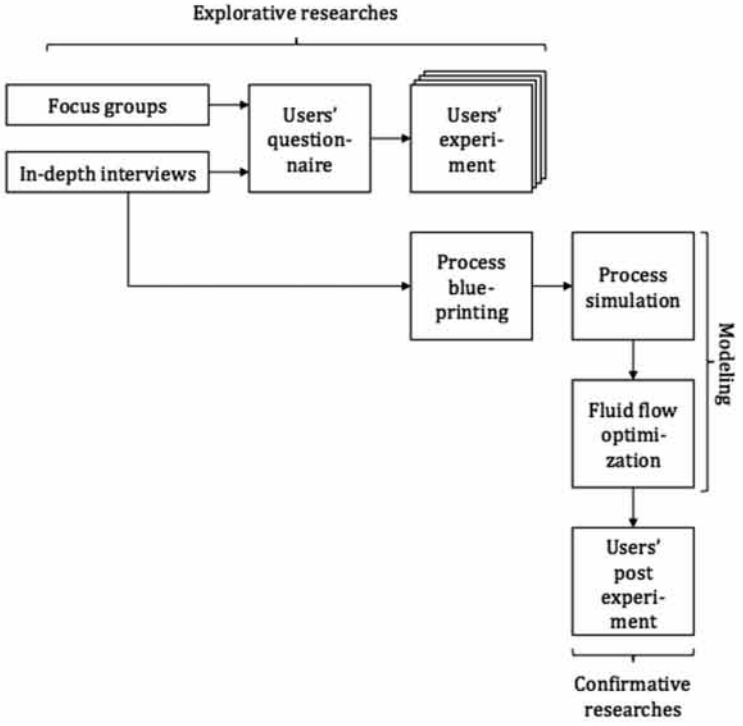

Fig. 3. Empirical framework

When asking details about the frequency of service utilization, it was revealed that public utility services, telecommunication (phone, internet), community travel and education are continuously used, or at least once on a daily basis. However, financial services and insurance are not considered continuous services.

In answering the question of which three service providers are regarded as the most important in our lives, respondents had identical opinions. The most important service providers in our lives are public utilities (electricity, water, gas, district heating) and the second is telecommunication service providers (phone, internet, TV). The third were banks and transport service providers in a dead-heat. Also, mentioned were educational institutions and catering units.

On the basis of what they chose as their present services, why were the above factors considered the most important? Answers were also in harmony with these issues. They were the most important because they are used most often and there is no life without them. As there is no alternative in the case of public utility service providers and public transportation, they chose what was available. In other cases, price, service and quality were the most important factors. Personal experiences were critical factors as well as recommendation of the family members (parents), acquaintances and availability (banks, catering establishment). Consumers do not meet "internal issues" of the organisation providing services. Therefore, these factors do not directly influence them. However, features of the service providers like physical elements, processes and the human element are important influential factors. Only a few people thought that during choosing their present service provider that their impression and preconceptions were determinate.

In the second half of the focus group interview, financial institutional services were put in the scope of the research. To start this part of the interview, we used the questions of Critical Incident Technique (CIT). Respondents could characteristically give details about their negative experiences. The sources of negative experiences were of providing basic services in an inappropriate way, improper attitude and defects in expertise of employees. Further problems were long waiting time or unilateral modification of the contracts at the expense of the client (payment instalments, costs). However, interviewees could also share their positive experiences. Sources of positive experiences were quick administration, nice front office workers, and potential complete online administration. To sum up, negative experiences were more permanent for the respondents than positive ones.

After negative and positive examples, we asked questions about the reputation of the commercial banks. We ascertained that spontaneous bank

awareness of the respondents can be considered explicitly high. They can mention 6-7 banks on average in a minute, but there was also a group where the average was 10 banks. Interviewees characteristically bought services of one commercial bank, but it also occurred that someone was in connection with two banks. The choice of the account-manager bank was a free decision for everyone. Younger people typically chose their bank according to popular opinion, the bank's offer and advice of their parents. Indeed, they were not solely the ones to make this decision. On the other hand, older people were more conscious and engaged during the process of bank choice. In their decision, elements like availability, negative experiences at other banks, offered services and list of conditions were factored. The switch to another bank usually happens on a rational basis.

In connection with having banking services, it can be ascertained that more and more arrange their financial affairs through netbank. This is the most often used service. Transactions, buying with credit card, cash withdrawal with bankcards, currency exchange, bank deposits, loan payments, and group order for collection. As for the intensity of using financial services, different respondent profiles seem to be outlined. Although bank account management is a continuous service offered by the banks, it is important to remark that no one mentioned the management of a bank account. This is probably because it does not require consumer intervention and collaboration.

We also examined in what form consumers get in contact with their bank. However, in this issue we have to make difference between active,-passive establishment and communication. Consumers characteristically get in touch with their banks on the internet or personally. Those who have closer acquaintance or a counsellor do this on phone. (Others do not like phone administration because of mechanical voice and its complicated menu system. Whereas banks first get in touch with the consumers by phone, letter or email.

As for the satisfaction with commercial banks, youth satisfaction is high and they get services suitable for their requirements. They did not have negative experiences and thus have no basis for comparison. Satisfaction of older people is relatively lower, but they can still be considered satisfied. (More people expressed their satisfaction and compared Hungarian conditions to positive foreign examples: low interest rates on deposit, high interest rate on loans, expensive services.)

Results of the in-depth interviews

During in-depth interviews, we got to know that respondents are exactly aware of the most important actors of their market (competitors, customers,

suppliers). Thus, they could be properly segmented. All the banks were considered competitors, but they added that competitors are different in different fields (population, big companies, credit cards, commodity credit, estate loans). A base for segmentation can be size on the basis of what difference can be made among large banks, small banks or owner groups. According to that, we can talk about Hungarian and foreign stake. As for customers we have to make distinction between client segment on the basis of European Union recommendation: population (Hungarian and foreign), micro-enterprises, SMEs, large companies, institutions, financial and non-financial clients, state, Hungarian National Bank. Most important are suppliers of commercial banks: external counsellor, software suppliers, property managers, HR counsellors, renovations and services in connection with maintenance, factor, leasing and collection companies. On one hand, strategic associations of financial sectors are a bank alliance. Further to this point, alliances are made between banks - insurance companies; banks - pension funds and banks - broker companies.

It also turned out from the experts' answers that they know their processes well. It does not matter whether it is a value creation or directly involves consumers.. Supportive, indirect consumer involvement and supportive processes are also of no consequence. They know their phases, sub-activities, can identify directors and collaborators of the processes. Value creator processes for banks: providing loan, collecting deposit for banks, estate handling, investment management, special investment services, insurances, and financial transaction services. The purposes of value creating process are "money reinvestment", meeting financial requirements of the customers. Phases are: obtaining more clients, establishing relationship, surveying demands, making offers, contracts, approval and money flow. Directing processes: account manager (counsellor, referent, administrator), from wider aspect project sponsor or CEO. Collaborators of value creator processes are the experts of co-departments. Besides these processes, there are also a lot of back-office processes the consumers cannot meet directly.

A majority of commercial banks have very precise process description (rules) that are destined to resolve further problems appearing in their processes. These problems appear continuously, but they are not enormous. Quantity aspect is in the background of the problems facing quality aspect (overburdened staff).

Interviewees could all determine which factors their customers judge regarding the level of their service processes on predictability, quickness, access, simplicity, confidence, personal relationship, directness, conformability, prices, expertise, communication, kindness, and flexibility.

As for the types of processes modular processes are mostly present in the practice of commercial banks which can be separated into smaller, shorter linear processes. Project processes also often occur, but they make up more regarding value than quantity. Almost no one can esteem how much impact the three process types have in the life of the company. However, experts that were asked emphasized that clients do not perceive which process type they meet.

Another big topic of the interviews with the experts was the measurement and assessment of the process effectiveness. Commercial banks apply such methods. They are obliged to because of the regulation (reports, indices). In general, we can state that evaluation of process effectiveness operations. There is no problem with the usage of financial measurement tools. There are efficiency reserves, but they are caused by soft factors that are hard to eliminate. There are BPR projects, yet the attitude of the companies is reactive to the factors. Consumer satisfaction is examined by telephone questioning. Furthermore, there are also time norms that are not good for the verification of anything according to certain experts' opinion. For the measurement, evaluation of efficiency certain information coming from banking IT systems serve as a basis.

According to our respondents, there are more factors that influence the efficiency of the processes at the same time. They depend on the identification with the processes, their acceptance, commitment, expertise and personal competence. Of these human factors, personal relationship is the most important. Based on these issues, a relationship that seemed a paradox could be explored. We could be quicker, but could also lose flexibility according to standardized processes,

Regarding the development possibilities we have to mention two key areas, namely our personal competence and the information technological development. As for human factor opinions were different. According to certain experts personal contact and administration is needed, communication has to be developed and also more clerks are required. On the other hand, according to others development of the applied software, integration information technological systems, that is "switching off" human factor would be a way to follow.

The generic design of the mathematical model

A mathematical model can be built on the basis of the previously given definitions and relationships. The aim of this model is to provide theoretical background to our future simulation model and on the basis of this mathematical

model the required computing model can be prepared. It should be kept in mind during the modelling that perception driven processes (PDP) must be mapped to the model level. In-model changes shall be reflected to the observed world as if it would take place in real world. This requirement is illustrated in figure 4 below.

However, a general model is created at this stage for each of the above-mentioned processes. It is not worth detailing the model even deeper since the point may be lost. Quantities in the system are the expected values of the random variables. Accordingly, each quantity has a probability distribution whose definition requires empirical studies and schemes may be different for each element.

During this examination of the system, nodes along with their data transactions and possible inter-nodal fluid flows are to be given. These will be given after our future empirical observations. The aim of the model is to develop a method which can provide input fluids (fluids on entry points) are able to reach output fluids (exit points) in the required quality and quantity. This should be implemented optimally. Optimality will be achieved by using the objective function.

Based on the concepts of the model, known and unknown variables should be given. In addition, conditionality should be built based on relationships between certain elements of the framework. For the final examination of the system, the objective function is presented in this paper. So as our model consists of two main parts:

- conditionality,
- objective function.

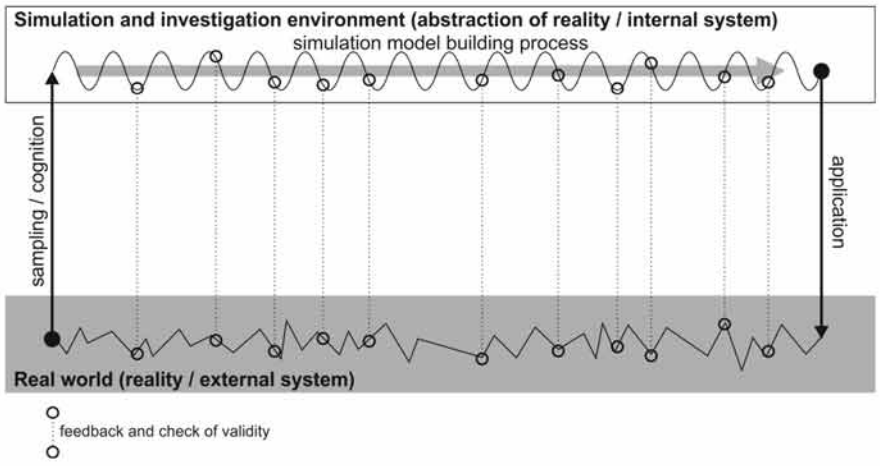

Fig. 4. Modelling requirement

Known data

Let

n_I be the number of INPUT nodes,
n_o be the number of OUTPUT nodes, and
n_k be the number of *interstitial but external* nodes.

Let

D^I be the weight of a D node appeared on the i^{th} input node (weight is considered in an abstracted term)
D^O be the weight of a D node required by i^{th} output node (weight is considered in an abstracted term)

Let

$D^I = \{D_i^I\}$ be the set of input fluids arranged by node sequence numbers
$D^O = \{D_i^O\}$ be the set of output fluids arranged by node sequence numbers.

There are some important conclusions of these assumptions. There are special nodes either on input or output side. Input nodes launch a fluid into the examined system through the particular fluid flow and they are unable to accept fluids.

Expected fluids will appear on output nodes (in appropriate quantity and quality). Here, the expectations are displayed via node related attributes. Output nodes do not emit fluids. Interstitial, but external nodes are those that are actually users intervening in the system to complete the entire process. They can emit and accept fluids.

The set of these three kinds of nodes is equal to the previously defined set of inter-users. Inter-users can be considered as the same nodes as the internal elements (nodes) of the system. Thus they can be featured by same functions, properties, transformations.

These remarks led us to conclude that a dual system is obtained. The primal system is the examined one while the dual is the independent (possibly dependent) one with external nodes.
It might be considered during our investigation as a joint connection of two of the same fluid flow system.

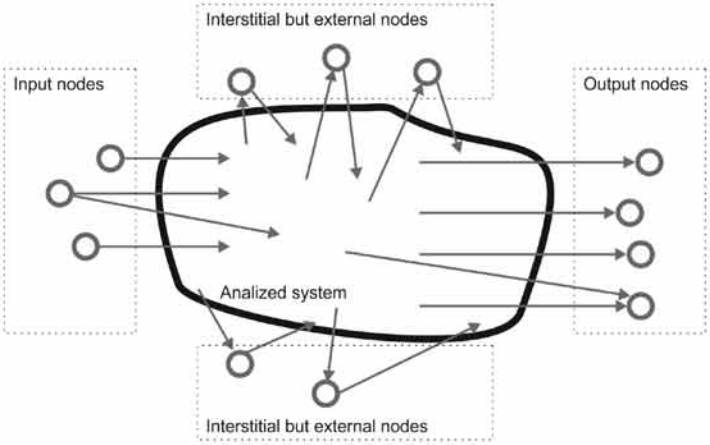

Fig. 5.: Representation of nodal flow model

However, all input-output, interstitial and external nodes can be considered as the same client. In our model, they are considered to be separate nodes for simplicity. This simplification does not violate the principles raised in the previous paragraph.

Determination of model inputs

Our system is basically built of nodes and fluid flows.

Let

n be the total number of nodes of the system

n_b be the number of interstitial but external nodes of the system

Every node is represented by an $i \in \{1, \dots, n\}$ value. $n = n_i + n_k + n_o + n_b$

If $i \in \{1, \dots, n_i\}$ then input node,

If $i \in \{n_i + 1, \dots, n_i + n_k\}$ then interstitial but external node,

If $i \in \{n_i + 1, \dots, n_i + n_k\}$ then output node ,

If $i \in \{n_i + n_k + n_o + 1, \dots, n\}$ then node in the system is considered.

m be the number of possible fluids. Every fluid is represented by a $d \in \{1, \dots, m\}$ value.

Every node is assumed to be an agent (or a computational object). Each node is structured as a set of attributes and transactions. The structure of i^{th} node consists of data and transactions.

Data

Let

$p_{max_i}(d)$ be the maximal capacity of i^{th} node in relation to fluid d. If this value is 0, then d fluid cannot flow through this node.

$h_i(d)$ be i^{th} node the compulsory node of fluid d.

$H_i(d)$ be the entropy of i^{th} node based on eq. (12).

According to these conditions – if necessary – minimal capacity may also be defined. Accordingly, inter-user entropy can be calculated based on eq. (17).

Transactions

Let

$q_i(k,j,d)$ be the measure of a unit of the transformation of d fluid to j^{th} node received from k^{th} node,

$t_i(k,j,d)$ be the time of transmission of d fluid to j^{th} node on i^{th} node (per unit)

$d_i(k,j,d)$ be the transformation of d fluid received from k^{th} node to j^{th} node (meaning that d fluid received from i^{th} node transforms into what fluid). Its quantity is determined by q_i.

$s_i(k,j,d)$ be the subject of the flow of d fluid received from k^{th} node to j^{th} node. This is an empirically determinable function, however it is also applicable.

$r_i(k,j,l,d)$ be the redirection of d fluid (received from k^{th} node and flowing to j^{th} node) when a problem occurs to l node.

Fluid merging can be specified with the application of d_i, t_i, q_i functions of two of the same fluids, thus it does not require any further definitions. Fluid splitting can be specified similarly with the given functions. As for example at $q_i(k,j,d)$ function fluid can be easily split by giving two different j.

Fluid flow model

Let (i,j) ordered pair denote the direction of the fluid flow, where i shall be the sign of the initial node of d fluid and j be the sign of the target node. In this sense every fluid flow can be represented by a separate ordered pair.

Let us assign to every (i,j) ordered pair an:

$\mathbf{E}_{n_d}(i,j)$ matrix (entropy matrix block)

$\mathbf{E}_{q_d}(i,j)$ matrix, which shows the weight of a given d fluid flowing from i^{th} node to j^{th} node

$\mathbf{E}_{v_d}(i,j)$ matrix, which shows the value of a given d fluid flowing from i^{th} node to j^{th} node

It is advisable to introduce an:

$\mathbf{E}_d(i,j)$ bivariate matrix, which has a value 1 if d fluid flows from i to j, and 0 if there is no flow.

The fluid process model

Based on above definitions of fluid, they can even flow in batches. Then $b(k,j,l,d)$ is the batch of d fluids flowing from i^{th} node to j^{th} node (where d vector contains the serial numbers of the fluids that are included in the batch). Batch flows can be also described by the given above and easily generalized functions.

Unknown data

Let

x_{ijd} be the weight of d fluid flowing from i^{th} node and arriving to j^{th} node.

y_{ijd} be the weight of d fluid flowing from i^{th} node and departing to j^{th} node.

Conditions

Not any d fluid can be transformed or flown through a given node than the maximum capacity of that node:

$$\sum_{d\ fluid\ entering\ to\ i \in j} x_{ijd} \leq p_{max_j}(d)$$

The sum of the continuation without any formal change of an entering d fluid and other fluids transforming to d must be equal to the sum of leaving d fluids from a node.

$$\sum_{d\ fluid\ entering\ to\ k \in j} x_{kjd} q_j(k,j,d) + \sum_{f_i(k,j,f')=f} x_{kjf'} q_j\left(k,j,d_i(k,j,d')\right)_i = \sum_{d\ fluidum\ flowing\ from\ i \in j} y_{ijd}$$

The objective function

Our objective in this system is to produce expected fluids on outputs flowing from inputs in required quality and weight. All of this is done by the minimization of the system's internal entropy, lead time and cost. Accordingly, the structure of the objective function is as follows:

$$c(D^I, D^O, P) = \lambda_1 K(D^I, D^O) + \lambda_2 T(D^I, D^O) + \lambda_3 H(D^I, D^O) \rightarrow min.$$

where

$K(D^I, D^O)$ is the cost of INPUT and OUTPUT fluid flows according to the system,

$T(D^I, D^O)$ is the lead time of INPUT and OUTPUT fluid flows according to the system,

$H(D^I, D^O)$ is the process entropy of INPUT and OUTPUT fluid flows.

The fulfilment of output requests is limited by the conditions, so it may occur that there is no possible solution to the problem. The λ_i's of the objective function are normalized scalars allowing us weighting of each component according to their importance during the investigations. If a certain $\lambda_i = 0$, then the aspect is not included in the examination.

Our investigations basically deal with the third component. The primary $\lambda_1 = \lambda_2 = 0$, and $\lambda_3 = 1$ assumed. Accordingly a P process with D^I, D^O input and output parameters in accordance with the previous chapter can be considered as follows:

$$H(D^I, D^O) = -\log_2 \min\{P_{Oc}(d) | d \in O(P)\}$$

Structure of the system

The system consists of nodes and fluid flows interpreted among them (batch of fluid flows can be considered as fluid processes). It can be described as a controlled graph containing circular paths wherein edges have no values, but rather functions. The objective is the circulation of the fluid from certain inputs to given outputs. This is done while minimizing the given objective function in such a manner that the fluid must pass over compulsory nodes.

These nodes can also be considered as special Mealy-automatons. In contrast to the classical Mealy automaton theory herein stated changes are not necessarily performed one after the other. However, parallel activities may occur. An important condition is that the criterion of discrete time scale is met.

Time, though, is allocated to status changes [see $t_i(k,j,d)$ function] that affect the launch of a following process and also the whole lead time.

Mealy automaton approach for fluid flows

The previously shown concept of logistification predicts a very difficult and complicated mathematical in IT task for process engineers. The solution must be exact. Even a single improperly modelled and implemented nodal transformation may generate an entropy growth flow causing the *entropy domino effect* (EDE). At this stage of our investigation, it can be theoretically foreseen that some obvious heuristic modelling tools (such as harmony search and genetic algorithms) should be abandoned. A certain implementation should be the application of Mealy automatons which could be easily incorporated into the simulations.

For this it must be assumed that the observed time interval can be divided into discrete time slots and each scale shall be considered as discrete exact moment.

The number of nodes is finite and the number of transformations in those discrete time slots is also finite. In the case of fluid flows, this means that such a time-slice (slot) allocation can be definitely formed in a natural fluid flow. An appropriate number of nodal transformations can be ordered and time structures can be assigned to these transformations.

Another very important characteristic of Mealy automatons is that they always respond to an input signal with an output signal (except condition state changes). In the case of fluid flows, this means that the automaton will produce output fluids through nodal transformations as a response for one or more input fluids. As the Mealy automaton possesses appropriate generalisation therefore nodes (with their transformations) can be easily considered as a single Mealy automaton.

In this subchapter a Mealy automaton based network will be given that describes the previously presented system of nodes and fluid flows.

Definition 10: **A Mealy automaton** is a tube $A = < Q, X, Y, \delta, q_0 >$, where Q is a finite set of states, X, Y are input alphabet and output alphabet, particularly, $q_0 \in Q$ is the initial state, and $\delta: Q \times X \rightarrow Q \times Y$ is the transition-output mapping.

The transition-output mapping in fact is a couple: $\delta = (\sigma, \rho)$, where

$$\sigma: Q \times X \rightarrow Q, \rho: Q \times X \rightarrow Y$$

and

$$\delta(q,x) = \big(\sigma(q,x), \rho(q,x)\big)$$

Let $X^{\varepsilon} = X \cup \{\varepsilon\}$. The transition-output mapping can be extended into $\delta: Q \times X^{\varepsilon} \to Q \times Y^{\varepsilon}$ as follows:

i. $\sigma(q,\varepsilon) = q, \rho(q,\varepsilon) = \varepsilon,$
ii. $\sigma(q,wx) = \sigma(\sigma(q,w),x),\ \rho(q,wx) = \rho(q,w)\rho(\sigma(q,w),x))$

Definition 11: **A network of Mealy automaton** is a set $\{\mathcal{B}, \mathcal{R}, \wp\}$, where $\mathcal{B} = \{A_i | i \in I\}$ is the set of automata, where $A_i = < Q_i, X_i, Y_i, \delta_i, q_0^i >$, $\mathcal{R} \subseteq \mathcal{B} \times \mathcal{B}$ is a relation between the automata, and $\wp$ is the set of mappings $\pi_i: \bar{X}_i \to X_i$, where if we denote by $X_i^{\varepsilon} = X_i \cup \{\varepsilon\}$, ε is empty symbol, $I_i = \{j |\ (A_j, A_i) \in \mathcal{R}\}$, then $\bar{X}_i = X_i^{\varepsilon} \times Y_{i_1}^{\varepsilon} \times Y_{i_2}^{\varepsilon} \times \ldots \times Y_{i_n}^{\varepsilon}$, $i_{k_i} \in I_i$.
$\bar{X}_i$ is in fact the set of extended inputs of the automaton A_i.

A network of automata can be considered as an automaton that is defined as follows:

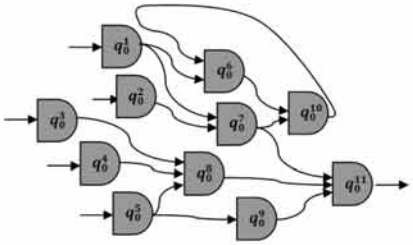

Fig. 6.: A network of automata.

Definition 12: Let $\aleph = \{\mathcal{B}, \mathcal{R}, \wp\}$ be a network of automata where $\mathcal{B} = \{A_i | i \in I\}$, $A_i = < Q_i, X_i, Y_i, \delta_i, q_0^i >$, $\mathcal{R} \subseteq \mathcal{B} \times \mathcal{B}$, and $\wp$ is the set of mappings: $\pi_i: \bar{X}_i \to X_i$. Then:

- The set of network states ($\aleph$-state) is $Q = Q_1 \times Q_2 \times \ldots \times Q_n$
- The set of network inputs ($\aleph$-inputs) is $X = X_1 \times X_2 \times \ldots \times X_n$
- The set of network outputs ($\aleph$-outputs) is $Y = Y_1 \times Y_2 \times \ldots \times Y_n$

Let's denote $X^{\varepsilon} = X_1^{\varepsilon} \times X_2^{\varepsilon} \times \ldots \times X_n^{\varepsilon}$ and $X^* = \bigcup_{k=1}^{\infty} (X^{\varepsilon})^k$.
Let's denote also $p_i: (X^{\varepsilon}, Y^{\varepsilon}) \to \bar{X}_i$, where

$$p_i\big((x^1, x^2, \ldots, x^n), (y^1, y^2, \ldots, y^n)\big) = \big(x^i, y^{i_1}, y^{i_2}, \ldots, y^{i_{k_i}}\big) \in \bar{X}_i,\ i_j \in I_i.$$

The **network transition mapping** $\delta_{\aleph} = (\sigma_{\aleph}, \rho_{\aleph}): Q \times X \times Y \to Q \times Y$ is defined as follows: For $x = (x^1, x^2, \ldots, x^n) \in X^{\varepsilon},\ y = (y^1, y^2, \ldots, y^n) \in Y^{\varepsilon}$ let
and

$$\rho_{\aleph}\big((q^1, q^2, \dots, q^n), x, y\big) = (\rho_1(q^1, \pi_1(p_1(x,y))), \rho_2(q^2, \pi_2(p_2(x,y))), \dots, \rho_n(q^n, \pi_n(p_n(x,y))))$$

The network transition mapping $\delta_{\aleph}$ can be extended into $\delta^*_{\aleph} = (\sigma^*_{\aleph}, \rho^*_{\aleph})$: $Q \times X^* \to Q \times Y$ as follows: For $q = (q^1, q^2, \dots, q^n) \in Q, w = w_1 w_2 \dots w_k \in X^*, w_j = \big(x_j^1, x_j^2, \dots, x_j^n\big) \in X^{\varepsilon}$, then

(1) $\sigma^*_{\aleph}(q, w) = q_0 q_1 q_2 \dots q_k \dots$

(2) $\rho^*_{\aleph}(q, w) = y_1 y_2 \dots y_k \dots$

where

$$q_0 = q, y_0 = (\varepsilon, \varepsilon, \dots, \varepsilon)$$
$$q_{i+1} = \sigma_{\aleph}(q_i, w_{i+1}, y_i)$$
$$y_{i+1} = \rho_{\aleph}(q_i, w_{i+1}, y_i)$$

The sequences (1) and (2) show the movement of the network $\aleph$ at the input w starting from the state q.

By definitions one can see that the network of automata is not only a set of independent automata. The working procedure of a network of automata is determined by the operation of each automaton in the network as well as the interactions between the automata.

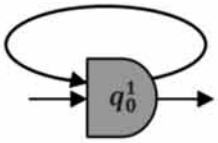

Fig. 7.: The network of a single automaton

A network of automata may operate infinitely in loops and will not halt. The set of sequences (1) and (2) characterize the feature of the network of automata.

Results and conclusions

To determine and model the operation of a process based system the first and most important task should be the conceptualization of the terms of the related discipline. In our research there have been many undefined and misunderstood terms and comprehension problems have occurred. In order to prepare the modelling phase of our research and to lay the foundations of logistification, this conceptualization is inevitable. Accordingly, the fluid flow based technical and mathematical model of a process system is prepared. A simulation built on this

can be carried out to examine and reorganize an arbitrary process system from a flow perspective.

A model for nodal process and user entropy is given in this paper. A full mathematical approach is also given on a service process-reengineering concept. This is combined with the development of classical Mealy automaton theory that now fits even for service processes.

Limitations and future research

Although many efforts were made to build a generally useable model for service process re-engineering, this paper presents only the first steps of conceptualization and mathematical framework building process. However, it still has some limitations. The model can only handle predefined node attributes. Thus, as node features arise (and even fluids) they can be incorporated into the system by an iterative fine-tuning of the model.

Transaction that appear in the model as a function must be well defined. Those parts, which may only be observed with significant subjectivity, cannot be taken into account at this stage. All items will be a numeric value, so the mapping of subjects may differ from reality. In its current form, the model cannot be dynamically modified during a simulation.

The introduction of Mealy automation into our model also elicits further questions. The individual automaton can be considered as the "nodes" in other fluid flow researches. Therefore, the network of automata can be considered as a model of the fluid flow with finite number of nodes. This model may be the object for more thorough studies of behaviour of the network, as well as the role of nodes in the whole model. As one can pick out, some states of the automaton are the "goal" states, or as "damned" (or "jammed") states. The operations of the networks to get the "goal" states, or to avoid the "jammed" states may be an interesting problem. However, the analytical problems of the fluid flows may be solved based on the model. Information-theoretical problems of the fluid flows may be solved based on the model as the performance of the network and its components may be therein determined

Further investigations should be performed in the areas of users' perceptions which are very important issues for either a production or service oriented business organization. In many cases, the demands of the system's outputs may be determined by the customers' perceptions. By the coordination of this two investigation areas such a simulation model can be developed. This could help in the amelioration of dysfunctional process systems.

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TERESA SHUK-CHING POON

UPGRADING THE INFORMATION COMMUNICATION AND TECHNOLOGY INDUSTRY IN CHINA: A GLOBAL VALUE CHAIN ANALYSIS[1]

Using the global value chain (GVC) perspective, this article examines the upgrading trajectory of the information communication and technology (ICT) industry in China. It argues that Chinese firms operate in technological and institutional contexts that have enabled the adoption of a model of industrial upgrading unique to China as a large and late developing country. Such a model of industrial upgrading is facilitated by China's huge and booming domestic market, culturally obscure to lead firms in advanced industrialised countries due to the relative lack of knowledge of local consumer preferences and requirements—as well as of the characteristics of domestic markets and institutions. In contrast, Chinese manufacturers of ICT products and providers of ICT services are able to offer architectural and incremental innovations that satisfy the local consumers' demand for less sophisticated products and services at more affordable prices. This article concludes by drawing some theoretical implications for the GVC perspective.

There is a growing body of literature examining the intricate relationships among globalisation, inter-firm linkages, and industrial upgrading. One important strand of this literature is the global value chain (GVC) perspective, which sets out to examine how firms in developed and less developed countries link to create and capture the relative value embedded in various economic activities carried out to generate end products and services. In examining the process of industrial upgrading in less developed countries, the GVC perspective explains the ways in which dispersed production and distribution systems are globally integrated, and how firms in developing countries—small- and medium-sized enterprises (SMEs), in particular—may enter into and capture the higher-value added activities of the GVCs (Gereffi 1994; Gereffi 1999; Gereffi et al. 2001; Gereffi, Humphrey, and Sturgeon 2005).

Using the information communication and technology (ICT) industry in China as a case study, this article argues that the specific technological and institutional contexts in which Chinese firms operate have enabled the adoption of a model of industrial upgrading different from that developed earlier in

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smaller economies. Such a model of industrial upgrading is facilitated by the country's huge and booming domestic market for less sophisticated products and services—Chinese firms are able to capture this market by producing architecturally or incrementally innovative goods and services at affordable prices. Its dynamic nature and extensive linkages to other industrial sectors make the ICT industry a good case for examining the usefulness of the GVC perspective in explaining the trajectory of industrial upgrading. The information used in this article is mainly collected from secondary sources.

This article contains five sections. Following this short introduction, the second section describes briefly how the GVC perspective explains the process of industrial upgrading in developing economies. The third section examines the development of the ICT industry in China over the past 25 years. The fourth section analyses the upgrading trajectory and model of the ICT industry. Finally, the fifth section concludes this article with a discussion of the theoretical implications.

GVCs and industrial upgrading

The GVC perspective has its foundations in the global commodity chain (GCC) approach, which focuses on mapping the internal governance of commodity chains containing various economic roles with different proportions of value added. With an increasing degree of globalisation and technological advancement fuelling further disintegration of the value chains, these economic roles are performed by a diverse range of firms located in different countries. The GCC perspective examines how lead firms—usually located in advanced industrialised countries—shape and control the development of commodity chains containing various economic roles with different proportions of value added assumed by economic actors located in various countries (Gereffi 1994; Gereffi and Korzeniewicz 1994; Gereffi 1999). The term 'global value chain' has been introduced to de-emphasise the limiting connotations of the word 'commodity' in 'global commodity chain', which—to many—means undifferentiated products with low barriers to entry. In contrast, the word 'value' in 'global value chain' highlights the importance of relative value creation and value capture by firms engaged in economic chains (Gereffi et al. 2001; Gereffi, Humphrey, and Sturgeon 2005).

A GVC denotes the economic activities carried out to bring a good or service from its conception—through production, marketing, and distribution—to the final provision of customer service and support. The GVC perspective examines

how production and distribution systems are integrated globally, and what the consequences for firms in developing countries involved in GVCs are in terms of access to global markets, upgrading opportunities, profitability, and employment. For firms in developing countries, access to markets in developed countries has become increasingly dependent on participation in GVCs controlled by lead firms based in developed countries—to close the technological gap gradually and upgrade successfully, firms in developing countries need to link with and learn from firms based in developed countries (Gereffi, Humphrey, and Sturgeon 2005).

From a GVC perspective, industrial upgrading represents the acquisition of technological capabilities and market linkages that enable firms to improve their competitiveness and engage in higher-value activities. From product or service conception to final use, firms in less developed countries can upgrade industrially by linking with lead firms based in more developed economies in different ways. There are basically four different kinds of industrial upgrading. First, firms in less developed countries have achieved *process upgrading*, if they reorganise the production systems and transform inputs into outputs more efficiently. Second, firms in less developed countries have achieved *product upgrading*, if they move into manufacturing more sophisticated lines of products. Third, firms in less developed countries have achieved *functional upgrading*, if they increase the overall skill content of various activities and successfully acquire new functions—for example, to move from assembly to original equipment manufacturing (OEM), to original design and manufacturing (ODM), and then to original brand manufacturing (OBM). Finally, fourth, firms in less developed countries have achieved *inter-sectoral upgrading*, if they use the knowledge acquired in particular chain functions to move horizontally into different industrial sectors.

The successful industrial development of Taiwan over the past few decades illustrates well the usefulness of the GVC perspective in explaining the industrial upgrading of less developed economies. Since the 1970s, Taiwanese firms—mainly SMEs—have gradually improved their technological capabilities through technology transfer and knowledge diffusion by hooking onto various GVCs as OEMs and ODMs for multinational corporations of developed countries. They started by picking up simple assembly skills and developing incremental process capabilities to control quality and the speed of production. Once full production skills were acquired, these Taiwanese suppliers became involved in product design, quality control, process engineering, and innovation.

Finally, they engaged in both product and process research and development (R&D) of the more mature commodities (Hobday 1995). Various types and levels of technological knowledge and skills absorbed by first-tier Taiwanese suppliers were diffused to smaller local subcontracting firms operating in the same GVCs. Consequently, entering from the mature phase of the product lifecycles, Taiwanese firms learned their way from the standardised later stages of technological development to the more uncertain—design-intensive and design-complex—earlier stages that demanded more innovation. Gradually, with each new wave of product innovations, Taiwanese suppliers for global lead firms became involved in the activities associated with the early stages of the product lifecycles, closing the technology gap with the global multinational firms incrementally—this process enabled both product and process upgrading. Some of the more established Taiwanese firms achieved functional upgrading by moving beyond OEM and ODM and engaging in OBM, selling and distributing products bearing their own brands. This played an important role in fostering the development of local entrepreneurship and a higher degree of domestic industrial integration. Fuelled by an increasing domestic demand for upstream components and downstream applications, some Taiwanese firms ventured beyond producing basic components and low-end products and into manufacturing more advanced products and critical components in related upstream and downstream sectors, achieving inter-sectoral upgrading in the process.

The development of the ICT industry in China

The early development of the ICT industry in China was associated with the development of the consumer electronics industry, which was promoted by the Chinese government in the early 1980s to stimulate the production of electronics components and integrated circuits. It was the original intention of the Chinese government to drive the development of the ICT industry using large state-owned enterprises (SOEs). In the early 1990s, the Chinese government attempted to develop SOEs into large 'national champions' that could compete with foreign multinationals. In 1993, the government formally announced the implementation of the big business strategy, merging existing SOEs across sectors and regions to form larger enterprises. However, as a result of

ineffective outcomes, such a policy was only short lived (Naughton and Segal 2002; Ning 2007).[2]

The firms that drove the growth of the ICT industry in China were actually mostly medium-sized high-tech start-ups—many of which were spun off from Chinese national research institutes, universities, and government ministries—manufacturing computer products or providing computer services. The first such company was a technology consulting firm known as the Advanced Technology Service Department, established in 1984 by a researcher at the Chinese Academy of Science (CAS) in the Zhongguancun area of Beijing (Cao 2001). Another well-known PC manufacturing company was Great Wall, which was spun off in 1986 from the then Ministry of Electronics Industry (MEI). The government-sanctioned management buyout (MBO) policy resulted in the privatisation of many of these firms owned by the state or state-affiliated institutes—Legend (currently Lenovo) was the first. Originally controlled by CAS' Institute of Computing Technology, Legend was corporatised in 1998, with the management acquiring 30 per cent of the shares (Ernst and Naughton 2008). Other leading Chinese ICT firms—such as Datang, Founder, Huawei, and Semiconductor Manufacturing International Corporation (SMIC), for example—were in joint public–private ownerships. MBOs spread to cover township and village enterprises (TVEs) controlled by local governments, in the 1990s, and even small- and medium-sized state firms, in the 2000s (Ernst and Naughton 2008).

From 1986 to 1992, the Chinese government implemented a policy designed to promote four targeted industrial sectors—integrated circuits, computers, telecommunications equipment, and software—thus, further boosting the development of the ICT industry. In March 1986, to develop and commercialise indigenous high technologies, the government approved a strategic '863 Plan' (so called simply because of the timing of its kick off). The 'Torch Programme'—implemented in 1998—was an offshoot of the 863 Plan, devised to provide the institutional and infrastructural environment needed to foster the development of high-tech industries and the commercialisation of new technologies. In a first instance, 54 Science and Technology Industrial Parks

[2] China is divided into provinces, which are both geographical and administrative. Each province is committed to its own industries, and is reluctant to cooperate with other provinces. Central government found it very difficult to overcome provincial separatism in the interests of a 'big business' approach. Tackling provincialism at the same time as everything else was too much.

(STIPs) and High-Tech Industrial Development Zones were established in a number of regions in China—firms operating in these Parks / Zones benefited from preferential government treatment and incentives. The same year, a newly established Ministry of Information Industry (MII) replaced the old MEI—seen as no longer suitable for fostering further growth, due to the specialised nature of the ICT industry (Kraemer and Dedrick 2002). With a view to stimulate the further growth of domestic ICT firms, the government implemented a number of industrial policies. These policies included (1) the establishment of tariff and non-tariff (for example, quota) barriers to protect the domestic market; (2) the building of supply chains through government procurement and local content requirements; and (3) the provision of direct government subsidies for R&D technology transfer, financial incentives, tax reliefs, and preferential loans (Ning 2007). With China's accession to the World Trade Organization (WTO) in 2001, tariffs on many ICT products—such as semiconductors and semiconductor manufacturing equipment, computers and computer parts, software, telecommunications equipment, and computer-based analytical instruments, for example—were progressively reduced until completion in 2005. Under the WTO agreements, China was restricted in the use of trade, technology, and industrial policies to promote its own industries.

Towards the end of the 1990s, many US multinationals entered into joint ventures with leading Chinese PC manufacturers such as Legend and Great Wall, with a view to produce desktops, laptops, servers, and peripherals—and with the hope that market share in China could be increased (Saxenian 2001; Kraemer and Dedrick 2002). Offshore production by foreign multinational firms was one of the most popular forms of foreign direct investment (FDI) in the ICT industry, due to the cost advantage of manufacturing in China—the Taiwanese FDI in the Chinese ICT industry was among the largest. Taiwanese ICT manufacturers have increasingly invested offshore in China, since the 1990s—in low-value added PC peripherals such as mice, keyboards, and power supplies, initially, and in higher-value products, such as scanners and motherboards, subsequently. By the end of 2001, the Taiwanese government had lifted the restriction on offshore production of higher-value added products in China, leading to the relocation of the production lines of high-value added ICT products—such as notebook PCs and liquid-crystal display (LCD) monitors, for example—to China at an extraordinary pace. The Taiwanese production volume of notebook PCs and LCD monitors in China increased exponentially, from 6.7 per cent and 3 per cent in 2000 to 97.8 per cent and 91.5 per cent in 2007 respectively (III 2007; III 2008). By 2004, China had become

the world's largest producer of computer hardware products, surpassing even the US and Japan (III 2003). This leadership position remained unchallenged at least until 2012—in 2011, for example, China contributed 50 per cent of the mobile telephones produced worldwide, 61 per cent of the computers, 48 per cent of the colour television sets, 80 per cent of the digital cameras, and 13 per cent of the integrated circuits (III 2011). As a result, many SMEs in China were drawn OEM into the global ICT value chain for a range of ICT hardware products.

There has also been an increase in the number of multinational firms offshoring product R&D to their China affiliates or outsourcing the function to specialised suppliers in China. With an abundant supply of low-cost R&D personnel, it is more cost effective for foreign multinationals to conduct product R&D closer to their manufacturing base in China. A survey of the world's largest R&D spenders showed that China had become the third most important offshore R&D location, by 2004, after only the US and the UK (UNCTAD 2005; Ernst 2008). The foreign multinationals intended to carry out product R&D in China in order to develop new products and processes that would suit the Asian market (Armbrecht 2003; Ernst 2006). In recent years, high-tech start-ups in Silicon Valley were required to present an 'offshore outsourcing' plan as a precondition for funding by venture capitalists (Ernst 2007). In the first nine months of 2006, a record USD 1.18 billion was invested by venture capital firms in 145 deals in China—ICT was the largest single industry that attracted a rising share of foreign funds (BMI 2009). For the non-equity form of R&D outsourcing, China was the world's third most important offshore location, in 2004, again behind only the US and the UK (Ernst 2006).

Since the year 2000, various firms in China have been engaged in the production of a diversified range of software products, including system software, maintenance software, and application software. Their marketing and sale were targeted initially at the domestic market, but expanded later to cover foreign markets. In 2000, Chinese firms produced USD 400 million worth of software for export—by 2005, this figure rose to a dramatic USD 3.6 billion (Ilett 2006). The same year, the Chinese government issued the *Policies for Encouraging the Development of Software Industry and Integrated Circuit (IC) Industry*—their major objectives were to simplify the approval of jointly or foreign-owned IC enterprises and grant the IC industrial sector various incentives and suitable intellectual property protection (Heng 2008; MOFCOM 2009). Since then, both Taiwanese and US companies have made major investments in semiconductor manufacturing in China, leading to a wave of US-

educated Chinese who bring technological skills and knowledge back home. The recent move by the Chinese government to establish IC Incubation Centres was devised to consolidate resources in designing advanced and specific ICs, tailored for the needs of downstream semiconductor manufacturers. It resulted in notable investments by renowned IC companies and foundries in the US and Taiwan—such as Intel and Taiwan Semiconductor Manufacturing Company (TSMC), for example.

Since late 2007, the Chinese government has been implementing a policy promoting the integration of informatisation and industrialisation and the application of information technology to various industrial sectors. As a result of increasing domestic market demands, the production value of the software and system integration sectors grew by an impressive 44 per cent in 2010 compared with the previous year, pushing the output value up to USD 201 billion (III 2011). The Chinese government identified cloud computing as a new driving force that can be applied in various industries—particularly in government and medical services, telecommunications, education, finance, and electronics. The market for ecommerce-related services also grew significantly in China, because of an increasing degree of acceptance—by both corporate and retail customers—of online purchasing and business transactions. As a result of active government promotion, the software markets for ecommerce and cloud computing entered a period of fast expansion, growing by 72 per cent in 2011 compared with the previous year and reaching USD 4.5 billion. By contrast, the domestic market for ICT hardware and consumer electronics stabilised, due to decline in general public consumption demands coupled with Chinese overproduction of such products. However, due to aggressive marketing campaigns by three big telecommunications carriers, the popularity of the broadband services, and the construction of the long-term evolution (LTE) networks, there has recently been a significant growth in the domestic markets for smart phones and network hardware and related IC products. To satisfy growing domestic market demands, the Chinese government has also been promoting the digital content sector of the ICT industry, with high value-added and requirements to meet the Chinese culture (III 2011). Last but not least, the Chinese government's subsidy to promote the purchase of green ICT consumer goods in the second half of 2012 is expected to boost demand for such products and drive further the ICT hardware sector (III 2012).

The upgrading trajectory and model of the ICT industry in China

Like in other developing countries, SMEs in China were connected to the global ICT value chain as suppliers of various ICT products. However, they were not the main actors charting the upgrading trajectory of the domestic ICT industry. Instead, SMEs—particularly those SMEs clustered in high-tech Parks and Zones—used production technologies provided by multinationals or contract manufacturers. While they might have gradually acquired new technologies from multinationals, SMEs lacked the resources needed for further upgrading their technological capacity—they were locked in the low-end production function, barred from advancing and engaging in more innovative and higher-value added activities along the global ICT value chain (Wang 2006). At most, SMEs were grasping industrial gains concentrated at the lower-end of the global ICT value chain.

Few SMEs in China became component suppliers for foreign firms or ODMs for Taiwanese firms, which would have been essential in fostering the development of backward linkages in the ICT industry. According to the 2007 MoEA *Survey on the Operations of the Taiwanese Enterprises Investing in China*, only 12.95 per cent of the 45 responding firms in the computing, electronics, and optical products manufacturing sector sourced machineries, raw materials, parts and components, and semi-finished products from non-Taiwanese enterprises in China—the majority (75.85 per cent) sourced them from either Taiwan or Taiwanese enterprises in China (MoEA 2007). In most cases, sourcing decisions relative to critical components were made not by Taiwanese ODMs, but by global lead firms concerned about the quality of components supplied by Chinese companies. With the increasing popularity of the build-to-order production model, Chinese SMEs found it even more difficult to become component suppliers—the inventory risks of the model were too high for them (Yang 2006). Similarly, foreign electronics firms with manufacturing facilities in China tended to source strategic components such as microchips and disc drives from foreign suppliers (Luthje 2004). Chinese SMEs lacked the requisite human and financial resources to venture beyond the production function and expand into marketing and selling and distribution activities along the global ICT value chain, making it equally difficult for them to forge forward linkages in the domestic ICT industry.

Similarly, SMEs in China were not much involved in the outsourced R&D activities of brand name vendors, aimed at adapting home-base-developed technologies for commercialisation on the Chinese market. For instance, the

2007 MoEA *Survey of the Operations of Taiwanese Enterprises Investing in China* found that only 5.56 per cent of the responding Taiwanese firms conducting R&D activities in China used Chinese firms in the production network as R&D partners. Most Taiwanese firms adopted home-base-exploiting R&D strategies, seeking to adapt technologies developed at home for commercialisation on the Chinese market. Not surprisingly, a much higher proportion of the responding Taiwanese firms—55.6 per cent and 27.7 per cent, respectively—used their customers and raw material suppliers as R&D partners (MoEA 2007). To protect core technological competences, Taiwanese firms transferred only old technologies—used for manufacturing mature products—to their R&D units in China. Many R&D units in China were—at best—responsible for system integration R&D activities and—at worst—engaged only in the implementation of sub-modules or the preliminary testing of the encrypted system kernel (Lu and Liu 2004). For Taiwanese firms adopting home-base-augmenting R&D strategies to tap into China's knowledge base, the popular R&D partners were technology transfer units (for 50 per cent of respondents), higher educational institutes (for 38.89 per cent of respondents), and technology consulting companies (for 22.22 per cent of respondents) in China—certainly not the Chinese SMEs in their own production networks (MoEA 2007).

The upgrading of the ICT industry in China was fostered more by domestic high-tech start-ups and large privately owned firms than by SMEs. Many of the Chinese domestic high-tech start-ups had close connections with national research institutes, universities, and government ministries. Spin-offs from public and related organisations, domestic high-tech start-ups were able to obtain core technologies from the associations with which they had previously connected. They also had a high degree of autonomy in formulating and implementing firm strategies to compete in the highly volatile and uncertain industrial market. Depending on the choice of corporate strategy, these companies might have initially engaged in product distribution, then entered into joint ventures with local or foreign firms, acquired foreign or local companies to form more complete product lines, or licensed the right to use proprietary technologies possessed by foreign companies. Medium-sized high-tech start-ups and large private firms—not the SMEs, lacking in both human and financial resources—forged forward and backward linkages along the domestic ICT value chain. Moreover, though medium in size, the high-tech start-ups benefited from connections with national research institutes, universities, and government ministries—and therefore from better access to existing technologies—unavailable to the SMEs. Engaging in the distribution function embedded in the

global ICT value chain allowed these Chinese firms to better understand the market trends—in turn, this enabled them to move upwards and engage in higher-value added activities. Also, buying in new technologies and assimilating technological knowledge from various organisations operating along the global ICT value chain allowed them to generate more innovative products and services.

Most of the private ICT firms in China were engaged in developing architecturally or incrementally innovative products. Architectural innovations require strong system integration and strategic marketing capabilities, but are not demanding in terms of scientific inputs and investment commitments (Ernst 2008). They seek to develop new products by changing the product architecture without the need to use highly technologically advanced product components. ME60 is one good example of an architecturally innovative product. ME60 is an edge router that sits between the Internet Protocol (IP) core and the access network, enabling telecommunications operators to aggregate multiple services from various networks into one IP core—thus, improving real time control over the services (Ernst 2007). Developed by Huawei, China's largest telecommunications and networking equipment manufacturer, ME60 was the first integrated IP service platform on the market. The Tianxi laptop manufactured by Lenovo is another good example of an architecturally innovative product, aiming to provide—through prior arrangement with China Telecom—easy Internet access at an affordable price, tailored for the needs of private consumers and small businesses in China (Ernst 2008). Like Lenovo, many other Chinese private ICT firms started off as distributors of foreign products, enabling them to acquire marketing and selling skills. Using existing component technologies supplied by specialised firms, they developed architecturally innovative products and services. Familiarity with the characteristics of Chinese consumer preferences, markets, and institutions allowed these local ICT firms to suggest products—with essential performance features—much less expensive than those offered by global industry leaders. In fact, the global lead firms' relative lack of understanding of local consumer requirements—as well as of domestic market and local institutional characteristics—rendered them oblivious to the presence of a market for architecturally innovative products, which could help resolve practical technological problems and bring convenience to end consumers.

Similarly to architectural innovations, incremental innovations require no substantial investments and inputs from science. Instead, they require entrepreneurial and managerial capabilities, as well as capabilities to provide

integrated solutions based on familiar tools and methodologies. Operating in a highly price-sensitive domestic market, the Chinese ICT firms were forced to pay particular attention to cost, time-to-market, and performance issues. Consequently, they were able to exploit all manner of opportunities to suggest incremental innovations along various segments in the value chain—including R&D; production; and the management of supply chains, customer relations, and information systems (Ernst 2007; Ernst 2008). Apple Peel 520 is one recent example of an incrementally innovative product, originally invented by two Chinese brothers and subsequently mass produced by Chinese ICT firms. Apple Peel 520 is a case containing a circuit board and battery that could be wrapped around an iPod Touch media player to enhance its function so that calls could be made after software has been installed (Culpan and Conley 2010). By using Apple Peel 520 (priced at around USD 74), an iPod Touch (priced at around USD 233) could be converted into an iPhone, and consumers would need to pay only a fraction (around USD 307) of the price of an iPhone (priced at around USD 1,190) to own a non-iPhone device with full iPhone functionality (Jones 2010).[3] The average Chinese consumer was unable to afford an iPhone, but was prepared to purchase a similar—albeit less sophisticated—product for a lower price. The business potential inherent in this market remained culturally obscure to global ICT industry leaders, but not to Chinese entrepreneurs in local ICT firms.

Building on capabilities in making architectural and incremental innovations, many private ICT companies in China adopted a technology diversification strategy, using applied research to broaden their technology base. Component and process technologies that were neither new nor difficult to acquire were used to develop new products (Ernst 2008). Chinese private ICT firms obtained these technologies through leveraging different types of networks formed with market and technology leaders, such as licensing arrangements and non-equity partnership arrangements. By adopting a technology diversification strategy, Chinese ICT firms were able to generate technology-related economies of scope to strengthen their capabilities in process development, prototyping, and electronic design, providing consumers with 'integrated solutions' (Ernst 2007).

Isolated innovations occurring at firm level were substantiated by the industry policies implemented by the Chinese government. They included the provision of preferential tax incentives, to help SMEs develop into high-tech enterprises, and the setting up of new capital markets (such as the SME Board on the

[3] The prices are valid as of July–September 2010.

Shenzhen Stock Exchange, for example), to help SMEs raise the capital required for developing new technologies. There were also support policies, to promote the operation of innovation service agencies such as the Technology Business Incubators and National University Science Parks. Funding was provided to establish public service platforms and foster the implementation of business cooperation projects in industrial clusters (Torch High Technology Industry Development Center 2013). In 2006, a clear policy direction was laid down in *The 11th Five Year Plan for the Technology Development of the Information Industry* to upgrade the indigenous innovation capabilities of the major actors in the ICT industry, the main objective of which was to enable them to control critical technologies (CNII 2006). By encouraging the development of strong support industries and linkages between private ICT firms, on the one hand, and universities and research institutes, on the other, the structure of the ICT industry was very much strengthened.

Conclusions and theoretical implications

It is beyond dispute that the ICT industry in China enjoyed a phenomenal growth rate over the past 25 years. After their humble beginnings in the early 1980s, the Chinese ICT firms became the world's largest producer of computer hardware products in 2004, surpassing even their counterparts in advanced industrialised countries like the US and Japan. This leadership position remained unchallenged at least until 2012 (III 2011). Besides manufacturing hardware products, an increasing number of Chinese ICT firms engaged in developing various software as well as producing semiconductors and other IC components. Could we then conclude that the Chinese ICT industry has followed the trajectories of counterparts in other developing countries to leverage participation of SMEs as producers in the global ICT value chain, gradually upgrading along the chain? The answer to this question is negative. Although they played a part in fostering the upgrading of the Chinese ICT industry, SMEs were not the major actors charting the industry's upgrading trajectory. Chinese SMEs were engaged in production and, in some cases, product development of ICT commodities outsourced or offshored by foreign brand name vendors—however, they were barred from involvement in the production and product development activities of higher-value added, innovative products. Foreign brand name vendors carefully protected their core technological competences, transferring only old technologies for mature

products to Chinese SMEs. Since SMEs lacked both the financial and human resources necessary to upgrade their technological and managerial capabilities, they did not play a major role in forging backward and forward linkages in the domestic ICT industry to become component suppliers, marketers, or distributors of ICT products.

The upgrading model of the ICT industry in China is unique to a large country which developed late. The upgrading experience of the Chinese ICT industry is different from that of smaller economies—like Taiwan—which developed earlier. To reach the innovation frontiers set by global lead firms, small Taiwanese manufacturers of ICT products and providers of ICT services had adopted a fast-follower strategy—the technology gap between global lead firms and small Taiwanese firms was closed incrementally, with each new generation of products and services. However, such a strategy was not very useful in the institutional and technological contexts within which Chinese ICT firms operated. The institutional barriers emerged as a result of the global lead firms stepping up actions to protect their proprietary technologies—a hard lesson learned from past experiences in outsourcing and offshoring production activities to developing countries. The technological barriers emerged as a result of the digital convergence trend, rending the fast-follower strategy largely irrelevant in the current technological context. Nowadays, data, voice, and video can all be turned into digitalised signals to be transmitted via telephone lines or the Internet and received by a wide range of products including personal computers, Internet television sets, game consoles, smart phones, and personal digital assistants (PDAs). Various innovative computing, consumer electronics, communication, and content products (4G, for example) are now competing to be chosen by consumers as data receivers, voice transmitters, and video players to perform a number of integrated functions (III 2007). Current competition is based on the ability to accurately anticipate future market trends and the capability to create new concepts, develop novel component technologies, and establish as well as control emerging industry standards for the innovative products which are to be chosen by consumers to perform integrated functions.

Large Chinese private ICT companies played a much bigger role than SMEs in fostering the upgrading of the ICT industry. They acquired component and process technologies—by leveraging various types of networks formed with market and technology leaders—and pursued a technology diversification strategy to broaden their technology base and develop a range of architecturally and incrementally innovative products. Knowledge of the characteristics of the domestic market allowed Chinese private ICT firms to apply existing component

technologies on new product architectures, developing architecturally innovative products that were not over-engineered and that could provide low-cost integrated solutions to customers' needs. An early example of such products is the electronic switching system HJD04, developed to optimise performance features in line with the specific characteristics of the Chinese telecommunications network structure and the specific needs of the service providers (Shen 1999). More recent examples include ME60, the first integrated IP service platform, produced by Huawei, and Tianxi, the laptop manufactured by Lenovo (see pp. 65). Chinese private ICT firms possessed capabilities in managing cost, time-to-market, and performance, and provided OEM for global brand name vendors, using familiar tools and methodologies to generate incrementally innovative products and services. Isolated firm-level innovations were substantiated by the industry policies implemented by government to foster the development of support industries and the establishment of industry linkages between firms, on the one hand, and local universities and research institutes, on the other. With the structure of the Chinese ICT industry thus strengthened, further innovations took place at firm level.

The role of the Chinese state in strengthening the industry structure and facilitating the development of an environment conducive to technological innovation should not be understated. The Chinese government has played a significant role in creating a framework for the implementation of industrial policies and programmes promoting the development of the ICT industry. For example, in 1986, the Chinese government set up the so-called IT Fund—the Development Fund for the Electronics and Information Industry—to support indigenous research and development of core ICT technologies and products (China Electronic News 2011). For another example, the Torch High Technology Industry Development Center (herewith, the Torch Center) was founded in 1989 under the auspices of the Ministry of Science and Technology (MOST) to implement policy tools that foster the development of high-tech industries and the commercialisation of new technologies through the promotion of innovation. Recently, the Torch Center has been restructured to take up an expanded function and lead in the building of an environment for innovation and in fostering high-tech industrialisation in China (Torch High Technology Industry Development Center 2013). More recently, in 1999, the Chinese government set up Innofund to support innovative technology projects with good potential markets and products commercialised at an early stage by technology-based SMEs not otherwise attractive to private capital (Torch High Technology Industry Development Center 2013). The Chinese government has

also implemented policies providing software and IC enterprises with corporate income tax holidays—beginning from the first profit-making year before the end of 2017—and immediate refunds of the value-added tax (Cai, Wong, and Leung 2011).

The case of the Chinese ICT industry illustrates the usefulness of the GVC perspective in explaining the trajectory of the industry upgrading of large and late developing countries. However, initially, the GVC perspective was developed in a context very different from that currently faced by firms in large and late developing countries. Proponents of the GVC perspective need to take into consideration the changing nature of the institutional and technological contexts as well as their impact on the industrial upgrading of developing economies—the fast-follower catch-up strategy to close incrementally the technological gap behind the innovative frontier set by global lead firms in advanced industrialised countries is rendered useless by the presence of both technological and institutional barriers. With huge and booming domestic markets characterised by consumers seeking products and services at levels of sophistication less obvious to the lead firms in advanced industrialised countries, firms in large and late developing countries need to pursue a model of industrial upgrading different from that adopted by firms in relatively small and early developing countries. However, to develop architecturally and incrementally innovative products and services not culturally obvious to foreign competition, firms in large and late developing countries have to make good use of their knowledge of local consumer preferences and needs—as well as of the characteristics of domestic markets and institutions.

The case of the Chinese ICT industry also points to the need for proponents of the GVC perspective to re-examine the definition of industrial upgrading as the acquisition of technological capabilities and market linkages that enable firms to improve their competitiveness and move into higher-value activities. There are process, product, functional, and inter-sectoral forms of upgrading, all of which are conceptualised to take place at the level of the firm. However, as the case of the Chinese ICT industry has illustrated, firm-level innovations are by no means indicative of successful upgrading at industry level. Isolated innovations at firm level cannot be sustained, if industrial and related policies are not formulated and implemented by government—at both national and local levels—to mobilise human, technological, and capital resources; develop an innovative support system; as well as foster the growth of technology-based SMEs and innovation clusters. It is important that the concept of industrial upgrading be reappraised and the definition reconsidered.

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"IT IS VERY TYPICAL HUNGARIAN: THAT YOU ARE TRYING TO SIT ON THE FENCE…" - INTERVIEW WITH DR. MÁRTA HOFFMANN, CEO OF THE TNS-HOFFMANN MARKET RESEARCH INSTITUTE

Interviewer: Thank you, Marta, for accepting our request and preparing for this interview with you as a company executive. You are the chief executive officer of TNS-Hoffmann. Could you please talk about the story of Hoffmann Research and TNS-Hoffmann; its establishment, the beginnings and how it developed to its current form?

Hoffmann: Yes, TNS-Hoffmann in its current form exists only since the beginning of 2011. Before that two separate companies: Taylor Nelson Sofres (TNS) Hungary and Research International Hoffmann operated. Both were on the market since 9-10-12 years. My part of the company, which is represented in the Hoffmann name, was established in 1997 under the name Research International Hoffmann and we operated under that name until the merger for the new company established as TNS-Hoffmann. Before that, I used to work as a partner in Medián opinion research from actually the change of the political system in 1989 and also before that, because I'm not that young, I worked as a communications researcher since 1979, when I finished the University. So I was going just backwards in the story, but I think, this also tells a bit of my background. In terms of my personal background other than of my degree as an economist, I also studied aesthetics at the ELTE Art Faculty, which I finished in the middle of the 80's. And I also did my doctorate degree actually combining the two interests in analyzing advertising of international kind trying to find patterns, which actually became my main interest afterwards. So I continued my career after the change of the political system in market research and since then I've been personally working as a qualitative researcher, and this also gives a kind of taste of the company because of my personal involvement. Research International Hoffmann and TNS-Hoffmann also have a bit of flair of qualitative research and is more associated with qualitative research as well.

Interviewer: I think you covered a bit from our second question, but if you can add anything a little bit to that and tell me about your career as a manager. How it started and how you became one, what it means.

Hoffmann: Yeah, exactly what I was saying before it was more about my professional career, or my professional background, my career as a manager was actually, well, like a lot of people in Hungary, I think, who are managers during these days. We were kind of forced in a way to become managers because under normal conditions, if we already had a good, well-developed market and market economy earlier, I don't think people like me would have ever become a CEO. It has never ever been my ambition to be a CEO, to tell the truth, it's not even an ambition after… I don't know… 25 years of having been a CEO, so for me being a CEO is more a title. Actually and as we'll talk about it: the way we distribute different tasks, I'm more, still more of a professional sort of leader in the company than the actual day-to-day operational management. Our current management actually consists of four people. So we are quite unique in that sense. Also part of the difficulty of course, in that sense we have four CEOs, so I am the CEO of the company but we still have four people who are legally CEOs. I'm more if you know the name on the top, because my name is included in the company name, but otherwise there are four people who distribute the managerial tasks between them.

The way we are organized…I will start with the easiest. One of the general managers is in charge of all the financials, the administration, and the operations; and the three other people are in charge of the professional tasks related to the actual research. So one person is in charge of a quantitative team and the whole of the quantitative operations, another one is in charge of the qualitative operations and I'm in charge - although I'm qualified too - but I'm in charge of the client service, so I'm head of the client service team actually, other than being the CEO, so that's how we are organized in general.

Interviewer: …and this is the system since the beginning so…

Hoffmann: Yes, that's the way we've been established, and…it was the way we had been operating before TNS and Hoffmann had been merged, so we kind of inherited this system but because this was the system, we developed ourselves… that's the best operation for us. The reason for that is that the company and I haven't talked about the ownership yet… it is not 100% owned by TNS, this is a joint venture and this is a 60% majority owned by the Hungarian partner, so it is a minority share, that the multinational has and because of that the owners who are also operating in the company want to have a very good overview of what's going on in the company, and that's why we shared the different tasks and responsibilities as well, so that's how we've been able to work together for seventeen years. Now, because you know, three people, who are owners… it has a certain dynamics, and

although the shares are not the same between the three people, the way we take decisions, the way we operate the company has always been as if we were equal partners. So we are equal partners in business, that sounds not equal in shares but that's something over the years that we could somehow push in the background and that's not an issue in taking decisions.

Interviewer: …and as you said from the beginning basically you operate internationally and what is the story of your international activities?

Hoffmann: Okay, the story of our international involvement or the international relationship goes back to 1994, when I gave a presentation at an ESOMAR[1] conference which was held here in Budapest. A person from Research International was present at the conference and listened to my presentation, and after the presentation he came up to me and asked me, if I we were interested in some type of a cooperation with Research International. At that time I was still at Median and because of that Median at that time in 1995 became part of Research International as an affiliate company. After that when we left and established our own company in 1997, Research International came with us as we were actually the only ones doing market research. The rest of Medián was doing political and social research primarily, so we, kind of, took over the market research side and this has continued until Research International and TNS were merged under the WPP ownership. So this has been like that, well, for exactly 20 years. So for the last 20 years we have been working for WPP companies, Research International and now TNS.

Interviewer: I don't understand, what does WPP mean?

Hoffmann: WPP is, well, that's the world's largest market services trust[2].

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[1] The European Society for Opinion and Market Research (ESOMAR) is a world association for market, social and opinion researchers. Founded in 1948, ESOMAR began as a regional association within Europe. Currently, with more than 4,900 members in over 130 countries, ESOMAR's global membership brings together professionals in market and opinion research, marketing, advertising, business, public affairs and media from across the world.

[2] WPP is a British multinational advertising and public relations company with its main management office in London, United Kingdom, and its executive office in Dublin, Ireland. It is the world's largest advertising company by revenues, and employs around 162,000 people in 3,000 offices across 110 countries. It owns a number of advertising, public relations and market research networks, including Grey, Burson-Marsteller, Hill & Knowlton, JWT, Ogilvy Group, TNS, Young & Rubicam and Cohn & Wolfe.

Interviewer: So, thank you for the details. What are the management issues and problems you have had to face during your tenure?

Hoffmann: Well, as I said the most important and biggest problem was to become a leader in itself. Because I'm personally not very much an assertive type, so I really had to change myself. You can't change your personality, but of course you can somehow develop your personality so I really had to develop into being able to direct other people and directly, you know, give them frameworks and create rules and create a way of working and develop strategy and things like that. So I used to be a communication researcher and I was very happy. My favourite project ever in my life was analyzing wedding photographs, so, yes, its fantastic and well after 20-30 years again I can again do projects like that, so it's amazing I had to build a big company in order to do that, to allow myself to do things like that. None of our managers are really the international type of managers, none of us has an MBA which I really think this company by now requires: somebody to lead with a very well created background and studied, and knowing all the management skills. We don't have management skills, all our skills have been developed as we go, but if you look around in the market research industry, in Hungary none of the companies so far have had a CEO, who would have had an MBA. Everyone is coming from the research career, everyone used to be a researcher and just developed him or herself into a manager… I think the times are going to change and this is more or less the time when the next generation taking over these companies is not going to be like us anymore. It's partly due to the history of these post-socialist countries, partly due to the uniqueness of the industry, because the clients want to talk to the people who know, who really know the ins and outs of the research, the nitty-gritty of how to do a group discussion or how to design a good questionnaire. Also in Hungary the size of the companies is relatively quite small, so to be able to manage a company with 30 to 60 or even a 100 people you don't really necessarily need all these skills or you had not, but now it's… I think it is very different and so now it's having done this over 20 years and you know relatively successfully. Because we are still here after 20 years… of course the profit rates are very different than in the 90's but this is not our fault only, but now the market has changed so tremendously, that you really need to use things that we just simply don't know. So that's my attitude to my own role.

Interviewer: Could you give me examples how did you overcome these difficulties…so far?

Hoffmann: Well, of course, yeah, well, first of all it was 10 years ago that we already realized it very clearly, that this is the situation and we need to do

something about it, and that was the moment, when we brought in a professional CFO who is now the fourth partner among the CEOs and although he doesn't have an MBA either… but he used to work for a bank, he has been a bank manager for a long time, he also has been manager of the Hungarian airport and of such huge operations. So for him something like 50-60-70 people is nothing, so he is much more professional in handling all those management issues except for the HR issues but the financial issues and all those things are not a problem for him. That's why we can have this luxury of, you know, really dealing with the professional part of the business much more and really the professional part of the business at the moment. As I'm saying it's changing, so now I feel this is more or less the point where we should either learn something which I'm not necessarily going to be able to do at close to 60. Or we're going to need to find people who are up-to-date.

Interviewer: About the management problems… Could you evaluate the management problems that arose from the international activity of your company and what are the solutions to those problems. Please, also specify how to manage international teamwork and how to handle intercultural conflicts. For structuring your answer please give details according to the following areas … So if you think we can go one by one or just list them …

Hoffmann: Yeah.

Interviewer: the accepted hierarchical pyramid; degree of organizational democracy; the lonely heroes versus team spirit culture; masculinity versus femininity; attitude towards risk and uncertainty; accuracy versus creative skills; relationship with time; low versus high context cultures and the national versus international multinational companies.

Hoffmann: Well, that's really a lot, so we should go one by one, so first of all, let's talk about international aspect with Research International for those 15 years, while we claimed an association with Research International. It was not so much an issue. The way we operated with them was that we paid a flat administration fee for being part of the network and we were able to use all their research products. We didn't get a lot of support though, because if you don't pay much and it wasn't much that we paid, much less than actually any of the other international companies paid to their headquarters, so it was very good to have the name, it was very good to have access to quite a few very good products, that Research International developed. But it wasn't a close relationship, in fact because they did not have any ownership. They didn't even have the right to tell us what to do or what not to do. They did not control our financials, they did not control our people, they did not control our

clients so they didn't really have a direct impact on the business. It was an opportunity for us … We tried to make the best of the opportunity, so we visited all the conferences, that were possible to visit and used the whole of the network, because there was quite a nice network. There was something like 3000 researchers in the network of Research International globally, so we tried to make good use of that, but that was a very loose relationship. Since now we are part of the TNS network and they have 40% share… it's a total change. So TNS… it became part of WPP and that's very important, because WPP, as I said, is the largest marketing services network. It owns Ogilvy & Mather, it owns GREY, it owns the biggest names in the media, advertising, public relations etc. world, so it's just an unbelievable size of an operation and because of that their procedures are all designed for this absolutely massive huge multinational. And then here we sit with our 68 people in Hungary with a turnover that doesn't even appear anywhere, …doesn't matter to anybody, it's so small and with only a 40% share, so everything is designed, you know, for huge, huge operations, that we are partly to follow. And here of course the stress is on "partly", because if we were to follow all the different procedures, that a wholly owned company has to, I would not be the CEO of this company, I would certainly not be, because that is just unbelievable… the control and administration what being part of such a multinational requires. So I would never ever do that; but because we are just 40%, it's there but it's much less and it's not always mandatory to follow everything, so our relationship… it is very typical Hungarian, I would say, in general: that you are trying to sit on the fence, you are trying to make the best of being part of it, but trying to reduce all the hassle, that goes with being part of the multinational. So for example, we still don't have timesheets, because timesheet is just one of the worst things in the world, I would say, although we sometimes, yes, you cannot control this and that, and that I'm saying ok. But overall productivity would go immediately down by 10 percent, if we had timesheets. So everything that we gain, we are going to lose on the other side. So we are in the position, that of course, we record everything in terms of financials, everything is 100 percent transparent: that is the first thing, that we must be 100 percent transparent on everything. So we are absolutely 100% following all the rules in terms of legal frameworks etc. But when it comes to following the managerial sort of ideas etc. …and the strategy, that's a bit softer, so in terms of financial control it's a 100%, in terms of professional control, it's not necessarily 100 percent. But because, you know, this is kind of the central versus periphery question. So what can a centre do? The centre can give you ideas, how to do it, they can give you tools, how to do it, but whether you use them and use them the right way, it's up to the end market, it's up to the periphery. We are trying to make use of what TNS has to offer, but… again, we are very small and because it is a very downgrading market at the moment. Just in parentheses: the

volume of Hungarian market research market from 2008 has gone to half of it by 2013, so it's an immensely shrinking market and it's a very-very difficult market. So the tools and all the different frameworks that TNS has to offer are very supportive for developing markets or stable markets, but they don't really help a lot for a market like us. We are still trying to do our best, but we know that a lot of things that help us go forward are not the multinational tools. Most important problem with the multinational tools is, that they are immensely expensive and Hungarian companies are just unable to pay that, and it really has to be the top multinationals in Hungary, who are forced by their own multinational networks to use these tools. Where we can sell them, so we sell them for the telecoms, we sell them for Telenor, we sell them for Nestlé, to Heineken which are all multinational companies and their headquarters prescribe them to use those tools. But this of course is very important and that's the reason, why we decided to join the TNS network, because otherwise we wouldn't have had the opportunities to stay on our own, after Research International and TNS International had been merged… I didn't talk about it at the beginning… it's quite an important point.

Interview: Thank you……

Hoffmann: Ok, please, can you just remind me of the other aspects I need to talk about.

Interviewer: The international activity of your company and the solutions to those programs. If you could give more examples, in what you have freedom and what you don't.

Hoffmann: Well, in terms of financial and legal, we have absolutely no freedom. So as I said we are following all the rules very closely and no exceptions. In our professional work it's more, more creative… we can use creative solutions, in taxation no creative solutions.

Interviewer: On the international teamwork and intercultural conflicts could you discuss?

Hoffmann: Well, international cooperation is, I think, that's really one of the strengths of the international companies: there is, for example, a tool which is called YAMMER, which is an international email network and it has just within TNS something like 50 different subgroups, which all talk about a certain aspect of the profession. This is actually just an email group tool, but if you sign up into that email group, which talks about service quality measurements - so service quality

measurements is a typical market research problem - then there is a service quality measurement subgroup within YAMMER, within TNS, and if you have a question 'Have you ever worked on… I don't know… nail polishing service or nail spa service quality measurement?' then you will immediately get an answer from 5 different people in the world, if they ever have. So this is really fantastic, this really helps: you know, you really feel that you are part of a network and of course, it's not just specific research issues that you can discuss, there are management issues, there are management subgroups. So, for example, the CEO of TNS!, the CEO of TNS has his own discussion group, where you can really post questions to the CEO of TNS, who is the head of… I don't know… 15 thousand people and he would answer! So this really gives access to all layers and all parts of the net, this is really great….There was another part of the question.

Interviewer: Yes, it connects, I think, to the hierarchical pyramid.

Hoffmann: Yes.

Interviewer: What is the accepted hierarchical structure…?

Hoffmann: Well, TNS is organized in a hierarchical way, because we are part of the Central European operation, and above the Central European there is a European operation and above that there is a global operation, so it's hierarchical, but the style of the company is not hierarchical. So, although yes, in decision making you need to climb the ladder, because we are small, and because we are working locally a lot and internationally, as well. And we can talk about most of our contacts outside of the local operation being either horizontal to the rest of the countries within the Central European network which is Poland, Czech Republic, Slovakia, Ukraine, all the Baltic countries we can even reach out to Russia if we need. So horizontal co-operations are really nice and strong, especially because there still are many people from Ex-Research International, and we know each other for 25 years; but there is also a hierarchical one and the head of the Central European operation is a Czech guy. He's very nice, so, if we have anything, we can discuss… also we have for example in a month, in exactly a month from today, we are having a Central European conference within TNS and it will be in Budapest, and it's in Budapest because I offered it, 'Why don't we have the next one in Budapest?' and they said, 'Yes, why not?'. So this gives us an opportunity to have more people in the conference and of course we are also happy to give them hospitality, so these are quite smooth and very supportive co-operations.

Interviewer: I think intercultural conflicts will be the next question.

Hoffmann: Well, what do you mean by intercultural conflicts? Because if we talk about intercultural in terms of Central Europeans behaving differently than British versus the American, then we don't. We really have this because we belong to the Central European network and we have the same culture…. when we talk to the German, the German will quite understand Central Europe, they are also kind of part of Central Europe. The British… I personally don't have a problem, because I've been working in London so much over the last couple of years, that I really know what the style and culture of working with British is. But because I've been working more or less all over the world from Brazil to China to India to Canada, that's one of my personal research topics… understanding different cultures, that's not an issue. So if that's the cultural aspect, then this is not a problem. If it's more the structure, then that could be a problem.

Interviewer: If you could give examples, I think, the question related to both aspects so maybe that you could give examples on what problems your colleagues met?

Hoffmann: Yeah, well, typically you find the Middle East and some of the eastern companies would not be willing to be very much on time, so timeliness is an issue. Also being precise, also, especially in the Middle East - I've been working in the Middle East for the last two years a lot - so, in the Middle East you never say no to anything…even as a business person, even if you were a part of TNS, even if you are a qualitative researcher yourself… the Egyptian research manager would never tell me, I am not able to do it on time. He will always say, "We will try our best", which to me, before I knew, meant that they are going to do it. Now I know, it means "I'm unable to do it", so there's these things, yes, create some issues, like you really have to learn, that in a different culture keeping time has a totally different meaning.

Interviewer: So now you know that it means 'I'm unable to do it'.

Hoffmann: Yes.

Interviewer: "I'm trying to do my best" how do you handle this? Because, while you know it means "I'm unable to do it" still, it has to be done. How do you manage it?

Hoffmann: Exactly…first of all, by the way I plan the project. So I know the timeline for these countries need to be much longer. So, for example, we are now

doing an 8-country study which involves countries from Ukraine to South Africa. Because we have worked in all of them, we know how to prioritize the countries, so we put the more timely ones to the beginning and the less timely ones to the end, but we start working with them at the same time so we start with Ukraine or Russia even better, then we start with some of those which we already know like, for example, South Africa is quite okay. So we do it in the middle and we put Nigeria at the very end, because for them it takes 3-4 times as long to do the same job. So it's kind of prioritizing and putting it in order. The other way is actually talking about the communication, so email *only* is never enough, because in email they will write you anything, which has nothing to do with actually what's happening. Another way is… you have to talk to them on the phone and make sure you make them say words, that they would never say in their own contexts. So you need to make them say, I am going to deliver it by Saturday. And, even if they say they are going to deliver it by Saturday - which already a step further than they would ever go on their own - if its Saturday…well, Saturday is wrong day for Middle East so never mind…so, on Wednesday you need to ask for a confirmation, "Has it already been done?", "How far have you got?" etc. If you don't get an answer within a half day, then you immediately call them again. Don't write an email, call them again and make them tell you. So, this really involves a lot of effort: you have to talk with them much more often, you have to press them much more also. What's very interesting in what I've found in the Middle East - when I haven't had much understanding of the culture yet- they are very hierarchical, so if somebody does not deliver on time they will immediately talk to their boss and the boss is going to play nearly the same, but he is going to make that person actually do the job; so you get much further quicker, if you use the hierarchy, because for us, with a very flat pyramid and everybody being a 100 percent responsible, it's not a question. If I talk to somebody in my company who is really at the lowest level of the hierarchy, he is going to be 100 percent responsible just as much as somebody on the top of the hierarchy, there's no difference between the people across the pyramid. But, for example, in the Middle East or in Eastern countries the higher you go the more reliable they are to a certain extent, but when it comes to big business, that's another issue.

Interviewer: Does it refer to, for example, asking for advice as well? Do they ask for advice or do they admit that they need more help or more information to do a certain job?

Hoffmann: Yes, they do, they ask a lot of questions. What I found that asking questions is a way to procrastinate, that they are trying to push the job delivery away, by asking too many questions about it. So once they start this, then we give

them a full response. Of course, then ask them "Ok, that's fine, now we have given you all the answers. How are you actually doing it?" So it has to be very much hands on sort of approach. …But there are other countries which are on the total other end, like for example Russia, what I was mentioning… Unbelievable! Before you ask them, they have already done it; you haven't even thought of something and they have already done it! So my experience with the Russians was just amazing, so they did a fantastic job in being responsive and creative and wanting to solve it and delivering everything the shortest possible time. Much better, than Hungary… to tell the truth.

Interviewer: Have you got other examples with other countries, maybe?

Hoffmann: Countries, well, yes, a lot. Yeah, Brazil has been quite difficult, but not as difficult as the Middle East countries. Oh, China has been very interesting. In China it's been a long time that I've been working in China, something like 10 years ago and haven't been there since, but at that time everyone was a beginner, because market research in China 20 years ago was hardly existent… very small, it was really just beginning and the people there were all very young and all wanted to learn, so they were like sponges. So you couldn't tell them enough h: if you spent two days telling them, they were sitting there for 48 hours and not moving; they were so keen to get all the knowledge, which is available already and they were immensely helpful. I remember when I called them by phone… of course China is terrible, because they don't speak English. You don't understand their English, even if they do and you can't say a word and you can't read anything. I wanted to take just a few Mandarin lessons to be able to say 'thank you' or things like that when being there. And they gave me lessons over the phone, there was somebody in the office, one of the researchers who said, "I would love to do it for you" and they spent I think 10 times one hour giving me Chinese lessons over the phone. They were really so keen they wanted to help, but their helpfulness is just unbelievable! And well, I've been working with them, just not been to China since then and it has even improved, so it's fantastic!

Interviewer: I suppose then their keenness on getting the knowledge gave very quick results as well.

Hoffmann: Yes, absolutely.

Interviewer: Very easy, too.

Hoffmann: It was very easy to cooperate and then they wrote very good studies, but of course it wasn't the level that here we do after 20-30 years of being in the industry, but to their level it was really perfect.

Interviewer: I think next on the list is the 'lonely heroes versus the team spirit culture'. How can you describe your company?

Hoffmann: They're very much teams, team workers. Of course, you always have some lonely wolves but it's very rare. So it's only for very very specific methodological parts or questions, where you have one single expert. So you have one fantastic expert for cluster analysis, who is the best in Central Europe. We have an absolutely amazing data analyst, who is doing all the very specific input data analysis, so these are quite rare… the lonely heroes, but overall we always work in team spirit in teams and although we always have one person, who is in charge, he or she would always work together with 2 or 3 other people. So we aren't trying to have a bit of a hierarchy but it's also because of the need of development. So, those people who are on lower level are also lower on the knowledge level, …are working together in teams with more senior people. They would learn a lot, so in market research, I think, it's quite typical that people would create these knowledge sort of things, knowledge based things.

Interviewer: The next was the masculinity femininity aspect.

Hoffmann: Multinational culture, per se, is masculine but there are various styles and types of it. Among the client companies I could– but will not – name some who have a strong macho culture, with all females killing their feet in stilettos all day and wearing mini-skirts and tight jeans for the joy of the male bosses. But TNS is very far from that, it is a very liberal and democratic company in terms of gender roles, so we have not experienced any male-female cultural issues there at all.

Interviewer: What can you say about the attitude within your company towards risks or uncertainty?

Hoffmann: Yea, that's a… When I was reading the guide, that was something I said, "Oh my God, what shall I say?" Well, because research is about uncertainty, we are absolutely living uncertainty every moment. So and especially because of the type of research… during the Research International times 80 percent of our business was *ad hoc* meaning you don't know on the first of January what sort of jobs you are going to do the next 365 days. 80 percent we didn't know which

means we normally do about 3-400 projects a year which meant that we need to win in terms of 300 projects a year, more or less *one* a day, it means about 5 times as many proposals. So we write about 1500 proposals a year and we are about 60 - something 65 people. So it's an immense pressure and this is all about risk and uncertainty: we will win or we will not win and you still have to have stable operations. So the whole company's built on this statement, too much built on that, because since we are part of TNS we got a lot of tracking studies. So now I would say about 55 percent of our jobs is still *ad hoc,* but about 45% is something that we know at the beginning of the year, that it's going to come and sometimes of course it doesn't. But it's not like, you know… shaking the operation.

Interviewer: You said something like…that has changed a lot since the beginning, since the joint venture started… these figures are…

Hoffmann: Projects or tracking? No, not really, because … because TNS used to have 8o percent tracking business and we used to have 80 percent ad hoc business. When we joined, it - kind of - levelled out, so that's why now- we were larger than TNS at that time- , that's why we are at 55- 45% but over the last 3 years it hasn't changed much.

Interviewer: The accuracy and the creative skill that was the next bit. Mentioned earlier as well…

Hoffmann: Yeah, but I don't quite understand, why these two would be opposite because precision doesn't kill creativity and the other way round: if you are creative, you still need to be very accurate. So we are trying to be both. Of course, you need different skills in different types of jobs more than the other. Qualitative in general is a bit more creative, although quantitative should be more creative as well and qualitative as well. Especially on our customer's mind or client's mind qualitative is not so much associated with precision and accuracy, although that is the one that really needs precision and accuracy. Not to be, you know, just talking out of the air, because there you don't really count… it's more opinions in people's mind that you explore. Exactly because of that, you need to have very accurate and very precise procedures to come to credible results. So yes, but otherwise precision is the heart of the market research companies. So if your data are not accurate and you cannot prove exactly where these data are coming from, that these are valid data, that controls data, then you can close down really quickly. In terms of creativity vs. accuracy being a multinational I think for a market research company creativity and accuracy both has to be present on all levels. If a global company loses either of these skills they will fail.

Interviewer: I think you already mentioned the relationship with time. If you can tell me more about it, my question would be how long it took to handle colleagues in other countries that had problems or different expectations with time management.

Hoffmann: How long did it take?

Interviewer: To realize or …

Hoffmann:
Time for a global company goes much slower than for a local branch. So what you find that the multinational will be very strict in asking for various data and would not give you a loose deadline. But when it comes to their own deadlines it will take them much longer than you would expect. Of course the multiple layers of hierarchy make decision making processes much more complex and that takes time.

Interviewer: The next question would be the low context versus the high context cultures. Your experience?

Hoffmann: High complexity culture exists in TNS when it comes to strategy and finance. The way these are managed are on a very high level and we are often facing very high complexity materials coming from the headquarters which then need to be translated and communicated in a much less complex culture to our staff. But TNS, specially recently, has started to do this translation process by itself and they developed- paradoxically – a very high complexity – high context procedure on how to translate the high complexity strategy to a low context one. The abstract type of concepts are very alien from our down-to-earth, tangible, can say populist style thinking and communication. So the slogans and 3cs and 4Ks and matrix charts are not so easy to accommodate in to our day to day operations. But this is the language of management today, so we just need to live with that. I personally took the decision to not to simply neglect it but try to make something of a more useful and inspirational communication to our staff. It definitely takes a lot of effort to go through these cultural translation processes and balance between being too abstract vs. being too vulgar. We are just learning these and I am sure younger ones, specially with proper multinational background will do it better in the future.

Interviewer: The last question on this list was the national versus the organizational culture.

Hoffmann: Yeah, well, yes, the national culture it's more an HR issue than anything else, because the national culture in Hungary is a complaint culture, as we very well know. It really represents itself and people very often start things listing the problems around something rather than the solutions. This is very different from, for example, British but totally opposite to an American as well, where they would immediately start giving lots of ideas on how to solve a situation, because they look at everything as a situation rather than a problem or source of problems. National culture is very much like that… if that was the aspect of the question, if not then let's change it.

Interviewer: Yes, who work here in this office area, are they all Hungarians, or do you have the international…?

Hoffmann: NO, we don't have ex-pats, everyone is Hungarian. Some are coming in from Transylvania, for example, and they do have a different work culture, it's very interesting, but we don't have international staff here.

Interviewer: And did you find it easier or hard to convert some people into, let's say, the international work culture.

Hoffmann: We didn't have to, because the interesting thing is, TNS used to be a 100 percent TNS owned company, so those who came from TNS part had already been very much accustomed to the multinational thinking. It was more for our Research International lag to get accustomed a bit more to, you know, multinational rules and having to follow certain, not necessarily and not always very nice or logical sort of rules.
Interviewer: Thank you and finally let me ask you what would be the lessons that can come from your experience as a manager and a CEO, and what recommendations would you give for managers who work in similar work environments?

Hoffmann: Oh…I don't know…Well, maybe there is one: the multinational companies have their own psyche, they have their own soul, they have their own way of operation, but you don't talk to an organization, you always talk to people. If you think of them as people, you can always find a way. It took us 18 months to sign the agreement with WPP and we - at the end of the day - signed a 120 pages long contract by British law. If I think of that, I would say, I would never do it again, but if I think of the whole process of the negotiation: British lawyers, British financial people etc. They were still humans and we could find a way to go through all the multinational bla-bla and difficulties, so what we signed at the end of the day was a mutual agreement. We agreed on something, it was very complicated, it was very tough, it wasn't the best that either of us could have thought of, but it was still an agreement and it was only because it was people involved, we took each other as people during the process… So I can't be smarter than that…

Interviewer: Thank you very much for your time.

Hoffmann: You're very welcome…ok.

FERENC BOGNÁR

THE IMPACT OF ORGANISATIONAL CULTURE AND MAINTENANCE STRATEGIES IN ORGANISATIONAL BUSINESS PROCESSES

When the financial prospects of the economy are limited, the emphasis is more explicitly placed on the preservation of the goods already possessed. This results in the increased importance of the role of maintenance. However, the undisturbed operation of a corporation's business procedures is not only important when the corporation's sources are limited due to the troublesome economic situation, but also in the periods of prosperity. Failures occur in every organisation's business processes, including those that are the best organised. Depending on activity profile, size and environment of the organisation, failures have different effects in the business process system. Note that due to the strengthening economic competition, the reliable corporation operations are more and more important. For example, in the automobile industry a few hours of breakdown could cost a fortune. According to Handy, it is becoming a trend that large and medium-sized enterprises – so called "elephants" – are served by small companies ("fleas") and formed into chains *(Handy, 2003)*. The question is what kind of behaviour the "elephants" should choose if they wish to organize their own processes and supply chain that consists of the "fleas" in a reliable way. The aim of this paper is to identify the relations of maintenance strategies of business processes in a procurer-supplier relationship of organisations. Further, the aim is to identify the relations between the corporate culture and the failures occurring in the business processes of an organisation. The paper expansively presents and evaluates the other technical and management related papers dealing with reliability, maintenance, and organisational culture. The focus is on the presentation of the different kind of failure modes. The empirical research is based on a questionnaire-survey; the data is collected from a large sample with the involvement of corporations operating in Hungary. The statements of the research are analysed by using statistical and econometric quantitative methods. Through the research results, the relations between the maintenance strategies of the procurer and the supplier organisations are revealed. Also, the relations between corporate culture and failures occurring in business processes are presented.

Theoretical background of the research

In close relationship to the research, five major phenomena should be described precisely with the aim of understanding the research focus and results. Thus the important definition of business process, reliability, failure,

maintenance strategy and organisational culture should be given in the first section of the paper.

The reliability aspects of business processes are widely described by Jónás *(Jónás-Kövesi, 2009; Jónás, 2010a,b; Jónás, 2011)*. Jónás extends the interpretation of reliability to business processes. In this context, reliability is not only related to machines, equipment, or different kinds of products, but business processes as well. Based on the definition by Jónás, business process is "*an umbrella term, which could mean different processes in relationship with the organisational operation in a broader sense*" *(Jónás, 2010b)*. Thus reliability of the business processes of the human resources department can be measured quite similar to the production equipment facilities. The only difference can be described in the measurement methods.

Definition, meaning, development and composition of reliability all have wide interpretations among many publications and standards *(Gnyegyenko et al., 1970; IEC 50(191):1990; Gaál-Kovács, 2002; Bazovsky, 2004; Kövesi, 2011; Smith, 2011; O'Conor-Kleyner, 2012)*. The definition of reliability is still developing. The appearance of newer technologies is leading scholars to rethink and redefine reliability. In the beginning, reliability was "working without flaws", but since that time this explanation has went through some major transformations. *(Mobley et al., 2008)*. Due to all these the definition of reliability should be given using a source. The source should probably include the most citations present in international literature on reliability. The application of the IEC (50)191:1990 standard widely appears in the international literature. There is a focus on reliability and maintenance in different research fields as well *(Catelani-Gori, 1996; Rausand, 1998; Gaál-Kovács, 2002; Pakanen-Sundquist, 2003; Kövesi, 2011)*. Meulen and Koorneef recommend IEC (50)191:1990 standard for interpreting reliability *(Meulen-Koornneef, 2002)*. Leger and his colleagues describe reliability in close relationship with IEC (50)191:1990 standard *(Leger et al., 1999)*. Due to the conceptual scope of detection of different failure modes, it is highly advised to base definitions using this standard *(Catelani-Giraldi, 1999; Catelani-Fort, 2000)*. Besides, some researchers connected reliability directly to the IEC (50)191:1990 standard *(Vatn et al., 1996; Hokstad, 1997)*.

Throughout the research dependability is defined by the IEC (50)191:1990 standard. Based on this definition, reliability (in general) is *"the collective term used to describe the availability performance and its influencing factors: reliability performance, maintainability performance and maintenance support performance" (IEC 50(191):1990)*. By the standard, the definition of availability is *"the ability of an item to be in a state to perform a required*

function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided" (IEC 50(191):1990). This ability depends on the combined aspects of the reliability performance the maintainability performance and the maintenance support performance. These definitions should also be provided. Reliability performance is *"the ability of an item to perform a required function under given conditions for a given time interval" (IEC 50(191):1990).* Maintainability performance is *"the ability of an item under given conditions to use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources" (IEC 50(191):1990).* Maintenance support performance is *"the ability of a maintenance organisation, under given conditions, to provide upon demand, the resources required to maintain an item, under a given maintenance policy" (IEC 50(191):1990).* In a narrower sense, durability and reliability are considered to be the same concept. Figure 1 shows the relevant relationships between the previously described definitions.

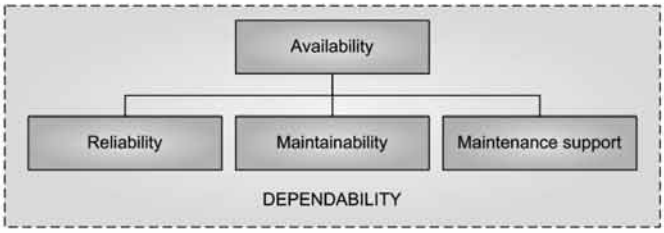

Figure 1. Dependability as a collective term
Source: *IEC 50(191):1990*

In understanding the possible failures of a business process, first the meaning of failure should be defined based on the previously applied standard. According to the standard, failure is defined as "the termination of the ability of an item to perform a required function" *(IEC 50(191):1990).* It should be noted that after failure, the item has a fault, and "failure" is an event as distinguished from "fault", which is a state. Figure 2 clearly shows the relationship between failure and fault presented by Rausand and Oien. *(Rausand-Oien, 1996).*

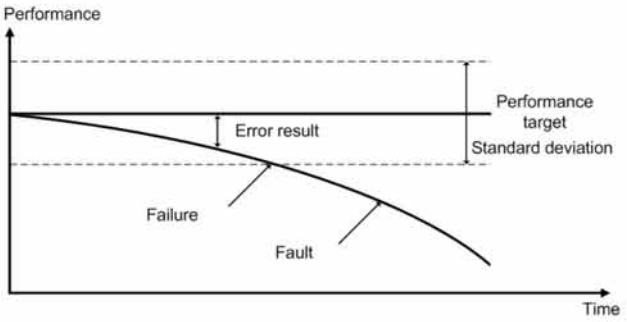

Figure 2. Relationship between failure and fault
Source: *Rausand-Oien, 1996*

In this context performance error results are not a failure until it gets hold of the lower limit of standard deviation. Under the lower limit of standard deviation, the item or process is in fault state. The other theoretical concepts of failure are widely described by several publications as well *(Balogh et al., 1980; Davidson, 1988; Gaál-Kovács, 2002; Narayan, 2004; Daley, 2008)*.

The rest of the publications related to reliability and failures suggest describing the nature of different failures using the IEC (50)191:1990 standard *(Catelani-Gori, 1996; Rausand, 1998; Pakanen-Sundquist, 2003; Del Frate et al., 2011)*. According to these recommendations, definitions of different failures and faults are also originated from this standard. This distinguishes many failures from each other. The most important ones from the point of this research are "critical", "non-critical", "misuse", "mishandling", "weakness", "design", "manufacturing", "ageing", "sudden", "drift", "catastrophic", "complete", "major", etc. failure or fault.

The phenomenon of reliability and maintenance "go hand in hand". It is also generally accepted that maintenance is a service activity and the recent decades have increased its relative importance *(Lewitt, 1997; Moubray, 1997; DIN 31051:2003-06; Karen et al., 2003; Szántó, 2003, 2008; Wireman, 2008a,b)*. According to numerous authors, nowadays many new objectives are related to the maintenance phenomenon. For instance, increase in productivity, JIT support, quality product development, environmental conservation and overall plant efficiency support *(Riis et al., 1997; McKone-Elliott, 1998; Al-Najjar, 2000; Leite da Silva et al., 2004)*. Just in the case of reliability, there are several definitions of maintenance applied in different publications. The purpose of these definitions has changed so much in time related to the development of the phenomenon *(Szabó, 1975; Rapatyi, 1976;*

Stanley-Howard, 1978; Lewitt, 1997, 2009;, Kovács, 2001;, Gaál-Kovács, 2002, Wireman, 2008a). According to Kovács, maintenance is the supporter of business processes. Thus one possible definition: maintenance is the sum of activities connected to a corporations' physical wealth that allows the successful completion of business processes *(Kovács, 2001)*. Moral wealth can be associated to Kovács's definition. Moral values (such as "good-will") contribute to the success of business processes as well *(Bognár-Gaál, 2011)*. The IEC (50)191:1990 standard defines maintenance as *"the combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function" (IEC 50(191):1990)*.

As the phenomenon of maintenance has lots of definitions maintenance strategy can also be defined in many ways. It is generally accepted in the scientific literature that two major groups of maintenance strategies (reactive and proactive) can be described *(Kelly, 1997; Wireman, 2004, 2008b; Wang et al., 2007; Boschian et al., 2009; Cheng-Tsao, 2010)*. In the research maintenance strategy is defined by following the definition of Gaál and Kovács. Thus maintenance-organization from the point of reliability theory approach must be based on the consideration of risks (technological, economical and human). Thus maintenance strategy belongs to the category of a leaders' decision. The idea of maintenance strategy should be defined on a decision-theory basis. Therefore, maintenance strategy is the chain of decisions made in order to reach a given goal *(Gaál-Kovács, 2002)*. The possible ways of maintenance strategy development are synthesized in many publications. Figure 3 represents one of these. Based on Dunn's work, Gaál states that different trends and conceptual scopes are widely related to each other. Thus in different comparisons it could be quite difficult to discuss them as individual phenomena *(Gaál, 2007)*.

According to Kovács four possible maintenance strategies can be described *(Kovács, 2003)*:

- Breakdown strategy (BDS) (The starting point of the decision chain is breakdown.)
- Time-based strategy (TBS) (The basis of the decision chain is a prescheduled repair strategy that can be developed in solid or flexible system as well.)

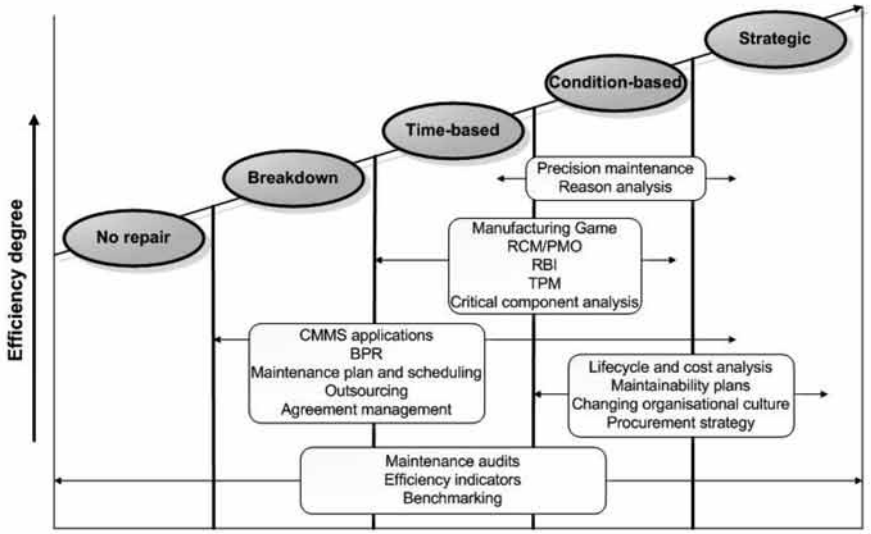

Figure 3. Different trends and conceptual scopes of maintenance management
Source: *Gaál, 2007*

- Condition-based strategy (CBS) (The basis of the decision chain is observation, measurement evaluation and a comparison of these with the desired state.)
- Maintenance prevention strategy (MPS) (This strategy recognizes the importance of reliability, maintenance and the economic efficiency at the design phase. In order to avoid breakdown teamwork, continual perfecting, involvement and authorization of employees are applied.)

Breakdown maintenance strategy waits for breakdown to occur while the other three are preventive maintenance strategies. Breakdown strategy is the least developed and maintenance prevention strategy is the most developed. In the case of an organisation, these four strategies can be used in parallel. This is because there are machines and processes that require only breakdown maintenance while others work better with one of the preventive strategies. Therefore, a selective strategy can be developed. The applicable strategy depends on the risk taken in case of breakdown.

Since the '70s, organisational scholars have been paying serious attention to the concept of organisational culture *(Kluckhohn-Strodtbeck, 1961; Hall, 1976, 1990; Hofstede, 1980, 2001; Trompenaars-Hampden-Turner, 1998).*

The relationship between organisational culture and maintenance has already been described. *(Thomas, 2005)*. Thomas represents organisational culture in his book as a "soft", phenomenon. This definitely can affect "tough" phenomena just like reliability of technological processes and maintenance systems. Until now, the number of different kind of culture definitions is well above 150 *(Kroeber-Kluckhohn, 1978)*. A generally accepted culture definition is that described by Schein who defines culture as the way of problem solving by different human groups *(Schein, 1985)*. Culture usually can be examined through a variety of points of view. Therefore many relevant dimensions, levels and contexts are revealed in the scientific literature *(Bergler, 1993; Borgulya, 2001; House et al., 2004; Kovács, 2006; Migliore, 2011)*. In synthesizing these findings, Karahanna along with other authors developed a general model. In this model which the relevant levels of culture can be easily described *(Karahanna et al., 2005)*. Figure 4 shows the relationship between the six levels of culture.

In this research, the main focus is on the level of organisational culture. Research scholars agree that the role of organisational culture is a key factor in the life of the organisation. It has a significant effect on the organisational processes *(Cameron-Quinn, 2006; Alvesson-Sveningson, 2008; Capon, 2009; Gregory et al., 2009; Jones, 2010; Senior-Swailes, 2010)*. Numerous models and typologies are described in the field of organisational culture that can help in understanding the specialities of this phenomenon *(Kono, 1990; Hofstede, 1991; Handy, 1993; Morgan, 1996; Trompenaars-Hampden-Turner, 2002; Cameron-Quinn, 2006)*. Some of these models and typologies (Kono's, Handy's, Morgan's) appear only on the pages of different textbooks. Still these works are significantly valuable ones. Present researchers seem to cite these models as only generally important and basic theoretical models. The much more active research trend focuses on the model of Hofstede, Trompenars and Hampden-Turner as well as Cameron and Quinn. In the research, the Competing Values Framework (CVF) originated to Cameron and Quinn is applied. CVF was originally developed measuring and changing organisational culture (up against Hofstede's model) and the evaluation of CVF is clearly independent (up against the model of Trompenaars and Hampden-Turner). CVF started in the '80s and after a long development period it gained its present form *(Quinn-Rohrbaugh, 1981, 1983; Cameron, 1986; Quinn-Cameron, 1988; Cameron-Freeman, 1991; Quinn-Spreitzer, 1991; Cameron, 1997; Cameron-Quinn, 2006)*.

Figure 4. The relationship between the six levels of culture
Source: *Karahanna et al., 2005*

As Figure 5 shows, CVF has two dimensions that form four quadrants. Each represents a distinct set of organisational effectiveness indicators. The first dimension is "flexibility and discretion" versus "stability and control". The other is "internal focus and integration" versus "external focus and differentiation" *(Cameron-Quinn, 2006)*.

As it can be seen on Figure 5, each quadrant has a name that distinguishes its most notable characteristics: Clan, Adhocracy, Hierarchy and Market. The orientation of an organisation with clan culture is collaborative. The leaders belong to the facilitator, mentor or team-builder type. The organisation values are commitment, communication and human development. The basic theory for success is that human development and participation produces effectiveness. Organisations with adhocracy culture tend to orientate toward creative solutions. The leader exemplifies innovation, entrepreneurship and encourages visionary behaviour. Values are innovative outputs, transformation and agility. According to this culture type, the best way to increase effectiveness is through innovation, vision and new resources. The basic concept of hierarchical organisations is controlling. The leaders' main roles are coordinating, monitoring and organizing. Main values are efficiency, timeliness, consistency and uniformity. Hierarchical organisations believe that control and efficiency with capable processes produce effectiveness. The market culture type believes in competition. Managers belong to the hard driver, competitor and producer type. These organisation values are market share, global achievements and profitability. In this context, aggressive competition and customer focus produces effectiveness *(Cameron-Quinn, 2006)*.

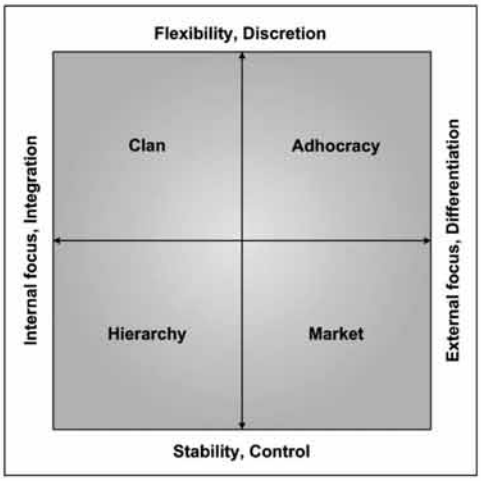

Figure 5. The Competing Values Framework (CVF)
Source: *Cameron-Quinn, 2006*

Nowadays, CVF is usually part of different studies that are related to organisational culture in the domestic private sector *(Balogh et al., 2010; Bognár, 2010; Balogh, 2011; Balogh et al., 2011a,b; Fekete, 2010, 2011; Gaál-Fekete, 2011; Gaál et al., 2010, 2013)*. Several other researchers confirm that CVF is an appropriate tool in measuring organisational culture in relationship with other variables. This is similar to ethical codes, managerial roles and effectiveness of IT systems *(Cooper-Quinn, 1993; Dipadova-Faerman, 1993; Hooijberg-Petrock, 1993; Stevens, 1996; Gardner et al:, 2009)*. CVF is widely applied to different operational areas like higher education and health care *(Smart-Hamm, 1993; Smart-St. John, 1996; Scott et al., 2003; Hartmann et al., 2009)*. Using CVF, Ralston compared the organisational culture of several Chinese organisations. Nummelin examined several Finnish organisations in the field of building industry and Vijayalakshmi examined the organisational culture of different kinds of banks in India *(Nummelin, 2006; Ralston et al., 2006; Vijayalakshmi et al., 2009)*.

Research focus and significance

Even in the best performing organisations there can be confusion and malfunction in the operation of the organisation's business processes. Different types of consequences can occur depending upon the organisation's business

profile, size and working environment. If the business process failures occur, it follows logically that different maintenance strategies can be utilized. There are different reasons for failure and often several subsequent maintenance strategies. These create a special maintenance strategy system on the organisational level. Some organisations maintain their most important business processes when the failure occurs; others check the operable minor business processes in order to avoid slight disturbances.

The examination of the reliability of organisational business processes is specifically a novel field. Domestic research results are fundamentally related to the work of Jónás, whereas other researches examine maintenance strategies in close relationship with business strategies *(Pinjala, et al, 2006; Jónás, 2011)*. Business processes ensuring organisational operation are most transparent for the leader of the organisation, both as a whole and separately, and it is also true in the context of organisational culture, the nature of which is frequently connected with most organisational characteristics. In his book, Thomas presents how maintenance and organisational culture are interwoven *(Thomas, 2005)*, while other authors find the knowledge of organisational culture vital in relationship with maintenance activities *(Reiman-Oedewald, 2004)*. In certain industrial branches reliability, maintenance and safety are so highly required for the operation of organisational business processes that a new form of culture, namely "safety culture", has evolved.

A key motive of the research is the analysis of the maintenance strategies of organisational processes. A second motive is the examination of the relationship between business processing failures and organisational culture. Hungary is a small open economy in this gradually globalizing world. The most significant economic organisations in Hungary are dominant mainly in the Eastern European region. In terms of worldwide economics, their significance is rather negligible. Domestic companies are principally suppliers of other (not necessarily foreign) organisations. This results in significant dependency in terms of the present day's economic conditional system. For an organisation to keep a supplier role or to join the supplying system, it is necessary to make efforts that often depend upon the procurer's regulations. The economic environment predictability on a global level has moved in an unreliable direction during the past few years. This has brought serious challenges into life for organisations. Procurer organisations have become more deeply interested in 'operating in a better way' and cooperating with 'good' suppliers. Whereas suppliers must work really hard to keep their place. The research has been carried out with the involvement of CEOs of economic organisations operating

in Hungary. The practical approach objective is to provide help for organisations in Hungary with the operation of their business processes in a 'better' way.

The research seeks answers to the following questions:

1. Is there a traceable relationship between the system of business process maintenance strategies of procurer and supplier organisations?
2. Does the knowledge of the maintenance strategies applied to maintain procurer organisational maintenance decrease the uncertainty concerning maintenance strategies applied to supplier business processes?
3. Is it possible to trace difference in relation to failures occurring in organisational business processes in case of organisations belonging to different organisational culture types?

Research hypothesis and research model

Research hypotheses are phrased that refer to the presumed relationships of the variables present in the research model. In the research, maintenance strategies are interpreted as two different strategy types. One is that maintenance strategies of the procurer applied for their own business procedures. The second is expected for the suppliers' business procedures. The maintenance strategies of the procurer are considered to be the independent variables. In contrast, the ones expected by the procurers from the suppliers are considered to be the dependent ones. In addition to these, the organisational culture is considered to be the independent and the failure type of business process is the dependent variable.

Hypothesis 1

There is a relationship between the maintenance strategy systems of the procurer and the supplier organisations' business processes.

Both in the case of the independent and the dependent variables, the four variables are the breakdown, the time-based, the condition-based based and the maintenance preventing strategy. On the basis of this hypothesis, it is supposed that there is a measureable relation between the procurer and the supplier part's maintenance strategy system.

Hypothesis 2

Knowing the maintenance strategies of the business procedures of the procurer organisation, we can draw conclusions concerning the maintenance strategies of the business procedures of the supplier organisation.

It is supposed that if on the procurer side, the organisation applies a given maintenance strategy system to maintain its own operation, then it acts likewise when it maintains the operation of the supplier organisation.

Hypothesis 3
Knowing the dominant corporate culture type of the organisation, a difference can be found between the average values of certain failure characteristics of corporate organisation.

The different corporate culture types influence the everyday life of an organisation. In the course of the research, corporate culture is considered an independent variable. The four culture types described by Cameron and Quinn are applied as a basis. Figure 6 represents the research model.

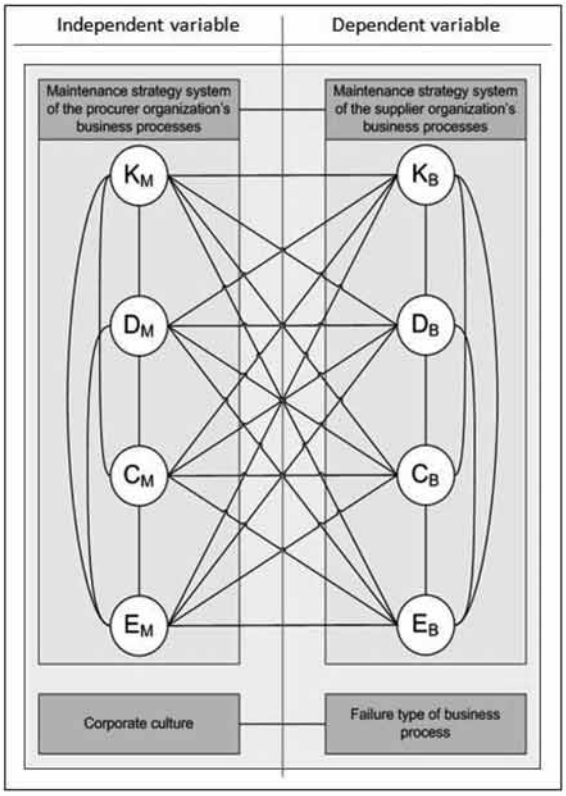

Figure 6. The research model
Source: *Bognár, 2013*

For testing of the first and second hypotheses, four variables are described in both the independent and the dependent sides of the model. These variables identify the four maintenance strategies applied in the research. The explanation of the notation is described below. Note that "M" in the lower index indicates the procurer's half and "B" indicates the supplier's part.

- E_M – breakdown maintenance strategy of the procurer organisation's business processes.
- C_M – time-based maintenance strategy of the procurer organisation's business processes.
- D_M – condition-based maintenance strategy of the procurer organisation's business processes.
- K_M – maintenance preventing strategy of the procurer organisation's business processes.
- E_B – breakdown maintenance strategy of the supplier organisation's business processes.
- C_B – time-based maintenance strategy of the supplier organisation's business processes.
- D_B – condition-based maintenance strategy of the supplier organisation's business processes.
- K_B - maintenance preventing strategy of the supplier organisation's business processes.

There are randomly drawn lines between the maintenance strategies in the model. These lines indicate the possible relationships between the maintenance strategies. The third hypothesis is illustrated in the bottom part of the research model. "Corporate culture" box includes the four culture types described by Cameron and Quinn. The box "Failure type of business process" indicates the possible failures occurred in the operation of business processes.

Applied methodology

In this section, it is presented how the concepts related to the research questions are made measureable in order to prove the pertinence of the research hypothesis. In the research, primarily the quantitative tools of social science methodology are used. At first, on the basis of the research model, the operationalising of the business processes' maintenance strategy system is carried out. It is important to mention that both in the case of dependent and

independent variables the maintenance strategy system of business processes is described according to the same pattern.

It is concluded that the maintenance strategy system should be measured based on the measured values and thus making the comparison of many organisational characteristics possible. The executive aspect should also be taken into consideration. Due to the above mentioned, the aim is to allow the leader of an organisation a panoramic view of the business processes' maintenance strategy system within the organisation. Accordingly, the four variables are interpreted as high level measurability variables. The goal of that is to make it possible for the measuring person to see to what extent each strategy is present in the maintenance strategy system of business processes. A short description and an example are provided for each strategy to the person involved in the analysis. To determine the maintenance strategy system of the business processes, the leader who carries out the measure is required to rate on a Likert-scale of 1-7 in four cases. The more dominantly a strategy is present, the higher score it receives and the less dominant it is, the lower score it receives.

To measure corporate culture as an independent variable, the Cameron-Quinn culture model and the Organisational Culture Assessment Instrument (OCAI) questionnaire are applied. In this section a brief overview of the measuring method of the OCAI questionnaire should be given. There are six dimensions on the basis of questionnaire measures that identify to which type of culture a corporation belongs (dominant characteristics, organisational leadership, management of employees, organisational glue, strategic emphases and criteria of success). The questionnaire connects each dimension to a statement. Each statement is related to one of the four types of corporate culture. Thus, in the case of each dimension there is a characteristic statement for all the four types of corporate culture in the questionnaire. Among these four statements, 100 points are to be distributed (in the case of each of the six dimensions). This depends to what extent the person who fills the paper out thinks a type of corporate culture is representative in the case of the given dimension. More points are awarded for a statement that better describes the representative values for a type of corporate culture in a given dimension. The 100 points is to be distributed completely according to the participant's own course, but more than 100 cannot be given.

For the analysis of failure reasons, CEOs were required to rate on a Likert-scale of 1-7 to what extent the failure of a business process can be originated from certain failure types. The bigger the number is, the stronger the relevance of the failure type is (1 if origination is not relevant, 7 if the origination is absolutely relevant).

To verify the hypotheses, the relevant methodological considerations to the evaluation are concluded from the nature of the certain variables. Also, they are concluded the results of previous theoretical researches. Regression and path analysis are applied for the evaluation of the first hypothesis. Cluster and crosstab analysis are used for the evaluation of the second hypothesis. Variance and post hoc analysis are applied for the evaluation of the third hypothesis.

General Background and Sample of Research

The research started in 2008 and was built on a quantitative survey. For data collection questionnaires were addressed to the CEOs of more than 2,700 companies in Hungary from different operational fields. More than 260 CEOs filled in the questionnaire. The data collection was carried out between 2009 and 2010. In the selection of target audience, the most important criteria was that CEO should have had an at least one-year work experience at the current organisation. This is because this period is necessary for sufficiently identifying the dominant company peculiarities. Considering the research focus, CEOs were the most relevant people in the company to answer the questionnaire. Only the CEOs had the right perspective to see through the entire business process system and the corporate culture. For measuring the internal consistency of the relevant variable groups of the questionnaire, Cronbach-alpha is an appropriate instrument. For each relevant variable group the Cronbach-alpha has higher than 0,7 value.

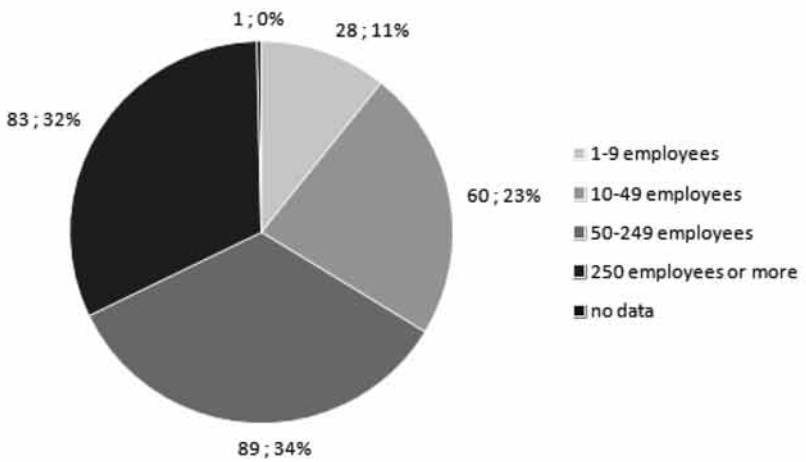

Figure 7. Distribution of companies by the number of employees
Source: *Bognár, 2013*

As Figure 7 shows, the sample is dominated by the medium and large sized companies. Small and micro-sized companies make up only one third of the whole sample.

Based on the data from the Hungarian Central Statistical Office, it is possible to determine the registered number of large and medium sized organisations in Hungary. 9,62% of the large and 1,68% of the medium sized organisations are represented in the research sample.

Figure 8 shows the distribution of the companies by the field of activity. The sample is dominated by the processing industry which contains companies from the automobile industry, electric industry, paper industry, process management industry, etc. The logistics and transportation field also has a significant part in the sample.

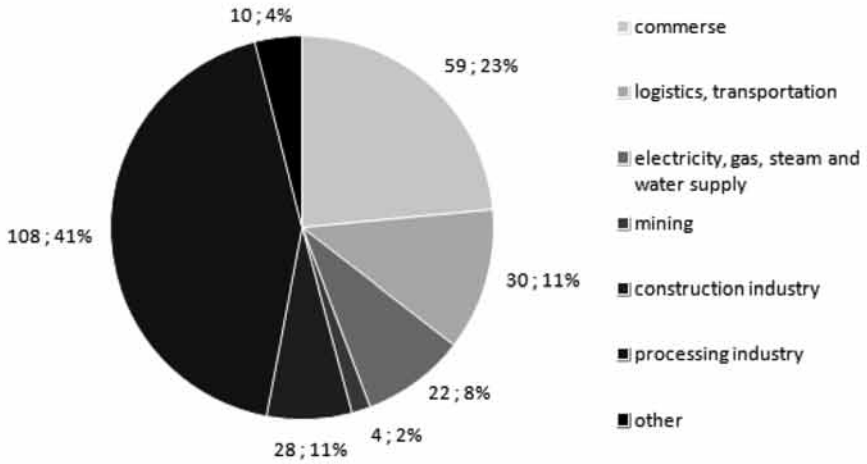

Figure 8. Distribution of companies by the field of activity
Source: *Bognár, 2013*

As it can be seen on Figure 9, the adhocracy culture type is significantly underrepresented in the sample. Based on the previous distribution diagrams, the cause of underrepresentation can be explained. Large and medium sized organisations have a significant proportion in the sample. In case of this organisational dimension, it is quite irrelevant that the organisation can have adhocracy culture type. On the other hand, the rest of the organisations are from operational fields where regulations and technological processes are strictly driven. Consequently, this is another disadvantage for adhocracy culture to gain a significant representation in the research sample.

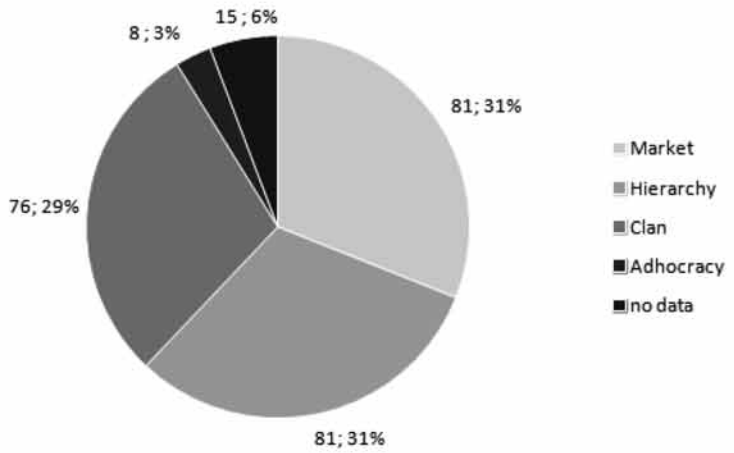

Figure 9. Distribution of companies by the dominant culture types
Source: *Bognár, 2013*

In light of this fact, those organisations which belong to the adhocracy culture type should be excluded from further tests related to the third hypothesis.

Research results

The results of the first hypothesis testing can be made visible as a path model which is built up by five linear regression models. All the prerequisites of each linear regression in the path model are realized. The value of the coefficient of determination (adjusted R^2) of each linear regression is high. The lowest value of the coefficient of determination is 0,237 and significant at 0,01 level, the highest is above 0,7 and also significant at 0,01 level. Figure 10 shows the developed path model.

Numbers over arrows indicate the value of the beta parameter of relationships. Numbers under arrows indicate the strength of correlations. One asterisk next to the number indicates that the value is significant at the 0,05 level, two asterisks indicate that the value is significant at the 0,01 level. The linear regressions are formally described below; while the coefficient of determinations are placed next to each linear regression:

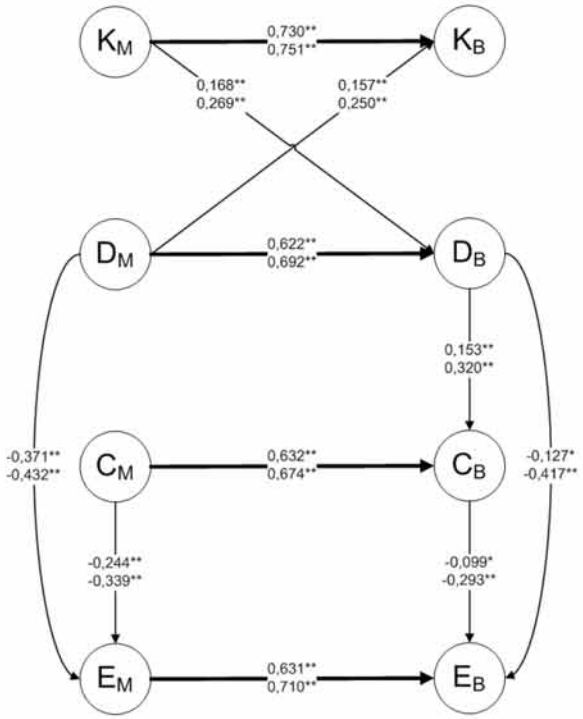

Figure 10. The five linear regressions in the path model
Source: *Bognár, 2013*

- $E_B = 0{,}631*E_M - 0{,}127*D_B - 0{,}099*C_B + RESID_1$ Adj. $R^2 = 0{,}525$
- $C_B = 0{,}632*C_M + 0{,}153*D_B + RESID_2$ Adj. $R^2 = 0{,}470$
- $D_B = 0{,}622*D_M + 0{,}168*K_M + RESID_3$ Adj. $R^2 = 0{,}507$
- $K_B = 0{,}157*D_M + 0{,}730*K_M + RESID_4$ Adj. $R^2 = 0{,}584$
- $E_M = -0{,}244*C_M - 0{,}371*D_M + RESID_5$ Adj. $R^2 = 0{,}237$

The correlation analysis identified relationships between dependent and independent variables. In some cases relationships were weaker and had lower value of the coefficient of determination (as, for example, in the case of C_B-E_B). Meanwhile other cases were moderately strong and had medium-level of the coefficient of determination (e.g. in the case of D_M-E_M). Besides, the correlation between dependent and independent variables were positive in some cases (e.g. in the case of D_B-C_B) and negative in others (e.g. in the case of D_M-E_M). Negative correlations only occurred when their directions were vertical. By

studying these relations with negative correlation coefficients, it also can be discovered that these relations in all cases strive to "keep a distance" from breakdown maintenance strategy. In interpreting these results as a whole, the kind of structure appearing on the dependent variables' (the maintenance strategies of the procurer organisation) side cannot be definitely decided in the case of a given structure of independent variables (the maintenance strategies of the supplier organisation). One of the reasons is that methods applied in the case of dependent and independent variables of high level measurement scale are incapable of defining such statements. Though it can be presumed that the two sides are going to be similar, it cannot be methodologically precisely proven. It also can be stated that effects from the procurer side have a stronger influence on maintenance strategy than effects occurring in the variables of the supplier side. On this basis, it can be concluded that there is pressure on the suppliers by the procurer, which urges the suppliers to form their own maintenance strategies according to the demands of the procurer organisation.

By two fundamentally different methods of cluster analysis, the high level measurement scale variables of the procurer and the supplier organisations were transformed into low level measurement scale variables. Since negligible difference between the results of the two methods was noticed, it can be stated that the cluster model is robust and the created clusters correctly describe the real phenomena. Accordingly, on the basis of the maintenance of their business processes, the organisations can be divided in two basic theoretical clusters; breakdown maintenance appliers and preventive maintenance appliers. This result can be anticipated, since if these two groups exist in the case of machines, then they are likely to exist in the case of organisations as well. Even though in relation to business processes, it has yet to be proven. Table 1 shows the final cluster centres on procurers' and suppliers' side as well.

Organisation		Procurer		Supplier	
Cluster identification		I.	II.	I.	II.
Maintenance strategy	Breakdown	6	2	6	3
	Time-based	3	5	3	5
	Condition-based	3	5	3	5
	Maintenance prevention	3	4	3	4
Number of cases		148	109	132	122

Table 1. Cluster centres on procurers' and suppliers' side
Source: *Bognár, 2013*

The question to be answered is whether the awareness of maintenance strategies applied by the procurer organisation on their business processes

reduces the uncertainty concerning the maintenance strategies applied by the supplier organisation on their business processes. To provide the answer, crosstab analysis should be performed on the two clusters (breakdown and preventive strategy), as Table 2 shows.

		Supplier		Number of cases
		Breakdown maintenance	Preventive maintenance	
Procurer	Breakdown maintenance	117	29	146
	Preventive maintenance	15	93	108
Number of cases		132	122	254

Table 2. The basic table for crosstab analysis
Source: *Bognár, 2013*

After calculating the chi-square statistics, the statistics were significant on a level of 1%. Consequently, the two variables of the clusters are not independent of each other. To study the strength of the relationships the phi-coefficient, the Cramer V indicator, and the Lambda indicator should be calculated. Then the percentage should be defined in which identical cluster-pairs (breakdown-breakdown, preventive-preventive) occur on the explaining and explained sides. On the 1% level of significance, the value of the phi-coefficient was 0,656, which means that there is a strong relationship between the variables. Since the subject of the study is the 2x2 crosstab regarding the previously presented formulas, the value of the other symmetric indicator (Cramer V), is 0,656 as well. This also marks a strong relationship. The value of the Lambda indicator (asymmetric) is 0,593 on a level of 1% significance. This means that knowing to which cluster the procurer organisation's business processes belongs reduces uncertainty to the cluster membership of the supplier organisation's business processes by approximately 60%. From the crosstab, it can be concluded that if the maintenance of procurer organisation's business processes belongs to a given cluster, then in 83% of the cases the maintenance of supplier organisation's business processes will be in the same cluster. On the basis of all these, it can be concluded that there is a strong relationship between the maintenance of business processes of the procurer and the supplier organisations. Awareness of the characteristic features of the procurer organisation allows for accurate conclusions about the characteristics of the supplier organisation.

To study the phenomena occurring among the failures in the business processes and the corporate culture, variance analysis should be performed. To

identify corporate culture, the culture types of Cameron and Quinn were applied. To compose the characteristics of the failures the IEC (50)191:1990 standard was used. Variance analysis resulted three significant solution (Sig.< 0,05) from the aspect of corporate culture as an explaining variable. Table 3 shows the descriptive statistics of these cases.

		N	Mean	Standard deviation	Standard error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower bound	Upper bound		
misuse failure	Market	80	3,63	1,679	0,188	3,25	4,00	1	7
	Hierarchy	78	3,08	1,657	0,188	2,70	3,45	1	7
	Clan	74	2,82	1,456	0,169	2,49	3,16	1	6
	Total	232	3,19	1,632	0,107	2,97	3,40	1	7
manifacturing failure	Market	80	3,09	1,434	0,160	2,77	3,41	1	7
	Hierarchy	79	2,77	1,609	0,181	2,41	3,13	1	7
	Clan	74	2,50	1,274	0,148	2,20	2,80	1	6
	Total	233	2,79	1,462	0,096	2,61	2,98	1	7
major fault resulted	Market	80	3,50	1,669	0,187	3,13	3,87	1	7
	Hierarchy	78	2,97	1,554	0,176	2,62	3,32	1	6
	Clan	73	2,73	1,346	0,158	2,41	3,04	1	7
	Total	231	3,08	1,561	0,103	2,88	3,28	1	7

Table 3. Descriptive statistics of significant cases
Source: *Bognár, 2013*

It can be concluded that the clan culture type is the most resistant to different kinds of failures compared to the other two culture types. Market culture type is the least resistant. Besides, hierarchy culture type takes place in between the other two types in all of the cases. By post-hoc analysis, it can be pointed out that there is a significant difference between the average values of dependent variables. In parallel placement four different post-hoc tests (Bonferroni test, Sidak-test, Scheffé-test, Tukey-test) mostly the same results were given in each significant case. Table 4 shows it on the example of misuse failure.

It can be seen, that there is significant difference (Sig.<0,05) between the mean of Market and Clan culture types. It can be realised that there is no significant difference between the mean of Market and Hierarchy culture types. Further, there is no significant difference between the mean of Hierarchy and Clan culture types. Figure 11 represents the most important results of the variance and post-hoc analysis.

Dependent variable		Group 1	Group 2	Mean Difference (1-2)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Misuse failure	Bonferroni	Market	Hierarchy	0,548	0,255	0,098	-0,067	1,164
			Clan	0,801	0,259	0,007	0,177	1,425
		Hierarchy	Market	-0,548	0,255	0,098	-1,164	0,067
			Clan	0,253	0,260	0,998	-0,375	0,880
		Clan	Market	-0,801	0,259	0,007	-1,425	-0,177
			Hierarchy	-0,253	0,260	0,998	-0,880	0,375
	Sidak	Market	Hierarchy	0,548	0,255	0,095	-0,066	1,162
			Clan	0,801	0,259	0,007	0,178	1,423
		Hierarchy	Market	-0,548	0,255	0,095	-1,162	0,066
			Clan	0,253	0,260	0,703	-0,373	0,879
		Clan	Market	-0,801	0,259	0,007	-1,423	-0,178
			Hierarchy	-0,253	0,260	0,703	-0,879	0,373
	Scheffé	Market	Hierarchy	0,548	0,255	0,102	-0,081	1,177
			Clan	0,801	0,259	0,009	0,163	1,438
		Hierarchy	Market	-0,548	0,255	0,102	-1,177	0,081
			Clan	0,253	0,260	0,625	-0,389	0,894
		Clan	Market	-0,801	0,259	0,009	-1,438	-0,163
			Hierarchy	-0,253	0,260	0,625	-0,894	0,389
	Tukey	Market	Hierarchy	0,548	0,255	0,083	-0,054	1,150
			Clan	0,801	0,259	0,006	0,190	1,411
		Hierarchy	Market	-0,548	0,255	0,083	-1,150	0,054
			Clan	0,253	0,260	0,596	-0,361	0,867
		Clan	Market	-0,801	0,259	0,006	-1,411	-0,190
			Hierarchy	-0,253	0,260	0,596	-0,867	0,361

Table 4. Results of post-hoc analyses on the example of misuse failure
Source: *Bognár, 2013*

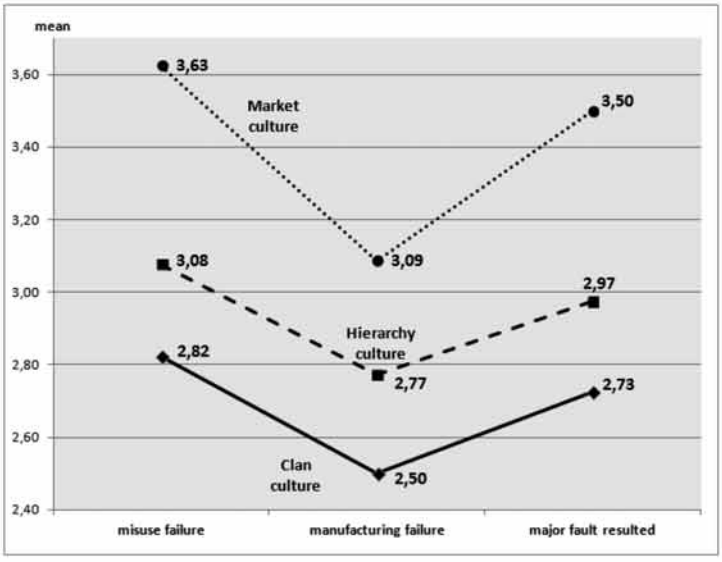

Figure 11. Results of the variance and post-hoc analysis
Source: *Bognár, 2013*

Figure 11 shows that clan culture type has the minimal mean values in relationship with all the significant failures, as well as, market culture type has the maximum mean values. Hierarchy culture type lies between clan and market culture in each case.

Discussion

The elements of maintenance strategy system were determined. Different kinds of relations were identified between the maintenance strategy systems of the procurer and the supplier organisation's business processes. As the result of the research, it can be concluded that if the maintenance strategy of business processes of the procurer organisation is known, conclusions can be drawn concerning the maintenance strategy of business processes of the supplier organisation. It became clear that if the procurer organisation maintains its business processes according to a given maintenance strategy, then the maintenance of the business processes of the supplier organisation is most likely to be carried out the same way. On the basis of this result, practical kind of suggestions can be drawn up. As a conclusion of this result, maintenance strategies can be defined as a phenomenon describing relations of organisations in business life. This is a determining factor from the aspect of the novelty of the results presented in this paper.

Differences can be found in failures occurring in business processes of organisations belonging to a certain type of corporate culture are defined in this paper. In the case of clan and market culture organisations, there is a difference in the average values of the numerous failure characteristics of these organisations' business processes. There is a difference in the case of the following dependent variables: "misuse failure"; "manufacturing failure"; and "major fault". On the basis of this result, suggestions can be composed to practicing experts related to the changes in the corporate culture that could help to reduce the number of failure occurrences in their business processes. An order of corporate culture types can be established according to which type is the most resistant. This is based on the average values of all failure characteristics occurring in business processes. This result can only be seen visually in an appropriate way.

Responses to research questions

Is there a traceable relationship between the system of business process maintenance strategies of procurer and supplier organisations?

Based on the research results, the answer is yes. By the creation of a path model, it can be proved that there are significant relations between the dependent and independent variables of the model. Herein, relations between the maintenance strategies of equal levels of development are stronger and have higher value of coefficient of determination. Between the maintenance strategies of different levels of development, the relations have lower value of Pearson correlation and coefficient of determination.

Does the knowledge of the maintenance strategies applied to maintain procurer organisational maintenance decrease the uncertainty concerning maintenance strategies applied to supplier business processes?

Based on the research results, the answer is yes. On the basis of the maintenance strategies of their business processes, organisations that filled the questionnaire can be divided into two groups by cluster analysis. Breakdown maintenance strategy is typical in one of the groups and preventive maintenance strategy is typical in the other. The knowledge of which cluster the business processes of the procurer organisation belongs reduces the uncertainty on the cluster membership of the supplier organisation by 59,3%.

Is it possible to trace difference in relation to failures occurring in organisation business processes in case of organisations belonging to different organisational culture types?

According to the research results the answer is yes. Differences can be identified in the average values in three cases. These three cases are "misuse failure", "manufacturing failure" and "failure causing major fault". Clan culture type is the least sensitive to all kinds of failures and their effects. The market culture type is the most sensitive to them. Hierarchy culture type is in between the other two culture types in all of the cases. There is significant difference between the average values of the presented variables in the cases of clan and market culture types.

Practical applications of the research results

The vast majority of Hungarian organisations are usually the suppliers of other organisations. This phenomenon is enhanced by the globalised world economy. In this economy, an organisation can more easily become the supplier of another than local economic networks were only available. Of course, this not

only means advantages, but disadvantages as well. There is an increased number of possibilities but the demands concerning the present and planned positions are higher. In many cases, the differences rooted in the cultures of organisations can cause problems in an inter-organisational cooperation.

The paper helps the Hungarian organisations to determine the behavioural roles that should be followed in order to become the supplier of another organisation, or to be able to keep a given position. The maintenance aspect concerning business processes can be applied to handle the possible confrontational basis of many organisations and departments within the same organisation. The CEO of an organisation is one of the main contacts between the organisation and other organisations in the area. If the executive keeps his or her eyes open, and is able to identify the practices of his or her procurers, cooperation is going to be easier. For the executive of an organisation, knowing how his or her business partners manage their business processes means a great advantage over the possible competitor when it comes to keeping or gaining a position. The knowledge of the dominant maintenance strategy of a procurer organisation's business processes is very advantageous for the supplier. If the supplier is able to create a similar system, fewer confrontations can be expected with the procurer. In certain industrial branches, there are regulations that prescribe the requirements an organisation needs to meet in order to play an active role in the given industrial branch. This is only necessary, though, to enter the market. To run an efficient operation, it is not enough to be suitable for the prescriptions and simply meet the requirements. A more specific knowledge is needed for the chief executive officer of an organisation. Many organisations may find it useful to take this into consideration.

One of the most characteristic definitions of corporate culture is related to Marvin Bower. According to him, corporate culture is "how we do our work here". This definition is broad enough to be interpreted only from a complex executive overview, but this is its big advantage as well. Based on the results of this paper it can be recommended for the leaders of Hungarian organisations to deal with the inspection of the corporate culture of their organisations. Through following the recommendations, they can be more resistant to failures occurring in business processes as well.

If leaders often notice symptoms that derive from the inappropriate performance of the workers duties, they should try to shift the corporate culture towards the clan culture type. The same suggestion can be made in the case of regular changes in the structure of the organisation. The plans for the change might look good on paper, but the actual realisation of these plans may be

distracted by many influencing factors on the workers. If the business processes' system is often reformed, then, on the basis of the research results, the reforming of the corporate culture towards the clan type can be recommended for the CEO. Strengthening the clan type's attributes also can be suggested. This is applicable if the problems occurring in the system of business processes affect an important function of organisational operation especially if that causes problems in a business process of great importance.

The questionnaire developed in the research process may be able to perform complete organisational mapping. As a result, the complete cultural map of the organisation can be revealed and the hardships that each department is struggling with could be specified. Thus, reforming the given subculture may result in a shift towards the theoretical optimum of corporate operation on the level of the whole system.

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