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TOWARDS TO TELEMATICS

The goal of this paper is to present new research subject called telematics, which can be found in wide spectrum user areas, from an individual multimedia communication to intelligent use and management of large-scale networks (e.g. transport, telecommunications, and civil service). Advanced telematics provides intelligent environment for knowledge society establishment and allows expert knowledge description of complex systems. At the end of paper, the application of telematics theory for transport engineering is shown. The presented results are supported by grant of Ministry of Transportation and Telecommunication No. 802/210/108 - "Intelligent Transport Systems in transport-telecommunication environment of the Czech Republic".

W KIERUNKU TELEMATYKI

Celem referatu jest przedstawienie nowych badań w temacie zwanym telematyką, który może być zastosowany przez szerokie spektrum użytkowników z różnych dziedzin od indywidualnej komunikacji multimedialnej do użytkowania inteligentnego i zarządzania sieciami na szeroką skalę (np. transport, telekomunikacja, służby cywilne). Na końcu referatu pokazano zastosowanie telematyki dla inżynierii transportu.

1. INTRODUCTION

Telematics definitely is a new dynamically developing branch that has an immense impact on economy and development of all organisations and becomes a tool of global economy. Application of knowledge in the field of telematics enables transition from mechanical management of companies to the so-called holistic control.

In the case of mechanical management, the whole organisation is comprehended as a sum of single parts, while in case of the holistic approach, each part of the organisation accepts unified general culture of management and business irrespective of its geographical location or territorial particularities. This change in organisation of labour enables fast development namely in branches with effect over the whole territory. However, the whole process must be supported by development of telematics systems, because they are the necessary technical condition for achievement of this state.

Although an explosion of information technologies occurred, although processing of acquired information is not optimal so that complete knowledge of processes is extracted and

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an optimal support for managerial decision is created. Topics of problems in the field of system integration of economy tasks leading to formation of knowledge were described in [1]. However, complete knowledge of processes includes processing of various information even from other activities of the organisation that were supported by computer technology [2, 4].

The whole process is subordinated to economy view so that invested resources bring the expected result. There is a direct link between the technical solution and economy of organisations. The aim of the research done at Faculty of Transportation Sciences, CTU in Prague is to define the basic relation of the technical solution of a telematics system with respect to economy of an organisation and to clarify basic topics of problems of further development of the filed of telematics.

2. BASIC PARTS OF TELEMATICS SYSTEM

To enable a proper overview of the problem, we shall divide the telematics system into three basic layers with description of expenditures connected with each layer:

- Collection of information (expenditures on sensor, creation of interface of single applications, creation of adjustment software, etc.),
- Transmission of information (expenditures on telecommunication services, investment cost of special telecommunication environment, etc.),
- Processing of information (expenditures on computer systems, knowledge systems at various levels of architecture, on software and hardware, etc).

2.1. EXPENDITURES ON COLLECTION OF INFORMATION

Information is the most valuable property of organisations and is hidden in single information subsystem [4]. As information technologies developed, requirements on solution of single information subsystems were growing without a clear concept. Due to absence of a system approach, partial problems were solved separately and without any link to other information subsystems. This resulted in duplicate collection of same information in several tasks. It is obvious that this increases expenditures on collection of information.

Another reason of growth of expenditures on collection of information is a non-systematic approach to definition of standards of collection of information, which leads to necessity to develop transformation or adjustment software.

As an example, we can mention counting of inhabitants, registration of identification cards, driving licences (where same data are duplicate collected at various offices). We could give tens of such examples.

2.2. EXPENDITURES ON TRANSMISSION OF INFORMATION

Expenditures on transmission of information are considerably affected by the following factors:

- Absence of a system approach to creation of telematics system,
- Redundancy of messages in all parts of the telematics system,
- Duplicity of transmitted information,

- Absence of knowledge of telecommunication technologies namely in building own telecommunication networks (integrated LAN and WAN networks).

Another serious reason of growth of expenditures on transmission of information, which is not less important, is the absence of offer of services meeting the specified requirements on availability, reliability and security of transmission. Organisations are forced to build their own telecommunication networks either on leased circuits or even on their own lines. Absence of these works is the direct reason of the current situation, when the demand for lease of permanent fibres of a physical layer of the telecommunication environment exceeds the offer.

2.3. EXPENDITURES ON PROCESSING OF INFORMATION

Building a teleinformation system using optimum methods of processing of information is a necessary condition of efficient processing of information. Extraction of knowledge consists in estimation of so-called markers (accepted from medicine) that describe the current situation much more economically than the measured data itself. The whole concept of architecture of telematics systems must be focused on acquisition of markers already in the lowest layer of the telematics system. Higher layers already work with these markers and their comparison enables acquisition of knowledge necessary for managerial decisions. Based on various levels of knowledge, we can create a model of a multidimensional system.

3. TELEMATICS SYSTEM ARCHITECTURE

The architecture of telematics systems can be generalised for all branches, because in wider meaning, it defines the basic structure of all systems and is a sort of a strategic plan for all designers.

The architecture reflects several different views of the examined system and can be divided into the following five parts:

- Functional architecture that defines all processes within the telematics system including data flow between these processes (correctly selected functional architecture reduces the information flow within the telematics system);
- Information architecture that defines the structure and hierarchy of the system including requirements on information (correctly selected information architecture synchronises information inputs and outputs);
- Physical architecture that allocates physical devices, which execute processes described in the functional architecture (correctly selected physical architecture optimises technical tools of the telematics system);
- Communication architecture that describes the transmission environment between physical devices (correctly selected communication architecture optimises telecommunication tools);
- Organisation architecture that specifies competencies of single management levels (correctly selected organisation architecture optimises management and competencies at all management levels).

It should be noted that it is impossible to purchase a telematics system, but it must be systematically built and must meet certain criteria and principles [1, 5]. Even in case of purchasing a physical layer of the system, there is still a long way left to reach a fully functional telematics system.

Although the aim of building a telematics system is efficient processing of information, it turns out that least financial resources are spent to it. The reason of the low rate of expenditures on information processing is just the absence of a correct architecture.

Processes that are not synchronised cannot be further processed efficiently (knowledge cannot be obtained) and therefore there is no will to invest money in the information processing systems. To change this situation, it is necessary to secure that the investments in information processing will bring effect.

Correctly conceived architectures of telematics systems in organisations will have a direct impact on the following factors:

- Efficient building of telecommunication environment and corporal networks will reduce their expenditures;
- Considerable reduction of transmitted information will reduce expenditures on transmission;
- Definition of requirements from the part of organisations will force the existing operators to offer services with these over-standard requirements, which will result in reduction of expenditures on building of special telecommunication environments;
- Economical convenience of new solutions of transmission of information will lead to increase of demand for new technologies of telecommunication networks namely in the field of access networks;
- It will be possible to secure modular development of telematics systems in single branches and organisations using the existing systems.

The above factors have an immense impact on economy of building of telematics systems. A correctly conceived architecture, which utilises advanced information processing system, logically leads also to reduction of expenditures on collection and transmission of information.

4. TRANSPORT TELEMATICS

The branch of transport telematics needs to be observed in broader context and defined in a system and developed in such a way that its feature use shall not be limited only to solve the transportation problems, but on the contrary, to have a conceptual formation of the entire integrated transportation system. Such telematics system shall have a strong impact on the transportation process pricing and shall lead to a higher customer satisfaction.

Price optimisation in transportation process leads to definition of tools similar to those used for production units management. That means it is necessary to observe the price of transportation process realisation and to optimise it by economic tools. In reality this means monitoring of many parameters obtained by transportation telematics system and using them for an optimum strategy of goods or passenger transport. However, should the transport telematics system meet this task, it shall not be limited to a single type of transport as it is

often the case in definition of road telematics, but for the concept it is necessary to respect the future connection of all kinds of transport.

The total price of transportation process realization consists of transport route price (transport infrastructure), price of surveillance or traffic control in transport routes (employees, transport police, road management) and consequence of transportation process realisation (investment in trnsport infrastructure, investment in ecology, etc.).

4.1. PROCESS MODEL OF TRANSPORT TELEMATICS SYSTEM

The process model itself is structured - it is made up of sub-models describing part of the corporate situation from a particular angle. The most significant models include a structured tree of processes, a model describing the chain of process links, an overview process model (containing input, output, organisational elements in relation to the process, etc.), a detailed process description, an organisational structure model, a data element structure model, etc.

Even a brief list like this hints at the opportunities available for the scope of description. According to the rules of model generation, the required subjects are recorded and the links between them are inked in. In addition to the simple interconnection of the subjects within the scope of the model, we can also create hierarchical links and generate a model structure. This is what allows us to break the process model down into sub-models.

Based on the process model the architecture of transport telematics system could be designed.

4.2. ARCHITECTURE CONCEPT OF TRANSPORT TELEMATICS SYSTEM

The architecture of transport telematics is designed in a way allowing for it to be applied by all transport types. This concept of transport telematics is the key tool of government transport policy and is an essential part of multimodal and intermodal transport.

Each layer can naturally be divided horizontally into following groups:

- traffic (carriers, passengers, drivers, etc.)
- means of transport (coach, train, etc.)
- transport infrastructure (roads, motorways, etc.)
- transport terminal (coach station, transit shed, etc.)

Information that can be used in transport management is today concealed in all information subsystems supporting the transport process. If the information flows in the transport telematics system are to be optimised effectively, they must be devided into characteristic groups that can be defined:

- The technical means of the transport process - these include all technical systems securing the direction of vehicle movements, supervision and control of the transport infrastructure, vehicles, persons, and loads, other control security systems of the transport infrastructure and mobile means.
- The means to manage transport process - these include all information systems securing the management, organisation, and supervision of the movement of vehicles, persons, and goods.

- Systems to keep records of the transport infrastructure and means of transport "passports" - these include digital records of the basic elements of transport routes, transport structures, vehicles, and related tangible fixed assets.
- Economic systems of organisations transport route managers, and hauliers - these include all economic systems of individual parts of the finances of transport companies, transport route managers, and other related economic units.
- Legislative support for the transport process - this includes inspection systems securing legislative supervision of the technical equipment of transport routes, means of transport, and the safety of traffic on transport routes.
- Strategic planning - this mainly includes systems securing the links of transport telematics systems to the state information system, which makes it possible to draw up strategic plans for the development of the transport infrastructure, the harmonisation of transport, and supervision of state and regional transport policy.
- Transport management - this includes systems for the support of the management decision-making process at various levels of the transport management hierarchy. The architecture of the management systems depends on the organisational structure of transport route managers, hauliers, and other economic organisations.

The above-mentioned characteristic groups can be used to define the structure of each layer of the transport telematics system. In each transport telematics subsystem the individual telematics applications are defined. Because telematics applications arose at various periods, they have different requiremens in respect of the collection, transmission, and processing of information.

Transport telematics applications have different requirements regarding the transmission of information between the individual layer. These requirements are well defined and handled in the field of information processing (control centre), but so far have not been fully accepted in the field of information transmission.

5. CONCLUSION

Generally, we can say that single branches are significantly stigmatised by the same mistakes in development of telematics systems. In all studied cases, the dominant mistake was a dynamic development of information technologies without having knowledge of basics of telecommunication technology (system convergence of informatics and telecommunication branches with a direct impact on economy of organisations).

The reason of stagnation of telematics is an inappropriate financial ratio between expenditures on collection, transmission and processing of information. By applying new technologies, conceptual approach to architecture of telematics systems, definition of interfaces, etc. will enable achieving an optimum ratio.

Processing of information is a dominant item, because acquired knowledge brings benefits to the organisation. Expenditures on collection and transmission of information only are a necessary cost that enables obtaining the knowledge. To overcome this state and to enable further development of the branch of telematics, it is necessary to solve many theoretical problems. These problems can be summarised in the following topics:

- Synchronisation of parameters (if the system parameters are not time, space and code synchronised, information cannot be efficiently combined and knowledge cannot be extracted);
- Optimum architecture of telematics system (information often of same character is collected in various parts of the telematics system, which results in increase of requirements on collection and transmission of information);
- Definition and standardisation of interfaces (the interface secures system modularity and enables optimum selection of modules irrespective of manufacturer of other components of the system).

It seems that further development depends on the process of solution of the above topics. EU Frame programs also support development of these methods and these works are also done within these programs.

The above described analysis shows that the branch of telematics becomes a tool of new management and decision in all organisations and it should be given maximum effort, because there are considerably large benefits in the economy field of organisations.

The concept of transport telematics architecture could be seen as one concrete example of haw to tackle the approach to the above mentioned problems of telematics.

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