OBSAH

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ABSTRAKTY

ZOSÚLADENÁ SPOLUPRÁCA – ORGANIZÁCIA BUDÚCNOSTI

MOSAD ZINELDIN

Kľúčové slová: kooperácia, súťaženie, zosúladená spolupráca, organizácia, podnikateľská excelentnosť

Abstrakt: Podľa Henslera (2000), konkurenčná psychológia je charakterizovaná lepším prezentovaním seba samého ako ostatných, kedy jeden (človek) je schopný zhromaždiť viac zdrojov na úkor ostatných. Nové podnikateľské prostredie núti organizácie si uvedomiť, že musia zmeniť a reštrukturalizovať spôsoby nadviazania a udržiavania vzájomných vzťahov. Spojenectvo alebo záujmová skupina založená na zosúladenej spolupráci, flexibilite, prispôsobení a zdieľaných záujmoch a cieľoch medzi odlišnými partnermi, sa ukázala byť najefektívnejšou metódou pri nachádzaní nových príležitostí a výziev z okolia (Zineldin, 2000; Zineldin et al, 1997). Podstata tohto vzťahu zosúladenej spolupráce obyčajne vedie k dosahovaniu synergického efektu a podnikateľskej excelentnosti. Vytvorenie vzťahu zosúladenej spolupráce však nezaručuje jej dlhotrvajúce udržanie. Zosúladiť spoluprácu a súčasne si vzájomne konkurovať nie vždy „prináša ruže“. Vzťah zosúladenej spolupráce sa môže ľahko zmeniť na konflikt. Cieľom článku je identifikovať základné kritériá na prežitie vzťahu zosúladenej spolupráce ako aj určiť konflikty, ktoré v tomto vzťahu môžu existovať.

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TQM S VYUŽITÍM PRAKTÍK 5-S

SAM K.M. HO

Kľúčové slová: 5-S, ISO 9000, ISO 14001, OHSAS 18001, TQM

Abstrakt: V japonských firmách bolo zistené že 5-S je prvým krokom smerujúcim k TQM. Počas minulého storočia Japonci vytvorili techniku a pomenovali ju Tréning 5-S. Autor tejto techniky vyvinul svetovo prvý Tabuľkový 5-S Audit a použil ho pri tréningu odborníkov kvality pre Asian Development Bank v Malajzii v rokoch 1993-94. V roku 1998-2000 bol autorovi tejto techniky pridelený grant na tréning 2 500 vedúcich audítorov 5-S v Hong Kongu, prvého svojho druhu na svete. Tento výcvik bol sprevádzaný dotazníkovým prieskumom. Článok pojednáva o výsledkoch vplyvu techniky 5-S na ISO 9000, ISO 14001, OHSAS 18001, TQM a Manažment zmien.

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DYNAMIKA ROZHODOVANIA O PRODUKTOVOM MIXE

OLLI-PEKKA HILMOLA & TIMO LAINEMA

Kľúčové slová: Simulácie manažmentu, produkčné prostredie , produktový mix, výnosnosť

Abstrakt: Vzhľadom na rozsiahlosť výskumu sa dá vo všeobecnosti tvrdiť, že rozhodovanie o produktovom mixe bude určovať konkurencieschopnosť výrobnej spoločnosti z krátkodobého hľadiska. Avšak stále je neznáme ako sa tieto rozhodnutia začnú rozvíjať v dynamickom prostredí. Tento článok analyzuje výsledky hry o výrobe v reálnom prostredí, ktorá bola hraná desiatimi skupinami študentov druhého a tretieho ročníka inžinierskeho štúdia. Každá z týchto skupín mala k dispozícii vlastnú výrobnú organizáciu a mohli ponúknuť na trh dva rôzne produkty. S ohľadom na aktuálne poznatky sa zdá, že najdôležitejším parametrom v rozhodovaní o produktovom mixe je zameranie sa na jeden produkt a ignorovanie druhého. Zdá sa, že výnosnosť jednotlivého produktu je tiež dôležitým parametrom a v kombinácii so správnym zameraním bude poskytovať

veľmi pôsobivé finančné výsledky. Prezentované výsledky poskytujú určitú podporu týkajúcu sa predošlého výskumu produktového mixu, ale dôležitosť zameraní stratégií je niečo nové a preto ďalší výskum v tejto oblasti je vskutku potrebný.

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NIEKTORÉ POZNATKY Z HODNOTENA ÚROVNE VYSPELOSTI SOFTVÉROVÝ FIRIEM PODĽA CMMI[SM]

PETER BOBER

Kľúčové slová: proces, zlepšovanie, modelovanie, CMMI, hodnotenie.

Abstrakt: Článok prezentuje poznatky získané z hodnotenia procesov malých softvérových firiem podľa CMMI[SM] (Capability Maturity Model - Integration). CMMI predstavuje vzorový model procesov. Určuje úroveň vyspelosti organizácie od 1 po 5 na základe vykonávaných činností v definovaných kľúčových oblastiach. Pri hodnotení sa činnosti firmy mapujú na procesy definované v CMMI a vzniká profil firmy podľa kľúčových oblastí procesov. Profil sa využíva pri určení cieľov a postupu ďalšieho zlepšovania procesov firmy. Na prieskume pomocou dotazníka sa zúčastnilo 10 firiem. Získané údaje sú komentované v závere článku. Tento príspevok vznikol ako jeden z výstupov projektu Inštitucionálneho výskumu č. 4415 na Fakulte elektrotechniky a informatiky, Technickej univerzity v Košiciach.

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RIADENIE PODĽA OBMEDZENÍ

PETER KMEC

Kľúčové slová: Teória obmedzení, zdroje, produktívna kapacita, tok materiálu a informácií, procesy, zlepšovanie výsledkov.

Abstrakt: Organizácie sú systémy, ktorých základná charakteristika je tok materálu a informácií cez procesy v zdrojoch systému. Nakoľko vstupy a výstupy organizácie vzhľadom na vonkajšie prostredie nie sú vyvážené (nová požiadavka zákazníka alebo nové materiály a technológie), v každej organizácii existuje zdroj s obmedzujúcou produktívnou kapacitou. Teória obmedzení (TOC) je manažérska filozofia ktorá je založená na poznaní, že obmedzenie a náhodné javy sú faktory, ktoré určujú výsledky organizácie. Akákoľvek manažérska metóda na zlepšovanie výsledkov by mala cieliť na obmedzenie čím sa dosiahne synergia s TOC.

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MANAŽÉRSTVO KVALITY PRODUKCIE NOVÝCH STAVIEB

TIBOR ĎURICA

Kľúčové slová: stavebný materiál, konštrukcia stavieb, nová produkcia, nová technológia, projektové riadenie, finálna analýza

Abstrakt: V tomto príspevku je diskutovaná problematika výroby novej stavebnej produkukcie, špecifikácia požiadaviek na kvalitu stavebnej produkcie, preukazovanie zhody **stavebných výrobkov**, navrhovanie stavebných objektov a nábehu výroby novej technológie pri dokončovaní investičnej akcie.

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EKONOMICKÉ OPATRENIA PRE AGILITU / FLEXIBILITU V KONTEXTE ELEKTRONICKEJ PRODUKCIE

PETRI HELO

Abstrakt: Agilita odkazuje na pochybnosť zvládnutia a zmenu pomocou integrácie obchodu, zamestnancov a informačných nástrojov vo všetkých aspektoch produkcie. Agilnosť zahŕňa tiež schopnosť operovať s rôznymi parametrami produkcie a s pridanou hodnotou pre zákazníkov. Koncepty agility a flexibility sa používajú na opis schopnosti systému vysporiadať sa so zmenami. Agilita odkazuje na základnú úroveň schopností a flexibility na úrovni zdrojov. Tento článok analyzuje výkonnosť spoločnosti v kontexte oneskorených vstupov čiastočnej produktivity spoločnosti vyrábajúcej elektroniku. Na začiatku je koncept totálnej produkcie predstavený v sústave merania výkonnosti na úrovni firmy. Neskôr sú odporúčané opatrenia pre agilitu a flexibilitu predstavené spolu so sturčným prehľadom literatúry. Na záver je predstavený dynamický modelový systém, ktorého funkčnosť je demonštrovaná na istých hypotetických príkladoch.

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ABSTRACTS

CO-OPETITION
THE ORGANIZATION OF THE FUTURE

MOSAD ZINELDIN

Keywords: cooperation, competition, co-opetition, organization, business excellence

Abstract: The traditional (or recent?) thinking about the intensity of competition as well as the old nature and boundaries of organizations become less useful in organizing economic activities. According to Hensler (2000),the competitive psychology is that, by representing oneself as better than others, one can garner more resources, be that compensation or otherwise, at the expense of the others. However, by diminishing others, one actually lowers oneself as well, and the water level drops to the detriment of all. The antithesis is active cooperation wherein one embraces colleagues in partnership toward raising the water level to the benefit of all. The new business environment led organizations to realize that they must change and restructure the way of establishing and maintaining relationships. In effect, an alliance or network based on-co-opetition (cooperation & competition),C & C, flexibility and adaptation and shared interest and objectives between different partners, has been emerged as a more effective approach to meet the new environmental challenges and opportunities (Zineldin, 2000; Zineldin et al, 1997) . The nature of this co-opetition relationship usually results in achieving synergy effects and business excellence.. However, the creation of a co-opetive relationship does not, of course, guarantee its long-term survival. To co-operate and at the same time to compete with the same actors does not always promise paradise. A co-opetive relationship can easily be turned into dark sides (conflicts). The aim of this paper is to identify the basic criteria for the survival of a co-opetive relationship as well as the conflicts which can exist in a co-opetive relationship.

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TQM VIA 5-S PRACTICE

SAM K.M. HO

Keywords: 5-S, ISO 9000, ISO 14001, OHSAS 18001, TQM

Abstract: It has been recognised that Japanese firms that 5-S is the first step towards TQM. Over the last century, the Japanese have formalised the technique and name it as 5-S Practice. The author has developed the world's first 5-S Audit Worksheet and used it for training in Malaysia under an Asian Development Bank Quality Expert assignment in 1993-94. In 1998-2000, a grant has been given to the author to train up 2,500 5-S Lead Auditors in Hong Kong, the first of its kind in the world. Through this experience, an intensive questionnaire survey has been conducted. The findings on the impact of 5-S on ISO 9000, ISO 14001, OHSAS 18001, TQM and Change Management will be discussed in this article.

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DYNAMICS OF PRODUCT MIX DECISIONS

OLLI-PEKKA HILMOLA & TIMO LAINEMA

Keywords: Management simulations, manufacturing environment, product mix, profitability

Abstract: According to vast amount of research, it has been generally argued that product mix decisions will determine the competitiveness of manufacturing company in the short-term. However, it is still mostly unknown how these decisions start to develop in dynamic environment. This paper analyses the results of real-time manufacturing gaming, which included ten different second and third year M.Sc. student groups. All of the different groups had own manufacturing company at their disposal, and they could offer two different products for markets. According to the presented findings, it seems that the most important parameter in product mix decisions is to have focus on one particular product, while ignoring another. It seems that profitability of single product is also important parameter, and combined with right focus, it will produce very impressive financial results. Presented results give some support concerning the earlier product mix research,

but the importance of focused strategies is something new and further research is indeed needed.

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SOME FINDINGS FROM MATURITY LEVEL ASSESMENT OF SOFTWARE ORGANISATIONS ACCORDING CMMISM

PETER BOBER

Keywords: process improvement, process model, CMMI, assessment.

Abstract: The paper presents the results of questionnaire survey among 10 software firms. The survey was made according SMMI^{SM} (Capability Maturity Model - Integration) which is a reference model for process assessment and improvement. This model defines five maturity levels of firm. Achievement of specific level is indicated by fulfilling of defined goals for given process areas. The results are shown in firm profile and helps to appoint a strategy of firm process improvement. The findings from survey are commented in conclusion. This paper arise with contribution of Institutional grant N^{o} 4415 at the Faculty of Electrical Engineering and Informatics, Technical University of Košice.

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MANAGEMENT BY CONSTRAINTS

PETER KMEC

Keywords: Theory of Constraints, resources, productive capacity, flow of material/information, processes, improvement of performance.

Abstract: Organizations are systems whose basic characteristic is flow of material and information through the resources of the system where processes take place. Due to imbalance in inputs and outputs with respect to the external environment (new demand of a customer or new material or technology), each organization has a constraint resource with a limiting productive capacity. Theory of Constraints (TOC) is a management philosophy which recognizes that the constraint and unpredictable random events are what determine the performance of the organization. Any management method for the improvement of performance should be targeted at the constraint and results in synergy with TOC.

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ECONOMIC MEASURES OF AGILITY / FLEXIBILTY IN ELECTRONICS MANUFACTURING CONTEXT

PETRI HELO

Abstract: Agility refers to mastering uncertainty and change by integrating the business, employees and information tools in all aspects of production. Agility includes also the ability to operate with different production parameters and add value for customers. The concepts of agility and flexibility are used to describe the ability of a system to cope with changes. Agility refers to a general level of ability and flexibility to resource level. This paper analyses the performance of a company as an input-delayed partial productivity in electronics manufacturing context. Firstly, the total productivity concept is introduced in the framework of firm-level performance measurement. Secondly, suggested measures for agility and flexibility are introduced with a brief literature review. Finally, a system dynamics model is presented, and its functionality is demonstrated with some hypothetical examples.

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CO-OPETITION
THE ORGANIZATION OF THE FUTURE

ZOSÚLADENÁ SPOLUPRÁCA[1] – ORGANIZÁCIA BUDÚCNOSTI

MOSAD ZINELDIN

To raise new questions, new possibilities, to
regard old problems from a new angle,
requires creative imagination and marks
real advance in science.

(Albert Einstein)

1 CO-OPERATION FOR COMPETITION, C & C

Co-opetive relationship (CR) consists of cooperation and coordination which refer to situations in which different independent parties have to simultaneously work together, coordinate different activities and collaborate to achieve mutual goals, i.e. to create new values together, and at the same time compete with each others as well as with other firms. The basic philosophy underlying the Co-opetition approach is that the *basic* of all industrial management activities should be the establishment of mutually beneficial partnership relationship with other partners including competitors (Zineldin, 1998, Zineldin, 2000). Two organizations can establish strategic alliance for product development and innovation (co-operation), and at the same time compete with each other in the marketing of the cooperating products. Co-opetition implies that organizations interact in rivalry due to conflicting interests and at the same time co-operate due to common interests (Bengtsson and Kock, 2000). The Goal is (*still*) to create *exchanges and added value*. Central to the co-opetition concept is exchange, which seeks to achieve satisfaction for the involved organizations. Hensler (2000) argue that the notion that

[1] **Co-opetition** – Spojenectvo alebo záujmová skupina založená na zosúladenej spolupráci , flexibilite, prispôsobení a zdieľaných záujmoch a cieľoch medzi odlišnými partnermi. (Zineldin, 2000; Zineldin et al, 1997) .

competition is an inevitable part of human nature, more productive, more enjoyable and builds character is a myth. According to him Kohn (1992) states "*The simplest way to understand why competition generally does not promote excellence is to realize that trying to do well and trying to beat others are two different things*"

Both Kohn (1992) and Margulis (1998), dispelled the first myth that competition is an inevitable part of human nature. Margulis' Serial Endosymbiosis Theory (SET) which is anti-Darwin theory of evolution of life forms, is a theory of coming together, of merging, of cells of different histories and abilities. Hensler (2000), states that merging of bacteria into the ultimate evolution of fungi, plants, and animals provides empirical support from nature for the merits of cooperation. Business ecology approach (Zineldin, 1998) is also applicable within the Modern organizations of the new economic arena. This approach implies that competitors and other parties can cooperate to create synergies (Zineldin, 1998).

Thus, the fundamental role of the organization of the future is to create and develop processes and strategic co-operation that will enhance long-term relationships, retention and loyalty. Co-opetition strategy is a relationship based on a value net of involved actors, e.g., suppliers, distributors, subcontractors, complementors and competitors. In such relationships the actors all together add value to each others organizations. Dell and Compaq are two hardware manufacturers that are competing and at the same time cooperating with each other. They are competing in the hardware manufacturing, but cooperating with software producers such as Netscape and Microsoft. The following example of companies who compete and at the same time cooperate are presented by Bengtsson and Kock, (2000).Trellex Ltd and Skega Ltd are two world leaders Swedish companies in mill lining *. They are considered as main competitors to each other. They were competing with each other in both product development and in the market. They are now co-operating at the same time with each other in the development of material and in basic research. Some main advantages of such competition are the pressure to take risks and be aggressive in product development, and the pressure to out-perform each other at the market. The main advantages of co-operation are the sharing of knowledge and pooling of competencies in the development of material. Another example is the cooperation and competition between Permanova, a Swedish manufacturer of fibre optics and Rufine Sinar, a German manufacturer of laser sources. The two manufacturer together develop lasers equipped with fibre optics. This cooperation provided Permanova with access to knowledge about lasers and access to the market. Both manufacturers get access to each other's existing developed industrial infrastructure.

** Lining products are made in rubber to produce mills, screens, etc from wear and tear to be sold to the Mining industry.*

2 UNDERSTANDING THE CRITERIA OF CO-OPETITION RELATIONSHIPS

The decision to implement a co-opetiton relationship is not an easy task. It involves interactions, attitudes, motives, and behavior. It is a process which includes three basic elements, needs, action and satisfaction. The parties involved in a co-opetition relationship identify their needs which will stimulate a drive or urge to take action which will lead to the satisfaction of the need. As shown in Table 1, for the development of enduring and mutually beneficial business relationships and exchanges to take place, seven conditions must exist.

Table 1 *Basic Conditions for a Mutually Beneficial Relationship*

1. Two or more individuals, groups or organizations are willing to be engaged and interacted in a relationship and exchange process.
2. Each party must possess something of value that the other party desires.
3. Each party must be willing to give up its ”something of value” to receive the ”something of value” held by the counterpart in return, i.e. a relationship must be a mutually rewarding connection between them.
4. Each party is free to accept or reject on terms and conditions of exchange that will leave them better off (or at least not worse off) than before the exchange.
5. The parties must be able to communicate and interact with each other to make their”something of value” available.
6. The parties to the relationship must be aware that ***ethical values*** and norms, interdependence, ***commitment***, and ***adaptations*** are most important cornerstones in creating, developing and enhancing a positive, sustainable long-term partnership relationship.
7. The parties must have the ability of creating a positive balance of both pros and cons associated with a close relationship.

An individual or organizational relationship, above all has to do with interaction and exchange. But an asymmetry of power in the relationship in consumer market is more obvious than in a business-to-business relationship. This does not mean that there is always a balance of power in business-to-business relationships.

3 DEVELOPING A CO-OPETITIVE RELATINSHIP

A large number of B2B scholars became dissatisfied towards applying the marketing mix theory on industrial goods marketing. In the "*International*

Marketing and Purchasing of Industrial Goods" Håkansson (ed.) (1982), developed a new *'interaction approach'* to the industrial markets. B2B scholars have stressed that the industrial relationships are frequently long-term, close and involving a complex pattern of interaction between and within each involved organizations. The theory of industrial marketing explains the determination of the relationship and interaction process between the seller and the buyer of industrial products in terms of four main components and a number of other sub-variables. These four components are: environment, atmosphere, interacting parties and interaction process.

The importance of the interaction/network approach is that all the four major components and their sub-variables must be seen together in order to understand the nature of relationship and the factors influencing them. Within a given environment, organizations must develop a clear, real, and strong relationship management and marketing orientation in formulating organization policy and mission.

Some features of close Co-opetive relationships are that the parties adapt their processes and products to achieve a better match with each other, sharing information and experiences, eliminating or minimizing the sources of insecurity and uncertainty. Sharing of information and experiences function as a way to demonstrate commitment which leads to a higher level of trust and a better atmosphere for creating and enhancing an ongoing strategic business relationship.

Relationships that partners ultimately deem successful involve co-operation and coordination to create new value together rather than mere exchange (Kanter, 1994; Christopher and McDonald, 1995; Grönroos and Ravald, 1996). The relationship and interaction process between the partners are influenced by the atmosphere in a specific environment where they co-operate and operate. In turn, the atmosphere is influenced by the characteristics of the parties involved and the nature of the interaction itself. The atmosphere can affect the relationship by improving it or by making it worse.

This atmosphere can be described in terms of power/dependence relationship which exists or emerges over the life cycle of a relationship between the parties, the technological leadership, skills and competence, the organizational size, structure, strategies and experiences, the state of cooperation or conflicts, uncertainty, closeness or distance of the relationship, as well as by the partner's mutual expectations at both the individual and organizational level. Based on our discussion, a Co-opetition (CR), can broadly be defined as:

Co-opertion Relationship (CR)

An ongoing relationship between different independent organizations (partners) which co-operate and at the same time compete with each other. They have a common vision and goal regardless of the legal or organizational forms and borders. The relationship can range from handshake agreements to licensing, and equity joint ventures. The partners are able and willing to co-operate and compete with each other on a basis of mutual commitment and trust, a mutual sharing of information, risks, and rewards of the relationship. A growing interdependence among key strategic partners is vital to continued strategic relationship. In such a CR, the partners are intended to run a non-zero sum game.

Creating a Co-opetition relationship is an efficient way to cooperate through strategic networks, as long as the sum of production and organizational costs is less than 'going it alone'. In short, the partners believe that their success does not require others to fail. They also have a philosophy that, in the spirit of trust and commitment, a win-win approach is most effective way to create a bigger pie and then obtain a bigger share of it. The main principle of CR is to seek out opportunities to create new values together and achieving synergy effects.

4 BASIC CRITERIA FOR THE SURVIVAL OF A CO-OPETIVE RELATIONSHIP

A well-developed ability to create and sustain fruitful CR gives organizations significant competitive advantages. Such relationships can also entail a huge burden and problem potential for one or more of the involved partners. The main question is how the organization of the future should develop an effective process for establishing and maintaining strategic CR.

> *"The primary task of the business manager is to handle the interdependency (between companies) by relating the actions and resources of his own company to those of its customers, suppliers and others in the complex network that surrounds it. This process is not simply about co-operation. It involves the manager working* with *other companies, but it also involves working* against *them,* through *them and often* in spite *of them* (Ford *et al*. 1998)."

The creation of a co-opetition and long-term relationship does not, of course, guarantee its long-term survival. A long-term relationship does not always promise paradise. The simple (but it may be difficult) key to run a non-zero- sum game relationship is trust and commitment. When there is trust, the need of pre-specifying

every possible future detail or outcome is greatly diminished.

Creating and enhancing a sustainable CR has both a cost and a value. It takes a long time to develop a new relationship, and the time dimension impacts the parties' profitability. Thus, the parties involved in such a relationship must have a philosophy about how they should run their ongoing CR recognizing the mutual interdependence of each partner. Each partner should consider that a poor CR can easily be turned into problems (conflicts). Indeed the best successful co-opetition relationships, like the best marriages, are true partnerships that tend to meet certain criteria. Zineldin (1998) identified the following criteria:

1. **Individual willingness, motivation, and strategic fit**: The business partners have a strong motivation for entering the relationship. They have something of value to contribute to a successful relationship. Each partner should have a clearly identifiable source of sustainable competitive advantage and it should develop an increasing level of interdependence. The business partner should have a common long term goal and they want to make the relationship work to achieve this goal.
2. **Interdependence**: The partners should have complementary assets and skills. Neither can accomplish alone what they can together. They invest in each other to demonstrate their respective stakes in the relationship and each other. They need each other.
3. **Cultural fit**: cultural fit requires that each partner carry out its commitments and shows its trusting behavior and attitude. They are able to share the information and knowledge required to enhance and sustain the relationship. Many partnerships have failed because the partners have not shared the needed information and have not allocated their best people/knowledge to the project or have placed it low on the priority agenda.
4. **Organizational arrangements and institutionalization**: The strategic business relationship is given a formal status. The partners have defined very clearly responsibilities and designed a good dispute resolution mechanism to be agreed on by them to ensure that when the first problem emerges it will not sour the atmosphere and lead to a decline in trust.
5. **Integration and Integrity**: For best survival opportunities the partners develop linkages and shared ways of operating so they can work together smoothly. They build an effective communication system between many people at many organizational levels. They do not abuse the information they gain, they are flexible, and they respect each other. They show a mutual integrity behavior and attitude toward each other in honorable ways that justify, enhance and sustain mutual trust and commitment.

Finally, as the development of a Co-opetive relationship depends on how either partner interprets and re-interprets different acts and behaviors during the life cycle of the relationship, the problem of maintaining an atmosphere of high loyalty may, therefore, be far greater than that of creating one in the first place, and it is principally in this that the challenge lies. While CR generally offers more flexibility and lesser cost than do traditional competition, organizational marriages require a melding of frequently disparate corporate cultures. Thus, unhappy relationships, many of them leading to divorce, are an all-too-common outcome, largely because of undesirable human behavior.

5 TRUST, COMMITMENT, BENEFITS AND DARK SIDES OF CO-OPETITION

Trust, Commitment and co-opetiton

It is imperative for a successful marriage relationship as well as CR between the partners to communicate, cooperate and compete in an atmosphere of frank debate, trust, interdependence, and mutual positive expectation so that the mutual benefits and interests may be achieved.

> *"Close cooperation and good communication processes are essential, gives the type of transactions involved, product features, and the client's technology...Compared to relationships with other customers, the relationship between Francelec and Honor is said to be based on an unusually high level of trust* (Perrin, and Valla, 1982)*."*

Sherman (1992) stresses that the biggest stumbling block to the success of alliance relationships is the lack of trust. Trust according to the classic view is a generalized expectancy held by an individual or an organization that the word of another individual or organization can be relied on (Rotter, 1967). Confidence on the part of the trusting party results from the organization belief that the trustworthy party is reliable and has high integrity, which are associated with such qualities as consistent, competent, honest, fair, responsible, respect, helpful, and benevolent (Sherman, 1971; Altman and Taylor; 1973).

Confidence, trustworthiness, mutual respect, ethics, and the way in which crises and difficulties should be treated and solved between the partners are central factors of relationships between people (e.g. friendship, romance or marriage) as will as business relationships. An organization must consider all of these factors in order to effectively create, manage, maintain, sustain, and enhance its relationships with other partners.

Trust does not imply naïve revelation of company secrets outside the collaborative arrangement, but it implies the belief that the partner will act with integrity. It does not either imply 'blind trust'. Trust and trusting behavior cannot be forced or

imposed. It has to be earned. Thus, developing trusted strategic business relationships will probably imply a long-term process or an evolutionary pattern, where stage by stage, the risk and uncertainty decrease, and commitment and trust increase.

Benefits of Co-opetition

In such a relationship, the partners can create new value by reducing the transaction cost, uncertainty and the level of the financial and practical risks associated with the purchase or joint investment. In such a relationship, there is a great opportunity to gain access to vast information about, for example, each partner's needs, wishes, business and investment plans, which provides a substantial competitive advantage in strengthening the strategic cooperation.

> *"Partnership in supply chain relationships is clearly a very powerful strategy. It encourages a joint approach to problems and it can lead to reductions in costs, improvements in quality* (Lamming, 1993*)."*

However, a careful strategic business relationship development based on credibility and commitment is a critical CR strategic issue. A mutually beneficial and closer relationship between suppliers and distributors/retailers based on interlinked logistics, Just-In-Time (JIT), and information on sales allows the supplier to schedule its production and distribution process on the basis of known demand rather than unpredictable upon orders.

Today, there are many organizations are competing through strategic cooperation instead of merely competition by establishing formal and/or informal strategic alliances and networks that range from simple technology and market exchanges to industrial megadeals. Examples of these organizations are Apple, IBM and Motorola the supplier of Apple's computer chips (a collaboration that would have been unbelievable 10 years ago); Orrefors Kosta Boda, a Swedish glass and crystal manufacturer who agreed to cooperate with the Danish competitor Royal Copenhagen; Mitsubishi and Volvo; IBM, GM and DEC (Digital Equipment Corporation); McDonald's; Benetton; Marks & Spencer in the U. K. and IKEA in Sweden, etc. These companies are competing through strategic business relationships and networks. Thus, they have achieved substantial and profitable growth because of their close and long-term strategic business relationships.

A sustainable partner relationship offers the partners with advantages and opportunities (Jüttner and Wehril, 1995). Partners can establish an alliance to develop collaborative programs beyond their legal boundaries in research and development, production and joint sourcing. This will lead to significant benefits and synergy effects such as:

- economies of scale,

- lower cost,
- skilled labor force,
- high R & D level
- access to superior engine technology,
- access to new markets,
- greater customer value-added is achieved at less total cost, and hence
- ensuring profit for all the partners in the alliance or network.

Dark sides of Co-opetition

As we mentioned above, most textbooks concentrate on the benefits of creating and enhancing a long-term business relationship. One main question is do all cooperation and long-term relationships promise heaven? The answer to this is, of course, such a close relationship involves cooperation and benefits, as well as burden, conflicts or even some evils/dark sides.

A close and tie CR between the involved parties has also its *limitations and disadvantages*. As a matter of fact, there is very little research on the burden and dark sides of the close relationships and this subject certainly deserves to be analyzed further.

> *"...At the same time one cannot avoid noticing that there is a lack of studies of the problems or difficulties with close relationships…Of course, there are a large number of studies analyzing market solutions, i.e. the case with no relationships, but that is another question. We mean that business relationships entail costs and problems that warrant some attention...It is argued that the burden of relationships is the other side of the benefit potential... it is the automatic consequence of the development of a fruitful relationship…"Close relationships can sometimes become 'black-holes' as mutual expectations increase and thus demand on each other's resources increases. In these cases a relationship can be an economic burden without anyone noticing it* (Håkansson and Snehota, 1995)*."*

However the following cases can illustrate some limitations and ***dark sides*** that can emerge as a result of creating too co-opetive relationships. Sometimes, creating a close relationship may entail more costs than benefits:

1. Building and keeping a too close relationship is resource demanding and always *uncertain investment* without a future outcome. A good relationship circle can turn into an *evil circle* which destroys efficiency, productivity, and profitability. The values of a co-operation are changing over time and the development of a relationship depends on *how either partner interprets and re-interprets*

different acts and different behavior during the life cycle of the relationship. Besides the obvious monetary costs, a close relationship has also *hidden costs* that must be taken into account.

2. Lack of experience in working together with new partners will probably put considerable demands on the management's time, attention, efforts, and energy which may lead to neglect of the running of the organization's core business activities. According to Bengtsson and Kock (2000) four different role conflicts exist in co-opetive relationships. These conflicts are, intra-partner conflict, inter-role conflict, inter-partner conflict, and person conflict
3. A co-optetition strategy may cause too many costs in *coordinating* and *controlling* the co-operation and competition strategies. Time and resources have to be devoted in order to learn about each other, to coordinate own activities with those of the potential partner, and to carry out necessary *adaptations* needed to maintain and enhance the relationship.
4. The adaptations (e.g. technological, economical, cultural, psychological, or administrative adaptations) also require resource mobilization. The predicted return on such investment is uncertain.
5. Sharing activities with others, and giving up control over some of the own resources to others, which seem to be more or less automatic consequence of close relationships, mean also that some degree of the own *one's freedom is lost*.
6. An important co-opetive relationship may be managed so poorly that a strategic opportunity is lost. Frequently that producers and distributors have *conflicting goals* and objectives. A manufacturer may believe that a distributor is not efficient enough or not actively pursuing new customers.
7. *Power* and *dependence* can also be viewed as conflict sources. One party can use its power (e.g. technical, political, financial, or emotional) to force another party to act in a way that is not in the counterpart's economic best interest. If a dealer is depended on one producer or few manufacturers, the manufacturers can force the dealers to take excessive inventory and incur high service cost. If a producer is highly dependent on a distributor, the distributor is powerful and has great influence over the manufacturer. In this case, the distributor can use its power in punishing the manufacturer. The company may lose touch with final customers.
8. If organizations become more dependent on other parties their vulnerability may increase. Too close CR can take *flexibility* away from an organization by forcing it to be tied to a specific technology. Some organizations/individuals can find themselves psychologically and economically far tighter than they had never considered before engaging in such a close relationship.

9. Being in a too close relationship can easily function as a barrier to leave this relationship. If partner X wishes to leave (for whatever reason), and such a wish is rejected by the partner Z. X may feel betrayed in case of losing the investments earlier made. Many subcontractors (de-integration form of alliances) who are *highly dependent* on their subcontracting companies may go into large financial trouble not because of inefficiency or of lack of their productivity but due to the problems that their customer may have.

Long-term business relationships do not come free of problems. When Ikea's" a Swedish world wide furniture company" sales volume has been reduced, very recently, many of its strategic partners (subcontractors) in Sweden and Denmark have gone bankrupt (Billing, 1996). The KLM "Royal Dutch Airlines" and Northwest Airlines alliance did not live up to its expectations and was considered a failure. KLM invested $ 400 billion in North West Airlines and the result was large losses for both (Alexander *et al.* 1993).

6 CONCLUSION

The development of a long-term CR for the organization of the future requires moral, ethic standards and enough trust and a willingness not to try to exploit the new relationship at the expense of long term cooperation, patience-payoff often takes time. Creating such a CR is like a marriage. There is a courtship period, when both parties begin to get to know each other. Then there is ceremony, or contract to do business, which binds both parties to certain terms and conditions. Also, there are conflicts between the couple. If the relationship becomes unsatisfactory for either party, there is a divorce. As a result of the evils outlined above, one natural question is: *Should people, countries or organizations have relationships at all*? A logical answer is that the question itself is an illogical one. A co-opetition relationship does not always promise heavens, at the same time, there is no life without relationships. People, countries, or organizations are not islands. Life without relationships which include sharing, love, passion, romance, friendship, anger, fear, interaction, conflict, and interdependencies is meaningless. A cornerstone is that the decision to be involved in a too close exchange relationship is not an easy issue. The burden/dark sides of relationships outlined above do not imply that the need to create, develop and enhance relationships is not important, rather it is essential to be realized and considered when facing the complexity in real-life, in order to have a realistic expectation of both pros and cons.

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TQM VIA 5-S PRACTICE

TQM S VYUŽITÍM PRAKTÍK 5-S

SAMUEL K. M. HO

1 INTRODUCTION

The 5-S practice is a technique used to establish and maintain quality environment in an organisation. The name stands for five Japanese words: Seiri, Seiton, Seiso, Seiketsu and Shitsuke [Osada, 1991]. The English equivalents, their meanings and typical examples are shown in the following table:

Japanese	**English ***	**Meaning**	**Typical Examples (out of 50) ***
Seiri	Structurise	Organisation	Throw away rubbish / return to store
Seiton	Systematise	Neatness	30-second retrieval of document
Seiso	Sanitise	Cleaning	Individual cleaning responsibility
Seiketsu	Standardise	Standardisation	Transparency of storage
Shitsuke	Self-discipline	Discipline	Do 5-S daily

* Invented by the author

The technique has been practised in Japan for a long time. Most Japanese 5-S practitioners consider the 5-S useful not just for improving their physical environment but for improving their thinking processes as well. Apparently the 5-S can help in all walks of life. Many of the everyday problems could be solved through adoption of this practice.

2 MANAGEMENT OF CHANGE

There is an old saying: "the only constant is change". If change is part of our daily life, how can we drive it under our control rather than being driven off by it? Change in organisation would, in the long run, lead to change in the organisational culture. A typical example is the learning organisation, where people are excited in trying out new ideas and recognise that failure is an important part of success. Let us take a step back to look at the traditional strategic change process which can broadly be summarised by five key steps [Ho, 1999]:

Vision ==> Mission ==> Behaviour ==> Action ==> Culture

A new paradigm is:

Action ==> Behaviour ==> Mission ==> Vision ==> Culture

In fact, the first step is nothing new. Peters and Waterman [1982], have already found out from over 46 successful firms that most of them choose 'action' as step number one in their pursuit towards excellence. The new idea here is that action leads to behaviour change of the employees. This arises from the learning process, and as Reg Raven [1983] said: "There is no learning without action and no action without learning." If learning has been taken successfully, the organisational behaviour will be lifted to a dynamic and challenge-seeking level. This will influence the top management in defining their mission. By then they are confident that the mission, spin off from the better organisation behaviour, will take off once it is announced. The chief executive will then be in a position to develop the corporate vision which will take the organisation through to world class against competition. Built on firm foundations, the new vision will establish a new culture within the organisation. One best known example of this new culture is 'Kaizen', the Japanese word for continuous improvement. Being action oriented, 5-S is a powerful quality tool for everyone to get involved in the improvement process. Therefore, it is a very effective way to implement the new management paradigm.

3 IS 5-S PRACTICE APPLICABLE TO THE WESTERN WORLD?

Research by Ho [1995] has shown that the western world seldom recognises the significance of the 5-S practice although there are indications that some companies have included some aspects of the 5-S in their routines without being aware of its existence as a formalised technique. There are many examples of successful implementation of some principles of the 5-S, especially in the service sector organisations, such as fast-food restaurants, supermarkets, hotels, libraries, and leisure centres. The difference between the Japanese and western approach lies mostly in the degree of employee involvement. By formalising the technique, the Japanese established the framework which enabled them to successfully convey the

message across the organisation, achieve total participation and systematically implement the practice. The 5-S has become the way of doing businesses, not only to impress the customers but to establish effective quality processes as prerequisites for good products and services.

4 THE 5-S PRACTICE IN DETAIL

In order to be able to comment whether 5-S practice is useful, the proprietary 5-S Audit Worksheet developed by Ho [1995] is exhibited below. Following the rule of TQM (i.e., KISS – Keep It Short and Simple), the check-points are mostly self-explanatory:-

5-S	What © Prof. Sam Ho – samho@hkbu.edu.hk	Where	How (4/X)	Who	When
S-1: Structurise					
1.1	**Throw away/return things which are not needed.**				
1.2	**Paperless and Re-cycle Bins for papers, bottles, etc.**				
1.3	**"Needed things" stored: low, medium & high usage**				
1.4	**Personal belongings kept to the minimum**				
1.5	**Treat defects, leakage, breakage and their causes**				
1.6	**One-is-best #1:Daily "Things-to-do" List**				
1.7	**One-is-best #2: one set of tools/stationery/1-page form**				
1.8	**One-is-best #3:one hour meeting**				
1.9	**One-is-best #4: one stop service for customer**				
1.10	**One-is-best #5: one location file (e.g. LAN server)**				
S-2: Systematise					
2.1	**Everything has a clearly designated name & place**				
2.2	**Every place should have a 'responsible person' label**				
2.3	**Eliminate unnecessary covers and locks**				
2.4	**Functional placement for leaflets, tools and material**				
2.5	**Filing standards and control master list**				
2.6	**First in, first out arrangement**				
2.7	**Zoning and placement marks**				
2.8	**Neat notice boards (also remove obsolete notices)**				
2.9	**Easy-to-read notices (including zoning)**				
2.10	**30-second retrieval of tools, document & parts**				
S-3: Sanitise					
3.1	**Individual cleaning responsibility assigned**				
3.2	**Make cleaning and inspection easier**				
3.3	**Clean even the places most people do not notice**				
3.4	**Cleaning inspections and correct minor problems**				
3.5	**Regular sparkling cleaning campaigns**				
S-4: Standardise					
4.1	**Transparency (e.g. glass covers for see-through)**				

4.2	**Straight line and right-angle arrangements**				
4.3	**'Danger' warning signs and marks**				
4.4	**Fire extinguisher and 'Exit' signs and safety device**				
4.5	**Work instructions and 'passed' labels**				
4.6	**Electrical wiring neatness and switch labels**				
4.7	**Energy Preservation – Aircon temp. mark/switch**				
4.8	**Colour-coded gangways/ pipes and directional marks**				
4.9	**Colour coding -- paper, files, containers, etc.**				
4.10	**Responsibility labels on floor plan or at site**				
4.11	**Prevent noise and vibration at source**				
4.12	**Department/office labels and name plates**				
4.13	**Foolproofing (Poka-yoke) Practices**				
4.14	**Park-like environment (garden office/factory)**				
4.15	**5-S Museum (including photos before/after 5-S)**				
S-5: Self-discipline					
5.1	Execute individual 5-S responsibilities				
5.2	**Wear, if necessary, safety helmet/gloves/shoes/etc.**				
5.3	**Good communication and telephone practices**				
5.4	**Daily 5-minute 5-S Practice**				
5.5	**One day processing of job/tasks**				
5.6	**Practise dealing with emergencies**				
5.7	**Organisation Chart and Performance Indicators**				
5.8	**Design and follow the 5-S Manual**				
5.9	**Quarterly 5-S Audit and Improvements**				
5.10	**Seeing-is-believing: check for 5-S environment**				

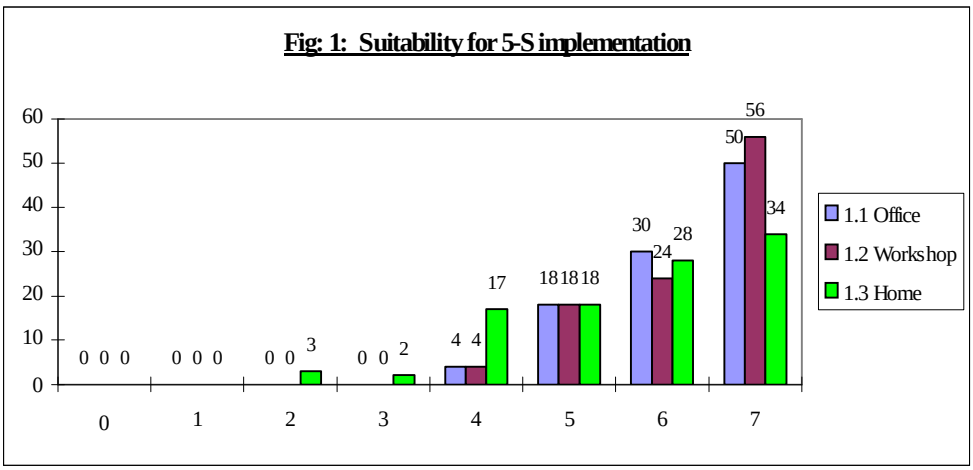
5 THE HONG KONG 5-S CAMPAIGN

In order to promote the 5-S practice in Hong Kong, it is important that a massive promotional campaign be launched together with a easily accessible training programme. In 1998, the HKSAR Government approved a HK$4.6 million training programme for the author for training up 2,500 people in two years' time as 5-S Lead Auditors, the first of its kind in the world. Each delegate was given a copy of the 5-S Workbook and attended two half-day sessions in consecutive weekends. In between the two Saturdays, the delegates had to do the 5-S Audit at their own organisation. Ten photos had to be taken, one each for the good and bad examples of 5-S. There was a written test on the second day, and each delegate would be awarded the 5-S Lead Auditor Certificate if they pass both the live audit and the written test. Since launched in April 98, over 5,000 Lead Auditors had been trained, including a number of in-company training for the manufacturing, service, health, education and public sectors. In 1999, the HK 5-S Association was established in order to continue promote the HK 5-S Campaign beyond the end of the funded project, with the world's first 5-S Convention held in May 99. Moreover, the training programme was franchised to the HK Civil Service Training

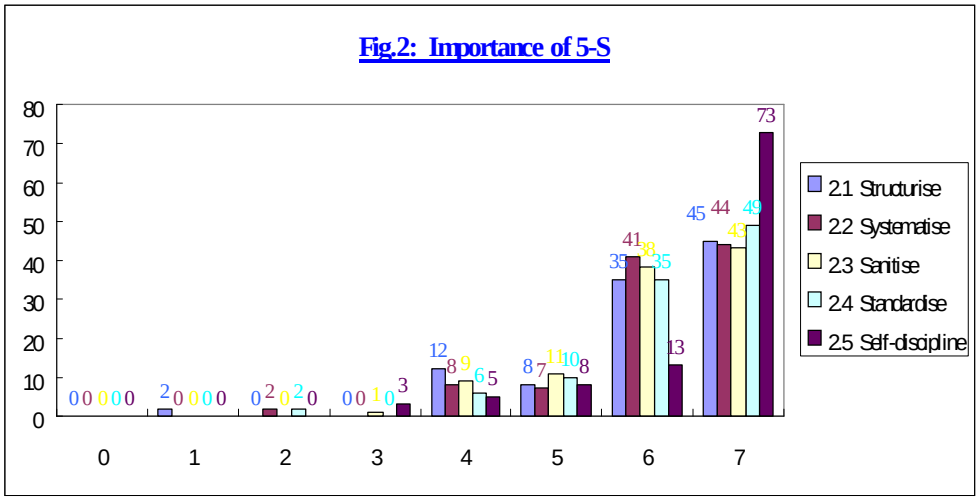
and Development Institute, Hospital Authority, DHL, and some statutory organisations in China.

In May 2001, a questionnaire survey was conducted to find out the suitability, importance, difficulties and benefits of 5-S implementation, based on a sample size of 102 delegates who attended the Annual 5-S Convention. The findings are shown in **Figure 1-4, and they are summarised as follows.**

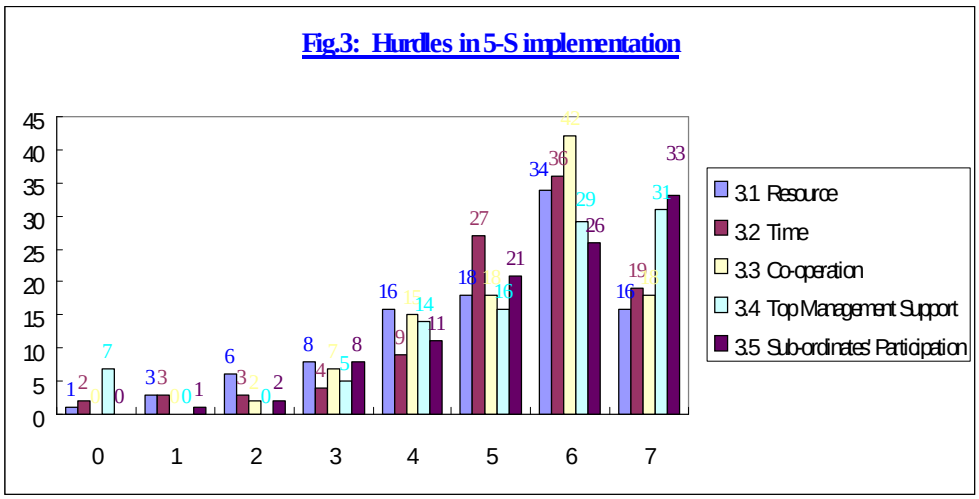
In Fig.1 (Suitability for 5-S Implementation), most respondents find 5-S suitable for implementation at their workplace and at home, with a skew towards scale 7 of the Likert 7-point scale. Moreover, workshop areas finds most benefit when compared with office and home.



In Fig.2 (Importance of 5-S), most respondents find 5-S suitable for implementation, with a skew towards scale 7 of the Likert 7-point scale. Moreover, majority people consider self-discipline as the most important element out of the 5-S.

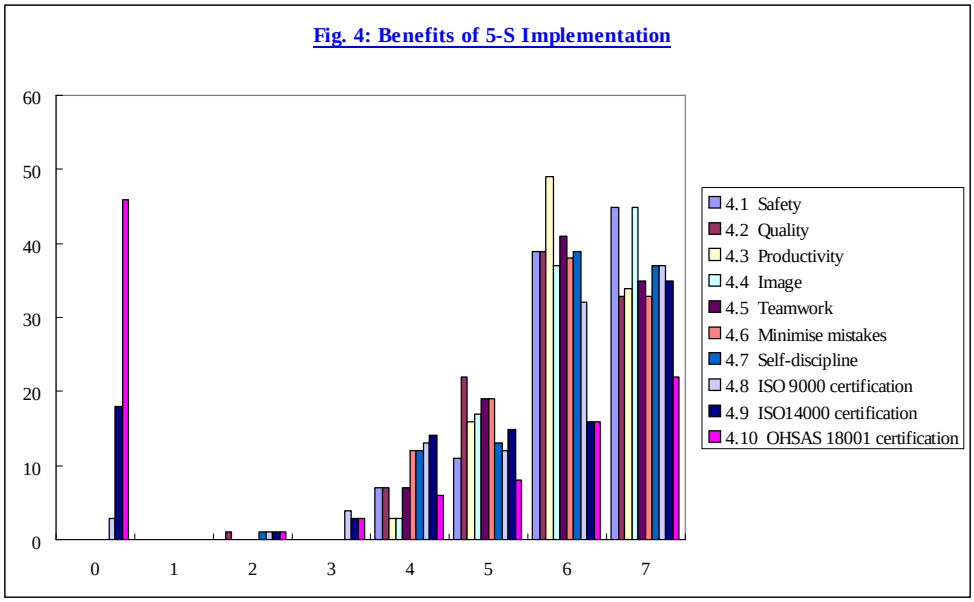


In Fig.3 (Hurdles in 5-S Implementation), most respondents find all elements (resource, time, co-operation, top management support and sub-ordinate's participation) relevant hurdles which they have to overcome. Amongst these, top management support and sub-ordinates' participation are most crucial.



In Fig.4 (Benefits of 5-S Implementation), most respondents find all 10 elements relevant benefits which they can achieve. Amongst these, safety, quality, productivity and image are more important to them. One interesting finding is that, for those respondents know about ISO 9000, ISO 14000 and OHSAS 18001, they all agreed that 5-S is useful as a stepping stone for their certifications – a distinctive

skew towards point 6-7.



The HK 5-S Association started certify companies for their 5-S practice, somewhat like the ISO 9000 certification. The major difference is that the 5-S manual is very thin (not more than 50 pages, and including 50 standard photos). For those who are certified, they find it very effective to motivate everyone to get involve, hence the word 'totality' of TQM. Since launched in 2000, 16 companies have been registered, and many more are in the process. The feedback from the senior executives of the sampled companies are quoted below.

5.1 A Construction Company

"The Hong Kong construction industry most operates under very low profit margins due to the competitive nature of the prevailing tendering systems. The hair-split difference between profit and loss are largely determined by how good our firm can organise, standardise and discipline our daily activities. We have found the 5-S useful in helping us to meet the quality and delivery requirements of our clients."

5.2 A Property Maintenance Organisation

"5-S is a simple but effective tool to improve productivity through a better management of the working environment. In view of the vast volume of work as well as data handled by the Maintenance Division, there is a need to adopt a systematic approach to organise information and manage our operations in order to provide a better service to public housing residents. The use of 5-S techniques

provides a solid foundation for the implementation of the Quality Management System in the Maintenance Division."

5.3 A Manufacturer with Factory in China

"Neatness and tidiness have always been our principles for creating a comfortable and safe working environment for our staff. The 5-S has provided us with a framework for implementing our principles effectively and systematically."

5.4 A Retail Outlet

"We aim at the operating the best traditional Chinese food chain in Hong Kong. In order to achieve this, we are totally committed to provide quality product and services to our customers. Our experience has confirmed that the 5-S practice is a very useful tool for us to provide a pleasant and customer-centred environment, making eating a completely new and exciting experience."

5.5 A Government Department

"The 5-S lays a foundation for our quality programmes and enables us to continuously improve our services to the customers. Staff can easily understand the simple and effective tools under the 5-S and apply them in their daily work with improved results. In addition, implementation of the 5-S provides a pleasant working environment conducive to staff morale and productivity."

6 THE NEW 5-S PARADIGM TOWARDS TQM

Through in-depth research in Hong Kong, Japan and the UK, the author has identified the 5-S practice as the step number one for a TQM programme [Ho & Fung, 1995]. Being action oriented, 5-S is an important step towards process improvement, the key to ISO 9000, IS• 14000 and OHSAS 18001. When added with the 50-points of the 5-S element, the quality, environmental and safety management systems can be steered towards TQM as shown in the flow diagram below:

5-S **è** ISO 9000 / IS• 14000 / OHSAS 18001 **è** TQM

The author is doing a longitudinal research in leading a number of major construction companies in the HKSAR towards TQM based on the above new 5-S paradigm. Since the construction industry in HK required certified in all three management systems by their major clients, they are experimenting to see how 5-S can be used as an integrating tool for this “Change Management”. A successful story was recorded in one of the construction sites in Tseung Kwan O in the Kowloon Peninsula. It has now been widely recognised as a model site for the construction industry, with zero accident, little quality problem, high productivity and meeting target completion date. More accurate comparative data before and

after changes are being collected in order to show more significant statistical results and analysis based on different site conditions.

7 CONCLUSIONS

The 5-S practice is a well-recognised methodology used by the Japanese for improving the work environment. It was found to be key to quality and productivity. This paper details the proprietary 5-S audit methodology and reports on how it has been adopted and adapted to the Hong Kong business environment through the training programme and case studies conducted by the Industry Department. The 5-S practice is useful because it helps everyone in the organisation to live a better life. It is the starting point of a TQM programme. In fact, many successful organisations, east or west, have already included some aspects of the 5-S in their routines without being aware of its existence as a formalised technique. The Hong Kong Government is fully committed to promoting the 5-S practice in order to help industries to improve their competitiveness. It is therefore hoped that this paper will serve as a seed and a working manual to promote such an effective and important quality techniques world-wide.

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DYNAMICS OF PRODUCT MIX DECISIONS

DYNAMIKA ROZHODOVANIA O PRODUKTOVOM MIXE

OLLI-PEKKA HILMOLA & TIMO LAINEMA

1 INTRODUCTION

Manufacturing companies face increasing requirements in the current global market place. As has been noted, the product life-cycles have dramatically shortened and within meantime the product variety has increased (Stalk & Hout 1990). This has caused several new interesting research directions. Many different studies have revealed that the information sharing among the supply chain partners as well as the development of more agile operations is very beneficial (Ackere, Larsen & Morecroft 1993; Lee, Padmanabhan & Whang 1997; Helo 2000; Hilmola 2000). However, the linkage to the whole business perspective has not been taken comprehensively into account. In the dynamic market place the results sometimes develop to yet unknown directions. For example, in many different research papers it has been shown that product mix decisions have very significant impact on business results in static setting (Goldratt 1990: 64-99; Corbett 1998; Corbett 2000; Hilmola 2001). But what if these decisions are put on the market place, where participants could learn from their mistakes and reshape used strategies?

The main research interest in this paper is product mix decisions, especially in dynamic manufacturing context, where there exist several companies, which could compete against each other. However, firstly the importance of product mix decisions within the static situations is introduced using simplified example. Afterwards the real time management game, called REALGAME, is introduced. In this section is also presented the parameters of this manufacturing management game in the beginning, when ten different student groups started to play against each other. The empirical part consist the analyzed results of this gaming session. According to it we conclude that the concept related to “focused factory” will produce desired results (Skinner 1969 & 1974). Thus, chosen product mix strategy will have an effect to the overall performance, and thereafter increase profits significantly.

2 PRODUCT MIX DECISIONS

Sustainable competitive position is eventually build up by the decisions related to the product mix, and most often it is considered that inside of the company there exist products which are more profitable than others. This results from the "rationalist" thinking based on the idea that choosing the most profitable product is conducted by the straight forward cost accounting procedures. Some of the more advanced approaches of cost accounting even try to share all the possible cost items to products with so called "cost drivers" (e.g. Gantt 1916; Staubus 1971; Kaplan 1984; Johnson & Kaplan 1989: 227-263; Kaplan 1995). These might include any arbitrary selected operational business measures, such as sales orders received, purchasing orders, manufacturing setups, manufacturing cycle time, total flow time of a product etc. However, the main idea has not changed at all – there surely exist profitable product somewhere inside of the available product range, but we only need to discover it by accounting exercise (Goldratt 1990: 64-99: Corbett 1998; Corbett 2000; Hilmola 2001).

To demonstrate the importance of product mix decisions, is imaginary manufacturing company offering only two different products used as an example. As is presented in the Figure 1 (Bill of Material (BoM) and product routing combined), products are similar in terms of purchasing. Both of these will require same amount of purchases, totally worth of 50 € per unit. However, production process requirements as well as product prices differ. Product XYZ requires 15 minutes per unit for manufacturing and 10 minutes for assembly, where product 123 will need 35 minutes for manufacturing and five minutes for assembly. As was mentioned, product prices have some differences. Product XYZ is priced to cost 70 €, where product 123 has price of 85 €. This is quite significant difference, in absolute terms 15 € (21 percent).

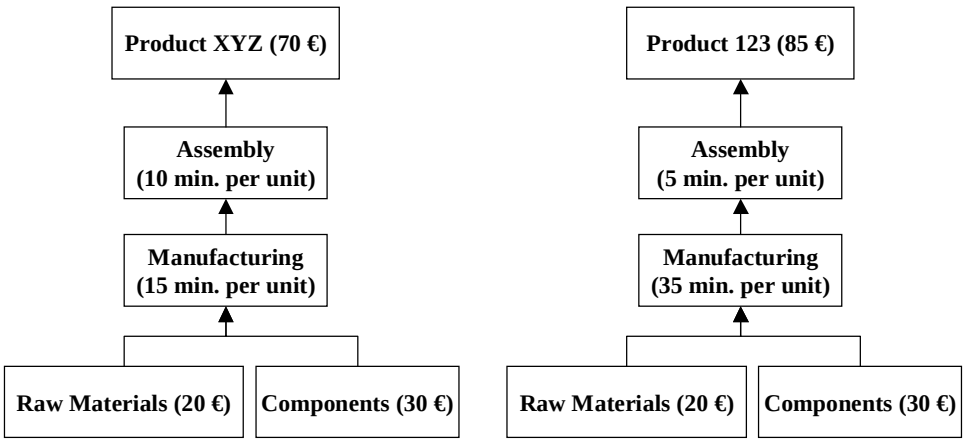

Figure 1 - Two different product alternatives, product XYZ and 123.

What kind of information we need more to make decisions related to product mix? Within current situation we assume that sales potential for both presented products is infinite and manufacturing process has as well infinite amount of capacity available. In reality both of these will have constraints. If they do not have, presented system, in this situation one imaginary company could grow endlessly in exponential terms. So, it is assumed that sales potential for products is as follows: for product XYZ it is 250 units per week and for product 123 it is slightly less, totally 150 units per week. Production capacity is as well limited. Manufacturing and assembly departments have weekly production capacity of 6000 minutes available. If it is also considered that other expenses than direct material are fixed (direct labour & overhead), totally 6 500 euros per week, we could start to sketch possible solutions.

Of course decision related to the right product mix would be unnecessary, if the available manufacturing capacity would be enough for the sales requirements. The rough check could be made with the information available from product routings (Figure 1). As could be noticed, the capacity of manufacturing function could be possible constraint. Producing 250 units of product XYZ would require 3750 minutes, so remaining 2250 minutes should be enough to produce 150 units of product 123. However, with short calculation it could be concluded that producing 150 units of them, the capacity available in the manufacturing function should nearly double (5450 minutes is required and only 2250 minutes available). So, now the right decisions related to the right product mix are more than needed. Should manufacturer concentrate to XYZ or 123? Which one of them should be preferred?

If decision would be based on the simple information concerning profitability of a single product, surely product 123 would be chosen. As previously mentioned, it will require same amount of purchases with XYZ, but its sales price is 15 euros above another. So there should not be any questions, why this product should not be favored. As the first priority manufacturer should produce all the demand, which market will require. If any capacity is available in manufacturing, it could be used to produce product XYZ.

The results of previously made decision could be found from Table 1. After producing 150 units of product 123, manufacturer will produce with remaining capacity product XYZ, totally 50 units. With chosen product mix manufacturer will end-up to the situation, where it will produce 250 euros loss, instead of desired profits. It would not be big surprise that manufacturer would focus then its efforts to sell more product 123, increase the capacity of manufacturing and downsize (re-engineer) capacity in the assembly function. However, these actions will require some time to be realized and it should be noted that every week additional 250 euros is produced as losses (13 000 euros in a one year time). Implementation of actions

might take too long with respect of shareholder patience.

Table 1 - Financial consequences of product mix decision based on assumption that product 123 is more profitable than product XYZ.

	XYZ	123	All
Quantity	50	150	200
Sales Price	70,00 €	85,00 €	81,25 €
Direct Material	50,00 €	50,00 €	50,00 €
Throughput	20,00 €	35,00 €	31,25 €
Total throughput	1 000,00 €	5 250,00 €	6 250,00 €
Operating Expenses			6 500,00 €
Profit/Loss			-250,00 €

	Cycle Time	Cycle Time	Required	Available	Difference
Assembly	10	5	1250	6000	4750
Manufacturing	15	35	6000	6000	0

With the approach called throughput accounting, the undesired situation could be avoided (e.g. Goldratt 1990; Corbett 1998; Corbett 2000; Hilmola 2001). No further actions needed, plain and simply, only producing product XYZ as much as possible and with remaining capacity producing product 123. How this kind of decision could ever be justified?

Favored product (XYZ) has lower sales price and lower profitability, in absolute and proportional terms. But what if the profitability is not evaluated according to cost accounting information, but as well using capacity of manufacturing process? If manufacturer would be seen as a money making machine, the profits should be made through value adding process and within the pace of it.

What is the drum of presented manufacturing process? If it is not the assembly function, then it should be manufacturing. And of course it should be, because we are lack of capacity there. However, being lack of capacity is not undesired situation. In the longer term companies cannot have excess amounts of capacity available, because further investments are needed to be made according to the diminishing demand. So, the capacity eventually is the issue of pricing. Wrong price and you are history (in terms of business).

In used exemplary situation the price has been set out in the markets, manufacturer could only choose which product to sell (and produce). It could be estimated that product XYZ will produce 1.33 euros per minute in manufacturing function (sales price less direct material divided by the cycle time; 20 € per 15 min.), where product 123 will produce 1.00 euros (35 € per 35 min.). To be profitable,

manufacturer would need on the average more than one euro per constraint minute, because other than direct purchases are estimated to be fixed in the short-term. Totally 6 500 euros per week is needed and we have only 6000 minutes of manufacturing capacity available. It should be noted that the requirement is on the average, so the manufacturer could still produce 123, if there is some capacity available. Something is better than nothing. So, according to this logic, manufacturer will favor product XYZ instead of product 123. Firstly is produced as much as XYZ and if there is any capacity left, product 123 is being produced.

Table 2 - Financial consequences of product mix decision based on assumption that product XYZ is more profitable than product 123.

	XYZ	123	All
Quantity	250	64	314
Sales Price	70,00 €	85,00 €	73,06 €
Direct Material	50,00 €	50,00 €	50,00 €
Throughput	20,00 €	35,00 €	23,06 €
Total throughput	5 000,00 €	2 240,00 €	7 240,00 €
Operating Expenses			6 500,00 €
Profit/Loss			740,00 €

	Cycle Time	Cycle Time	Required	Available	Difference
Assembly	10	5	2820	6000	3180
Manufacturing	15	35	5990	6000	10

The results of made decision could be seen from the Table 2. According to it, manufacturer would produce 250 units of XYZ and 64 units of 123. This will provide very favorable results; instead of losses, manufacturing unit seems to be very profitable. No further actions are needed, manufacturer would only need to ensure that the markets of XYZ would not dramatically change and the capacity in manufacturing function is available as promised. However, in the meantime manufacturer could start to seek available capacity from alternative sources (e.g. subcontracting). This should not be too difficult, because every 123 will produce 35 euros more profit, so every minute costing below it should be carefully considered. Of course subcontracting would require as possible some amount of free coordination capacity, free transportation capacity and inventory investments, and therefore costs of these should also be taken under consideration.

3 RESEARCH PROBLEM FOR THE STUDENT GROUPS USING REAL TIME PRODUCTION GAME

The interest area of this paper, product mix decisions within dynamic environment, were studied using the results of REALGAME interactive on-line production game (Lainema 2001a & 2001b). This game was played in the local network between ten different groups, which contained approximately three persons of second/third year M.Sc. (Econ. and Business Adm.) students. All of these students participated one course related to the issues of industrial management. So, it could be concluded that these students should have some amount of awareness and knowledge, how industrial companies should and could be managed. However, different groups competed against each others in the "virtual" environment, where made decisions were about to be made in dynamic manner, and therefore giving very challenging task for them to reshape made decisions, if necessary. It should be noted that not only the production process was uncertain, right decisions should be made also in purchasing and marketing. Everything in the game changes according to the made decisions, and therefore the successful strategy will contain many specific, in the situation related parameters. Figure 2 represents user interface of REALGAME: player could open and close needed modules of different business areas to complete desired actions.

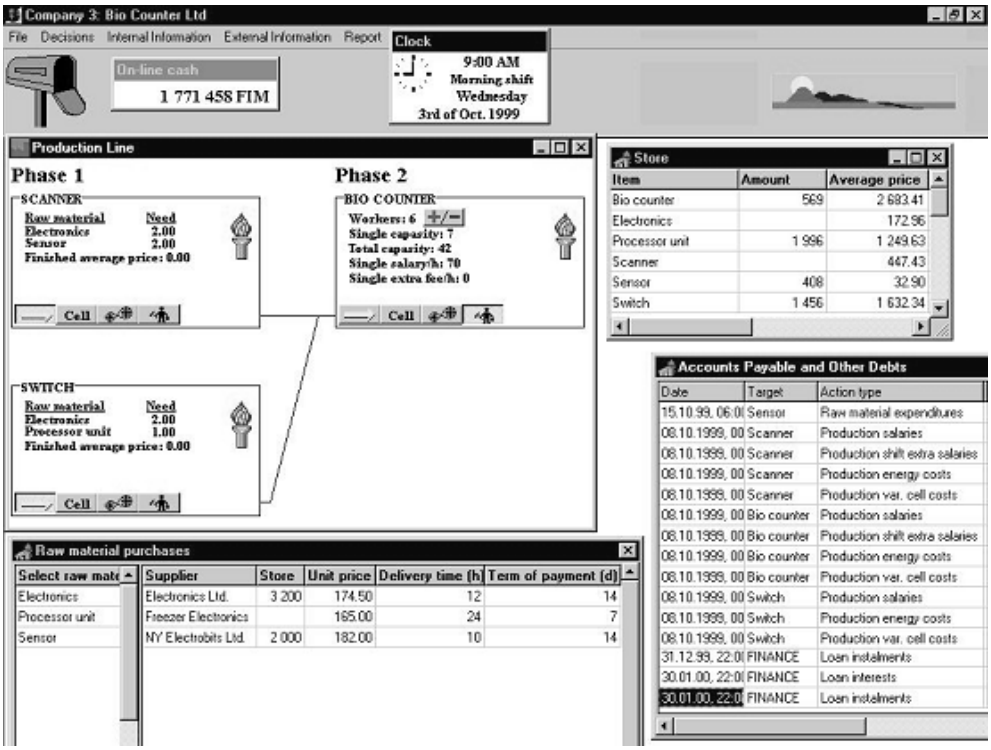

Figure 2 - User interface of REALGAME.

The starting parameters of two different products (these could only be offered; no product development work could be completed) were set as is shown in Figure 3. Products were quite similar in terms of manufacturing, deluxe model of product called Bio Counter needed two manufactured switches instead of one (the case with regular model). So, the direct purchases were in deluxe model over one and half times more than in regular model. The determination of direct purchases is anyway troublesome, because the costs of purchases are dependent to the used purchasing lot sizes and desired supply lead time. However, on the average total purchases of regular model were 6 784 euros and correspondingly in deluxe model these were 11 306 euros. If direct material costs are compared to the average sales prices in three different markets, it could be concluded that regular model will produce approximately 1 500 euros profit, where deluxe model will produce 100 euros of deficit. It should be highlighted that these estimations are only the values in the very beginning, and these could dramatically change, if the different groups are about to notice that prices should be increased.

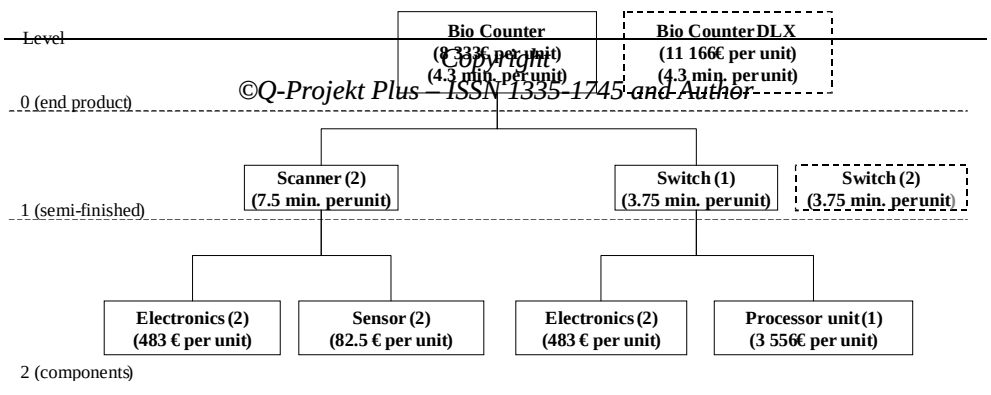

Figure 3 - Bill of Materials (BoM) and product routings of two alternative products (Bio Counter and Bio Counter DLX).

As could be concluded from product routings of Figure 3 as well as from the capacity available given in Table 3, the capacity constraint will develop to the different places with selection of different product mixes. If all the efforts are focused to the production of regular model, then capacity of scanner function will most probably represent constraint. In the opposite situation, where only deluxe model is being produced, with high probability the capacity of switch function will represent constraint then.

Table 3 - Capacity available and setup times of required resources (minutes per week).

Phase	Capacity	Setup time
Final Assembly	480 min.	120 min. for Bio Counter and 180 min. for Bio Counter DLX
Manufacturing of Scanner	1440 min.	360 min.
Manufacturing of Switch	480 min.	360 min.

However, chosen production strategy will affect to these assumptions (e.g. Tersine 1985: 458-496; Lockamy & Cox 1991; Ptak 1999: 63-81). If inventories are desired to be accumulated just before final assembly (Assembly-to-Order, ATO), instead of end-item inventory (Make-to-Stock, MTS), the constraint could shift to assembly function. This is inconsequence of increased setup activity due to shorter production lot sizes of assembly. Also made decisions during the game could change the situation dramatically; shrinkage of capacity in some function or oppositely capacity enlargements using more working shifts and/or increased investment activity could have their effect.

4 EMPIRICAL DATA ANALYSIS

All of the empirical material analyzed in the following is a result of one three-hour gaming session, and according to "the internal clock" of the game this is correspondent for 44 business days (roughly six weeks). All of the groups were familiar with the game controls, because they had played game one time before, but

not with so high level of managing requirements (e.g. internal clock was much slower, direct purchases were less for produced and sold products, more manufacturing capacity was available and both of the products had positive margins after deduction of direct materials).

In the Table 4 is shown correlation analysis of different performance measures, which were the result of three-hour gaming session (Note: The number of observations is quite small, because only ten different student groups were participating analyzed gaming session.). First four measures are production related; two first mentioned are produced amounts of semi-finished products (scanner and switch) and two following reveal produced quantities of two final products (Bio Counter & Bio Counter DLX). Fifth measure is absolute profit and the last one is measuring the successfulness of general production management (inventory turns). As could be noticed from Table 4, only three statistically significant ($p < 0.05$; underlined and with bold font) correlations were identified.

Table 4 - Correlation between different performance measures in REALGAME (n=10).

	[1]	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*
[1] Scanner, produced (units)	1.000					
[2] Switch, produced (units)	**0.907**	1.000				
[3] Bio counter, produced (units)	0.459	0.044	1.000			
[4] Bio counter DLX, produced (units)	0.623	**0.893**	-0.409	1.000		
[5] Profit	0.332	0.003	**0.742**	-0.311	1.000	
[6] Inventory turnover (per year)	0.477	0.393	0.248	0.271	0.595	1.000

The first correlation, the positive one, was identified between production of two semi-finished products (scanner and switch). This correlation could be explained with generally chosen product mix strategies – in total groups favored two product alternatives equally (in total production quantity was 168 694 units, from where the regular model accounted 59 % and deluxe model remaining 41 %). It could be assumed that there were groups, which tried concentrate to one from two final product alternatives. However, it is interesting to note that there did not exist any group, which had courage to concentrate only on deluxe model for whole 44 day period. Maybe losses gave their indication to change chosen strategy. Oppositely there exist four groups out of ten, which solely produced and sold regular model. Maybe success gave support for chosen strategy and it encouraged continuing with it. This phenomenon has been identified and reported by Schein (1985).

Understandably production quantities of deluxe model and switch (semi-finished item) had positive correlation. This could be explained with the behavior of six

student groups, who decided to produce both product alternatives. It should also be noted that regular model only needed one switch, but deluxe model contained two of them. Interestingly, production quantities of switch did not have any correlation with produced units of regular model. Also notable is the correlation between production of another semi-finished product, scanner, which had lower correlation with regular model (0.459) than with deluxe (0.623). Explanation for all of this is also arising from the two alternative final products – when finally student groups noticed that regular model is more profitable to produce, they rushed to its market. Suddenly in regular model's market there were companies with totally different amounts of cumulative production. There were companies, which had tiny fraction from total production (from one to three percent; totally four companies), companies which had around 10 percent from it (totally three companies) and three remaining companies, which had share around 20 percent or above (ranging from 18 to 29 percent). If this is compared to the markets of deluxe model, the three biggest producers eventually took 87 percent from total market, where three biggest producers in regular model market had only 66 percent from total market. So, it could be argued that "oligopolies" could develop because of poor managerial decisions – of course the interest towards these markets will suddenly collapse, when the companies start to realize that profits are not easily available. The concentration of these markets will also make it harder to change the product pricing dramatically in short time for desired direction. Companies with market dominance will produce some small profit even with only minor adjustments of prices.

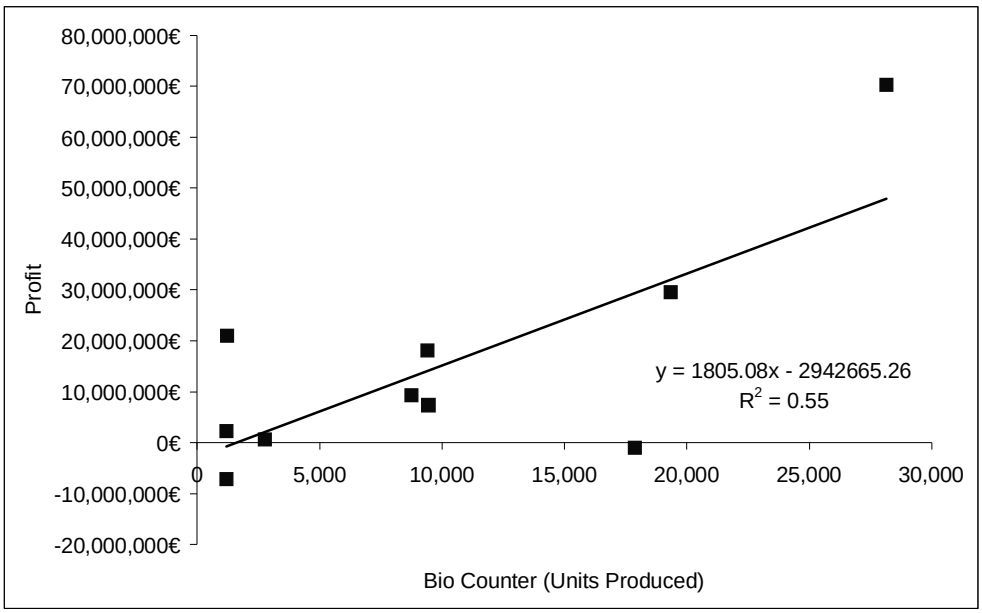

Figure 5 - Produced amounts of Bio Counter determines the level of profits.

The third and last statistically significant and also positive correlation could be noted to happen between regular Bio Counter production and absolute profit. Correlation is quite strong, even if the competition in the markets was increasing in the latter parts of the game. However, as the regression graph (Figure 5; above) reveals that the deviation around rising linear curve is quite extensive. There was even one company, which tried to focus on both of the end products. According to its Bio Counter production (17 887 units), the linear regression curve predicts that the absolute profit for it should be around 30 million euros, but in reality it is one million euros negative. Sometimes unfocused product mix approach (concentrating to everything) might lead to very devastating results. Interestingly, four companies operating in low volume environment have also quite different results. All of these companies were trying to satisfy markets of both products. The highest profit in this group is achieved by the company (21 million euros, third largest in absolute terms), which is the second largest in the deluxe model market (cumulative production volume 15 561 units), so the scale benefits will create very good platform for the production of lower volume, but very similar product. Lowest result in this group (minus seven million euros) is caused by the very low volume in both markets (1 211 units of regular model and 4 531 units of deluxe).

So, as a rule of thump it could be argued that manufacturing company needs to have certain amount of volume, even without given any thought for the profitability. Hence, the volume might be very rewarding (Skinner 1969 & 1974; Chandler 1986; Buzzell & Gale 1987). As could be noticed from the top right corner of Figure 5, being the largest producer with focused principles is very, very rewarding. Solely producing 28 156 units of regular model will generate over 70 million euros of profit within 44 days. Similar results could be reported from the company producing second largest amount of regular products. Producing and selling only these (19 346 units) will result for 30 million euros profit.

Table 5 - Chosen product mix and absolute profit of ten different student groups.

Strategy	Profit
Focused	70,272,725.00€
Focused	29,563,989.00€
Mixed	21,010,481.00€
Focused	18,066,031.00€
Mixed	9,288,374.00€
Focused	7,316,685.00€
Mixed	2,216,160.00€
Mixed	627,395.00€
Mixed	-1,068,114.00€
Mixed	-7,165,059.00€

Table 6 - Average and median absolute profits and standard deviation with respect of chosen strategy.

Average

Focused	31,304,857.50€
Mixed	4,151,539.50€

Median

Focused	23,815,010.00€
Mixed	1,421,777.50€

Standard Deviation

Focused	27,521,048.11€	87.9%
Mixed	9,819,230.62€	236.5%

According to the Tables 5 and 6, it could be concluded that focused strategy will produce much better financial performance as compared to mixed approach. As previously has been mentioned, the two most profitable companies used focused strategy, but it is more interesting to note that this strategy will produce very positive results in every situation (places fourth and sixth). Companies using mixed strategy are able to produce also positive results, but on the average this will lead up to 4.1 million euros profit, where focused strategy is able to provide 31.3 million (7.5 times more). It should also be noted that the standard deviation in the profitability is much higher within the group of mixed strategy companies, if it is compared to focused ones.

5 CONCLUSIONS

According to the completed empirical data analysis of management gaming, it seems that using the focus in product mix decisions is one of the most important decision parameters. In used situation, different student groups could produce either or both of the offered products to the markets (Bio Counter and Bio Counter deluxe). It should be noted that in the starting situation deluxe model had on the average negative profit margin, after deduction of direct material. Despite of this, there existed at least one student group, which was able to show profits with efficiently and in right manner managed operations, even when they were practically producing only deluxe model for the markets. In other situations, where student groups tried to use mixed strategy (producing both products), the results were somewhat less successful. There even existed three groups, which had considerable volumes in regular model, but their performance was below the student group, which only focused to deluxe model production. It was not so surprising to find out that highest profits were achieved with focused strategy, directed towards regular model.

Represented research results support partly the findings arising from static product mix research. In these situations, manufacturer should give more focus for some of the offered products, instead of less profitable ones. These latter products could be produced and sold, as long as these will produce some incremental profit. However, it seems that in the dynamic environment, happened competition will ensure that this approach is not adequate. In dynamic markets, product market shares are not stable, and therefore with proper management actions small number of companies could take major part from the total volume. This phenomenon also occurred within the imaginary markets of two offered products and eventually the winners were those, who had highest penetration rates.

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NIEKTORÉ POZNATKY Z HODNOTENIA ÚROVNE VYSPELOSTI VYBRANÝCH SOFTVÉROVÝ FIRIEM PODĽA CMMI[SM]

SOME FINDINGS FROM MATURITY LEVEL ASSESMENT OF SOFTWARE ORGANISATIONS ACCORDING CMMI[SM]

PETER BOBER

1 ÚVOD

Zlepšovanie procesov vo firme nasleduje po uvedomení si nutnosti zmien. Dôležité je však poznať čo zmeniť, aký má byť nový stav po zmene a akým spôsobom sa zmena udeje. Prínosy po zmene musia prevýšiť náklady na zmenu.

Softvérová firma sa pri prebudovávaní svojich procesov môže oprieť o niektoré štandardy, ktoré vznikli v 90-tych rokoch a neustále sa zdokonaľujú. Patria medzi ne CMMI[SM], ISO/IEC 12207 (Moore, 1996, 1997), ISO/IEC 15504 (ISO/IEC 15504 DTR: 1995) a iné.

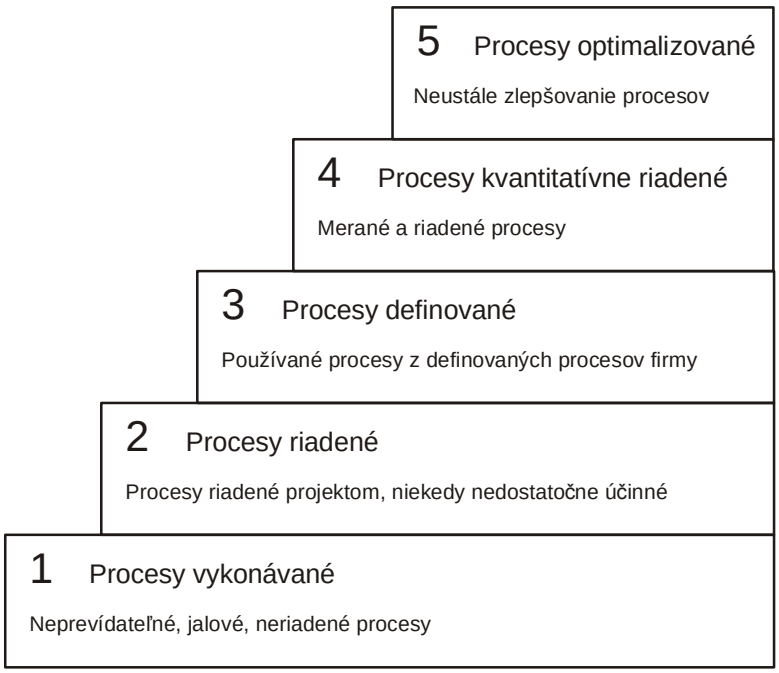
Spomenuté štandardy slúžia ako referenčný model pre budovanie a zlepšovanie procesov. Stručný prehľad je možné nájsť v (Bober, 2000).

2 CMMI

CMMI (Capability Maturity Model – Integration) patrí do skupiny CMM modelov, vyvinutých na Software Engineering Institute, univerzity Carnegiho Melona v Pitsburgu (http://www.sei.cmu.edu). Podľa (CMMI, 2002) model predstavuje zjednodušenú reprezentáciu reálneho sveta, konkrétne firmy, ktorá sa zaoberá vývojom, dodávkou a údržbou softvéru alebo softvér je súčasťou výsledného produktu alebo služieb. Zámerom vytvorenia modelu bola ochrana investícií štátu a organizácií pri zlepšovaní procesov a náhrada použitia viacerých rôznych modelov. CMMI zavádza jednotnú terminológiu, spoločné prvky, metódy hodnotenia a spoločné tréningové materiály. Týmto spôsobom sa znižujú náklady pre zavedenie a udržiavanie konceptu trvalého zlepšovania pre viaceré oblasti produkcie a služieb a

to aj mimo oblasť tvorby softvéru.

Model CMMI bol vytvorený na základe štúdia praktík organizácií, ktoré úspešne implementovali zlepšovanie procesov. Pre každú z vytypovaných oblastí procesov definuje ciele, dosahované rôznymi praktikami. V stupňovitej reprezentácii definuje CMMI 5 úrovní vyspelosti firmy (obr.1).



Obr. 1 – Úrovne vyspelosti firmy podľa procesov (CMMI^{SM}-SE/SW, 1999).

3 METÓDA

Hodnotenie firiem sa robilo na základe údajov, získaných dotazníkom. Dotazník sleduje splnenie cieľov, definovaných pre oblasti procesov v jednotlivých úrovniach vyspelosti, pomocou vhodne zvolených otázok.

Miera dosiahnutia cieľov pre jednotlivé oblasti procesov vytvára profil firmy. Na základe analýzy profilu je možné formulovať odporúčania pre ďalšie zlepšovanie.

4 DOTAZNÍK

Samotné zostavenie dotazníka a vykonanie prieskumu bolo predmetom práce Hudca (Hudec, 2002). Dotazník obsahuje 136 otázok, mapujúcich 25 oblastí procesov pre úrovne vyspelosti 2 až 5. Úroveň 1 sa považuje za počiatočnú, kde jednotlivé

činnosti sa vykonávajú “ad hoc” a procesy nie sú definované (tab.1).

5 VYHODNOTENIE ÚDAJOV

Na prieskume sa zúčastnilo 10 softvérových firiem. Na obr. 2 je znázornené dosahovanie cieľov (priemerná hodnota), vytýčených pre jednotlivé úrovne vyspelosti podľa CMMI.

Z grafu je zrejmé, že dosahovanie cieľov určených CMMI je pre všetky úrovne pomerne nízke a hodnota pre úroveň 5 je paradoxne najvyššia. Úroveň vyspelosti 5 sa zaoberá analýzou príčin nedostatkov a zlepšovaním (oblasti 24 a 25 z tab.1). Vysoké hodnotenie vyplýva z toho, že firmy pociťujú jednoznačnú potrebu flexibility a učenia sa. Avšak tieto snahy nie sú podporované adekvátnym meraním, čo naznačuje nízke hodnotenie pre úroveň vyspelosti 4, zameranej hlavne na kvantitatívny manažment. Toto tvrdenie je zrejmé aj z grafu na obr. 3, ktorý znázorňuje priemerný profil firiem podľa oblastí procesov. Oblasť procesov 5 – Analýza a meranie dosahuje veľmi nízke hodnotenie.

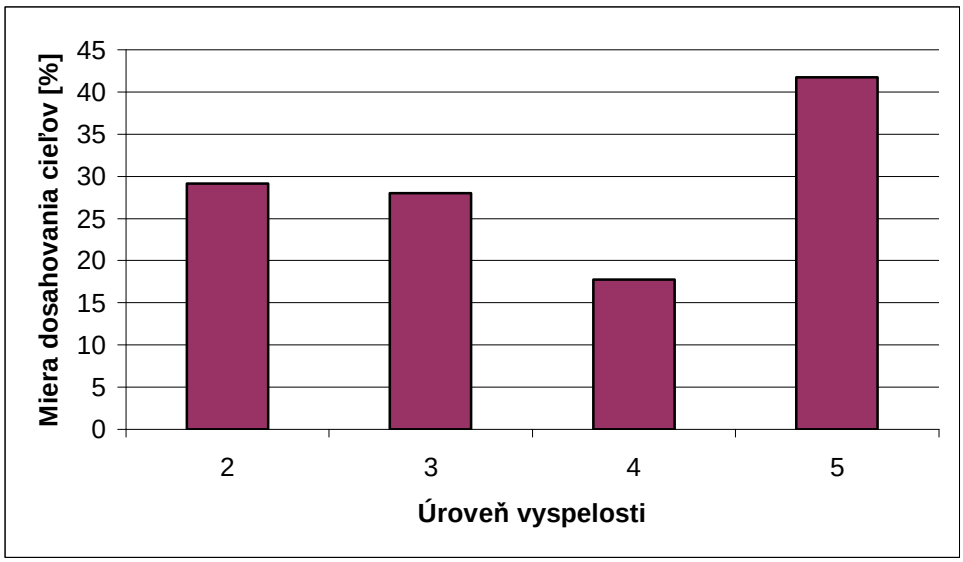
Tab.1 Oblasti procesov zatriedené podľa úrovní.

Úroveň vyspelosti	**Oblasť procesov**
2	1. Manžérstvo požiadaviek
	2. Plánovanie projektu
	3. Sledovanie projektu
	4. Výber dodávateľa
	5. Analýza a meranie
	6. Zabezpečenie kvality softvéru
	7. Riadenie konfigurácií
3	8. Stanovenie požiadaviek
	9. Technické riešenie
	10. Produktová integrácia
	11. Verifikácia
	12. Validácia
	13. Orientácia organizácie na procesy
	14. Definovanie procesov organizácie
	15. Tréningový program
	16. Integrovaný projektový manažment
	17. Manažment rizík
	18. Integrácia tímu
	19. Analýza rozhodnutí
	20. Vytvorenie prostredia pre integráciu
4	21. Výkonnosť organizačného procesu
	22. Kvantitatívny projektový manažment
	23. Manažérstvo dodaných produktov

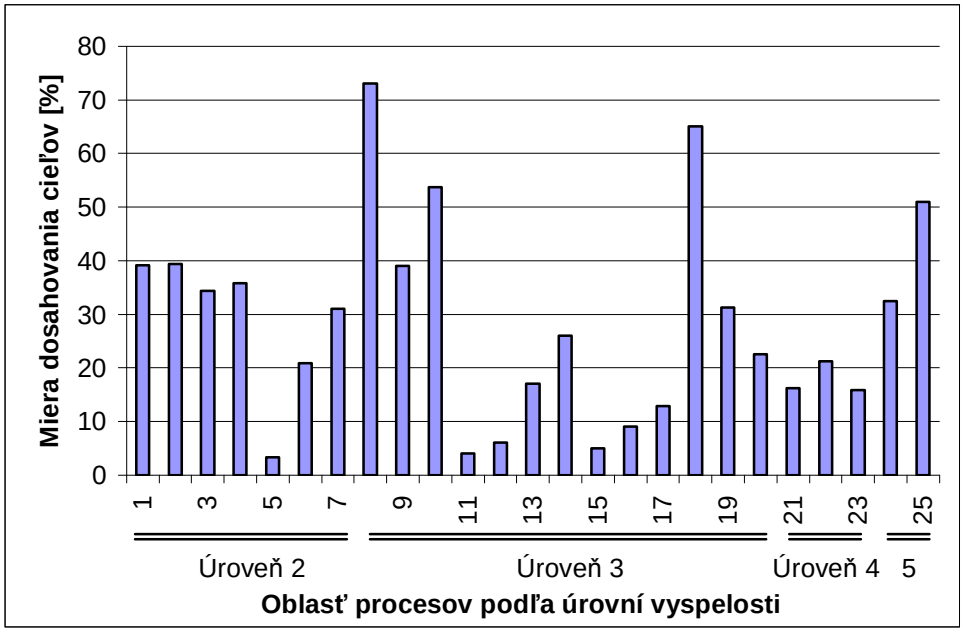
5	24. Organizovanie inovácií
	25. Analýza príčin nedostatkov

Z grafov na obr. 2 a 3 môžeme formulovať nasledovné tvrdenia:

1. Hoci firmy vykonávajú niektoré činnosti zo všetkých úrovní vyspelosti, nemajú dobudované základné procesy, charakteristické pre úroveň 2.
2. Pre úroveň vyspelosti 2 majú skúmané firmy nízke hodnotenie v oblastiach:
   5 - Analýza a meranie
3. Pre úroveň vyspelosti 3 sú slabé v oblastiach:
   11 - Verifikácia
   12 - Validácia
   15 - Tréningový program
   16 - Integrovaný projektový manažment
   17 - Manažment rizík
4. Hodnotenie oblastí procesov v úrovni vyspelosti 4 je všeobecne nízke.
5. Hodnotenie oblastí procesov v úrovni vyspelosti 5 je pomerne vysoké.
6. Vysoké hodnotenie oblastí *8 - Stanovenie požiadaviek*, *10 - Produktová integrácia* a *19 - Analýza rozhodnutí* ukazuje, že význam týchto skupín procesov je ľahko rozpoznateľný a firmami všeobecne akceptovaný.



Obr. 2 – Dosahovanie cieľov pre jednotlivé úrovne vyspelosti.



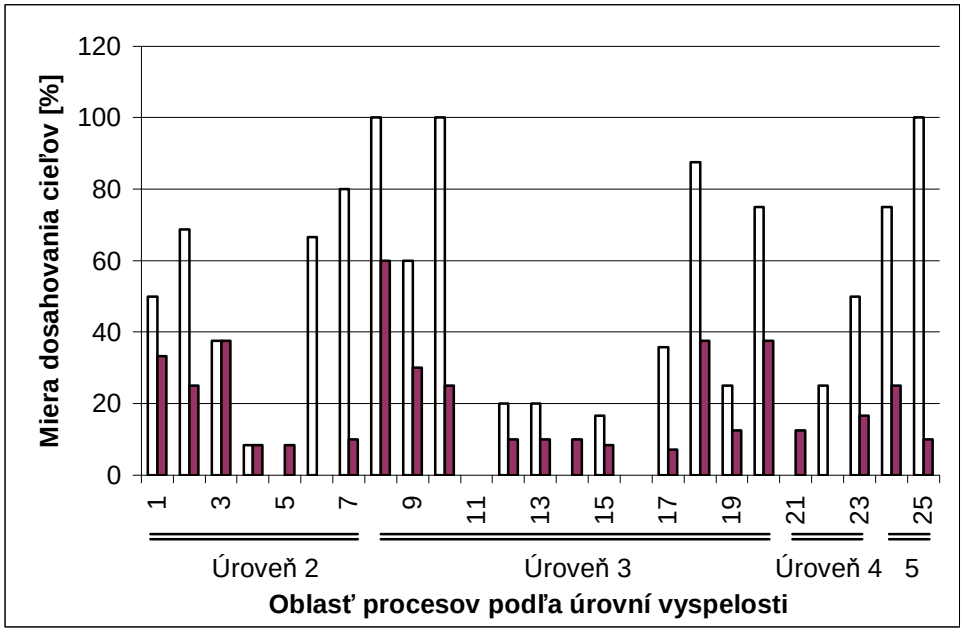
Obr. 3 – Priemerný profil skúmaných softvérových firiem.

Autori CMMI odporúčajú budovať procesy postupne, pretože každá úroveň vyspelosti stabilizuje dôležitú časť procesov firmy (CMMI, 2002, s. 10).

Na základe predchádzajúcich konštatovaní si dovolíme formulovať nasledovné odporúčania:

1. Sústrediť sa na zlepšovanie procesov patriacich do úrovne vyspelosti 2.
2. Hlavný dôraz klásť na zavedenie merania svojich aktivít (*5 - Analýza a meranie*).
3. Používať hodnotenia procesov podľa CMMI alebo inej metodiky.

Graf na obr. 4 slúži na ilustráciu rozdielov v profiloch firiem. Pre porovnanie boli vybrané firmy, ktorých celkový priemer hodnotenia bol najvyšší a najnižší.



Obr. 4 – Profil "najlepšej" a "najhoršej" firmy.

|| - *"najlepšia" firma* ▌- *"najhoršia" firma*

6 ZÁVER

Použitie hodnotenia úrovne vyspelosti firmy podľa CMMI je praktický spôsob, akým sa dajú stanoviť ciele pre zlepšovanie procesov v softvérovej firme a zároveň sledovať progres. Dostatočné porozumenie otázok dotazníka spolu s úprimnými odpoveďami dáva použiteľný obraz o stave firmy. Pravidelné hodnotenie je podľa súčasných trendov zlepšovania procesov nevyhnutné a je zahrnuté aj v skupine noriem ISO 9000:2000. Firmy, ktoré dosiahli úroveň vyspelosti 2 alebo 3, potrebujú veľmi málo pre prechod na ISO 9001:2000 napriek tomu, že neexistuje jednoznačná a úplná korešpondencia medzi požiadavkami ISO 9001:2000 a CMMI (Paulk, 2002).

Všetky činnosti, spojené so zlepšovaním procesov, musia byť naviazané na sledovanie hlavných cieľov, ktorými sú spokojnosť zákazníkov a zamestnancov, dobré postavenie firmy v spoločnosti a v neposlednom rade zisk. Zanedbanie tohoto faktu môže spôsobiť to, že opatrenia neprinesú želaný efekt a podobné postupy hodnotenia nebudú praxou akceptovaná v potrebnej miere.

Tento príspevok je jedným z výstupov projektu Inštitucionálneho výskumu č. 4415 na Fakulte elektrotechniky a informatiky, Technickej univerzity v Košiciach.

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MANAGEMENT BY CONSTRAINTS

RIADENIE PODĽA OBMEDZENÍ

PETER KMEC

1 INTRODUCTION

The last couple of decades brought a lot of new management methods that claimed to make an organization more effective, productive, leaner, faster, or better. This trend was reflected in the proliferation of acronyms like TQM, BSC, MTM, 6σ, MRP I, MRP II, TOC, and many others. It became hard to keep track of what they stand for, not to mention implementing them in an organization. Many managers ask, "When I want to implement a new management method, do I have to give up the old one? Which of them are compatible with each other? How do I recognize that a management method is good for me?"

Any management method should declare the assumptions it makes about a system under consideration. Therefore, when choosing a management method it is important to inspect whether the assumptions about the system are valid for its successful implementation. Theory of Constraints (TOC) is a heavily popularized management method in novels, books, essays, and learning programs (Goldratt 1992, 1990a, 1998, 2001); however, there is a lack of resources that present the principles of TOC demonstrated as straightforward consequences of few underlying assumptions. The objectives of this article are: 1.) to present the fundamental principles of TOC in a compact form; 2.) to demonstrate that the assumptions that TOC makes are valid for practically any organization.

For the purposes of this article, we define a management method as a set of rules that one applies for affecting the behaviour of a system. A system can be defined as a network of interdependent components which work together to achieve the goal of the system (Lepore and Cohen, 1999, p.17).

2 THE PRINCIPLES OF TOC

TOC, formulated by Eliyahu Goldratt, is a management method and also

a philosophy based on the identification and exploitation of bottlenecks – constraints – in a system whose typical feature is flow. An organization is an element with an interface through which it communicates with its environment. It utilizes inputs from other companies and converts them into outputs which are absorbed by other organizations or directly by the market. The inputs and outputs can be material or information, or goods. Therefore, an economy could be pictured as a flow of material and information among organizations (Fig. 1). To maintain the flow, each organization expends energy that in economy is measured by money, that is, money flows in a direction opposite to the flow of goods.

A closer look at an organization reveals that its internal structure is a lot like the structure of the market: there are elements with inputs, processing, and output of material and information (Fig. 1). The goal of any for-profit organization is to make money. Its ability to make money is proportional to flow of material and information through the organization (see the more precise TOC term "throughput" (Goldratt 1990b, p. 52)). Likewise, on a larger scale, an important measure of the health of an economy is the flow among organizations. (Remark: the flow of money within the organization is not drawn because the net profit of the company is the only thing that matters.)

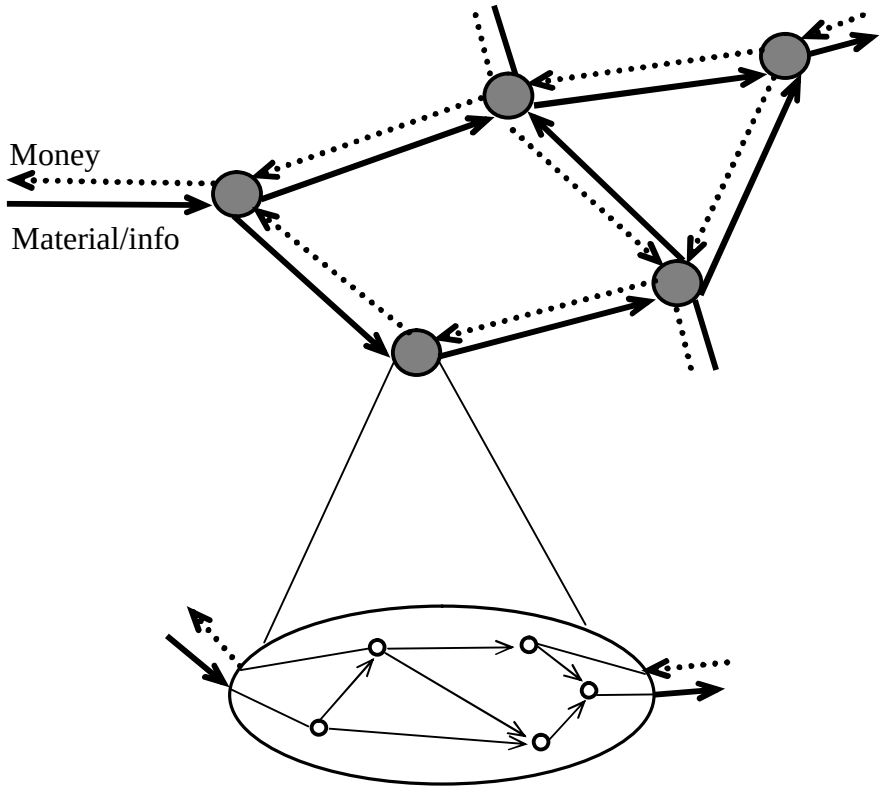

Fig. 1. An economy and an organization from inside .

TOC rests on two assumptions (discussed on a lecture by Goldratt (2001)):

I. Each system has a constraint.

II. There are random events in any system that cannot be predicted with arbitrary accuracy.

I. Why does each system have a constraint? Consider an organization or a supply chain as a system. As any system, it consists of elements called resources that convert inputs into outputs with some output capability. The maximum output capability is called productive capacity. Suppose that at the beginning, the system is perfectly balanced so that the flow of material or information is smooth with no idle resources or excess inventory. However, this balance is tied to specific inputs and outputs. Any change in inputs or outputs – a new demand of a customer or new material or technology – leads to an imbalance in the system and some resource cannot keep up the pace with the other resources due to its lower output capability. Such a resource is called a constraint (more precisely, a physical constraint). The organization has now two options: a) Try to achieve a new state of perfect balance or b) Accept the fact that a constraint exists. The option a) is not realistic due to big expenses that it often requires and due to the ever changing inputs and outputs.

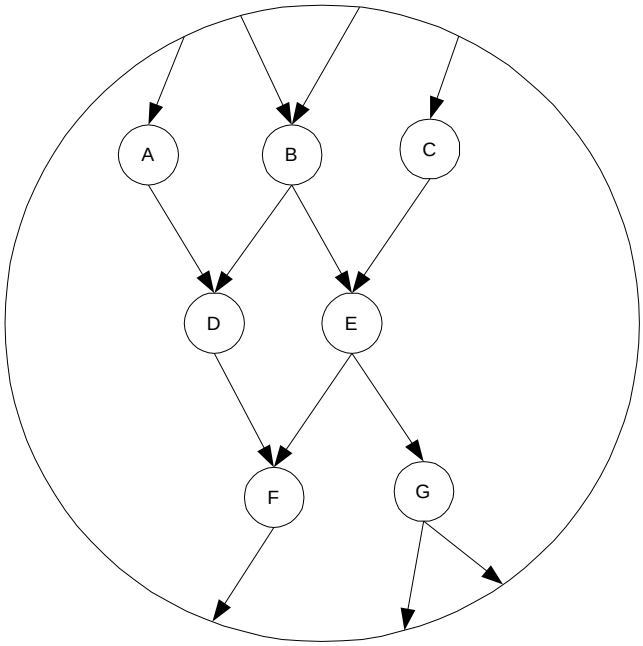

Fig.2. A schematic view of an organization with resources A through G and flow of material/information. For example, if resource F is the constraint, excess inventory accumulates at resources A, B, C, D, and E upstream; if resource B is the constraint, the downstream resources D, E, F, G starve for work even though their productive capacity is higher

Consequences of the existence of a constraint (Fig. 2):

1. A higher productive capacity of the resources which supply the constraint with inputs (including all of the resources upstream of the constraint) is cut off by the limiting productive capacity of the constraint. This excess capacity is materialized as excess inventory.
2. The performance of the resources that receive material/information from the constraint and of all resources downstream of the constraint is dictated by the performance of the constraint, even though their productive capacity is higher.
3. From 1.) and 2.) it follows that the overall (global) performance of the system is not a sum, average, or combination of the performance of individual resources. The overall performance is given by the productive capacity of the constraint. In other words, "An hour lost at the bottleneck is an hour lost for the total system" (Goldratt, Fox 1986, p. 179)
4. An effort to improve the performance at a non-constraint is a waste.

5. Taking care of the constraint is what really counts. Thus TOC points out where the focus for improvement should be, whereas the application of a suitable management method brings quick returns of the effort invested (see the five focusing steps, Newbold 1998, p. 152). TOC is compatible with other methods of management.

II. Unpredictable random events (called "Murphy" in the terminology of TOC) simply exist and no complex system is free of them. For organizations, it is exactly the randomness that often sets apart the success from failure or profit from loss. Since random events are unpredictable, it is not possible to determine the optimal functioning of an organization because it is tied to specific predictable conditions. Therefore, the best choice is a method robust to random fluctuations, yet sufficiently simple to implement.

Consequences of the existence of random events:

1. Resetting of optimal control (management) every time the randomness strikes leads to fluctuation and imbalance in the organization and threatens its global objectives. (an interesting demonstration is the funnel experiment proposed by Nelson and Deming (Tkáč, 2001, p. 155)).
2. From 3.) it follows that if randomness strikes, the consequences show up at the constraint.
3. The constraint should be protected with a buffer that can be estimated using heuristics or estimated from statistics of random events in the system.
4. Nonconstraint resources of the system do not need to be protected with a buffer. Their idle capacity (with respect to the constraint) works as an inherent buffer to cope with unexpected random events.

3 CONCLUSION

TOC is a simple philosophy of approaching the management of an organization. The prerequisite is that the boundaries of the system, its resources, and flow of material and information is known. The constraint of the system can be identified by VAT analysis (Cox, Spencer 1998, p.101) or by using the TOC thinking processes (Scheinkopf 1990, Halušková 2000). The constraint-focused use of a suitable management method brings fast returns from the synergy with TOC (for arguments see Newbold 1998, p 132). The effect of management by constraint can be explored by simulation of inventory and production as described by Gregor et al. (1998, p. 55) before implementing the solution in the organization.

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NEW BUILDING PRODUCTION QUALITY MANAGEMENT

MANAŽÉRSTVO KVALITY PRODUKCIE NOVÝCH STAVIEB

TIBOR ĎURICA

1 INTRODUCTION

From the constructional point of view every building is considered a new product in the production of which predominantly well-known methods and processes are used.

Research and development of building products is more or less similar to R&D of any other industries. According to Act No. 90/1998 Corpus Juris on building products in the wording of subsequent laws and regulations, before placing a particular product on the market, the manufacturer is obliged to submit its certificate (showing the conformity mark of the product – its certification status).
As far as building constructions are concerned, customers/employers specify their requirements on quality, approve of structural design, and control the quality of construction work during the building process. The specification of customer needs with respect to building construction concerns mainly the required standards, used building materials, operational conditions, and the location of a building in a particular environment. At the completion of construction work, it is essential to certify that the building – a new manufacturing complex – fulfils designed parameters from both capacity and production quality aspects.

2 DESIGN OF NEW BUILDING PRODUCTS

For building products, the requirements specified by customers are to a great degree determined by technical standards (so-called harmonized standards in the future), technical specifications and technological regulations. Furthermore, there is legislation in the construction industry governing minimum values for building products regarding health and life protection, protection of property, and environmental protection (i. e. regulated sphere). These are defined in the Directive

No. 89/106/EEC as 6 basic requirements (mechanical resistance and stability; fire safety; hygiene, health and environmental protection; occupational safety; noise prevention and anti-vibration protection; energy saving and thermal insulation). The requirements given in the Directive No. 89/106/EEC are incorporated in Act No. 80/89 Corpus Juris on building products in the wording of subsequent laws and regulations and in Act No. 50/76 Corpus Juris in the wording of subsequent laws and regulations (Building Act).

When planning a new product development, an organization is to follow the analysis of market needs, trends in customer needs development, examine domestic and foreign competition in a particular market segment, and keep an eye on the development of new technologies in various manufacturers. R&D workers must examine and follow the development prognoses of potential customer needs.

An important task of R&D workers is the examination of the relationship between the specification of quality requirements and the actual quality achieved at a particular time. Fig. 1 shows the relationship between the specification of quality requirements and the actual quality achieved at the time of its assessment.

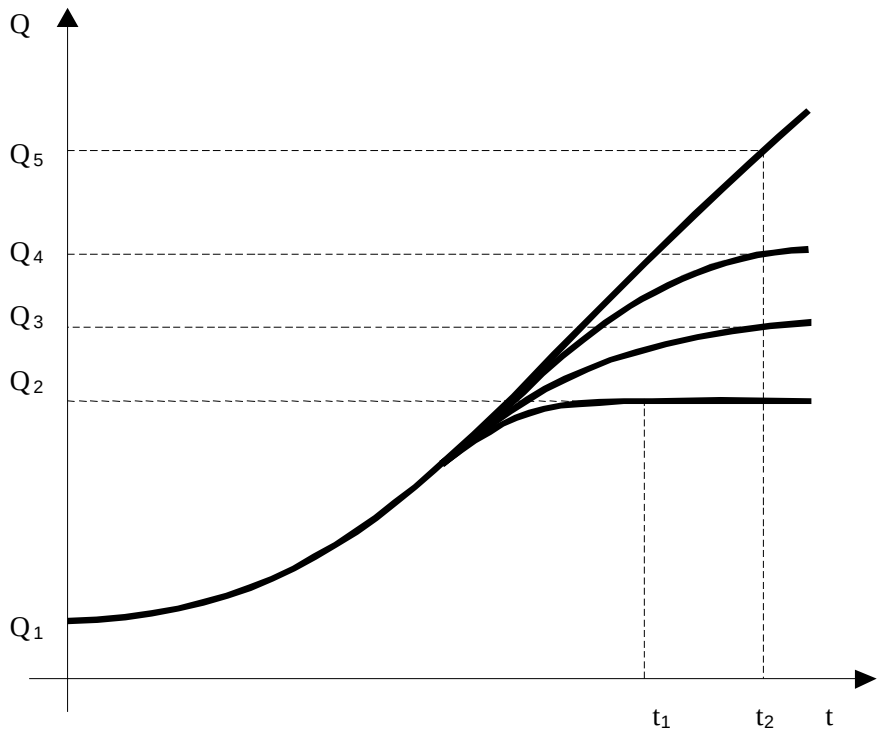


Fig. 1: Time-related quality assessment

Q is understood here as one of partial or total indicators/characteristics being assessed, such as: product quality, the efficiency and effectiveness of processes and/or organizations – cf. Tab. 1. The partial building product quality index QP is given by the relationship:

$$Q_P = \frac{X_S}{X_V}$$

where:

X_S is the actual quality achieved,

X_V is the quality required.

If QP>1, the product quality is higher than the requirements specified. If QP<1, the manufacturer supplied the market with the product the quality of which does not conform to the specified requirements and must take action on a non-conforming product to improve its quality and make it acceptable for the intended usage.

The purpose of the application of a comprehensive index of quality, efficiency and effectiveness is to obtain an opportunity of modelling the time relationship of one of characteristics Q created on the basis of multidimensional weighted set of indicators [5].

Tab.1: An example of total characteristics of quality

Building Product	Building	Processes	Organisation performance
Strength	Standard	Design work	Efficiency
Durability	Architectural and structural design	Purchasing	Competitiveness
Dimensions	Energy consumption	Groundwork's	Customer satisfaction
Thermal conductivity	Operational costs	Concreting	People results including partnerships
Appearance and surface	Aesthetic impression	Masonry	Solvency
Price	Surrounding environment	Handling changes	Size of the market segment
	Price	Contracting	
	Scheduling	Improvements Prevention	

The level of product quality (Q5) as well as the level of performance, production and product life cycle in a particular market segment and region is governed by leaders´ organizations. Other organizations more or less successfully catch up or copy the well-established trends.

If we are to examine the relationship between the specification of quality requirements and the actual quality achieved, it is obvious that the quality of a building product or building itself can be always, in all circumstances, given at a certain level (Q1) that should be higher than the acceptable minimum Qmin. Another question is what the acceptable product quality means from the point of view of its competitiveness on the market.

In quality planning (designing a new product, new product launch, organization reengineering, etc.), newly defined and specified quality requirements at a certain level (Q2) are suggested.

The essential aspect is that the planned level of performance, product and life quality Q2 can sufficiently predict and anticipate the increase in future customer quality requirements at the time t1; and the crucial fact is to compare the level of product quality Qt1 to the level of competition product quality at the time t2.

An organization may win or lose towards the competition according to the level at

which it specified product quality requirements. The costs of an organization to ensure the quality of products of its competitors will be higher than it might have been in case the entrance product quality specification had been at a higher level, i.e. between Q3 and Q5. The organization will make a lower sales profit on such products compared to those at the quality level between Q3 and Q5; therefore, it can be said it suffers certain economic losses.

Similar results are obtained when the customer satisfaction with the quality of a final product – a building construction – is being assessed. The operating costs (e.g. heating, maintenance costs, etc.) of the building with the level of quality Q2 at the time t2 will be higher than those of the building with the level of quality between Q3 and Q5.

Building organizations, excluding a few exceptions, do not have their own research and development departments and in the majority of cases they do not deal with product design and development. They solve the problem by means of purchasing necessary building products. Research and development of building products is usually within the scope of work of the manufacturers who supply various mass-produced materials on the market. These organizations can fully apply designing procedures according to the standard ISO 9001:2000, Art. 7.3. It is often reminded that standards are meant for the average and the final goal of an organization is not to go through a certification procedure and acquire the certificate of quality management system; however, it is to increase its performance results and competitiveness.

From the point of view of new product development (building constructions and structural elements), the role of a contractor (building organization) is rather complicated in the process of construction, or even, it can be said, suppressed to the minimum. Pre-contract work for the tender usually includes the design documentation of a particular building that must be almost ready or at least at the stage so that the building permit can be issued. Technical specifications of the employer (the client) usually involve the design of single structures and structural elements of the building. The responsibility of the contractor, after winning the contract by tendering, is to carry out the work before a stated completion date at a fixed price upon the conditions of contract at the quality specified in the contract documents. The contractor is left very little space to search and develop new building materials and technologies and is not forced to deal with their design either.

Generally speaking, planning and development of new production processes are closely connected to the process of new product development. These processes occur more in prefabrication and industries manufacturing building materials rather than contracting organizations. Contractors follow the working drawings, specifications and schedules, plus the conditions of contract of a particular building, sometimes involving new technological processes. Inputs and outputs of single

processes include only those activities that are aimed towards meeting customer needs (materialized in the design of a building) and the main objectives of an organization. A number of further processes result from the performance of managing and supporting processes.

As a result, within the frames of quality management system, an organization must link all its processes in a complex way. In order to proceed and carry out the next technological procedure, the organization must receive an approval of the contractor responsible for the work as well as the site supervisor/project manager representing the employer (the client) and make a record in the construction diary.

Variations and further changes in the construction design frequently occur in the building process. All changes must be controlled, verified and approved of (depending on the character of change by the employer, architect, consultants, site supervisor, contractor, etc.) The records regarding all changes performed must be kept and stored (in a construction diary, project documentation, records, writings, etc.).

Quality assessment of building products is based on the experimental determination of specific characteristics and their comparison to the criteria specified in technical specifications (technical standards and certifications).

Issues concerning risks involved in the design of new building products and their launch are approached from various aspects. The results of single characteristics of a building product are obtained in so-called certification procedure that verifies the conformity of a resulting product to the specified requirements, while a particular margin/reserve must be created to cover the expected oscillation in the product quality that may occur in mass production conditions. The certification criteria specified for the assessment of characteristics are remarkably tougher than those required in mass production.

To illustrate the point, at the launch stage of fresh concrete production, much stricter criteria are stipulated by the relevant technical standards depending on the volume of concrete produced, especially for the first batch of 50 m3 if compared to its initial production and later to its regular production. Equally, the number of samples is greater and the frequency of sampling much higher at the launch stage.

The quality of a final building product – construction work – is influenced by a set of factors, the majority of which are as follows:

- specification of customer needs (standard, comfort, luxury, price, time available, durability, usability, etc.),
- specification of society requirements (safety, health and life protection, protection of property, environmental formation and protection),
- **urban, architectural and structural design,**

- quality of building products,
- **quality of technological processes,**
- building control, site supervision of the employer (customer),
- operating conditions.

When analysing the significance of single quality factors that influence the final quality of work, they can be further subdivided into small details necessary in the design of a particular building – see [2].

In verification and validation of product design assessment, methods based on measurements of single product characteristics are commonly used. The quality assessment of a final construction work – a building – is more complicated, as, from the urban and architectural points of view, the assessment of the customers and/or the parties involved is to a great extent subjective and depends on a personal opinion. Among more complex and objective evaluation methods applicable in quality assessment are the following:

- **energy audit of buildings** – evaluates the consumption of all kinds of energy in a building during the specified assessment period (a season, a year, etc.),
- **environmental** audit of buildings – measures the quality of building interior.

One of the most significant quality factors of a building product or the whole building is their lifespan. The lifespan of a building is greatly influenced by its design, durability of building materials and the lifespan of structures and structural elements. The durability of building products is a function of their quality, degradation factors of the surrounding environment (chemical, physical, climatic and biological factors), and the care of the owner during the occupation of a building.

Unlike industrial products, buildings have a remarkably longer life cycle and it comes up to several decades or even a few hundred years. From the point of view of their lifespan, structural elements can be classified as either elements of long-term durability (foundations, vertical load-bearing structures, horizontal load-bearing structures, stairs, and the roof structure) or elements of short-term durability (insulations, floorings, paving, plasterwork and painting, panelling, facades, windows and doors, building equipment, installations, etc.).

The elements of long-term durability are designed mainly with respect to safety and durability taking into account their operating conditions and the surrounding environment. The elements of short-term durability are designed mainly with respect to hygienic requirements and health protection; occupational safety; noise prevention and anti-vibration protection; low energy consumption and thermal insulation. Trouble-free usage rests in the capability to maintain required use

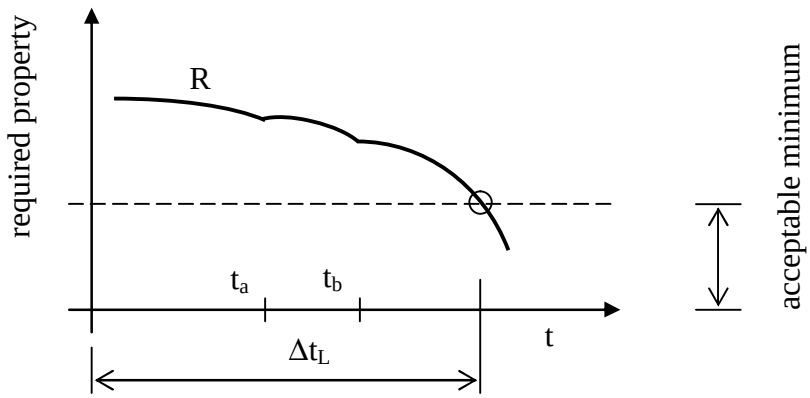
properties during the whole life of the building. The life cycle of a product (a building structure, structural or building equipment element) can be defined as a time interval starting at the point of putting the completed work into operation and ending at the moment when the required properties fall below the acceptable minimum – Fig. 2 [4].

The important role (in the determination of residual life and renovation costs) is played by the maintenance and repairs performed during the occupation of a building. If the distribution of a required property (which must not fall below the acceptable minimum) of the structure or its element (strength, thermal conductivity, etc.) copies the curve in Fig. 2a), its lifespan is given by the line segment ΔtL. However, proper maintenance in the time interval between the points ta and tb (Fig.2b)) and/or repairs at the same points (Fig.2c)) could remarkably prolong its life cycle.

The essential point is the attitude of the customer who is responsible for the specification of all requirements on building quality, inspection procedures that ensure the building is correctly designed and the construction work paid for is properly done. During the occupation of the building it is the due care of the owner/user of the building – its maintenance and necessary repairs – which may decide its actual lifespan.

To determine the optimum life cycle of the elements of short-term durability, it is necessary to consider more economic rather than technical life cycles of the elements. The economic life cycle, besides normal physical wear and tear, plus obsolescence, respects design costs as a component of the whole project cycle, including other aspects, such as technological, economic, social, sociological, aesthetic, and ecological requirements, as well as the possibility of modernization and adaptation.

2.a)



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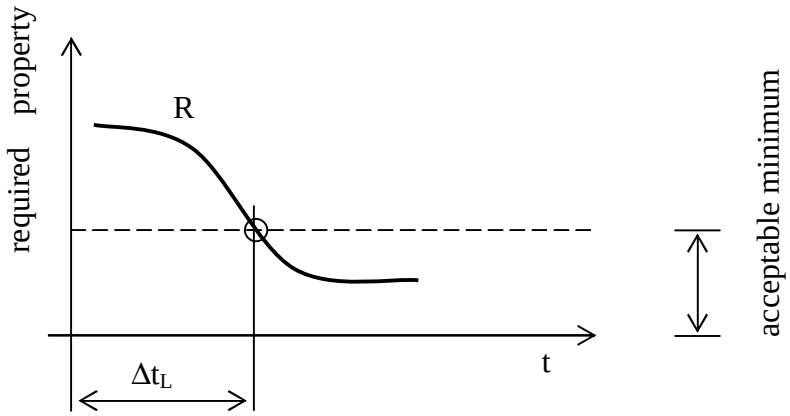

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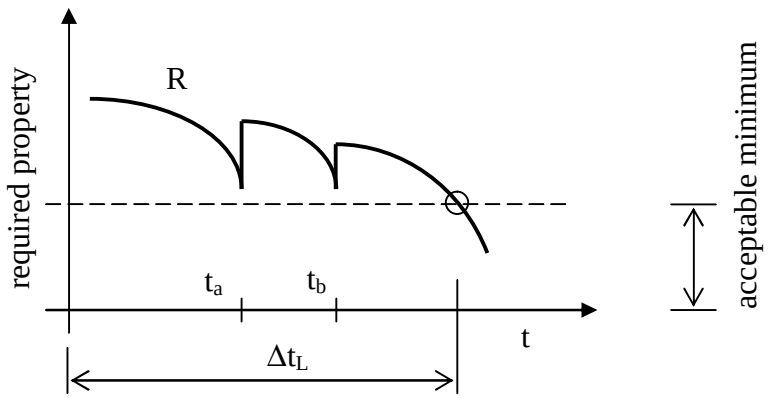

Fig. 2c The influence of maintenance and repairs on the lifespan of a building [4]

Economically appropriate life cycle assumes that all relevant aspects, such as those mentioned below, are taken into account:

- design, construction and user costs,
- costs resulting from operational obstacles,

- risks and consequences due to failures arising during the life cycle of a building and insurance costs to cover those risks,
- planned partial renovation,
- inspection, maintenance and repair costs,
- operational and administrative costs,
- environmental aspects,
- demolition and removal of debris and materials.

Requirements on buildings intended for demolition present a special case. This area has not been paid sufficient attention so far. As a rule, new buildings are constructed with the neglect of this factor. Demolition work, after completing a building life cycle, includes mainly the following aspects:

- safety of workers at demolition and removal work,
- minimum risks of damage to adjacent buildings, equipment and other facilities,
- prevention and avoidance of release of toxic and other health-hazardous materials and radiation during demolition,
- simplicity of demolition work,
- minimization of demolition costs,
- recyclability and re-use of building materials and structural elements.

3 EVALUATION OF CONSTRUCTION WORK (AN INVESTMENT)

One of the main methods used in the management of construction processes is project management. It is an integral system of a finite sequence of purposeful, fact-based, scheduled and financially arranged activities happening in a particular environment that leads towards a defined goal (or a set of goals). The sequence is finite, i.e. it has a final point – an approval of construction work. For more details see Project Management in [1].

Project management methodology contains gradual steps that include mainly these project activities: defining, planning, managing/control, monitoring, and assessment. Standardized methods based mostly on capital appreciation in real time are applied to obtain objective opinion on feasibility of the project. By means of these methods it is possible to analyse and compare various phases and stages of the project.

Upon the completion of construction, the employer (client) or the project manager (client's representative) in so-called handover inspects the construction work and

fulfilment of the requirements specified in the contract. Meeting the conditions defined in a building permit by the contractor is supervised and approved of by the relevant building authority in so-called approval of the building. Moreover, for building contracts in the public sector, the building control authority verifies the conditions stated in the tender. Finally, based on the certificate of practical completion, possession is returned to the building owner, the client, and the building authority grants the user the occupancy permit.

When speaking of new product launch quality management, it is essential to carry out a final analysis that documents the success of a completed project from the financial point of view. After completion, a final technical-economic assessment of the project must be carried out (final analysis) taking into consideration all financial (comparison of planned and actual costs), scheduling (meeting deadlines) and fact-based (construction work quality assurance) aspects.

With projects having a technological character, the responsibility of the project manager involves also inspecting and approving of future operational technology. An industrial complex is considered to be completed when pilot and warranty tests are successful and failure-free test operation (pilot run) can prove it is able to achieve planned performance results of the required quality and quantity and still ensure a reasonable amount of reserves.

4 CONLUSION

The manufacturer is fully responsible for the quality of a building product. According to Building Act, the contractor must not build in any product that has no certificate (has not successfully gone through the process of certification) and the building authority must not approve of such a building. An organization should predict, on the basis of a detailed market analysis, the development of customer needs, requirements, and wishes. Research and development of new building products should follow those prognoses.

The final technical-economic assessment of the construction work (investment) should only document the correctness of usage of free finance/financial resources, specification of project requirements, the quality of the approved project, the quality of construction work and the assembly of manufacturing technological equipment, as well as the effectiveness of the whole production complex and the production quality.

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ECONOMIC MEASURES OF AGILITY / FLEXIBILTY IN ELECTRONICS MANUFACTURING CONTEXT

EKONOMICKÉ MERANIA AGILNOSTI/ FLEXIBILNOSTI V KONTEXTE ELEKTROTECHNICKEJ VÝROBY

PETRI HELO

1 INTRODUCTION

Flexibility research originates mainly from economics, decision science, competitive strategy and manufacturing management (Upton 1997). From a general point of view, flexibility is a characteristic of the interface between a system and its environment. Despite the extent of the existing literature, a certain ambiguity in definitions still prevails (De Toni & Tonchia 1998). This has led to little use of the measures in practice. Flexibility refers to company's ability to adjust from one operation to another. Agility, however, can refer to any dimension of flexibility. The key difference according to Vokurka and Fliedner (1998) is the ability to react to non-predictable changes in markets. Swink and Hegarty (1998: 378) stress the difference between manufacturing outcomes and manufacturing means. The definition for general flexibility is proposed as follows.

In this paper, we will consider only those uncertainties which originate from the market environment (i.e. external flexibility). Electronics manufacturers' top priorities are related to product availability and pricing issues. For this reason we should value agility / flexibility against lead time and cost. These attributes are connected to three uncertainty dimensions, which are typical of the context: (1) Volume flexibility – the ability to change throughput in terms of response and range, (2) Product mix flexibility – the ability to change products in production in terms of response and range, (3) Life cycle flexibility – the production ability to change the expected life cycle of a product.

2 LITERATURE ON FLEXIBILITY AND AGILITY MEASURES

De Meyer (1989) was one of the first researchers who noted the strategic value and importance of flexibility. Flexibility is a multidimensional concept, which can refer to many issues in production, for instance process or product related factors. Browne et al. (1984) suggested the following eight dimensions from a flexible machine systems perspective:

1. Machine flexibility refers to the ease of making changes required to produce a given set of part types
2. Process flexibility refers to the ability to produce a given set of parts, each possibly using different materials, in several ways.
3. Product flexibility – design-change flexibility stands for the fast changeover to produce a new set of products very economically.
4. Routing flexibility – the ability to route products through a system.
5. Volume flexibility – the ability of a system to cope with increasing demand (Chen et al. 1992)
6. Expansion flexibility – the ability to build a system and expand its capacity (Browne et al. 1984, Chen et al. 1992: 435, see also Parker and Wirth 1999: 439)
7. Operation flexibility – the ability to interchange the ordering of several operations (sequences) for each part type (Browne et al. 1984).
8. Production flexibility stands for "the universe of part types that the system can produce". (Browne et al. 1984)

Correa (1994) made a distinction between unplanned change and flexibility as the ability to control the system. According to this framework, there are five different attributes related to change: size of change, novelty, frequency, certainty and rate. The control of these elements depends on the flexibility. Upton's (1994) framework makes a similar classification in terms of flexibility to handle uncertainty. For each flexibility dimension there are different time perspectives, i.e. volume flexibility may be required for daily changes or for long trend changes. Each of these capabilities includes three elements: the range of adjustment, uniformity of the range and the mobility within the range. Based on a large literature review, De Toni and Tonchia (1998) suggested a classification framework for proposed flexibility measures. According to this framework, the operational flexibility measures can be based on the evaluation of options, output variety analysis, manufacturing parameters, economic performances, non-cost performance and synthetic measures. Examples of economic based measures are Mills (1984), Browne et al. (1984) and especially Son & Park (1987). Additionally, some entropic measures have been

proposed.

Mix flexibility is one of the most confusing flexibility dimensions suggested. It is very intuitive and it has a direct impact on markets (Suarez, Cusumano & Fine 1996: 227). Product range or mix range flexibility may be characterised by the number of SKU's produced or by the capability to produce a great range across key features of product (Upton 1997). The problem with product flexibility measures is in assessing the difference between parts. Nilsson (1994) analysed machine flexibility, *cb*, as the ability to "*reuse the equipment for other purposes than those originally intended*". This approach refers to the machine life cycle versus product life cycle. Analytically this can be expressed as function *cb*, which refers to the time period taken to consolidate the invested capital.

$$cb = \frac{(1-f)G}{a - fG \cdot ann_d(n,i)}, \tag{1}$$

where G is the total initial outlay as $G = G_f + G_r$, G_r the risky part of the initial outlay, G_f the flexible part of the initial outlay, f component flexibility $f = G_f / G_r$, a annual net receipts, n life span, i annual discount rate, ann_d discrete annuity function (inverse of the present value function).

Son and Park (1987) suggest a general Total Flexibility Measure from an economic point of view. Flexibility is here determined in a similar way to partial productivity measures. The total flexibility for a given period is defined as:

$$TF = \frac{O_T}{C_l + A + C_w + H}, \tag{2}$$

where O_T refers to total output, C_l to labour cost, A to setup cost, C_w waiting cost of parts produced and H to the inventory costs of finished products and raw materials. The model includes similar measures for different dimensions of flexibility, but the drivers for flexibility are not visible in the basic equation.

Parker and Wirth (1999) suggested analytical economic based measures for volume and expansion flexibility. They propose criteria of general comparison for the measure. The initial measure for volume flexibility describes the break-even point for volume as:

$$VF = \frac{V_R}{C_{\max}} = \frac{C_{\max} - aN_B}{C_{\max}}, \tag{3}$$

where V_R is the profitability range, C_{max} is the maximum capacity of the system, a the number of capacity units required per parts produced, and N_B the lower limit of profitable production range.

Another way to describe the volume flexibility is the quadratic cost function which originates from industrial economics, proposed by Mills (1994). This method differs quite drastically from the Son and Park (1987) model, even though both approaches are related to productivity analysis to some extent. Whilst Son and Park consider flexibility as a partial productivity of setups, Mill's quadratic cost function sees flexibility as an ability to maintain total productivity in different production volumes. The formula can be expressed as follows:

$$C(x,a,b,g) = a + bx + \frac{x^2}{g} \qquad a,b,g > 0, \tag{4}$$

where C is the total cost, a, b, g are positive constants and x stands for production volume.

Mill's approach suggests that unit costs in manufacturing decrease in terms of rising production volume up to a point where all resources are fully used and increasing the production rate will require additional investments. The shape of the cost change is assumed as a general quadratic function.

3 PROPOSED TPM MEASURE FOR AGILITY / FLEXIBILITY

A lot of attention has been paid to total productivity measurement (TPM) as defined by Craig and Harris (1973). A lot of modifications of this productivity framework have been suggested. Craig and Harris argue that their measure shows the company as an entity and furthermore maximises the return of invested capital. However, the issue of flexibility was not considered at all. Richardson and Gordon (1980) claim that companies need to utilise different performance measures at different stages of a product life cycle. In the first stage, the firm maximises the performance by concentrating on innovation, flexibility and responsiveness. In the second stage, a firm operates in a growing capacity. Appropriate measures include capacity utilisation, growth, order backlogs, stock outs and lost sales. In the third phase, cost minimisation is important. Measures such as cost per unit, labour productivities, etc. are in use. Performance measurement framework, suggested by Richardson and Gordon (1980), also claims that as product life cycles decrease the importance shifts from productivity to measures related to innovation and flexibility. If a company is ruled by bare productivity measures, the consequences may be dysfunctional.

Agility is a business level measure similar to flexibility. Whilst flexibility is connected to cost performance in uncertain environments, agility may refer to cost efficiency or the value creating side. According to the definition taken in this paper, the major different between agility and flexibility is the level of concern. We claim that flexibility is always connected to the cost aspect and the concept of agility refers to sensitivity of the productivity of a firm. Agility is a business measure, which is assessed against the productivity of a company, whilst flexibility may be analysed against market parameters such as cost or lead time sensitivity. In other words, the agility of the company is the sensitivity of the productivity, whilst changing the uncertainty parameters of volume, product mix, or product life cycle. Analytically this may be expressed as follows:

$$a(d_{vol}, d_{mix}, d_{lc}) = \frac{\Delta p}{p_{INIT}} \quad \text{and} \quad p = \frac{\sum o}{\sum i}, \tag{5}$$

where p is the productivity of the firm defined as the ratio between total tangible outputs o and total tangible inputs i. The total productivity of a company in our aspect is the ratio between created outputs, and the used inputs, measured as units of money. This approach makes it easier to compare different creators of value, such as labour, purchases, capital, etc. (Craig & Harris 1973).

Gustavsson (1984) proposed that dependence between flexibility and productivity is partly misleading. He suggested that when flexibility is increasing, the productivity should decrease. This claim is logical at first glance, but inconsistent by definition in a deeper analysis. Instead of productivity, one should analyse the trade-off between efficiency and flexibility. By balancing these, better financial performance, good productivity, can be achieved. For instance, great efficiency may be productive in the short term, but in the case of product changes, the efficiency will be lost if flexibility is low. On the other hand, great flexibility is not productive if manufacturing is very repetitive and unchangeable. Too much flexibility, compared to the required flexibility, is non-productive if the cost of additional flexibility is high. The behaviour suggested by Gustavsson may be true in some cases, but it depends on other parameters as well. Capacity utilisation is one of these in addition to flexibility and efficiency. (Figure 1).

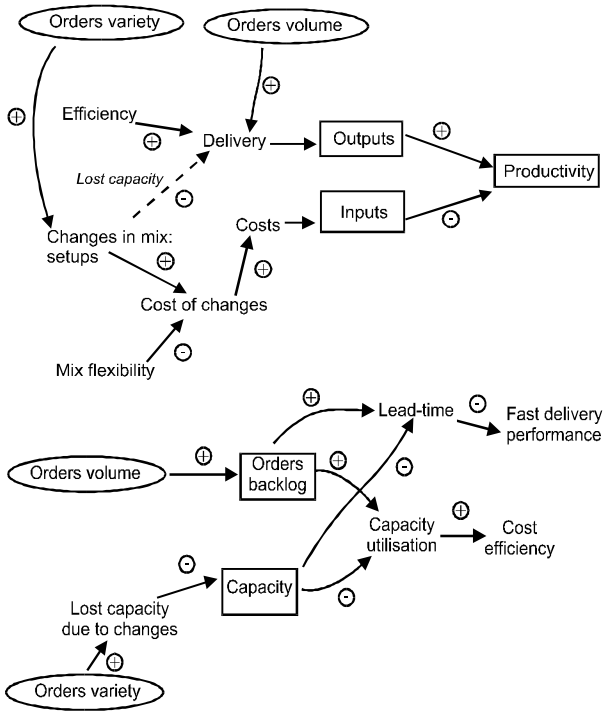


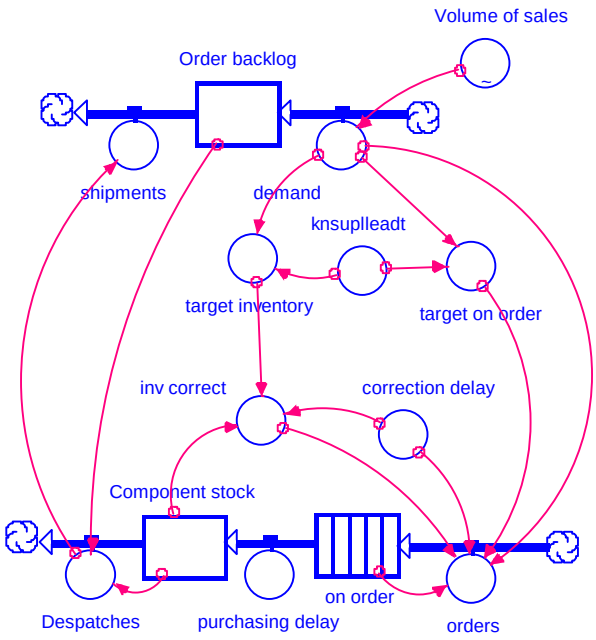
Figure 1. Efficiency and flexibility are independent components in productivity (author).

4 SYSTEM DYNAMICS MODEL

A simple system dynamics model of production is build for demonstrating the practical use of the suggested agility measure. In this model (figure 2), the sales orders accumulate into a backlog depending on volume. The ratio between orders backlog and capacity defines the average lead time for customer order-fulfilment. Orders variety parameter use setups and consume capacity. High capacity utilisation leads to cost-efficiency. On the other hand, high utilisation makes queue time longer for an order. Cost efficiency and fast delivery are trade-off performances, which cannot be maximised at the same time. Economic reactivity depends very much on the cost structure of the product to be manufactured. In addition to volume, the same order-fulfilment dynamics applies also in the product mix. In terms of mix response, lot sizing decisions have the most important effect on order-fulfilment. Orders variety parameter or smaller production runs, i.e. smaller lot sizes, increase the setup-time, which consumes the available capacity. Less capacity directly weakens the delivery performance. However, the issue of capacity utilisation plays a crucial role in this structure. If the order-backlog stays

at a low level and stable, or in other words the ratio between orders and capacity is low, the lost capacity due to changes does worsen the delivery time remarkably.

The sales is accumulated into an order backlog. This starts production and gives impulses for purchasing. Finished items are released from stock: *"Finished_items_stock(t) = Finished_items_stock(t - dt) + (manufacturing_delay - Despatches) * dt"*. However, the capacity of the production system constrains the despatching equation *"Despatches = MIN(Order_backlog,utilised_capacity)"*. The delay caused from manufacturing lead time is derived as well from utilisation: *"manufacturing_delay= delay(shipped_by_supplier,1/utilised_capacity)"*. The purchasing activity from the supplier is organised from actual sales demand. The ordering policy is based on current sales as: *orders = demand + inventory_correction + (target_on_order - Supplier_backlog) / correction_delay*. This equation has variable *inventory_correction*, which takes work-in-process and goods in transportation into account as *(target_on_order - WIP) / correction_delay*. Targeting is based on assumed lead time from supplier. This ordering policy takes all phases of physical transportation into account and moreover, its reactivity is adjustable with term *correction_delay*. This parameter defines the sensitivity to changes in finished product demand. The smaller correction delay we set, the more sensitive target adjustment we perceive.



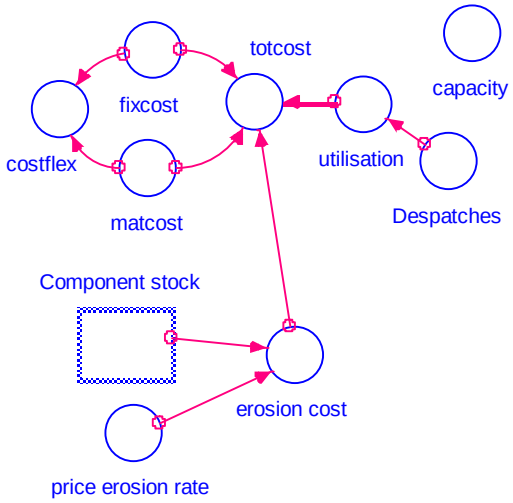


Figure 2. Production and supply part from the simulation model.

The ability to respond to changes is built on two main levels: These are (1) the local capacity and (2) the supplier system ability. Purchasing activity represents the supplier performance of the chain. The local ability is built into component stock level and manufacturing capacity. The complete model structure from production / operations part is illustrated in figure 2. This includes order-backlog mechanism at the top, purchasing policy at middle-right, capacity adjustment at middle-left, and the actual goods flow at bottom.

The dynamic behaviour of production emerges due to delays in ramp-up, delays in logistics and the effects of inventories. Figure 3 illustrates the demand, actual shipments, component stock level, and order-backlog. In the beginning, the ramp-up constrains the production flow. At $t=7$, the full capacity is in use and the lead time starts to decrease. It is easier to react against the next sales demand peak at time 16, when the system has stabilised at the normal capacity performance level.

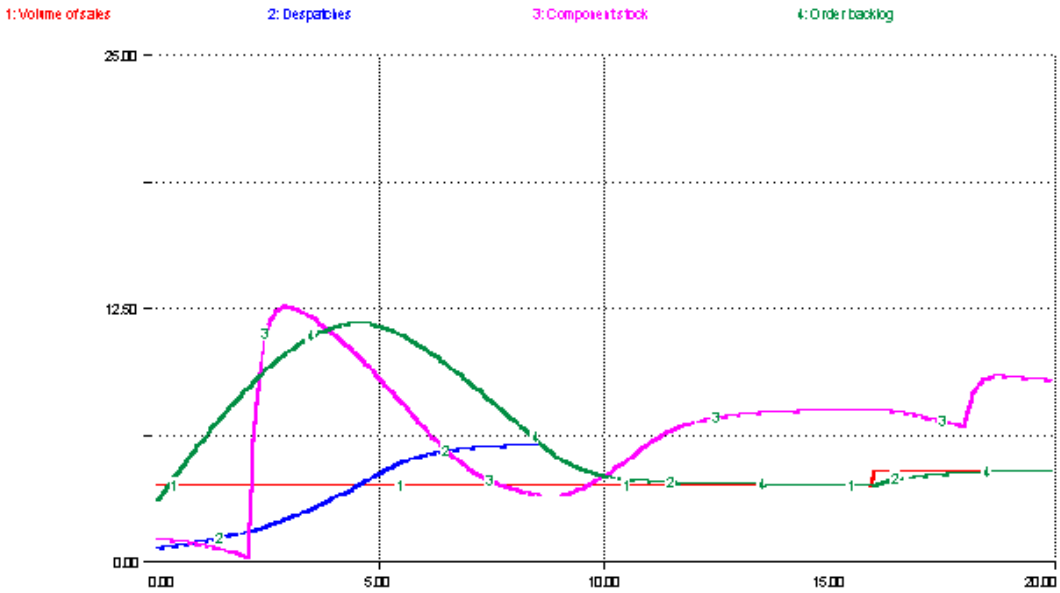


Figure 3. Demand, despatch and inventory.

Cost drivers, such as despatch, inventory levels or capacity utilisation are located in the actual model and are linked to the financial performance analysis part. The financial analysis parties are based on two main cost components: materials costs and fixed costs. The materials costs consist of direct materials consumed and the price erosion component, which increases the costs of components based on the inventory delay. The lead time for orders is approximated as a division between order backlog and the total capacity. The inventory cycle time is calculated in a similar way: the *Component_stock* level is divided by the current level of *Despatches*.

In order to analyse the agility in fluctuating demand, we test the model by using varying demand. Figure 4 illustrates two cost structure scenarios. The upper part of the picture refers to accumulated productivity in the case of fixed cost structure (90% of costs fixed, 10% variable). The productivity will decrease about 19% in this uncertainty. Productivity behaviour of a variable cost structure (90% variable costs, 10% fixed) in a similar environment is less sensitive. This means that the agility is higher.

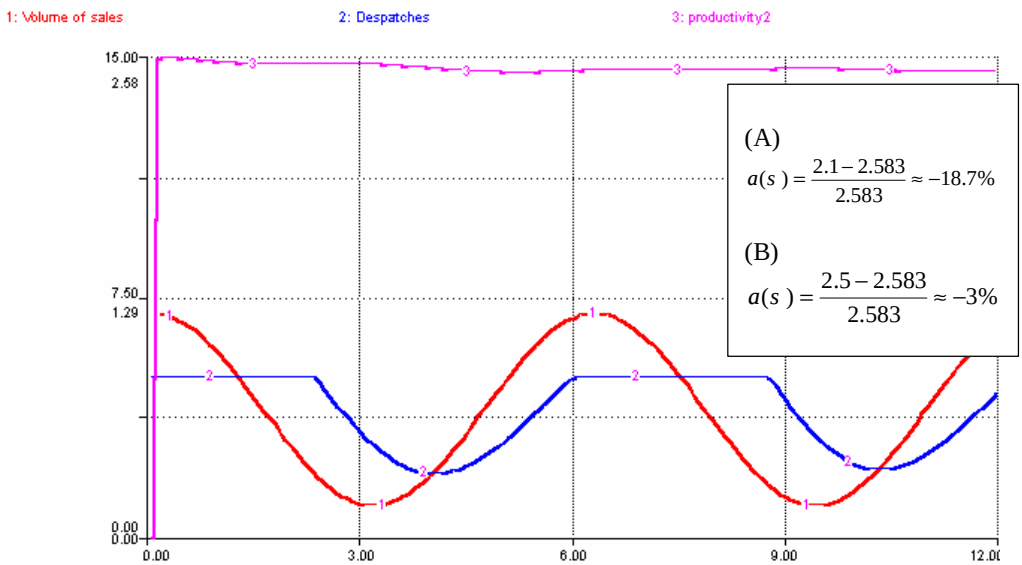


Figure 4. Agility with different cost structures under demand fluctuations.

5 CONCLUSIONS AND DISCUSSION

The analysis of the model suggested that the cost structure of a company has an important effect on the firm's capability to tolerate productively against volume fluctuations. A high amount of direct materials makes cost structure less sensitive to demand changes. Based on this we can propose that *variable cost structure and low inventory holding costs enable agility.* Mix response flexibility deals with the issue of the cost of variety. A production system is more flexible the more it can tolerate different products. This discussion can easily lead to assessment of diversity – how different are the products? In our model, we simplify the aspect of only those products, which are already manufactured with the system concerned. Potential new products are not taken into the analysis of flexibility. Lot-sizing decisions both in manufacturing and purchasing have an important effect on lead time. The mix response ability is connected to the *"batch and queue"* effect. When utilising a discrete manufacturing system, there is always a concern of appropriate cost efficiency, which is greatly affected by setup costs and lot-sizes.

The proposed measure connects the measures of flexibility and agility to a larger theoretical framework, namely productivity measurement. In any case, agility as presented is a short-term measure, which is suitable for system comparisons rather than actual systematic and operational performance measure. However, some points should be noted. Firstly, a required level of agility depends on the uncertainty perceived from the market environments. There might emerge several different kinds of environments that have different requirements for

performance capability. Agility and flexibility are dynamic measures i.e. the value depends from on previous value. (e.g. utilisation and cost in increasing demand). The need for these measures may vary also over time. The usefulness of this apparoch is that agility / flexibility is compared against the perceived or expected uncertainty and economic break-even-point analysis is used for understanding the sensitivity to market changes.

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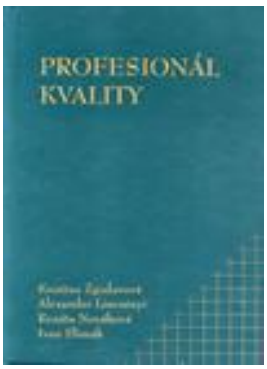
Note. Details of the model are available from the author upon request.

PROFESIONÁL KVALITY

KRISTÍNA ZGODAVOVÁ, ALEXANDER LINCZÉNYI,
RENÁTA NOVÁKOVÁ, IVAN SLIMÁK



Motto:

Čo treba urobiť, aby sa človek stal vzorom profesionála kvality?

„Podľa môjho názoru si to vyžaduje jasné chápanie teórie podmieňujúcej dosiahnutie hlbokých znalostí.

Domnievam sa, že profesionalizmus je viac ako sú bežné technické znalosti inžinierstva kvality, audítorstva a štatistiky. Profesionalizmus si vyžaduje okrem toho aj schopnosť tímovej práce a skupinovej dynamiky, spôsobilosť rozvíjať praktické odborné znalosti a dosahovať znamenité výsledky.“

Gregory H. Watson
ASQ president
(Quality Progress, 9/2000)

Poslaním učebnice je poskytnúť taký sumár poznatkov z teórie a metodiky rozvoja kvality procesov a produktov akejkoľvek cieľove orientovanej činnosti, ktorý by záujemcom umožňoval získať úroveň znalostí, predpokladanú u profesionálov kvality G.H. Watsonom. Učebnica vyhovuje aj pre univerzitné vzdelávanie pre odbornosť inžinierstvo kvality produkcie.

Cieľom učebnice je, aby študujúci nadobudli schopnosti modelovať, analyzovať, hodnotiť, projektovať, riadiť a zlepšovať produkčné procesy profesionálnymi metódami a nástrojmi v týchto oblastiach:

- marketing kvality,
- manažérstvo kvality,
- inžinierstvo kvality,

Učebnica je spracovaná v štyroch kapitolách:

1. kapitola sa týka marketingu kvality a pojednáva o požiadavkách a potrebách zákazníkov, charakteristikách marketingového prostredia, o špecifikách kvality a ich potvrdení obchodnou zmluvou.
2. kapitola pojednáva o manažérstve kvality a ozrejmuje koncepcie riadenia kvality na úrovni vedenia organizácie, od vytvorenia politiky a cieľov kvality až po ich sústavné meranie, preskúmavanie a zlepšovanie.
3. kapitola je orientovaná na inžinierstvo kvality a rozoberá problematiku dosahovania vyžadovanej kvality produktov prostredníctvom transformačných procesov, ktoré prebiehajú v organizácii od návrhu a vývoja, cez technologické procesy až po udržiavanie produktov v prevádzke u zákazníka.
4. kapitola je venovaná nástrojom a metódam profesionála kvality a obsahuje tie identifikačné, modelovacie, analytické a hodnotiace, projekčné a riadiace postupy, ktoré umožňujú riešiť všetky hlavné skupiny problémov a úloh kvality, vrátane vytvorenia systému manažérstva kvality. Táto kapitola udáva v zozname sedemdesiatjeden aktuálnych nástrojov a metód patriacich prevažne do inžinierskych teórií kvality, pričom šesťdesiatosem je aplikačne spracovaných a pre ďalšie tri sa uvádzajú vhodné literárne pramene.

Predpokladá sa, že študujúci majú základné znalosti z organizácie, riadenia a ekonómie, z metrológie, teórie pravdepodobnosti a matematickej štatistiky, psychológie, sociológie a technickej legislatívy ako aj z technológie v rámci ktorej chcú pôsobiť.

Učebnica je koncipovaná tak, aby sa stala dlhodobejšie hlavnou literárnou pomôckou profesionála kvality.

Jeho doplňujúcimi literárnymi prameňmi sú popri odborných časopisoch, najnovších knihách a informáciách z internetu, najmä medzinárodné normy ako aj normy a predpisy vlastnej organizácie.

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