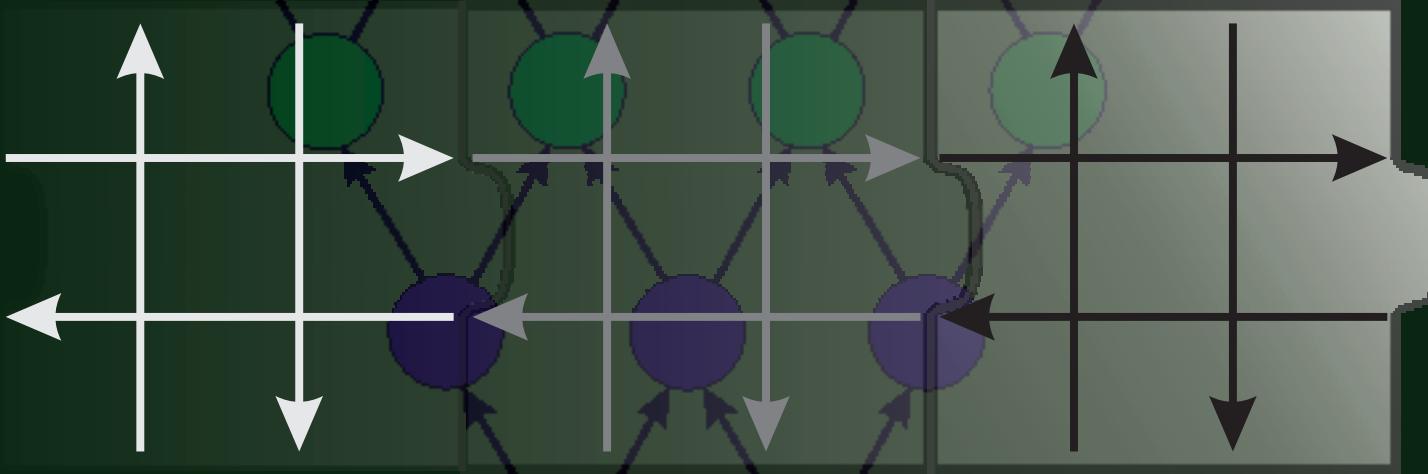
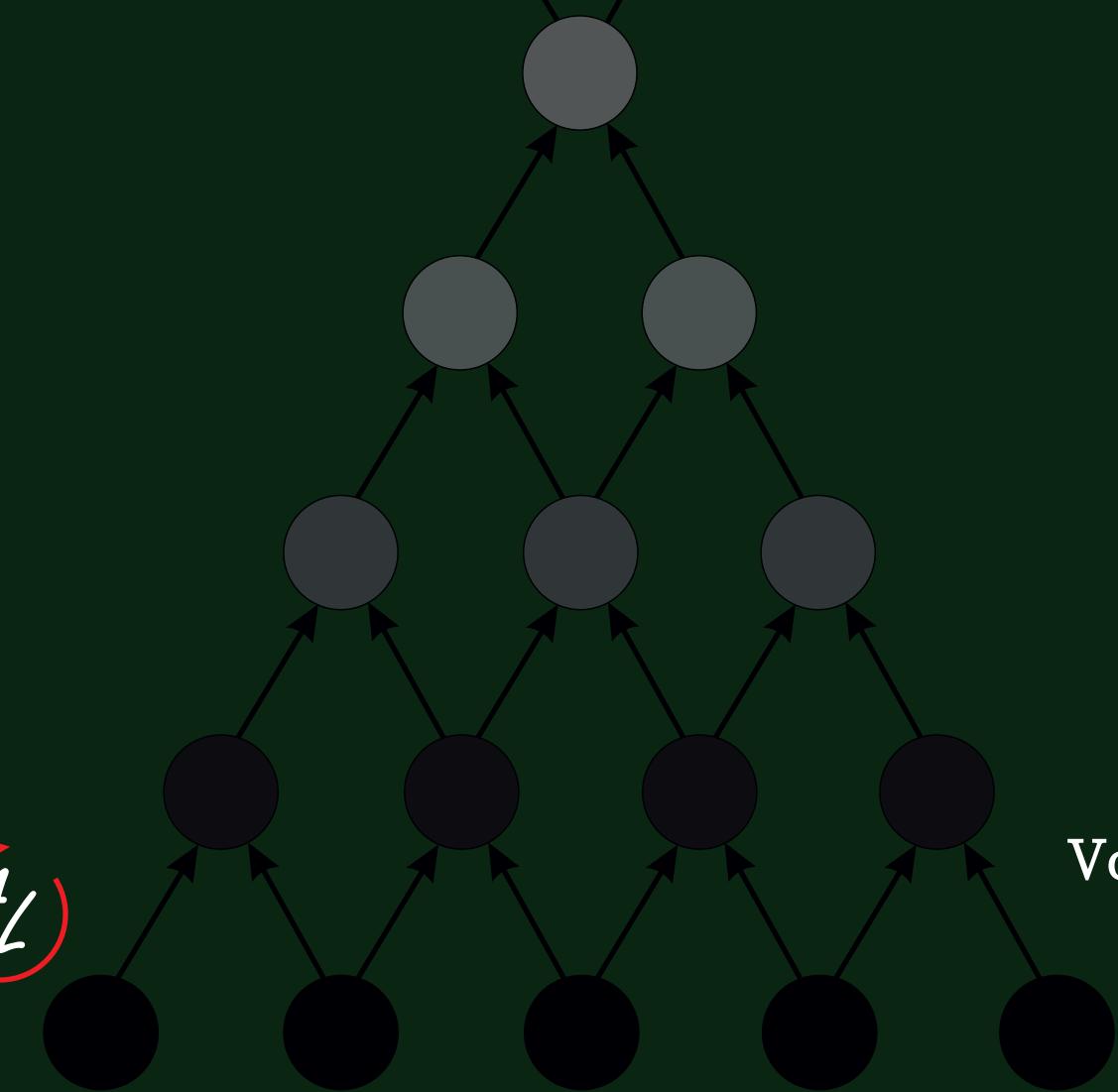


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# IMPROVEMENT OF PRODUCTION PLANNING IN COMPANY PARS KOMPONENTY

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**Keywords:** the MRP system, production planning, reserve time, stocks

**Abstract:** The article analyzes the current status of production planning in company Pars Komponenty s.r.o., proposes a new method of planning based on application of the principle of MRP. It is a discrete type of production with high complexity of BOM and MTO (Make-to-Order) and ETO (Engineering-to-Order) from the point of decoupling point. The original planning system plans according to production capacity backward without collisions, but for a given type of production does not work in practice. Planning system was analyzed and the main problems were identified, which were high work in progress and material stocks. This article target is to propose a new planning system based on the inclusion of time reserves of purchased material items. New planning system was tested in practise with benefit in reducing both the material inventory and work in progress.

## 1 Introduction

This article describes the design and implementation of a more efficient method of production planning in the company Pars Komponenty s.r.o. based on the application of principles of MRP systems.

Pars Komponenty s.r.o. develops and manufactures components for mass passenger transportation vehicles, in particular, railcars, underground vehicles, trams, trolleybuses and buses.

The bearing manufacturing program of the company is manufacture of interior and exterior doors, pneumatic and electric door systems, windows, baggage racks, lifting platforms for disabled passengers and interior partitions for mass passenger transportation vehicles.

It is a discrete type of production and MTO (Make-to-Order) and ETO (Engineering-to-Order) from the point of decoupling point. This type of production is very specific and the designers who design unique products to meet specific customer requirements play an important role here. The customer and business world are more interconnected here. When the product is designed as well as manufactured the customer makes changes and clarifications.

This type of production is specific for:

- High complexity of BOM (even 20 levels)
- High number of operations that enter into the planning process
- Extensive modifications of existing products in accordance with customer requests
- A large number of customer changes during production (especially for prototypes)

- Material utilization mainly in accordance with customer specifications and requirements and therefore longer delivery times
- Limited outsourcing at other suppliers, as the customer certifications are needed
- The occurrence of floating bottlenecks, due to irregularity of production series composition

## 2 MRP Systems

MRP is a concept developed in the early 1960s in the USA. It can be said that it was focused more on inventory control than on the planning and management of the production process. Its basis is to replace the until then widely used inventory management system, which is according to the standards more effective and is based on the directed order of material according to the actual needs of production where the information is processed by the means of computer technology. The starting point for the calculation of the material requirement plan (MRP analysis) is the gross production schedule. It is built on the basis of purchase orders, or prediction of demand for products [1], [3].

The rapid development of MRP began with the transformation of the production plan which was designated by the number of final products manufactured according to the specific requirements of individual workplaces. This MRP itemizes constantly, transforms basic information, for example the need for the necessary capacity, materials, people, raw materials for the manufacture of parts and assemblies. With the ongoing time of production it determines which department, when and how much of what passes [3], [4].

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MRP therefore answers these three basic questions:

- What is needed?
- How much is it needed?
- When do we need it?

The primary inputs to the MRP are:

- Bill of Materials (BOM) – a list of all usable materials and raw materials, parts and sub-groups, forming the final product. It is one of the three primary inputs to MRP.
- Master production schedule – a schedule which says how many finished parts is required and when.
- Stocks – a range of stocks. It provides information about each item in a production mix over time [4].

Input information is processed by different computer programs and they determine binding requirements for each period of the planning horizon. The master production schedule is one of three basic inputs to the MRP. It specifies which items are produced and when they should be completed and in which quantities. Requirements of the master production schedule are generated from the following sources: customer requirements, demand prediction and storage requirements to reduce or increase reserves. They affect seasonal variations or external needs [6], [8].

The master production schedule is usually prepared in weekly periods for several months (a quarter). The length of time horizon is determined by the length of the continuous time of product production. The length of planning time horizons also stems from the needs of customers.

At the end of the twentieth century with the development of competition and computer technology there rapidly increased demands on the quality of company's management, and special demands on the quality control of its production system. Widespread development of computer technology has created major innovation of MRP system.

This innovation of the original MRP system is called MRP II (Manufacturing Resources Planning). The main benefit of MRP II has been connection of running production systems with the main areas of management of the entire enterprise. Only a quick connection of marketing, financial management and production allows the application of a real business perspective to the production activities of the company. Only the integration of efforts across the company enables the actual implementation of such total quality management. MRP II is directed at the integration of all management in search of prosperity in an increasingly challenging competitive environment [2], [3], [4].

Material Requirements Planning remained the focus of MRP II. The system always starts with the aggregating of all contracts, the sum of total demand. Managers of

production, marketing and financial management then jointly draft the main plan of the production. Responsibility for developing the draft plan of the main production is not left to production managers, since detailed knowledge of this document is a prerequisite for the successful work of the company as a whole.

In the next stages of work with MRP II everything is gradually specified and is flexibly adapted to important needs and circumstances, such as technical, to preserve the original concept. System MRP II has improved simulation capabilities and the finding of answers to questions like "What happens if ...?" Working with MRP II should be a continuous process of searching and deciding about preferred alternative solutions. Reminding one that management is a decision-making process which is aimed at the achievement of business goals [2], [3], [4].

## **2.1 Important Aspects of the Use of MRP II**

### **Top-down planning**

There are two basic approaches to processing production plans using the MRP:

- Regenerative approach. This approach is based on the master production schedule, which breaks down by BOM (Bill of Materials) of the product. There are generated priorities. There are completely recounted net requirements from planned orders. The entire planning process is carried out in batches with high demands on time and computing capacity. To make everything clear and on time, everything is processed in a regenerative manner (usually weekly or monthly).
- The net change. In this approach, each network changes orders or material requirements, which is immediately reflected into the computer system. Whenever an unplanned event occurs (unscheduled contract, a change of BOM, increased consumption of resources etc.), there is initiated partial conversion of needs (articles) affected by the change [3], [4].

Regenerative systems work with master production schedules as a fixed document, which is issued regularly (monthly) in the new version. While the access of network change considers the master production schedule as the subject of the changes which have occurred since the last processing. In most of our businesses the slow approach of regenerative-approval approach (access of straitjacket) is still used. The philosophy of network change brings the necessary advantage of quick reactions. There is a certain disadvantage of "instability" of the system which is manifested especially in low labour discipline. A badly designed and used system of network

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changes leads to unplanned events. Production planners are then burdened with a stream of meaningless exceptional messages which cause chaos [3], [4], [7].

**Time Display**

In the terms of the flow of time, it is possible to distinguish two types of MRP systems:

- The system working with the time period (Busketed) which performs in each period (a day, a week) and accumulation of quantitative information is included in this period. Each period represents a data cell, which generates a predetermined number of the planning horizon. The planning horizon means the time interval from today to the specified date in the future. In this framework there are generated material plans. The planning horizon in the world is at least equal to the longest lead time + production time for obtaining material and raw material. If less, there can be problems associated with time for arrangement of material. In the case of materials with an extremely long order period with unnecessary extension of the planning horizon, the orders must be based on the techniques of statistical inventory process (safety stock, the use of safe consumption per capacity etc.). A too long planning horizon in the master production schedule again brings a risk of unrealistic prediction of requirements.
- System which works with no time period (Bucketless): Each data element (request, order) contains timing information. There is no need to accumulate information over time periods. Approach allows daily monitoring of planned and actual requirements. It is flexible but places greater demands on computer technology. They are redeemed by better use of advance time and overhangs, thus more accurate information for decision making [3], [4].

**Rescheduling bottom-up**

MRP like any current planning system must be able to react quickly to changes of plans. This is the way of management "top" system plans. However, in cases of various deviations and unexpected events (failure in production, delivery delay etc.) there is a need to respond. So firstly to find out which articles are affected by this event. This process of control production plan is called bottom-up replanning [3], [4].

### **3 Case study of planning system at Pars Komponenty**

The following chapter describes the analysis of the current status of production planning system in company

Pars Komponenty s.r.o., proposed a new method of planning based on application of the principle of MRP II and verification of the proposed solution by comparing the plan and reality.

#### **3.1 Description of the Original Production Planning System**

The input to the production plan is a business plan compiled by the sales department based on the customers' orders. After deduction of the time required for the final inspection and shipping, from the originated selling terms, the production plan can be crude with the utmost production deadlines. The standard planning process in the information system works on the principle of MRP II. The system plans according to production capacity forward or backward, either with or without collisions. For a given type of production with the need to adhere to established sales terms only backward planning can be used, but neither option (with collisions / without collisions) works in practice.

When planning without a collision an unrealistic plan occurs, because the system does not allow capacity constraints. It only works with net technological times and technological delays. Therefore production is planned under ideal conditions for unlimited capacity, which cannot be achieved in real conditions. The use of such a production plan for the management and purchase of inventory would lead to the late delivery of material and to the collapse of production.

While planning with collisions very different problems occurred. The system could not find the space capacity of the generating plant. In this case, the system created a production schedule too far in advance, by as many as several weeks or even into the past. The standard planning system did not address the possibility of an operative solution of the narrow point through exceptional innings. The use of such a plan has not been possible for both the control of production and the basis for the purchase of materials. There would be a disproportionately high amount of inventories as well as work in progress.

Another problem was the removal of offline batch of manufacturing operations. This means that the operation has been physically done, but not accounted in the information system, so the system continues to block the capacity for this operation. In addition to this method of removal operations mistakes occurred due to the human factor thereby blocking further production capacity. During replanning, due to customer or internal changes an absurd production plan resulted.

The entire process of planning and management in production was thus based on the experiences of workers (especially dispatchers of production) which determined operationally what and when would be released to manufacturing. Based on the experience there the following table was prepared for the purchasing

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department and production that defined deadlines for delivery of materials to production (see Table 1). Extra dates have been divided according to the production lines and fields of materials.

*Table 1 Deadlines for delivery of materials to production*

	Group of materials	Doors	Windows	Platforms
1.	Al profiles	3 months	2months	
2.	Metallurgical	3 months		3 months
3.	Locks, Swing-Plug doors	2 weeks		
4.	Step Boards	2 weeks		
5.	Fasteners	3 weeks	3 weeks	3 weeks
6.	Blocks of electronics	2 weeks		2 weeks
7.	Buttons, switches	3 weeks		2 weeks
8.	Wire	2 weeks		2 weeks
9.	Tractions	2 weeks		3 weeks
10.	Brakes			3 weeks
11.	Motors			3 weeks
12.	Forging, casting	3 months		
13.	Bearings	4 weeks		5 weeks
14.	Lines	4 weeks		
15.	Pneumatic components	3 weeks		3 weeks
16.	Rubber	3 weeks	3 weeks	
17.	Glass	3 weeks	3 weeks	
18.	SOD 97, 98, SPD10, JKP01	2 weeks	2 weeks	2 weeks
19.	Horns	2 weeks	2 weeks	2 weeks
20.	Pneumatic components – EVV panel	2 weeks	2 weeks	2 weeks
21.	Plastic	2 weeks	2 weeks	2 weeks
22.	Sensors	2 weeks	2 weeks	2 weeks

Delivery dates include net production time and time reserves for cases of technical downtime or lack of human capacity, protection against material shortages caused by late delivery by the contractor, contingency reserve (faults) etc.

The Purchasing Department created orders according to these terms by complex calculation from the terms of production, which featured a large amount of work involved and significantly increased staff requirements. In manufacturing, the production was initiated according to the delivery of metallurgical materials and then it was managed by the dispatcher of production. The whole procedure of production is therefore limited to "emergency" problems.

### 3.2 Summary of Problems of the Original Method of Production Planning

The main problems were:

- a) High material stocks because of the term protection, both of the purchase and manufacture
- b) Line of materials did not always enter into the production process at the same stages, so in the terms of production the delivery of the material was inaccurate, eg. Metallurgical material usually enters 2-3 months before the date of manufacture. In the production of spare parts there are material requirements of production to production of the complete product entirely different
- c) The management of production and purchase entirely outside the information system
- d) High work in progress
- e) High labor intensity of inventory management
- f) Inability to replan the production plan for the reason of outdated accounting data in is
- g) The total lack of support of the information system

### 3.3 Proposal for a New Method of Production Planning

The newly proposed method of planning is based on the principle of MRP of reverse planning with collisions. Plans are according to the technological times and sequences of processing at each stage of production, but with the inclusion of time reserves of purchased material items.

These time reserves should extend the production process for real continuous production time to produce a production plan corresponding with the real requirements for purchased material and featured purchase plan without the necessity to recalculate delivery times. This established plan permits the use of automatic ordering of materials, thus greatly reducing the labor intensity of inventory management in the purchasing department.

The principle of the creation of the plan is shown in a simplified manufacturing product tree consisting of three preparations (see Figure 1), where TV is a production deadline. For the manufacture of products, respectively semi-finished products, there serve bills of materials for the production schedule. These dispatches are reciprocally connected in the relation of superior-subordinate document.

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Final product				
Oper.	Time	Material	Reserve time	Plan from-to
10	150min	mat.A	1500min	TV-2150min to TV
		mat.B	2000min	
20	200min	product A	-	TV-2350min to TV-2150min
		product B	-	TV-5450min to TV-2350min
30	100min	mat.C	2000min	
		mat.D	1000min	

Product A				
Oper.	Time	Material	Reserve time	Plan from-to
10	100min	mat.A	1500min	TV-4450min to TV-2350min
		mat.B	2000min	
20	200min	-	-	TV-4650min to TV-4450min

Product B				
Oper.	Time	Material	Reserve time	Plan from-to
10	200min	product C	-	TV-5650min to TV-5450min
20	200min	mat.D	1000min	TV-6850min to TV-5650min

Product C				
Oper.	Time	Material	Reserve time	Plan from-to
10	200min	mat.F	500min	TV-6350min to TV-5650min

Figure 1 Simplified scheme of technological continuity and creation production plan

Time reserve in one operation is not added, but the reserve operation is given only by the highest value of material assigned to the operation.

For the meaningfulness of the new production planning and in particular its replanning for the reason of permanent changes especially from the customers' side, we have established the following points:

- Online conducting of operation, so we removed the differences between the physical and financial status of completion of production
- Gradual conducting of production, ie. That the operation cannot be conducted if it is not a priority
- Accurate material assignment to operations
- Possibility to conduct operations by units
- Possibility of conducting operation proportionally, because of the assembly operations, where the

process times required for the installation of one piece are in the order of days.

### 3.4 Setting up a New Way of Planning

To set the time for planning of time reserves we have chosen eight representatives of key product lines, where we checked in detail a new plan based on the experience of production dispatchers. We gradually put final touches to time reserves for individual fields of materials according to the Table of Extra Materials (see Table 1), which had to be extended to more subsets. This allowed a more accurate assignment of time reserves for individual materials and the resulting production schedule matched real possibilities of production capacity. The result was the gradual debugging of time reserves for individual fields of materials. The final distribution of fields of materials for time reserves is shown in Table 2.

Table 2 Fields of materials

Type	Field	Type of material
Fasteners	11	Screws
	12	Matrix
	13	Washers
	14	Screws
	15	Cotter
	16	Rivets
	17	Pins
	18	Special
Metallurgical	10	Other
	21	Steel – fe
	22	Steel - Stainless
	23	Aluminum
	24	Non-ferrous metals
Electrical	20	Other
	31	Installation
	32	Machinery and equipment
	33	Electronic components
Chemical	30	Other
	41	Adhesives
	42	Paints, thinners
	43	Cleaners
	44	Oils
Rubber, PVC	40	Other
	51	Rubber profiles
	52	Rubber panel
	53	Hose
	54	O-rings, oil seals
	55	Polyamide, PVC, fabrics
	56	Plugs, caps, fillings
	50	Other

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*Table 2 Fields of materials - continuation*

Type	Field	Type of material
Components	61	Bearings
	62	Pneumatic
	63	Belts, chains
	64	Lin. Leadership
	65	Mechanisms, transmissions
	66	Springs
	67	Cases
	60	Other
Subcontracting	71	Castings and forgings
	72	Products
	73	Locks
	74	Step boards
	70	Other
Non-metallic	81	Glass
	82	Fabrics
	83	Hides, skins, felt
	84	Brushes, strip
	85	Honeycombs
	80	Other

*Table 3 The main outputs compared to planned dates for delivery of materials and the terms of their actual consumption*

Field	The most frequent deviation (days)	Frequency (%)	Mean (days)	Standard deviation (days)
12	22-28	34.41	22.31	7.1
18	22-28	28.82	21.28	4.17
21	8.14	16.22	7.75	23.53
22	1.7	18.18	-5.44	18.26
23	22-28	18.7	17.8	17.24
24	8.14	28.57	1.69	17.41
31	8.14	55.56	16	5.84
32	29-35	62.5	26.74	8.01
33	29-35	70.37	29.74	3.34
51	15-21	36.76	22.78	7.33
55	22-28	23.08	6.5	18
56	22-28	44.9	26.65	5.13
61	1.7	47.37	9.03	4.76
62	22-28	51.51	18.36	9.37
63	1.7	50	9.9	6.23
64	8.14	26.32	9.32	12.94
66	22-28	52.86	22.63	6.38
71	29-35	20.56	16.46	17.09
73	8.14	32.14	5.68	23.94
81	22-28	37.84	19.19	4.79

### 3.5 Verification of a New Way of Planning

Verification of the new production planning was performed after four months of operation, where we investigated the differences between the planned delivery dates of materials to production and their actual consumption. For each field of material there was statistically processed the deviation from plan to reality in the form of average and standard deviation.

After evaluation of all the data, it was discovered that only one third of the material was removed as planned and the remaining two thirds was taken earlier or later than scheduled. The material was taken up mainly after the schedule time, which indicates a large permanent protection of the production dispatchers and purchasing departments. In Table 3 there is given for each field the size of the most common material deviations by which the reality differed from the plan, as well as the frequency deviation, the average deviation is reckoned from all data material consuption according to the reality and the standard deviation of the data [5].

### 3.6 Benefits of Newly Proposed Process for Planning

The main benefit of the new proposed method of planning should be to reduce both the material inventory and work in progress. This is due to two factors. The first is the reduction of time reserves of the original materials to delivery deadlines (see Table 1). The second factor is that the purchasing department will be based on the actual bill of material of the product, not estimated times (see Table 1) and it is going to order material as it should gradually enter into production, even though it will be the same material.

Another benefit is the simplification of the workforce of the purchasing department, because no longer do they have to calculate the amount and timing of delivery of the material in a complicated way, as was the case with the original system. The staff of the purchase department also have the possibility of using IS standard function for automatic order of materials according to the requirements of the plan schedules.

The third benefit is the ability to track the course of the production (compared to reality and plan), which enables quick and flexible response to emerging issues.

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**4 Conclusion**

A new production planning system has been introduced to the company, which is based on the principles of MRP systems. This system is based on backward planning with collisions. It is planned according to technological continuity and processing times at each stage of production and the inclusion of time reserves of purchased material items.

The material was divided into 49 fields and into these fields have been calculated and allocated reserves. There reserves have been agreed by dispatchers of production to avoid jeopardizing the fulfillment of contractual terms.

The system has been operating for four months and after that was verified by comparison of the planned dates for delivery of the material in terms of production and their actual consumption. For each group there was statistically processed material deviation from the plan in the form of mean and standard deviation. Time reserves are analyzed periodically to verify and refine the values.

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# **STRATEGIC PURCHASING IN A PROJECT- BASED COMPANY – TO CENTRALIZE OR DECENTRALIZE**

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**Keywords:** purchasing, centralization, decentralization, transparency, competencies

**Abstract:** Organizations all lie on a spectrum, at one end of which are firms with complete centralization of purchasing, and at the other end are firms with complete decentralization. Most firms lie somewhere between the two extremes, and we have already mentioned the most common model that has certain decisions centralized (perhaps strategy design, selection of suppliers, purchasing of major capital equipment, training, co-ordination, communications, etc.) and bulk of purchasing devolved to local buyers. There are many variations on the type of activities that are either centralized or decentralized. In the last 12 years purchasing has noticed two radical changes in the majority of facilities. First change was the reverse of supplier – customer relationships where the role of purchasers changed from persuading and begging the suppliers to ever deliver, preferably with minimum delay (for fixed prices), to standard purchase activities where the purchaser can choose from many suppliers and negotiate prices with vendors to achieve the best conditions for his buyer. The second change was the establishing of a modern IT system that made purchasing activities more effective, more automatic and transparent to a considerable extent. It is good to realize whether all changes have led to improvement or whether these changes have caused a stop or a slowdown of the project purchasing – whether it is possible or even necessary to take into account global as well as local suppliers or to combine them. This Case Study demonstrates how a project - managed organization could look like, where it is necessary to take into account customer's wishes and benefit.

## **1 Introduction**

The best pattern is different for every firm, and it varies over time. In the 1970s centralized purchasing was popular, with a large staff at corporate level having complete control and doing virtually all the procurement activities. Unfortunately, this model often developed into bloated central organization structures, which made decision-making slow and unresponsive. So firms moved towards faster, more agile decentralized purchasing in the 1980s. Better communications and IT encouraged firms to decentralize all the activities that could be dealt with better by local staff, and centralize only the core tasks. [5].

The target of the study is to illustrate, propose and scientifically clarify the trend and development of project-based purchasing organization - where the main task is to give the customer the required goods - in optimal costs, the required delivery date and highest quality.

## **2 Purchasing and its competencies, transparency**

Due to global competition and the related intense pressure on reducing costs and improving competitiveness, purchasing competencies are one of the key skill sets in every company. In everyday practice, however, mistakes or ignorance occur frequently, costing companies lots of money. It is always necessary to think about how it is possible and necessary to prevent mistakes so that purchasing organizations work effectively.

And that is why it is more than necessary for the customers and their requirements to remain at the forefront and for the purchasing strategy to only follow.

### **2.1 Transparent purchasing**

For many years purchasing and its main task has been talked about especially as the power of transparency, decreasing corruption and reducing costs. The more I think about this idea, the more convinced I am that these are just words, not actions, and I am convinced that a vision and clear goals have to go hand in hand with the management of purchasing, along with managers who are able to predict the direction of the economy and industry and not just blindly fulfill the companies' strategies but be fully involved in them or even change them.

#### **2.1.1 Transparency**

Knowledge is savings. So if purchasing is done transparently, it opens the company doors to considerable savings. Transparency combined with the active management of suppliers is the foundation for successful strategic purchasing.

Purchasing experts agree that in today's world a system of managing the supply chains is necessary and gaining in importance. Globalization keeps getting stronger, the competition keeps getting louder and only dynamic markets can now do much more than ever before. It is necessary to evaluate the suppliers and actively review and optimize them; this is the right system for managing the supply chain. Managing the supply

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chains helps strategic purchasing to optimize processes, which improves the performance of purchasing and thereby increases the company's value. So the key factors for success in strategic purchasing are therefore without a doubt the so much discussed transparency, along with the systematic management of suppliers.

### 2.1.2 So what is transparency

I am not afraid to estimate (without any research) that this word is used every day in all media as well as in day-to-day communication, not only in companies but also in conversations between colleagues and partners.

Verifiable sources define transparency as the requirement of transparent and publicly accessible conduct. That what covers nothing from view is transparent. Institutions as well as procedures applied by modern companies keep getting more and more complicated, which allows them to hide various types of dishonesty and abuse. Of course the people committing them are interested in concealing their actions as much as possible. This applies to both the procedures used by accountants, as well as to the procedures used by public institutions and authorities, where it is necessary to strictly separate public interest from the private interests of the people who are supposed to enforce it. The omnipresent phenomenon of corruption is based on the possibility of the abuse of entrusted means by the people handling them.

Although various types of controls are used to fight corruption in private and public institutions, they always raise the question of who will control the inspectors. The most effective form of control is thus control by the public, which - however - requires the transparency of institutions and their procedures. The requirement of transparency is thus the most effective means of the fight against corruption. In practice this usually means that procedures need to be as simple and understandable as possible to the general public and that clear documents (accounts, meeting minutes, resolutions, etc), which need to be publicly accessible, must exist for each decision and handling of entrusted means<sup>1</sup>.

### 2.1.3 How to implement transparency in purchasing

The first goal should be creating transparency. The simplest way for organizations is having advanced software solutions for tenders and contracts. This will provide a company-wide view of all general agreements and contracts or contractual conditions that are or were considered as the best conditions. By having its own supplier database, the given company also has a transparent overview of all of its suppliers [1]. And last but not least, I am talking about a bid system that would impose and identify the given transparency.

The following can be provided as examples: the SupplyOn<sup>2</sup> collaboration system, information from suppliers and loan reports on a publicly accessible portal.

The next step towards transparency is an annual analysis: documentation of the purchasing volume in all purchasing fields, whether direct or indirect. This is followed by regular reporting of the attained savings or increased prices, the justification of them and the standard inputting of these data into the central database.

Transparency has no impact if suppliers are not administered in the same database at the same time. This means that qualifying suppliers, evaluating suppliers, their reliability and performance or strategic significance, as well as the support with the management of supplier quality must be managed in a single software system with an integrated process that starts with strategic supplier management and provides support for the qualification, evaluation and development of suppliers. And last but not least, it is always necessary to have feedback or controls in place.

Only when these components fit together in the system is the maximum benefit for purchasing and its transparency created (Figure 1).



Figure 1 Transparency

## 3 Centralization or decentralization

In industry as well as in public services the main task of purchasing is to specify the job or tender in a clear and meaningful way. This always has several factors that are significant, especially in the current global economic crisis. The share of purchasing and services, whether in public or other jobs, requires a great deal of involvement; purchasing thus takes on a considerable degree of responsibility, the requirements for the management of risks and checks must be defined clearly, and this always raises the question of whether purchasing can be managed in only a centralized or decentralized way.

<sup>1</sup> Source: <http://cs.wikipedia.org/wiki/Transparentnost>

<sup>2</sup> SupplyOn: <http://www.supplyon.com/start.html>

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In my opinion, purely centralized or decentralized forms of organization are no longer able to deal with the changing and strongly fluctuating needs of customers, especially in project-based organizations, and cannot provide a long-term competitive advantage. My experience has shown that four questions that are appropriate and decisive for tenders must be answered, as they can decide whether purchasing should be oriented more towards centralization or decentralization.

- a) Does purchasing play a key role in the selection of suppliers?
- b) Is there friction in the purchasing organization between needs in various places?
- c) Are centrally prescribed standardized material groups necessary?
- d) Is having a locally managed local organization of purchasing necessary or appropriate?

These questions are often answered -- and usually with a YES -- especially in the area of the comprehensive provision of services, and the answer has to do with the scope and complexity of the organization performing the tender.

In the answer to the question of the need for centrally established standardized needs of material structures, especially the requirements of purchasing controlling as related to transparency play a very important role.

### 3.1 Global Purchasing

Firms are looking further afield in their search for global suppliers. Manitowoc Company, a large maker of cranes, is searching the world for goods – tyres from China, bearings from the USA, chassis parts from Poland and so on. At Manitowoc, purchasing has been given executive level status, with a senior executive who can lead and manage complex outsourcing and global sourcing decisions, who can establish global supplier relationships and who is knowledgeable about various foreign cultures.

The company recognized that it had to establish this purchasing executive post to be in charge of procurement for its 41 facilities in 14 countries across three divisions. Improving procedures with better performance, ensuring dependable supply from worldwide sources, and redesigned organizational structures – all in support of globalization – are the main thrusts for the future [5].

### 3.2 Placement of Purchasing Authority

Placement of purchasing authority refers to the location of its decision-making, and particularly the choice between centralized and decentralized organizations. If a senior purchasing executive at corporate headquarters has authority over the majority of an organization's purchases, the organization has centralized authority. If authority for the majority of

purchases is at divisional, business or site level, then an organization has decentralized purchasing authority [5].

The benefits of centralized purchasing are generally greater than those of decentralized purchasing. The foremost of these advantages is increased leverage with suppliers because purchase volumes are much larger. Large volumes allow suppliers to take advantage of scale economies, which they can pass along to the buying firm.

### 3.3 Risk management

The systematic management of risks in public procurement significantly contributes to a company's overall stability. The purchasing department must have the necessary knowledge and know-how.

The list of risks faced by companies in public procurement or tenders is long and the following list is not complete: natural disasters, bankruptcies of key suppliers, lack of raw materials, dangerous transport routes, political unrest, drastic currency and price fluctuations, environmental pollution, etc. But these unpleasant consequences can quickly raise the following question: If we do our purchasing only close by, what are the threats? Loss of production, supply outages, price increases? Of course it is not possible to identify all risks in advance and avoid them. But who knows, maybe it is and can be realistic, or there is a greater chance to limit the damage by taking early counter-measures or making economic arrangements.

*"The economic crisis and volatility on the markets have impacted the world", says Axel Schmidt, senior partner at Roland Berger Strategy Consultants<sup>3</sup>.* So what is the trend in risk management? The awarding and tendering of public contracts is used more and more to hedge against the fluctuations of currency exchange rates or supplier risks." This is demonstrated by Roland Berger in their "Purchasing Excellence" study in which over 500 purchasing managers from all over the world were surveyed. The goal of the study, which was launched in 1999 for already the fourth time, is to identify the key trends in purchasing.

If shopping is a "pleasure" in the private sphere, then it is a highly risky and frustrating matter in the business sphere, as purchasing positively or negatively affects the interests of the company owners, customers as well as employees. Where are the risks? Is the fact that we will not get what we expected, both from the perspective of quality as well as quantity. Sometimes even the price is different from our original calculation. The worst situation is when our customer points out our bad purchase when returning a product that we produced. But we, because of a bad contract with the supplier, are unable to transfer the liability for the defects to the supplier. Then the full impact of the incurred damage goes against our bottom line [2].

<sup>3</sup> <http://www.rolandberger.com/media/press/>

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In the current version, the study also took a look at the impact of the financial and economic crisis in 2008 and the focus for 2009. Whereas in the previous years the focus was on process optimization, organizational development and supply chain management, as these were identified as the key trends in purchasing back then, now it is “risk management in an unstable environment” that is at the forefront. The following question remains: Where should small and medium sized businesses acknowledge and specifically identify the risks associated with purchasing so that they can be eliminated or minimized.

### 3.4 Reducing risks

If we would like to reduce the risks in purchasing, then in my opinion the main building blocks that small and medium sized businesses and project oriented companies can use to avoid them are defined in the following points:

- 1) Improving employee skills and defining a clear structure in purchasing
- 2) A comprehensive strategy in the management of purchasing risks is a key element
- 3) Managing purchasing, which is an ongoing continuous process, whether purchasing attained the goals that were set
- 4) Intense management of supplier quality
- 5) Intense management of the supply chain, including a systematic analysis of supplier liquidity
- 6) Market research
- 7) Professional management of contracts with suppliers, including addendums for securing risks

Purchasing strategies that are focused on highly dynamic and changing suppliers, often combined with radical price negotiations or price instability, can be classified as “high risk”. “It is nearly impossible in practice to buy from a much cheaper supplier without increasing the risk,” said Philipp Dickmann at a Global Purchasing conference for a world-renowned car manufacturer in Germany. Because the costs and risks associated with logistics processes must also be collected. The crisis solution should also be reflected in prices: for example, expensive. Crisis management should also be reflected in prices. For example, expensive air transport should be replaced by sea transport, which is much cheaper. **Already today flexibility is the decisive competitive selling point and is often more important than the price of the product.** Unfortunately it has also been my experience that this opinion remains in the background compared to the global strategies and goals in purchasing.

Too often, perhaps even more than ever before, suppliers are expected to bear the costs of the risks, including the consequences of currency fluctuations or political instability in their prices, which are usually

negotiated for a longer period of time in advance. Innovations or replacing critical raw materials by raw material reserves can be a certain alternative.

But here it is more than necessary for the purchasing department to work together in the organization with the other departments or divisions as equal partners, for example in new product development or project design.

Unfortunately, this is usually not true in practice, not by a long shot, as according to Roland Berger and his study<sup>4</sup>: 77 percent of respondents stated that purchasing enjoys wide support at the executive level. “Even more alarming is that in almost one half of the companies purchasing is not at the same level as other areas, such as sales, finance and marketing.” In 2003 it was two thirds of companies in the given matter. “Especially in Germany we see the purchasing function gaining in importance.”

## 4 A combination of global and local suppliers

We will all surely agree that combining purchasing quantities means savings. But sometimes a misconception arises here that only organizations that are managed centrally and have their central strategy and use global contracts can be successful. Together with the help of local purchasing organizations, it is possible to attain far greater savings than just a globally or centrally managed organization can. Only a few purchasing organizations have the ability to consolidate and centralize purchasing and the expert knowledge of purchasing specialists, global agreements and the ability to negotiate. That is why purchasing organizations must also adapt to multiculturalism and the customers’ demands or wishes. Not all material groups are suitable for centralized tenders. Goods with a high degree of standardization and low technical complexity are best suited for centralized purchasing. A differential approach and use of flexible organizations, i.e., decentralized purchasing organizations, must be used for technically demanding and time-consuming elements.

Depending on whether standard supply is concerned or not, purchasing must be near the required support.

### 4.1 Centralized versus decentralized purchasing

**Centralized purchasing** - has all the actual purchasing done centrally, typically in the corporate headquarters [6].

**Decentralized purchasing** - devolves all purchasing decisions to local facilities [6].

**Location:**

<sup>4</sup> Roland Berger Strategy Consultants was founded in 1967 and is one of the leading companies in strategic consulting. Via its 36 offices in 25 countries, the company successfully offers its services on all main international markets.

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Two location issues affect purchasing: where should purchasing decisions be made. And where should suppliers be located:

- Where should be effected buying decision
- Suppliers location

### **Centralization versus Decentralization:**

In the single-facility organization, the question is whether decisions should be made by department managers on a decentralized basis or by a central purchasing department. In the multiple-facility organization, the question is whether decisions should be made at the plant or division level or by a central purchasing group based at headquarters. Pros and cons exist for centralized and decentralized purchasing in both the single-facility and multiple-facility settings.

Centralized buying up a majority in those companies where it is possible to combine purchasing volumes and thus have a stronger foundation for price negotiations. Table 1 summarizes the main advantages and disadvantages of centralized and decentralized purchasing.

*Tabel 1 Advantages and Disadvantages of Centralized and Decentralized Purchasing (modified according to [6])*

<b>Centralized Purchasing</b>	
<b>Advantages</b>	<b>Disadvantages</b>
Almost invariably makes for more efficient ordering of materials	Detachment of production and according to the needs of individual orders
Forms a basis to gain bargaining advantage	Very little flexibility – discretionary issue where ordered
Eliminates duplication of efforts	Centralized purchasing is little slower and more cumbersome than decentralized purchasing
Helps procuring uniform and consistent materials	
Simplifies purchasing procedure	
Simplifies the payment of invoices	
Permits a degree of specialization among buyers.	
<b>Decentralized Purchasing</b>	
<b>Advantages</b>	<b>Disadvantages</b>
Improved efficiency	Different plants of a large organisation require quite different types of materials
Faster procurement of materials	Loss of influence of the supplier – smaller

	purchasing volume
Control over purchases is no longer remote.	The fact that buying efforts are duplicated across the organization
Decentralized operations are more flexible.	
Department or plants has more control of purchase	
Improved ability to respond to the needs of the department or plant	
For organizations in which it operates geographically dispersed purchase - this advantage is the efficient to use local suppliers	
Large international company with factories located throughout the word often rely on decentralized structure to meet the requirements of individual races	

## **5 Case study – a project-based purchasing organization**

A case study illustrates the integration of methods for tenders in a project oriented company and purchasing organization of international companies in a system of the production of technically demanding specific elements.

First of all, it is necessary to focus on the optimization of quality and costs, and then on improving the position of the organization of company XY on the public procurement market. And last but not least, it is important to improve the performance of the individual purchasing units as far as the effectiveness of work is concerned, as well as the technical knowledge and flexibility towards a common goal: customer oriented customer requirements.

### **5.1 Specification of project**

What is necessary to introduce and define, if we consider the change and the structure of purchase:

Actions:

1. Defining the key indicators, skills, activities and needs of purchasing organizations
2. Optimizing the supply chain
3. Implementing the purchasing processes along with their optimization

Goal:

- Simplifying the indicators of costs and supplier quality
- Simpler cost reporting structure
- Continuing and developing the purchasing organization

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- Developing the transparency and anti-corruption strategy based on the organization's requirements

Project specification:

- Integrating decentralized purchasing groups in the Europe region
- Specifics of standardized and technically demanding and time-consuming products and their breakdown - preserving the local responsibility of the purchasing department on a technically demanding or time-consuming product delivered with regional powers

### 5.2 The breakdown of purchasing in Europe

So what should the tasks of purchasing organizations be?

A central purchasing organization combines the activities of a local organization and local purchasing specialists in one person. It is organized and broken down according to the purchasing commodities and according to the organization's valid regulations and processes.

The local organization breaks down the roles of central and local responsibility according to the assigned material commodities (see Figure 2).

The regional breakdown according to the division of Europe (North, South, and East) with the corresponding assignment of plants and individual regional purchasing organizations is illustrated on Figure 3.



Figure 2 The breakdown of a purchasing organization in Europe

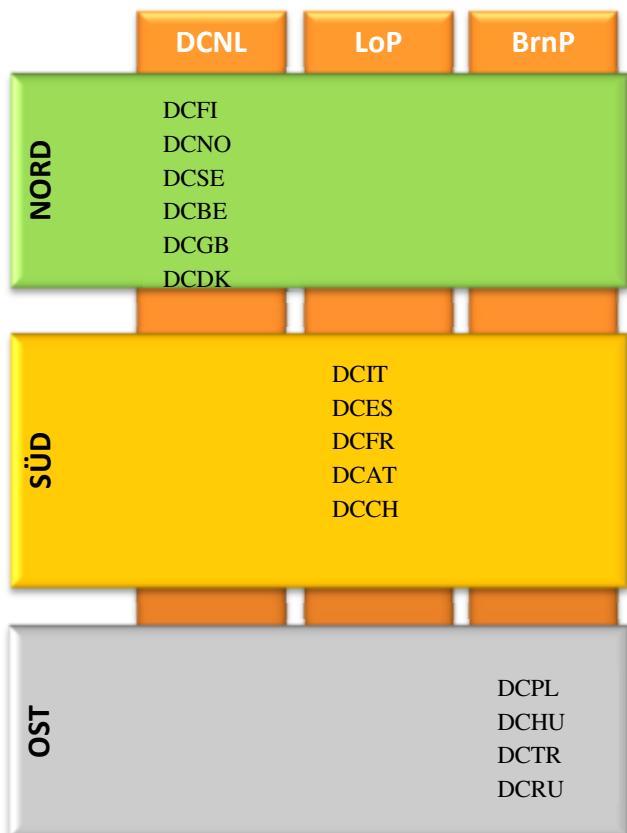


Figure 3 The breakdown of a purchasing organization in Europe by individual countries

## 6 Conclusion

Managing purchasing successfully means decreasing costs while maintaining quality [2].

The demographic development of the world, its globalization and the subsequent discovery that not everything that is central is best make purchasing organizations ponder what is actually the best? And here I raise another question: Do we really want the best or the most suitable for the customer. And what is the most suitable? [3]

Because often there is no competitor that can provide the much needed feedback, it is necessary for the managers in purchasing or the top executives in the organization to predict what actually is the most suitable. What does the customer really want? Obviously we all know it, but do we really go by it? The customer wants the required quality in the required time at the required price. In the times of strained political and currency impacts and raw materials policies and economic globalization, it is key to install the professional and sustainable management of suppliers and risks and to break purchasing down into centralized and decentralized, or local if you want.

In the following months I would like to present my, their research in the purchase of modern purchasing in a project-based organization. Next steps of research will be devoted to structure of purchasing in the international

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organization, which would be applied in smaller companies focusing just on project management purchasing organization.

**I would like to thank my parent organization for its cooperation, as this article could not be published without it. I would also like to thank my trainer.**

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## Review process

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# **APPLICATION OF THE LOGISTICS PRINCIPLES FOR THE COMPANY OMEGA, S.R.O. IN CRISIS TIME**

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**Keywords:** crisis, company, analysis, impact of crisis

**Abstract:** The article is focused on a concrete company and its management practices in crisis state. The content of the article are the characteristics, decomposition, development and consequences of crisis and crisis management through the identification of crisis initiation of crisis management, halting of crisis development and evaluation of crisis management. The article is focused on the possibility of solving crisis that may happen in the company, through avoidance of a crisis implementation of monitoring and controlling the business and to reduce risks and deal with them as soon as possible. The next center of article is evaluation of appropriate methods, which company should focus in case that will into a state of crisis, such as outsourcing, union materials in production, redundancies, restructuring, acquisitions, mergers or sale of the company. There are also evaluated individual company departments by ABC analysis.

## **1 Introduction**

Crisis management is applied in practice in different areas, and although a number of practices and methods are identical, there are three different approaches. They are identified mainly in the areas of social policy, the economic and crisis as a result of natural disasters and accidents.

Crisis management in the widest sense begins much earlier than it is possible to identify a crisis and before it gets to the stage of decisive break, even before the crisis occurs. Crisis management is therefore in a permanent process that includes preventive measures leading to a reduction of the destructive effects of the crisis, the establishment of systems for early identification of crisis development and systems for mitigating the impact of the crisis and its rapid successful management.

### **1.1 Phases and instruments of a crisis management company**

The duration of the single phases of the crisis varies considerably (Figure 1). For example, a potential crisis if it can be understood as a crisis is a permanent crisis. It is always present in any business enterprise. The second stage is a latent crisis that has just hidden his character and it gives the impression that the company is all well and nothing extraordinary is happening. The problems that arose are common problems, which do not need special attention. There are known cases in which the firm operates at this stage for several years, before swinging into acute crisis phase. Sometimes the transition to this stage is very sudden and fierce. The company has been on the edge between latent and acute phases for a long time,

but then just a little momentum, which causes a shift to set imbalance growth in motion.

The third and final phase is usually significantly shorter [1]. Throughout the duration of the crisis, it is necessary to count on its end, and focus its efforts on the future development of the company, have business strategy prepared, which should be focused on the unique production or the services with high added value. If a company comes up with a new business strategy after a crisis, which is based on innovation or technically challenging and unique solutions, then the possibility arises immediately acquire new markets and new customers. Therefore, it is also necessary to think in times of crisis the range of possible changes, changing customer segment, the internal changes in the company etc.



Figure 1 Crisis phase process

In order to prevent especially the final stages of the crisis, managers can use a variety of instruments such as cash flow business, cost management, monitoring of customer insolvency and so on.

#### **1.1.1 Ensuring of sufficient company cash flow**

At the time of the crisis, businessmen have limited options to get the money quickly. Banks are more

cautious and very often refuse to grant credit in the required amount and its long-term clients. A client with a history always has a better chance to succeed than a new client, which runs only with the requirement of the loan. Another option is to obtain cash sale of any real estate firm, of excess inventory, or other unused investment or business property. Traditional options to ensure faster cash flow are factoring, forfaiting, re-leasing and other tools for risk reduction.

### **1.1.2 Management of reducing costs (cost cutting)**

If the sales are decreasing, you need to do the restrictions on the cost side as well. This does not just mean the layoffs (even if the salary costs for employees can save up immediately), it is possible to use less drastic ways, such as various forms of reduction of working hours, the usage of unpaid leave and the like. It is necessary to think about the future of the company and keep human resources, if it is possible. Usually there is a significant reduction in the cost of travel, investments in computers and office equipment, fleet renewal and all resources that can be postponed.

In a time of crisis can be relatively easily in firms use a method of centralized purchases of selected raw materials and commodities, which is traditionally recommended for non-manufacturing organizations as one of many economic instruments designed to combat crises [1].

### **1.1.3 Monitoring of company customers insolvency**

The course of corporate cash flow is disturbing situation when customers do not pay on time, sometimes because they are not being paid on time, by their customers. The problem of secondary insolvency at the time the crisis is a constant and serious threat. On this occasion, it is necessary to keep in mind that the company has a number of key customers, or some main commodities that form the core of its gross profit. The fall of key customers may cause significant problems in the company. It is therefore necessary to monitor not only cash flow, but also the overall financial situation of key customers. Here is the classic division of customers and suppliers by Pareto principle in place. According to him, is that 20% of customers create 80% of total income. It is therefore necessary to take care especially on key customers, but also need to monitor their payment behavior or other signs of the eventual economic problems.

Even during the crisis, it is necessary to count on its end, and concentrate their efforts on the future development of the company, have prepared the business strategy of the company, which should be focused on the unique manufacturing or service with high added value. If after a crisis comes up with a new business strategy, which is based on innovation or technically challenging and unique solutions, then the possibility arises immediately acquire new markets and new customers [2].

Therefore, it is necessary also to think in times of crisis the range of possible changes, changing customer segment, the internal changes in the company etc.

## **1.2 Possible solutions of crisis**

At the time of the crisis outbreak, it is important from the perspective of businesses to keep calm and not to succumb the panic. The consequences of the crisis in uncontrolled company are much worse than vice versa, because each business has the potential, which can saved before the crisis and evaluated.

### **1.2.1 The crisis prevention**

More important than the solution of crisis from the perspective of the company is that company mustn't get into a crisis. In order to avoid crisis situation, it is appropriate to introduce monitoring of risks, by which to monitor, evaluate and analyze potential risks and hazards that may occur using instruments as:

- monitoring,
- internal audit,
- controlling and so on.

### **1.2.2 Appropriate solving methods for company when it finds herself in crisis stage**

In common sense understanding of the concept of restructuring the company to a situation where the business is falling. It is therefore need for a comprehensive, essential change of structure of the company, activities that are going, adjustment or modification of inputs and outputs. The restructuring of the company is a process that tries to solve the serious situation in the life of the company. Restructuring involves serious and substantial interventions in the strategic management of the company and in all departments, whether economic, personal, commercial and industrial [3].

Outsourcing generally refers to securing some of the other activities of the company, outside the organization. Outsourcing is thus a kind of hiring external resources. The purpose of outsourcing is therefore doing activities that the company can provide someone else a cheaper and better to concentrate on the business in which the company incurred. Outsourcing also allows you to temporarily increase the capacity of a company to meet sudden demand.

Management staff reduction could mean a reduction in the firm's financial claims, limiting the negative consequences for the remaining employees, as the case may be, will also create space for the company to restructure and launch new processes. The company should firstly to monitor the early warning signs that may herald the need to reduce the workforce. Such monitoring is sometimes possible to avoid the danger of redundancies.

If the company finds itself in a crisis, the acquisition is for him the possibility of rapid growth with relatively

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little expense, acquisition of intangible assets and easier access to new markets. When a company decides to transpose a joint stock company, then this is done by purchase so-called controlling stake in the company. Acquisition can be achieved by increasing the value of the company, for example, strengthening market position, acquiring know-how and increase revenue through synergistic effect when combining the two companies created a group whose value is greater than the sum of the two companies.

In case the company decides to deal with the crisis through fusion or download companies can have a society benefit from the synergy effect. Synergy benefit based on the consideration that the firm after joining of the two companies has more value than the sum of the individual companies.

### 2 Analysis of the company Omega, s.r.o.

Company OMEGA, s.r.o., doing business in the field of electrical engineering in electrical engineering heavy current segment is stabilized by a clearly defined program of steady production, skilled labor force and perspective production program. OMEGA, Ltd. currently offers a wide range of electrical devices of low and high voltage, forming a comprehensive and complete solution for both low voltage installations residential and commercial space, and industrial spaces, for needs of energy and railways. The company has its own development department, which deals with the upgrading of the main production segments. In his own laboratory company implements basic tests of produced production. The society is also a tool shop that produces molds and tools for newly developed products, but also for re-production.

#### 2.1 ABC analysis

Due to the fact that the various products and centers have the same impact on the company profit, it is important to classify the items according to their impact on the observed phenomenon in certain categories. In this case, it is appropriate to use the ABC analysis (Table 1), which helps to divide the items into three categories based on the percentage of the total value of the parameter.

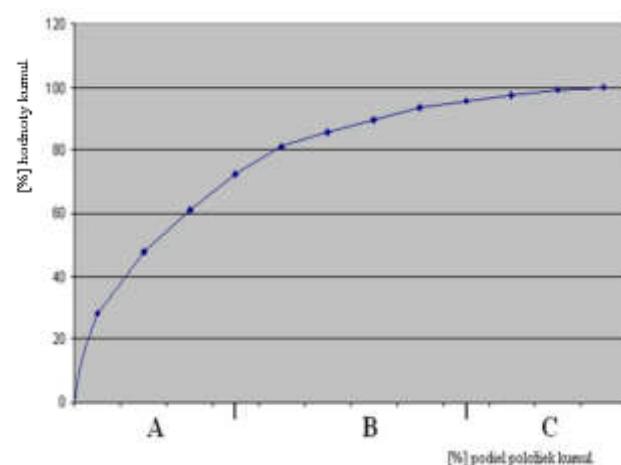
*Table 1 Results of ABC analysis*

Items class	Items numbers	Percentage stage of items count	Percentage stage of turnover value
A	1,4,5,9	33,33 %	72,48 %
B	2,7,8,10,12	41,67 %	23,04 %
C	3,6,11	25 %	4,48 %

Items are arranged in categories according to their importance (Figure 2):

- In the category "A" are items that are very important to the organization, they represent great value share of the total annual turnover.

- In the category "B" are less important items, which pays less attention.
- Category "C" grouping items that represent only a small portion of the total value of turnover.



*Figure 2 Lorenz curve, ABC analysis*

### 3 Design of rationalization measures for increasing the efficiency of company

If the enterprise wants to be ahead of the competitors, has plenty of money and have not declined over time into a state of crisis, whether effects of the economic and financial crisis, unfavourable legislative standards or other negative phenomena, which may affect the firm, the enterprise should play to their strength sites, to overcome weaknesses by the opportunities and seek to minimize costs.

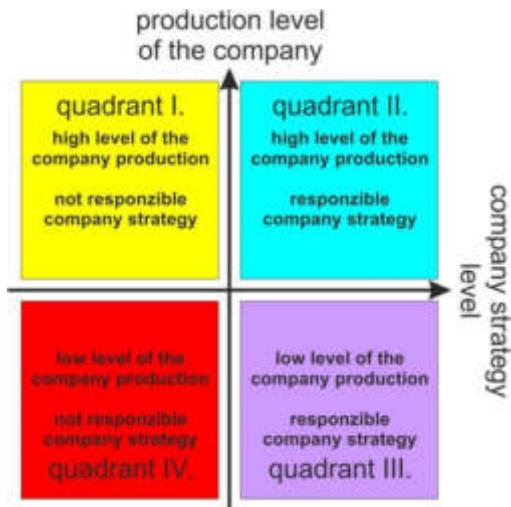
#### 3.1 Restructuring the firm

Experts agree that restructuring may pass by stages. This view is evidenced by the fact that in this case the risk of losing control of the business is clearly smaller than those of the revolutionary transformation company [4]. The practical experience shows that the success of the restructuring can be achieved even when jumping into this process through selected stages. The desired results may be available much sooner than the first approach, although it will need a lot of work. In this case, the risk of losing control of the company is higher. A good practical tool for the design of restructuring becomes called 4Q matrix restructuring (Figure 3).

Graph shown in Figure 3 can also quantitatively evaluated and based on the result achieved to decide on follow with the changes in terms of production and in terms of corporate strategy.

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*Figure 3 4Q matrix of restructuring*

### Quadrant 1

In the first quadrant, centers are classified class of A - B. This group consists of centers that do not yet sufficient profit, but there is opportunity to grow with them. Here again it is necessary to focus attention and business to spend high investment to ensure the operation and upgrade production technology. Here's effort to split the type of transaction that is not in line with the strategic objectives of the company. A clear recommendation is to integrate it into the organization's strategic objectives. It is not worth risking the technical and technological level that is high enough. If it even can not be done, it must be an entity separate economic entity and remain in a high-level cooperation association with the company, which excelled.

### Quadrant 2

In this quadrant are classified classes of A centers, which have the highest proportion of annual turnover. These centers are the basis of the profitability of the company and they should be given high attention and additional investments. The company should try to maintain this position as long as possible.

The company would construct here "the skeleton" of the company, which is based on a state of crisis. It is clear that from the first quadrant of the distribution tends to transfer or change the type of business in the second quadrant, which still corresponds to the structure of the new company after the restructuring activities.

### Quadrant 3

Quadrants contain centers class of B. Constitute a relatively small share of the profits, but still firm enough to be earning. It is appropriate that the company used the proceeds from that group and used them to finance the first and second groups, which would ensure their long-term operation and profitability. One possible recommendation for this quadrant is the application of outsourcing, which would reduce the cost of production.

A clear plus for a business unit becomes in the case of strategic importance for the company. Because is the most appropriate recommendation transferred upgrading or other activities that will allow pick up the production level, ie transfer them to the second quadrant.

### Quadrant 4

In the fourth quadrant are the centers with the lowest share of the annual turnover. The enterprise should evaluate whether to continue running the group or delete it before being able to focus more on the first three quadrants. There are presented entities and activities that do not meet business strategy, but the company will be adopted if passed restructuring production levels. Best in this case liquidation or separation into a separate legal entity, respectively new economic entity. If you manage to find an investor, then it makes sense to save the selected relations by transforming unprofitable units in the constitutional capital investor. Then you need to decide whether it is better to give an undertaking to the liquidation or sell it to an investor. In this method, it is important to know that the alignment strategy is more important than the current level of the unit or activity.

### 3.2 Use of outsourcing

One suitable means to save costs for the company is to focus on a total or partial outsourcing activity. It is best to use outsourcing to third quadrant matrix restructuring since the centers have a very high share of the income and who would be able to reduce production costs. In addition to reducing the cost of outsourcing has yet another advantage, and that will increase revenue by focusing on the core business [5]. Then the company does not have to deal with problems that others know better resolved. Introducing outsourcing company can gain several advantages:

- The company can focus on the main core business - if the company will focus only on their core business and leave other operations to other companies, starts to show much greater flexibility and flexibility in management. This may occur as a result of the higher quality products and services because the company guarding the quality and operation of only one main activity.

- Access to expert solutions - by outsourcing their support activities can gain access to experts and technologies that would otherwise have been difficult for him to reach. Better technology can help improve the quality of production.

- Improving the management - That advantage is closely related with a focus on the core business. By focusing on smaller volume leads to more operational activities, management style and more efficient management and production.

- Reduce costs - is one of the important reasons why the company should introduce outsourcing. Cost reduction can be achieved mainly through economies of scale, which the supplier to achieve greater efficiency by

**APPLICATION OF THE LOGISTICS PRINCIPLES FOR THE COMPANY OMEGA, S.R.O. IN CRISIS TIME**

Michal Balog; Martin Straka;

providing services and products to more customers. It is also possible to reduce the cost of better know-how when it can be assumed that a company that specializes in the particular focus will be the best and also better technology and experts.

- Time Benefits - handing over certain activities to external suppliers to significantly reduce production cycle time, which is operated by the company. This makes it possible to provide products or services to customers faster.

- Abandonment of an activity for external suppliers to the firm reduces its fixed costs in the form of fewer assets that would otherwise have had to ensure these activities. With the outsourcing of such fixed costs routed out of business and are purchased as intermediate products and services in the form of variable costs. Variable costs are fixed over the advantage that occurs at such time and the amount that they are required to ensure production.

- Increase the volume of production - increase own production can also be achieved through outsourcing, both in the aftermath of the acquisition of free resources for expansion, as well as in the aftermath of the removal of the bottleneck capacity utilization increased supplier.

- Improve cash flow - the sale of fixed assets, the company receives cash, which can be used otherwise.

- Reducing the risk in the long term - even if outsourcing is considered a risky move, paradoxically, it may be a reduced risk, and if the company transfers the risk of possible investments or changes in technology to the supplier.

### **3.3 Unification of input materials**

Another form of cost savings for the company in the event of a crisis can be the unification of the starting material in the production of goods. From ABC analysis of firm shows that are least profitable household installation materials, for which the company should focus its attention. In an effort to reduce production costs and more attractive due to its sale, it is necessary to examine the logistical aspects that can support this effort [6]. Unifying the starting material, companies OMEGA, s.r.o. in times of crisis gain several advantages:

- Limit the number of suppliers, resulting in a reduction in acquisition costs, which do not need to buy different raw materials from multiple suppliers, but the company will purchase select suitable raw materials in large quantities from fewer suppliers.

- Reduce unit cost of the product.

- Quantity discount - given that the company will buy a few ingredients in bulk, there is a possibility of quantity discounts that suppliers can provide.

- Reducing the cost of transport.

- Increase competitiveness - if the company buys only one type of raw materials and use them for a greater range of products then consequently can reduce the selling price of products and thereby increase their competitiveness in the market.

### **Conclusion**

Crisis as part of the life cycle of the firm is not currently the focus of the company's management, because of its connection with the adverse effects. Nevertheless, the crisis can be seen as a sure chance that you can use to streamline company operations, reduce costs and increase its competitiveness. Very important is the early identification of the symptoms of the crisis, analyzing its causes and launching crisis management. The analysis shows that the Omega Company, Ltd., are some of the few centers financially viable in a time of crisis, the company had a closer focus to restrict potential companies reported higher profits, for example, through the unification of materials in the production, manufacture or transferring to outside the manufacturer by outsourcing. If the company is in a crisis situation as the best solution appears to restructure the company, but first and foremost it is important to avoid concentration risks to these situations and avoid all unnecessary company maintained no amount of money. To prevent risk should mainly introduce the best monitoring and controlling for successfully managing the potential risks.

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## **INTELLIGENT TRAFFIC-SAFETY MIRROR BY USING WIRELESS SENSOR NETWORK**

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**Keywords:** traffic, safety, wireless sensor, wireless network

**Abstract:** This article is focused on the problematic of traffic safety, dealing with the problem of car intersections with blocked view crossing by a special wireless sensor network (WSN) proposed for the traffic monitoring, concretely for vehicle's detection at places, where it is necessary. Some ultra-low-power TI products were developed due to this reason: microcontroller MSP430F2232, 868MHz RF transceiver CC1101 and LDO voltage regulator TPS7033. The WSN consist of four network nodes supplied with the special safety lightings which serve the function of intelligent traffic safety mirror.

### **1 Introduction**

Traffic monitoring became very important hand in hand with the growing number of registered motor vehicles. Coming out from [1], more than 250 million vehicles are on the European roads and this number still rapidly increasing. And as higher this number is, as higher is the probability of accidents on the roads also. Therefore and mainly in the modern society the traffic monitoring systems are used on the on different parts and parcels road networks, intersections, as well as other intelligent transportation systems (ITS) of nowadays which substitute role of humans. The most used conventional methods utilized for the vehicle's detection are based on the using of video detection cameras or magnetic loops in roadway [2]. These methods have also some disadvantages. Beside that the camera systems are very expensive and the magnetic loops require roadway cut, both methods require external power supply because of their power consumption. Because of it one low-power method for correct vehicle detection is utilization the Earth magnetic field disturbance [3].

frequency to minimize the power consumption of the network during communication and maximization of the network operating range [4].

The place of application can be distinguished by blocked view on actual traffic situation (Fig. 1.) or by specific conditions making the guidance of traffic participants important, as e.g. guidance of blind, visually impaired or elderly people (Fig. 2.).

### **2 Intelligent traffic-safety mirror**

The prototype of a special wireless sensor was developed embedding magnetometer sensor into the particular WSN nodes. The WSN is based on the principle using multi sensing places for sending the information about vehicle's presence into the server station. This approach is in place because of the high power effectivity and low computational requirements of the sensor nodes also. Sub-GHz ISM band was used as the WSN protocol's

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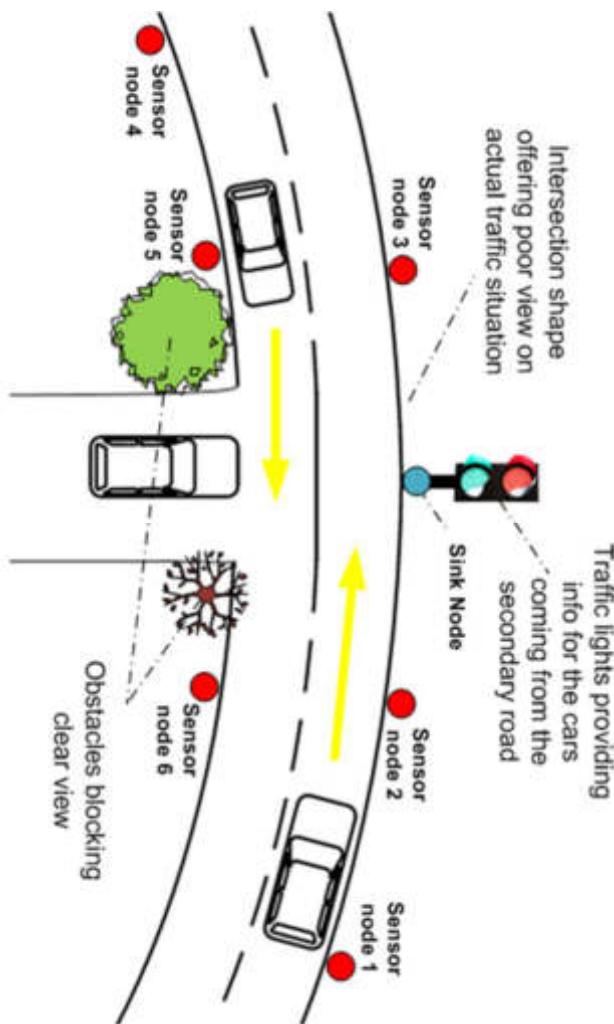


Figure 1 Traffic situation with blocked view

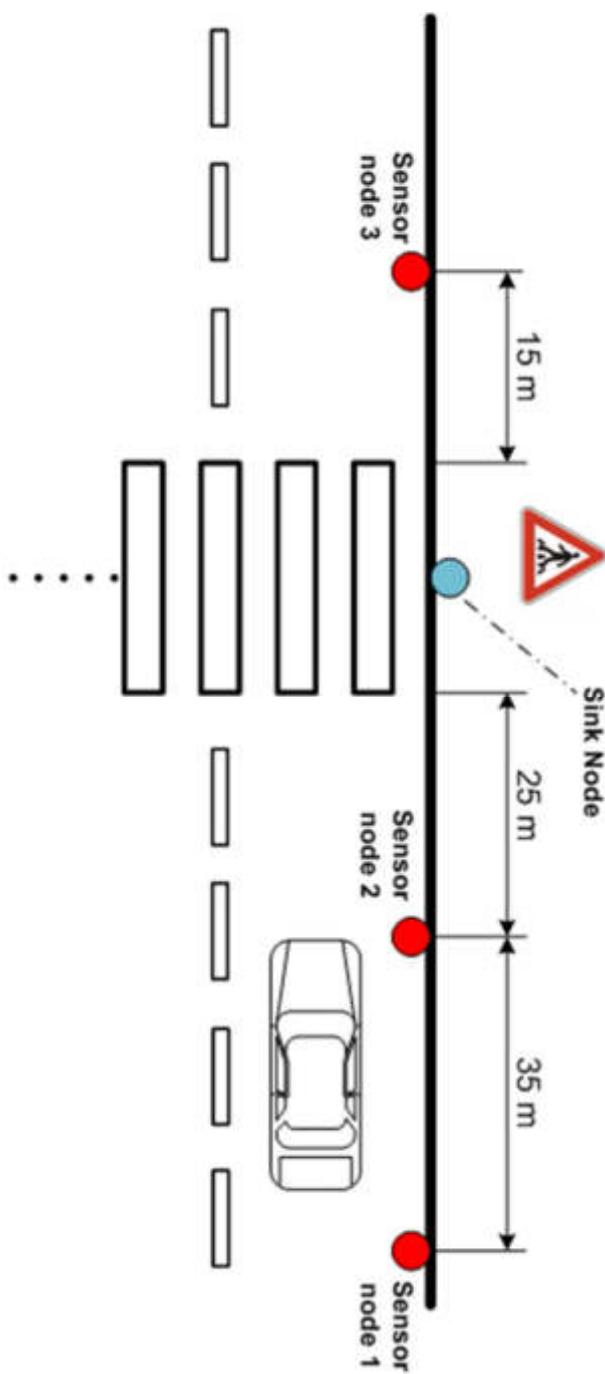


Figure 2 Specific traffic guidance demanding situation

Locations of the WSN sensors are targeted for utilization at the place, where the risks of crash coming out from the blind traffic situation are quite high. Since the placement of safety-mirror is the common method for these kinds of risk direct reduction, the introduced WSN could be then considered as a kind of Intelligent Traffic Safety Mirror since it simulates its functioning by informing the traffic participants about possible crash danger. Developed devices are depicted in the Figure 3.

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*Figure 3 Photo of the developed device of solar-energy harvesting system with the lighting signalization*

## Conclusion

The sensors will be deployed within selected road along the edges of desired testing road with distribution depending up the maximal speed limit applied for vehicles driving within the area. The typical application is situated inside the cities where the maximal speed limit is 50 km/h. WSN consisted of three nodes spaced ca. by 20 meters apart from each other will be sufficient to be implemented for reliable vehicle detection. The network will be able to detect vehicles even exceeding speed limit and driving up to 50 m/s. The WSN could significantly improve traffic safety as the unique platform considering navigation of the drivers at the places where even the usage of traditional traffic safety mirror is unsuitable. Moreover, application of the guidance of physically impaired persons within critical places of city centres is another advantage of the system. It can be concluded that the WSN will provide important mean for the traffic safety improvement necessary for the savings of human lives.

## Acknowledgement

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# **TRACKING AND TRACING SOLUTION FOR DANGEROUS GOODS CARRIED BY INTERMODAL TRANSPORT**

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**Abstract:** This paper deals with the problem of designing a complex tracking and tracing solution for dangerous goods transportation with the support of modern information technologies. This research activity presents a part of the "ChemLogTT" [2] project solved at the University of Žilina. The main goal of our contribution is to present basic conception of a complex developed software tool for monitoring and analyzing mentioned dangerous goods transportation.

## **1 Introduction**

Several thousands of various means of transport carrying dangerous goods circulate within European transportation networks every day with the aim to satisfy given requirements. They utilize urban and rural roads, highways, railways and rivers as well. When planning the routes of particular vehicles for such transportation it is necessary to take into account that they are not allowed to access certain areas. One of the main reasons is the character of transported cargo which can be flammable, explosive, corrosive, or even radioactive and may cause fatal consequences in case of a serious accident. Another, but not less important is the fact that vehicles carrying dangerous goods are not allowed to enter tunnels, long bridges or specific geographical areas with natural resources like sources of water. Improper handling of dangerous goods can easily result in environmental contamination, huge material losses or even death of many people. That's why this kind of transportation must be monitored and managed properly due to potential risk for society and nature. [2, 3] In recent years, great progress has been achieved concerning the improvement of transportation safety and increasing the quality of European transportation networks. In spite of that, accidents still place a heavy toll, both in terms of human life and economic damage. Therefore a big effort has been made to implement many sophisticated solutions to improve safety of dangerous goods transportation. [1] Recent advances in computing and Information science offer the opportunity to decrease the impact of the accidents that may happen at a statistically predictable rate. By utilizing a systemic approach, real time

infrastructure information, detailed and accurate knowledge of the materials being transported and the vehicles transporting them, on-board sensors, many useful advanced algorithms are being developed. Realization of such information systems may significantly contribute to improving safety of people and environment and developing methods to minimize damages and costs, improving the exchange of information between centers of production, carriers, receivers and emergency centers and determine methods of cooperation at the place of a breakdown.

In this paper we present a universal software tool for analyzing and monitoring dangerous goods transportation based on geographical data processing and visualization.

## **2 System design**

### **2.1 GPS Trackers**

GPS trackers are commonly used in cars for various purposes. Companies used them for checking the usage of cars, determination if the cars are not used for employers personal purposes or company can make available online the information of product positions for customer. Another frequent use of GPS trackers is to quickly locate the vehicle after the theft. There are many different types of GPS trackers which are offered by various vendors. Most of them consist of GPS module for location, GSM module for online transmission of information, high capacity battery (there exists also versions with external power supply) and various sensor devices according to where are deployed (thermometer, accelerometer, gyroscope, etc.). These all devices are inserted into the

## TRACKING AND TRACING SOLUTION FOR DANGEROUS GOODS CARRIED BY INTERMODAL TRANSPORT

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resistant box and may have external antenna for GPS or GSM signal or for another sensors. Figure 1 shows GPS tracker on a rail wagon. Some manufacturers of GPS trackers specified battery life up to three years on a single charge. It depends on the number of sensors, frequency of transmission, signal of GPS and GSM networks and the other factors. One of the objectives of our research is to monitor batteries life and their usage in various types of trackers.



Figure 1 GPS tracker in box on a rail wagon

GPS trackers mostly communicate in a one way from tracker to server via GSM module. There exists also trackers which communicate in both ways, but there are more energy intensive and expensive. We are working with trackers that send information with an interval from 10 second to a few minutes from different vendors.

### 2.2 GPS Trackers problems

The big problems for such a monitoring system are territories without the coverage of GSM signal. For some trackers it is possible to record information on an intern medium and then send all the buffered data at once when GSM signal is reached. However, the problem that we have not actual data still remain. There is no possibility to respond to a situation that occurs. The second problem is the territories without or with low coverage of GPS signal. The shorter outage of GPS signal can be corrected by analysis of previous and subsequent positions data. Another reason of GPS outage can be for example when the cargo container is loaded into enclosed space into a ship. This outage will last during the entire cruise of ship. In such cases it is appropriate to integrate the ship or another transporting positioning system (for example marine traffic [5] in water transport) which can send missing data to our system. The integration of these systems is not easy especially if we require information in real time.

### 2.3 Tracked events

Position – actual position, designed system allow visualizing actual position, speed, direction and the other data from sensors. See figure 2.

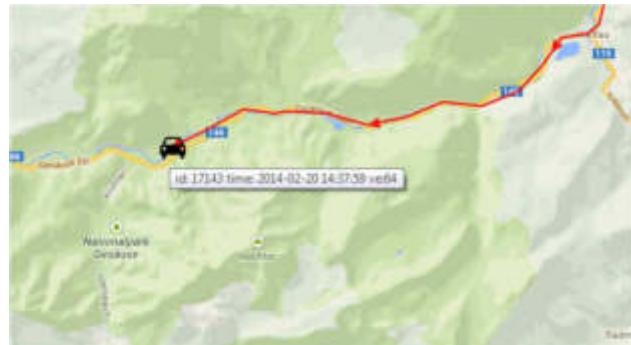


Figure 2 Online actual position with last 10 positions

It is possible to show overall routes of selected containers or for example see all routes of all containers in selected area. See figure 3 and figure 4.

Speed, temperature and other sensors – with respect to the type of dangerous goods it is possible to set alert sending after exceeding a defined value of sensor. For example when the temperature of cargo is increased or the driver exceeds the maximal speed operator is informed real-time via email or SMS to deal with the situation.

Crash detection – using the accelerometer it is possible to detect cargo crash. Accelerometer in GPS tracker is checking the force vectors and after the exceeding allowed value in resulting force vector GPS tracker sends the information about crash and buffered data for a more detailed analysis to a server. We have not still crash detection fully solved because for example when the cargo is loaded or is manipulated with it sometimes the resulting force vector is greater or equal then crash force vector. Because of these situations it is appropriate to check another data of cargo sensors (position, speed, etc.) to determine if it was really an accident or not.



Figure 3 The routes of two containers

## TRACKING AND TRACING SOLUTION FOR DANGEROUS GOODS CARRIED BY INTERMODAL TRANSPORT

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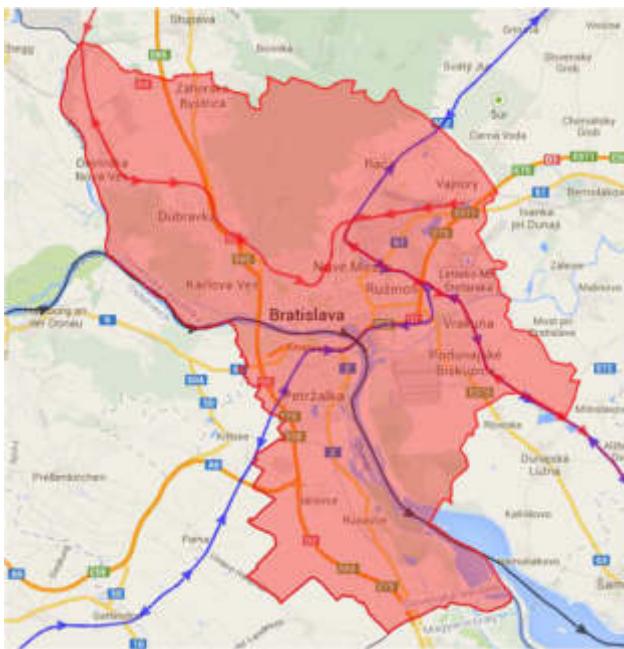


Figure 4 The routes of containers in selected region

### 2.4 GPS Trackers problems

Designed system allows monitoring entry to restricted areas. There are containers with hazardous materials that cannot enter for example to an area where the drinking water source is, national park or cannot enter the tunnel for security reasons, etc. The restricted areas are permanently checked with each new position of GPS trackers and after crossing the entry area of restricted area designed system generates email or SMS to competent person to deal with the situation and alert the danger. See an example on figure 5 to monitor the tunnel. Designed system has to send an alert in sufficient time to prevent the entry.

Another planned functionality is to send customized information to maintainers of regions, countries or other areas. For example the maintainer of Bratislava region gets on-line information about each entry of containers and will be allowed to track the movement of the containers on his territory. Also the alerts will be sent to him during the transit through his area. After exiting his area the report with relevant information and path will be sent to him and archived for further reports.

## 3 System implementation

We actually test multiple devices. Each GPS tracker vendor provides another user API with different functionalities. There is no user API which provides all the functionality we need. So we built an own server system where all the information from GPS trackers are real-time sent through providers services. Most of providers offer WSDL services to get raw data from the trackers. We catch these data in a loop and store it to the database. We build also a service which checks alerts (restricted region entry, exceedances of sensors) and send

them to competent person. Some data are imported to our system for testing purposes not on-line (some containers have two different types of GPS trackers and one of them is off-line for testing). We implemented web user interface using Google maps API (JavaScript, AJAX, web services) [4] which offer cheap and simple tools for drawing and working with maps. Our system offer real-time web user interface and exports of raw data in CSV, XML and KML exports for geographical data of paths, events and regions. We have some minor problems to obtain the coordinates of EU countries and region borders. We used free geo databases [6], but the data are not precise enough so we are still working on their improvement.



Figure 5 Monitoring the entrance to the tunnel by restricted area (tunnel Horelica)

## Conclusion

This contribution was aimed at the designing of a complex tracking and tracing solution for dangerous goods transportation within the European transportation networks. Monitoring of actual state, features and movement of any dangerous material plays a very important role in human and environmental safety, that's why big attention has been paid to this research area, mainly to minimize potential fatal consequences in case of serious accidents. The consequences may take many forms like environmental contamination, huge material losses or even death of people. The substantial contribution of this paper consists in suggested universal software solution based on new information technologies. As we have mentioned, the necessity of permanent monitoring of dangerous goods transportation has led to the implementation of complex systems that enable monitoring and visualization of big amount of data obtained from the devices connected to particular means of transport. We have presented a system design based on Google API, real-time geographical data processing and visualization of results in a proper form for the users. Despite the fact that our application involves a lot of useful features and different settings presented in this paper, there are still many possibilities for extension. As a part of future possible research, we would like to implement a global interface which would support the integration and cooperation of existing systems and overcome the disadvantages of them which consist in different standards. Each company usually provides its own application that is not capable of communication with other systems. Furthermore, our solution can be easily extended by implementation of new features and services. Similar monitoring systems are usually connected with large databases providing real time infrastructure information, detailed and accurate knowledge of the materials being transported and the actual weather situation which can also influence the goods transport. By these new features we would like to achieve improving the exchange of information between centers of production, carriers, receivers and emergency centers and determine methods of cooperation at the place of a possible breakdown. Therefore the future research in this area will be oriented at developing new functions according to the users requirements and common standards in mentioned field.

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## **IMPLEMENTATION OF ASSET MANAGEMENT IN ROAD ADMINISTRATION OF SLOVAK REPUBLIC**

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**Keywords:** Asset management, Maintenance Repair & Reconstruction, Road Administration

**Abstract:** The article presents basic principles and solutions for the application of Asset Management as part of road administration in Slovakia. It deals with application of Assets management methods and best practices of global trends in road maintenance, repair and rehabilitation strategies. An effective public Asset Management combines principles and strategies of asset management used in private sector with sound practices and methods proven to be applicable by public road administrator and his digital information systems. The under-funding of road management leads to development of tools and methods, which enable us to define criteria for establishing priorities for investments into road assets.

### **1 Road Administration in Slovakia**

Available resources allocation, in the field of maintenance, repair and rehabilitation, is made by Road Administration in Slovakia by the method of the proportional rationing in combination with pavement management system. New investment projects and reconstruction projects within the road network require a positive technical and economical assessment before approval. Financial crisis and economic problems of the country lead to decreasing of the road agency budgets, and foremost, a constant pressure to operate more effectively - spending of public resources lead to requirement for more effective operation standards, and more efficient management of the existing road assets. Best practices in Asset Management and innovative approaches and effective methods for engaging the private sector in the management of road systems may bring the solutions for the increasing needs in the field of road management.

National Road network composes a primary asset of any country in the world. Efficient and well-maintained infrastructure is essential for societal stability and for

promoting economic growth and environmental sustainability. Queiroz and Gautam (1) identified a very strong association between economic development, measured as per capita gross national product (GNP), and road infrastructure. Furthermore, the World Bank's (2) research showed that the economic development of nations correlates to a high extent with the countries' infrastructure systems. Sound public infrastructure plays a vital role in encouraging more productive and competitive national economies.

The road network of Slovakia consists of 391 km of limited access roads (motorways and express roads) and 174 367 km of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> class roads. The main objective of motorway network is to provide transit according to Pan-European transport corridors, namely the IV., V. and VI. corridor. The purpose of express road network is to collect and transfer the transport generated by Slovak republic's regions, and contra wise, to distribute transport from foreign countries from motorways to the body of Slovak Republic. The 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> class roads fulfill the service task of transportation between-and-within regions of Slovak republic. On top of

## IMPLEMENTATION OF ASSET MANAGEMENT IN ROAD ADMINISTRATION OF SLOVAK REPUBLIC

Lubomír Pepucha; Ľuboš Remek; Juraj Šrámek; Peter Danišovič; Martin Slabej; Michal Grinč

this network a network of urban communications and minor purpose communication is connected.



Figure 1 Pan-european corridors in SR

The full road network of Slovak republic is portrayed in Fig. 2. As seen in Tab. 1, different types of roads have different owners and administrators with their executive offices. This paper is aimed on the topic of asset management; therefore the viewpoint of administrators of road network will be crucial.

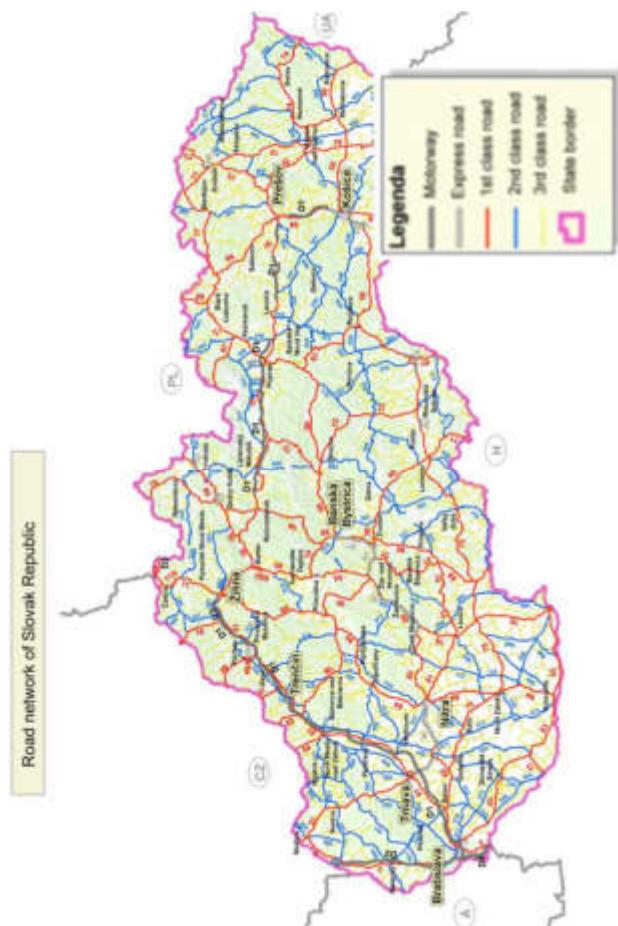


Figure 2 The full road network of Slovak republic

Road administrators differ significantly with available budget, length of roads they are responsible for, demands put on their assets, demands put on acquisition of new assets and many other issues, yet, and their task is the same. Their task is to develop and maintain a safe, eco-friendly and efficient transport system. This may be seen as securing a fluent and safe transport on them entrusted roads by providing maintenance, winter service, repair, reconstructions and acquisition of new assets according to concept of development of road network of Slovakia.

The main functions road administrator needs to fulfill are:

1. road management and creating conditions for safe traffic on responsible road network;
2. increasing traffic safety and reducing harmful environmental impact of vehicles;
3. organization of traffic and public transport;
4. state and owner's supervision over road construction and road maintenance, road usage, the service level of roads and organizing state supervision over compliance with the requirements established by legislation;
5. keeping road databank of roads, vehicles and public transport; observing special requirements established by legislation;
6. participating in the elaboration of policies, strategies, and development plans of road development.



Figure 3 Road network of Slovak republic and its composition (3)

Various evaluations investment efficiency in road transport in recent years have highlighted the fact that the amount of fund expended on the development and maintenance of the road and highway network, as the top processes in the road management, does not reflect actual requirements. Organizations managing the road network therefore feel the need to improve procedures and methods for determining the efficiency of their operations, thus use the allocated resources more economically and efficiently.

## 2 Asset management in road administration

Asset management, broadly defined, refers to any system whereby things that are of value to an entity or group are monitored and maintained. It may apply to both tangible assets and to intangible concepts such as intellectual property and goodwill. Asset management is a

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systematic process of operating, maintaining, and upgrading assets cost-effectively. (5)

- Long-term in outlook.
- Accessible and user friendly.
- Flexible.

Table 1 Road network administrators of Slovak republic (3)

Type of communication	Owner	Administration and maintenance			Executive administration office
<b>Motorways</b>	State	National Highway Agency			Minister of Transport, Construction and Regional Development
<b>Expressways</b>	State	National Highway Agency			Minister of Transport, Construction and Regional Development
<b>1st class roads</b>	State	Slovak Road Administration Bratislava	Administration-	Regional offices	transportation
<b>2nd class roads</b>	Regional administrations	Slovak Road Administration		District offices	transportation
<b>3rd class roads</b>	Regional administrations	Slovak Road Administration		District offices	transportation
<b>Urban roads</b>	Municipal authorities	Municipal authorities		Municipal offices	
<b>Minor purpose communications</b>	Municipal authorities	Municipal authorities		Municipal offices	

Asset Management as applied to the roads sector represents a systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organised and flexible approach to making the decisions necessary to achieve the public's expectations.

Road Administrations must maintain, operate, improve, replace and preserve this asset whilst, at the same time, carefully managing the scarce financial and human resources needed to achieve these objectives. All of this is accomplished under the close scrutiny of the public who pay for and are regular users of the road network, and who increasingly demand improved levels of service in terms of safety, reliability, environmental impact and comfort.

In practice, an Asset Management System will include all the processes, tools, data and policies necessary for the effective management of all the assets for which the Road Administration has responsibility, including physical highway infrastructure such as pavements and bridges as well as human resources, equipment and materials and other items of financial and economic value.

As a general principle, an Asset Management System should be:

- Customer focused.
- Mission driven.

## 2.1 Implementation of asset management system into road administration system

Each Road Administration is responsible for the management of its own unique set of assets but the typical assets of a Road Administration can be broadly summarized as:

- Physical infrastructure, such as pavements and bridges.
- Human resources (personnel and knowledge).
- Equipment and materials.
- Other items of value such as rights-of-way, data, computer systems, methods, technologies, and partners.

Asset Management Systems should generally:

- Include inventory information for the asset and condition measures.
- Include values of condition of the asset.
- Include a performance prediction capability.
- Ensure data integrity, enhance data accessibility and provide data compatibility.
- Include all relevant components in life cycle cost analyses.
- Enable the removal of outdated systems and unproductive assets.
- Consider both system and project optimization.
- Output useful information on a periodic basis, ideally in real time.

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- Facilitate iterative analysis processes that can be performed on a regular basis.

The type of assets and the requirements we put on a asset management system form a framework for an successful implementation. In terms of road administration the main systems we need to take into account are:

- Pavement management system.
- Bridge management system.
- Other already working management systems.

### **2.1.1 Pavement management system**

Pavement Management System (PMS) offers road administrator the ability to select the most appropriate works program to maximise the long-term performance of the network under a range of user-defined funding and treatment strategies. The PMS consists of two basic components: A comprehensive database, which contains current and historical information on pavement condition, pavement structure, and traffic. The second component is a set of tools that allows us to determine existing and future pavement conditions, predict financial needs, and identify and prioritize pavement preservation projects.

### **2.1.2 Bridge management system**

Bridges are considered to be vital links in any roadway network. Complete or partial failure to maintain these links paralyses the overall performance of the roadway network and causes excessive public and private losses. The ultimate goal of a Bridge Management System (BMS) is to provide a clear roadmap for the maintenance and rehabilitation of your bridge inventory. It must provide a strategy, or number of strategies, for a given set of budget constraints. It must also be capable of assessing the minimum budget requirements for a targeted level of service.

### **2.1.3 Other already working management systems**

All others management systems which are proven themselves to help administrator to carry out his task are considered important. Therefore is a wise decision to try import any useful already working management systems into the overall asset management system. These system may be aimed at various areas of administrators activities be it his inner corporate management or directly at his area of focus.

## **2.2 Foreign experiences**

In most OECD Member countries, the road network constitutes one of the largest community assets and is predominately government-owned. For their part, governments are placing greater pressures on road administrations to improve the efficiency of, and accountability for, the management of the road network. Indeed, in many countries, national road administrations and some smaller, local highway authorities face formal

accountability and reporting requirements on how they manage their assets.

Asset management is ultimately about managing a road administration's resources more like a business. In many countries, road administrations are now required to implement standardised asset inventory, valuation and depreciation approaches and enhance the information provided as part of their annual financial statements, in a manner more in line with those used by private sector companies.

The experiences of those OECD Member countries that are moving towards asset management in the roads sector have indicated that there are a number of points that should be considered by road administrations before implementing an asset management system:

- An asset management system should integrate existing management systems for individual assets, thus enabling a common approach to be adopted for the management of different assets.
- Improved collection, storage and management procedures for asset information, including inventory, location and condition data, will be required.
- Analysis capabilities should include the ability to prioritise maintenance options on the basis of the life-cycle cost of the assets.
- Asset management will encourage road administrations to adopt a more business-like approach to the management of the assets for which they have responsibility while the concept of asset valuation and depreciation will provide engineers with a common language with budget holders and decision makers. This will enable the implications of different investment strategies to be determined, including, potentially, assets in other sectors. Asset management will further encourage the concept of performance monitoring including, for example, performance indicators.

## **2.3 The process of implementation of asset management in road administration**

In the private sector, industry leaders develop tailored asset management systems that let them monitor and assess the status and condition of their assets (real estate, physical plants, inventories, and investments) individually and collectively. These systems give them the information and tools they need to retain their competitiveness. Similarly, public sector officials responsible for the nation's infrastructure have to maintain, replace, and preserve these assets. They have to make the best use of limited resources and have to ensure accountability to the public service. In addition, the need for more "business-like" practices has been accentuated due to the recent trend towards privatization of some of the government infrastructure development and maintenance activities.

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Table 2 State of road asset management in foreign countries (4)

Country	Pavement management system	Bridge management system	Other system	management	Integrated asset management system
<b>Australia</b>	yes	yes	no	Implemented	in Western Australia
<b>Belgium</b>	yes	yes	no	no	
<b>Canada</b>	yes	Being studied	Maintenance, road features	Being implemented	
<b>Finland</b>	yes	yes	Gravel road maintenance management system Short-term strategy and project management system Contract management system	Being studied	Financial accounting system for the state including accounting of road assets
<b>Hungary</b>	yes	yes	Maintenance management system	Being studied	
<b>Japan</b>	yes	Being studied	Tunnel management system (being studied) Disaster prevention management system (being studied)	Being studied Database for all national highway information in use	
<b>Mexico</b>	yes	yes	Road network maintenance strategy being studied	no	
<b>Netherlands</b>	yes	yes	Environmental management system	Being studied	
<b>Poland</b>	yes	yes	Winter management system	No	
<b>United Kingdoms</b>	yes	yes	All asset routine maintenance system Environmental and winter maintenance management system	Resource accounting and budgeting (pilot) Being studied	
<b>United states</b>	yes	yes	Various types of information systems	Being studied	

There is a concept of a total highway management system for a state highway agency. Based on a comprehensive review of the state-of-the art in highway infrastructure management systems, there is a clear tendency towards integrated, flexible, and distributed systems. The concept of generic systems is practical for developing decision support systems for infrastructure management. Fig 4 shows a developed integrated infrastructure management system that can be used to manage a wide variety of infrastructure data.

There are many advantages to these integrated systems including better flow of information among subsystems, elimination of redundant data, reduction in system development and maintenance, and better and more consistent optimized maintenance and rehabilitation programs for the various infrastructure types. The use of generic models, which can be customized by the user to fit local conditions and experience, reduces the implementation efforts and allows for the exchange of experiences among infrastructure types. Integrated infrastructure management systems have been developed and implemented at the national, state, and municipal levels.

Typically, an asset management system in use by a road administration will utilize the following data:

- Definition of the network.
- Definition of the assets on the network (e.g. bridge, pavement).
- Location of the assets on the network.
- Condition of the assets.
- Levels of use (e.g. traffic flows).
- Policies and standards (e.g. maintenance standards and treatment designs as well as monitoring).
- Information such as performance measures).
- Budget information (e.g. broken down by asset type, program level).

Uprising from these deductions a set of needs we have to define for working asset management system is following:

- Data administration,
- Data collection,
- Data storage,
- Management systems,
- Data analysis.

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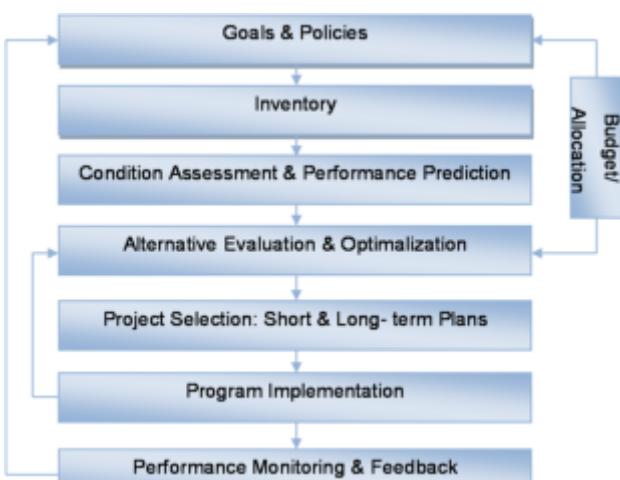


Figure 4 The proposed generic scheme for an asset management system

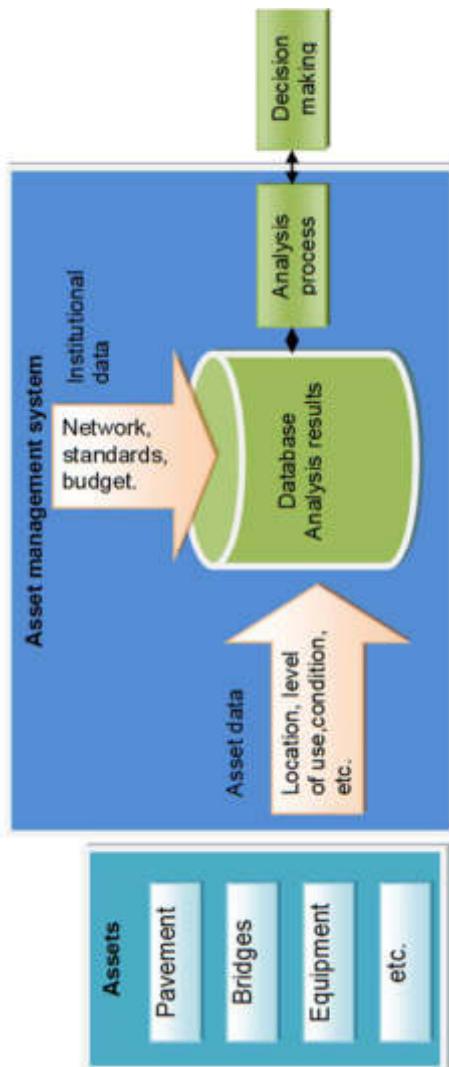


Figure 5 Typical flow of data into and out of a generic road asset management system

### 3 Implementation of asset management in road administration of Slovak republic

As presented in the first chapter of this paper a group of administrators manage the road network of Slovak republic. For securing a complex asset management system a decision was made to implement an asset management system for every administrator and try to make them cooperate. Of course since these administrators have separated budgets the cooperation we speak of consists mostly of data sharing. The analysis process and decision making process thus have to be individual for each and every administrator.

A scheme for infrastructure asset management as we propose is shown in fig 6.

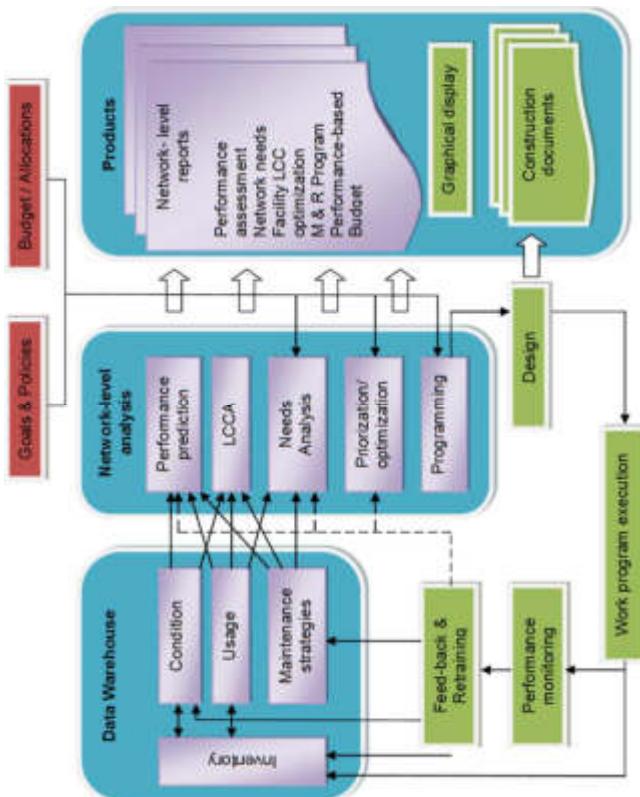


Figure 6 Infrastructure Asset management system

While looking frightening at first glance it's simple in its essence. A data warehouse stores the main input data and should be separated for every administrator, these data are then used in network-level analysis. The network level analysis will use the same mechanic for every administrator with different inputs from data warehouse (internal inputs) and data regarding goals policies and budget (external inputs). The products will then be the outputs listed in fig. 6.

#### 3.1 Data warehouse

Currently the internal data which should be stored in a data warehouse are currently collected by Slovak road administration for 1st class roads in a road databank

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(fig. 7). Slovak road administration is also collecting data for limited access roads as contractual agreement with National Highway Agency and keeps them up-to-date.

The problem lays in 2nd and 3rd class roads which volume exceeds the capabilities of Slovak road administration to for monitoring and updating. Therefore, to compile with this need for working asset management additional resources must be infused to boost the the data gathering capacity of Slovak road association, or to a 3rd party tasked with the data collection. Various maintenance strategies for different roads are well defined, tested and broadly used in the environment of Slovak republic; therefore the data gathering stays the main concern on this level.

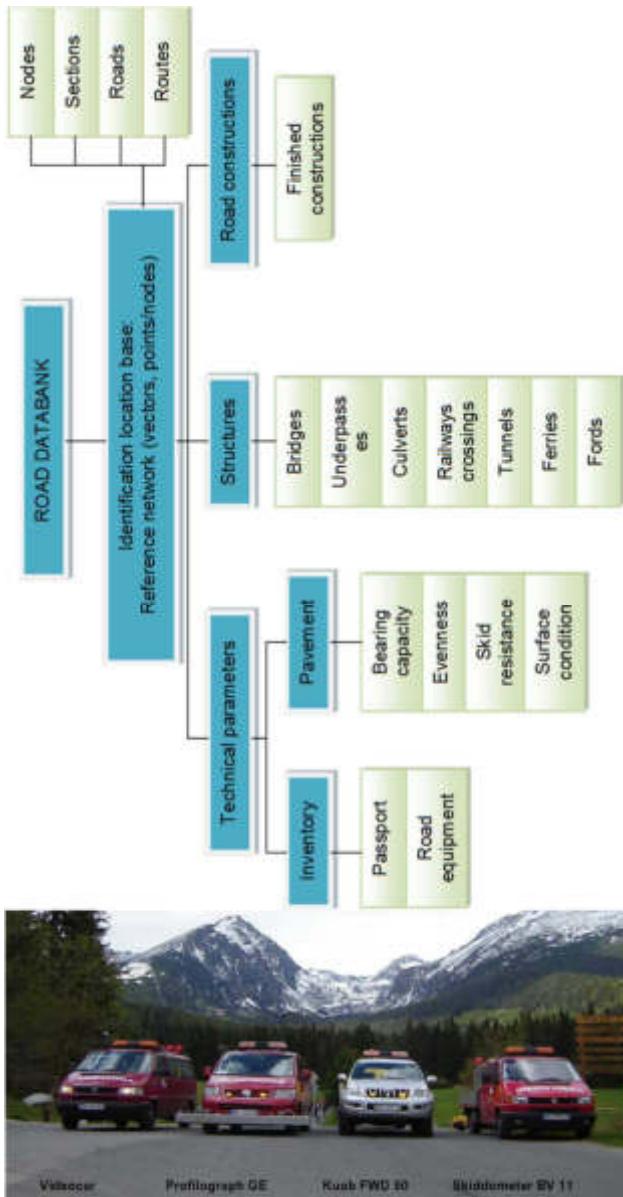


Figure 7 Road database scheme and Data gathering fleet of Slovak Road Administration

## Conclusion

The decision to implement an Asset Management or to integrate the existing commonly used separate systems is now being considered by road administrators of Slovak republic. A major consideration in this decision is the potential benefits that are available over those provided by the separate systems. Clearly there is a need for efficient management systems given the common background of ageing infrastructure, reduced budgets, reduced staff resources and increased public expectations.

There is also a need for engineers to be able to clearly communicate with financial managers in understandable accounting terms rather than with just engineering condition indices. While asset management encourages road administrations to be more business-like, and uses recognised accounting principles and practices, it also assists in budget justification within the framework and the recognition of various competing government programmes.

This paper describes the road network of SR and its road administrators. It describes the problematic of asset management in road administration and gives an insight into foreign experiences related to road asset management implementation. The last part introduces a framework for infrastructure asset management system and examines the current state of things regarding its implementation. The research implies the need for more resources towards data gathering and managing of a data warehouse as the main input source for asset management. It also underlines the need for transparent software for assessing of life cycle cost of new construction.

There are still issues that need to be solved. For one it's the asset valuation which plays an important role in asset management because one of the main purposes of valuation is to enable reporting in monetary terms to reflect the physical conditions of the road network, and to assist asset managers in informing asset owners of the effects of different financing strategies.

Or the issue of monitoring of the performance of the asset against defined required outcomes or targets of performance. One approach for this is the use of performance indicators to measure progress towards achieving the road administration objectives. Other simpler approaches include the straightforward recording of condition of the asset with time.

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