INTELLIGENT SYSTEMS FOR DECISION-MAKING SUPPORT BASED ON BCM APPROACH

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Abstract: Tis paper represents research of several years which is conducted at the Centre for Quality at The faculty of Mechanical Engineering in Podgorica. The main objective was to obtain performances improvement measures for business processes by gathering various approaches and techniques and by underlying importance of integrated approach. This paper gives completely new approach in management systems which aim to provide business continuity according to previous defined goals. Following this, it has been created a system for risks prediction and elimination that could endanger organization functionality and could also deteriorate its performances. In this vein, a base for functioning of intelligent decision-making support system is provided. Hence, we accomplished preconditions for organizational performances improvement and knowledge acquisition concerning areas that must be under special treatment in order to enhance firm performance level.
Keywords: improvement of organizational performance; systems for decision- making support; business continuity; management for business continuity.

1. INTRODUCTORY CONSIDERATIONS

Difficult and complex conditions under which organizations have to operate in economic system represent, on one hand, threat for organizational survival and, on the other hand, they represent initiative for many researchers, experts, managerial structures and employees to find ways, directions, models etc, for the organizational performances improvement. It is one of the basic conditions which could provide opportunities for an organisation to survive in the complex business environment and to create environment for constant improvement and development.

In order to improve performances, organizations develop many integrated systems that are implemented through organizational specificities. The efforts and initiatives that can be observed in the area of organisational performances improvement are oriented towards enhancement of existing models through retesting of their usefulness and development of completely new approaches based on analogy, experience, senses, scientific capacity, etc.

Many models have been developed in that direction and they are, in one part, standardised and can be developed by the combinations of existing models and techniques for improvement. As a support for development of the models many information tools can be used.

For that purposes, utilisation of tools for artificial intelligence is particularly important and it is in its initial phase. Moreover, utilisation of modern information tools is significant, especially in part of modern systems for decision-making support that can be connected to other systems in order to obtain system with higher intelligent level. The traditional integrated approach systems for decision-making support and expert systems represent most used approaches for intelligent system establishment (1, 2, 3, 4). This is true because regular DSS (Decision Support Systems)-systems enable users to manipulate with data and models while integrating expert systems that move to intelligent domain.

KDD (Knowledge Discovery in Databases) approach is ideally suited to this approach or for approach that has huge database. In fact, the knowledge level can be raised what will improve better organizational performances (5).

They are also preconditions for the decision-making support systems development. Besides this approach, we have corresponding approach that was defined on dynamic memory concept and which is defined as: process for problem solving through memorising previous situations and repeated solving actions and similar problem basing on experiences presented in forms of data, information and knowledge: CBR (Case Based Reasoning) (6).

The purpose of this paper is to present new management model that provides business continuity and which also provides data that is necessary for the functionality and development of intelligent system for decision-making support.

This would enable creation of an approach that would have its sustainability, renew ability, continuity and which can provide constant data that would be stored in database of this intelligent system for decision-making support.

2. MANAGEMENT BY BUSINESS CONTINUITY AS THE BASE FOR INTELIGENT SYSTEM FOR DECISION-MAKING SUPPORT

As already noted, constant improvement of process performances and system in its entirety is the most significant part. Capacity of the system to retain certain performances and to improve them through iterative mechanisms is something what need to present priority tasks in one organizational unit. The significance of these efforts has been recognised at The Faculty of Mechanical Engineering in Podgorica, among the rest and through the model for improvement of organizational performances based on analogy with human body. This model works on the basis of human body functioning. The model compares best international experiences and winners of business excellences and it improves performances in specific conditions. In this model, basing on process modelling approach, it introduces an aspect which concerns degree of efficiency of process for attaining the best results (S_i). Parallel with this, the model obtains automatically degree of efficiency for the entire system and one may observe areas in which performances levels can be improved on a higher level.

In parallel with these efforts, Britain Institute for Standardisation has created standard BS 25999.2006 (7,8) that serves for the establishment and improvement of BCM (system that may help researchers and model developed at The Faculty of Mechanical Engineering in Podgorica). In this paper, the authors try to present similarities of these two concepts and possibilities of their gathering in order to improve all organisational performances and not only those that are related to quality management systems. Hence, the following lines of this paper are dedicated to short description of the BCM model and to authors' opinions about the ways that this system could be used for organisational performance improvement.

The BCM concept is oriented to all organisations regardless their activities, size and organisational structure. This is model that is derived from the best international business experience and its implementation in the best international organisations is without any doubts. This system pervades entire organisational structure from top management to all other employees. With the application of this model, it is possible to integrate and to increase database to other areas, not only for quality management systems. This is a basic preoccupation and aim of the authors to develop system that will be directed to improvement of all organisational performances and which will in the core have system based on the BCM approach.

The BCM approach or management by business continuity is business oriented with aims to direct system that gives organisation possibility of proactive behaviour and improvement of efficiency or capacity level (*Efficiency or ability are words that are related to possibility or capacity of an organisation to respond to the impact of particular incidental situation. In standard BS 25999 this "efficiency" is defined as "resilienc".*) in order that organisation can respond to eventual impact of incidental situations. It is very important to note, and it is precisely defined by standard, that under incidental situations we can consider all situations that lead to impossibility of accomplishment of previously defined strategic goals.

This concerns strategy and target oriented activities of this system. Also, BCM means that stakeholders' strategy is clearly recognized and it provides environment for achieving the strategy.

The BCM model is compatible with the models related to management by risk (9,10,11,12,13,14) by which is possible to establish frameworks for identification, analyse, estimation and risk control. With help of BCM model, organisation can recognise activities which must be defined before an incidental situation emerge in order to protect organisational performance and to ensure accomplishment of define advantages and outputs of one efficient BCM modelÿÿre:

- Identified key products, provided their safety and continuity,
- Possibility to respond to certain incidental situations,
- Obvious needs recognition and importance of all interested parties,
- Trained staff that can recognized system defaults or incidental situations,
- Employees have clear information flows in case of incidental situations,
- Relationships with users and providers,
- Organizational reputation is protected,
- Organisations make that system proactively works,
- Underline communication and synergy of process teams,
- and others.

The BCM model is represented in Figure 1. In figure 1 we can notice four basic processes inside the BCM concept. Through the process "Understanding of organisation", organisation must identify key processes that are of strategic importance, that have priority from the point of existence and attaining advantage in competition area.

Also, in these processes priorities must be known and its importance must be determined. Standard demands, and is very important, that so called analyse of business importance be performed (BIA-Business Impact Analyses) and it is starting point for establishing the efficient of the BCM concept.
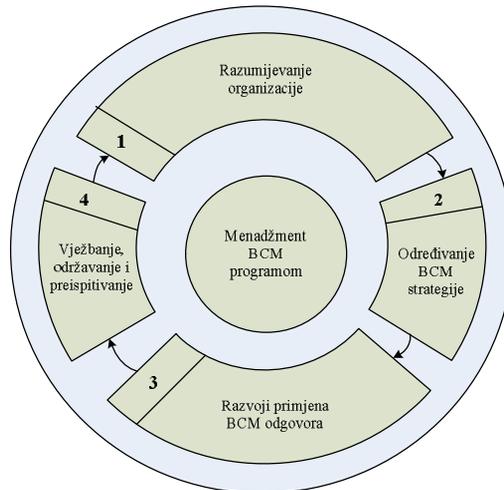
Figure 1: The BCM model

3. POSSIBILITY OF THE BCM MODEL APPLICATION IN THE PROCESS OF THE CONSTANT ORGANISATIONAL PERFORMANCES IMPROVEMENT

In the core of integration model, which is previously mentioned, there is a technology of learning on the basis of experience of others that is also used for doctoral dissertation (15) applied to model ISO 9001 and demands that are defined in it, due to data availability. The author has an idea that this system could be applied on other areas. Just suited for that is the standard that defines the BCM technology. This model corresponds to mentioned integration model if term incident is equal to term of system incompatibility. Just as an incident leads to far-reaching consequences, system incompatibility has an impact on entire system stability.

In this sense and according to more and more pronounced elements of integration approach to management systems, the authors, having in mind named properties of the BCM approach, recommend that organisations, as a precondition for improvement of performances, define incidental situations or define particular system incompatibility that can have far-reaching consequences for system.

Of course, there we should have in mind strategic aims of organisation, key processes in organisation and certain situations that can jeopardize attainment of these aims and functioning of key processes.

On the basis of recommendations of the standard that define the BCM, the authors recommend that organisations must perform BIA-Business Impact Analyses. Following this, the starting points of incompatibility of system or incidental situations are well defined.

In the framework of the BCM standard, as already defined, term "resilience" emerges, namely capacity of system to oppose to certain unplanned, random incidental situations. The authors of integration approach introduce different approach for defining system ability. They define the term "degree of efficiency" of process for attaining high results. This has a little different insight, although concordances are visible in part of critical areas identification in relation to occurrence of instability. In this sense, we observe frequency of occurrence of instability and critical areas identification based on high results attainment and this is also based on system stability.

Based on previous analyses and visions, based on the standard for establishment of the BCM system and based on developed integration approach, we recommend concept for improvement of organisational performances, presented in Figure 2.

In Figure 2, we can observe possibility of the BCM approach implementation in part of organisation performances improvement periodically. Besides that, it is possible that this is performed yearly and it, in some sense, could be in comply with recommendations of standard ISO 9001 where retesting by executives and also retesting of goals is performed at least once a year. The authors recommend, in comply with the best international experience that these periods be quarterly, when testing of system stability and system capacity and level of accomplished goals are performed. On the basis of indicators from BCM approach, at that time, retesting of system state is performed and also the goals are being redefined.
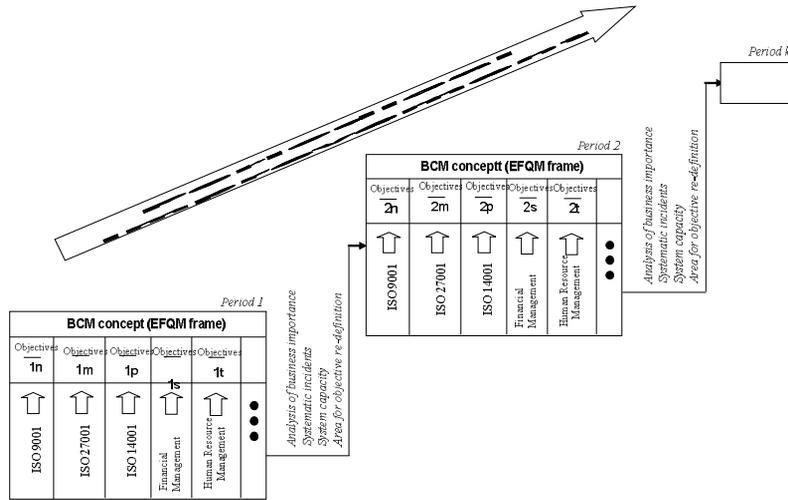
Figure 2: Approach for organisational performances improvement

Therefore, following this approach as output elements of the BCM mechanism, it would be possible to get certain data that enable:

- Defining areas that have priority importance for organisation as the results of Business Impact Analyses,
- On the basis of system "condition" its continuality, we get information about possible weak areas where the levels of goals should be enhanced and where we must pay particular attention,
- In case of entire system stability (that is rare occasion, because all systems during their lifetimes experience certain instabilities), the goals are redefined on level of higher importance, namely, "higher" goals are being set,
- etc

Therefore, the BCM approach can be applied on all management systems in organisation if incidental situation is seen as a system incompatibility that leads to failure of attaining of previously defined goals that were in comply with business strategy in organisation. The BCM system, that defines activities for maintenance of work continuity, gives important information that can be of high importance for the improvement of certain system. Therefore, the BCM concept should be preconditioned for the improvement of organisational performances. This improvement can be accomplished in two following ways,

1. If, in some organisation, one adds time dimension to the BCM approach and performs periodic testing and improves the approach on next level,
2. If an organisation uses information produced

by the BCM from several organisations that have already implemented the BCM concept and if this is used as an example for other organisations that have the same volume activities in the area of the BCM concept

Based on previously defined analyses and approaches, we get system that is absolutely strategically oriented and which, on the highest level, respects approach of integration of different systems and approach of constant improvement of organisational performances.

4. INTELIGENT DECISION-MAKING SUPPRORT SYSTEMS BASED ON BCM APPROACH

The importance of development of efficient intelligent systems as a support for attainment of improvement organisation performances in order to accomplish advantage over the competition has already been highlighted. On the other hand, development of these systems also represent a challenge for researchers because all analyses indicate the fact that these information systems are in initial phase (16,17,18,19,20). Recent trends in this area, in most parts, move into the directions of gathering classic systems for decision-making and expert systems based on theories of CBR and KDB (21,22,23,24,26,27).

In the literature, we can find two possibilities how to gather classical DSS system and expert system:

- Expert system related to DSS componenets,
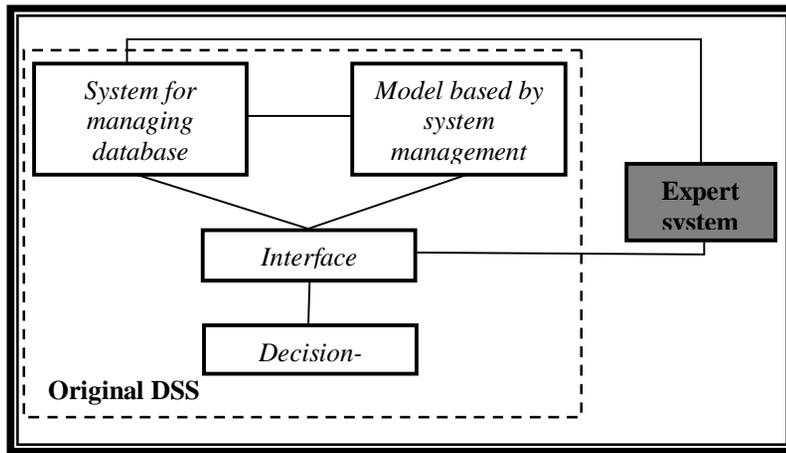- Expert system separate from DSS components.

Figure 3: Expert system separated from DSS components

In sense of expert systems development, there are two approaches: systems based on rules and systems based on cases. Usually, traditional expert systems are based on IF-THEN concept or concept based on rules. Modern approach, and also compatible approach with CBR technology which is presented in this work, is expert system based on case (28,29,30,31,32,33,34).

The systems like this, works on principle of recognitions of certain cases that are stored in the database, comparing with presented case and decisions-making based on recommendations that are stored in database.

Now it is possible, to realize integration with basic, more precisely with linked the BCM system (Figure 4).
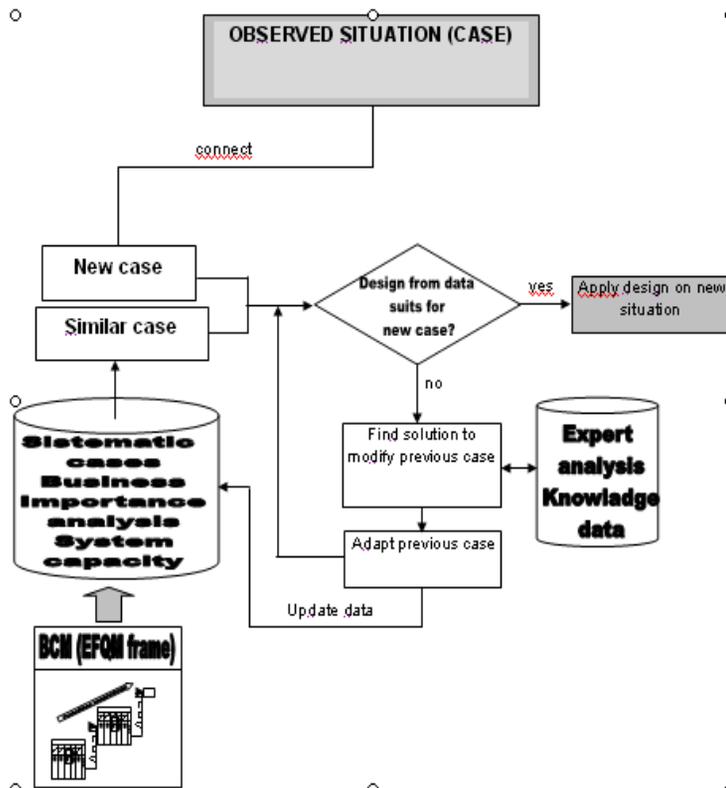

Figure 4: The concept of the intelligent system for making-decision support based on the BCM model

Based on output data of the BCM system and are related to:

- Results of business importance analysis,
- Possibility of responding to organisational system problems,
- System capacity,
- Area for redefining priority goals.

It is necessary to define base of cases for intelligent system that is presented in Figure 4. This is also a basic characteristic that is assigned to knowledge data formed by the experts in certain areas and which gives new cases that represent settlement of previous situation and have not occurred in mentioned organisation.If such a system is updated by time component, that follows earlier named BCM conception, this leads to dynamic system and constant enhancement of intelligent level of the system. Moreover, the system updates constantly data and knowledge for database. This system can use possible available data from other compatible systems in other organisations and what will improve the level of its performances

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5. CONCLUDING CONSIDERATIONS

Organisational performances improvement process is unavoidable situation which, under modern and complex business conditions, should be performed on the basis of recognised methods and techniques or on the basis of specific organisational conditions oriented to systems development. This process should be constant and strategically oriented in order to constantly improve level of performances above the level that the competition imposes. Today, there is underlined possibility of including various software sets that represent good technical support for performing certain methodologies for improvement of process performances. In this sense, it is necessary to perform integration of several information systems, particularly in the area of artificial intelligence in order to create efficient intelligent system.

As today, there is various processes that operate inside organizations as well as there are trends towards more and more uniformity and standardization, it is necessary to follow direction based on integration and synergy of several management systems such as management by finance, human resources management and others. In such an environment one can realize good base or object which can be a tool for constant improvements and source for many data that are used for maintenance of database in intelligent systems. Thanks to the model for development for macro-management of incompatibilities, and based on learning theory on case studies, with recommendations that offers standard BS 25999:2006, the authors recommend establishment of management system by continual business that works on base of the cases that are important for system stability. Development of this system should be performed in comply with recommendations offered by European Framework for Quality Management (EFQM) in order to get compatible system whose performances can be compared with "outstanding organisations".

In the sense of more information systems integration, the authors recommend model for integration of classical DSS systems and expert systems following the concept of separate components. Together with this, the authors also recommend application of expert systems supported on the case that functions on the basis of recognition of similar or same situations in database and on the base of recommendations for decision-making support.Such a concept should be assigned to established the BCM model in the framework of EFQM model and for wide range of management systems. Such a model in its output gives data for obtaining the intelligent system database. If that model is assigned to data dimension, we will get sustained and dynamic system which gives recommendations for decision-making in sense of improving performance level in organisation.

5. REFERENCES

[1] Turban E., Watson H., *"Integrating expert systems and decision support systems",* Management Information Systems Quarterly, pp. 121– 136, June, 2002.

[2] Cheung W., Leung L., Tam P., *"An intelligent decision support system for service network planning",* Decision Support Systems 39, (2005), 415– 428

[3] Fedorowicz J., Williams G., *"Representing modeling knowledge in an intelligent decision support system",* Decision Support Systems 2, (1) (1996), 3 –14.

[4] King D., *"Intelligent decision support: strategies of integrating decision support, database management, and expert system technologies",* Expert Systems with Applications 1, (1), pp. 23– 38, 2000.

[5] Aamodt A., Plaza E., *"Case - Based Reasoning: Foundational Issues, Methodological Variations, and System",* Approaches. AI Communications. IOS Press, Vol. 7:1, pp. 39 - 59., 2004.

[6] Wittgenstein L., *"Philosophical investigations",* Blackwell, pp. 31 - 34, 1993.

[7] *British standard BS 25999-1:2006, Bussines continuity management – Part1: Code of practice.*

[8]   British standard BS 25999-1:2006, Bussines continuity management – Part2: Specification

[9]   Standards Australia, "Risk Management, AS/NZS 3360:1999", Standards Australia, 1999., Strathfield

[10] Chapman J., *"Effectiveness of working group risk identification and assessment techniques",* International Journal of Project Management, Vol. 16, No. 6, 1998., pp. 333 - 43.

[11] Zhi H., *"Risk management for overseas construction projects",* International Journal of Project Management, Vol. 13, No. 3, 1994., pp. 231 - 7.

[12] Boehm W., *"Software Risk Management",* IEEE, Computer Society Press, Washington, DC, 2004.

[13] Baccarini D, Salm G., Love P., *"Management of risks in information technology projects",* Industrial Management & Data Systems, Volume 104, · Number 4 · 2004 · pp. 286 – 295

[14] Reason J., *"Managing the Risk of Organizational Accidents",* Aldershot, U.K.: Ashgate Publishing Ltd., 1997

[15] Vujović A., "Poboljšavanje performansi procesa na bazi sistema menadžmenta primjenom alata vještačke inteligencije", Mašinski fakultet u Podgorici-Doktorska disertacija, 2007.

[16] Schank R., Leake D., *"Creativity and learning in a case - based explainer",* Artificial Intelligence, Vol. 40, No 1 - 3, pp. 353 - 385, 1989.

[17] Schank R., *"Dynamic memory; a theory of reminding and learning in computers and people",* Cambridge University Press, 1992.

[18] Anderson R., *"The architecture of cognition",* Harvard University Press, Cambridge, 1983.

[19] Kolodner J., *"Maintaining organization in a dynamic long - term memory",* Cognitive Science, Vol.7, pp. 243 - 280, 1983.

[20] Gentner D., *"Structure mapping - a theoretical framework for analogy",* Cognitive Science, Vol. 7, pp. 155 - 170, 1993.

[21] Carbonell J., *"Derivational analogy; A theory of reconstructive problem solving and expertise acquisition",* In R.S. Michalski, J.G. Carbonell, T.M. Mitchell (eds.): Machine Learning - An Artificial Intelligence Approach, Vol.II, Morgan Kaufmann, pp. 371 - 392, 2002

[22] Ljungstrom M., *"Implementation of a Work Development Oriented Strategy for Continious Imrovement"*, Lulea University of Technology, Doctoral Thesis, 2004.

[23] Ross B., *"Some psychological results on case - based reasoning",* Case - Based Reasoning Workshop , DARPA 1989. Pensacola Beach. Morgan Kaufmann, pp. 144 - 147, 1999.

[24] Helmreich R., *"Managing Human Error in Aviation",* Scientific American, str. 62 - 67, May, 1997.

[25] IOM, *To Err Is Human, Reason J., "Human Error",* Cambridge: University Press, 1990

[26] Dornan B., *"A status report: artificial intelligence'',* Production, pp. 46 - 50, 1987.

[27] Barr E., Figenbaum A., *"The Handbook of Artificial Intelligence",* Vol I - III, Vitman, London, 1982.

[28] Padhy N., *"Artificial intelligence and Intelligent Systems",* Oxford University Press, 2006.

[29] Panduranga Rao J., *"Expert systems in agriculture",* McGraw - Hill 1991.

[30] Laurier J., *"Problem Solving and Artificial Intelligence",* Prentice Hill, New York, 1990.

[31] Ignizio J., *"Introduction to Expert Systems - The development and Implementation of Rule based Expert systems",* McGraw - Hill Internationaledition, New York, 1991.

[32] Radenković B., Stanojević M., Marković A., *"Računarska simulacija",* Fakultet organizacionih nauka i Saobraćajni fakultet u Beogradu, 2000.

[33] Acquire Users Guide, *Acquire Inteligence Inc., Victoria, Canada, 2004.*

[34] Hunt V., *"Artificial Intelligence and Expert Systems Sourcebook",* Chapman & Hall, New York, 1986.