Methodology for overall company restructuring and the simulation as added value

Robert N. Minovski, Bojan D. Jovanoski

Abstract— **How do you improve one's enterprise performance? What is the best time for the management team to appoint more efforts and resources in restructuring? How, when and what needs to be taken care of? Answers to these questions and similar issues are treated in this paper, where the methodology of creating a model for selecting an optimal solution for enterprise restructuring will be described. For better understanding of this kind of model, brief introduction to the performance measurement and a short overview of the performance measurement methodology COMPASS (COmpany's Management Purpose ASSistance) are presented. COMPASS is based on its performance measurement system which is consisted of numerous Key Elements of Success - KEs (like, Time, Quality, etc.). The basic idea is to measure those KEs from the importance point of view (outer stand) and the performance point of view (inner stand). The KEs where inconsistency between importance and performance is detected are Critical Elements (CEs) that should be treated further in order to improve the actual situation in the enterprise. In general situation there are numerous actions (here called Success Factors - SFs) that can be taken into consideration for every CEs. In order to cope with these combinations, scenario technique and simulation are utilized. The outcomes of the simulation are further processed, presented in scenarios of possible solutions that are basis for future analysis and creating a decision for the measures that need to be taken.**

Index Terms— **COMPASS, enterprise restructuring, model, scenario, simulation.**

I. Introduction of COMPASS

In the late 90s, a research project was conducted, titled as "Methods repertoire for determination of the industry capabilities on the example of chosen enterprises of the metal - working industry in Macedonia". The research institutions were Fraunhofer Institute of Production and Automation (Fraunhofer Institut fuer Produktionstechnik und Automatisierung), Stuttgart, Germany and Faculty of Mechanical Engineering, University of Ss. Cyril and Methodius, Skopje, R. Macedonia. This research project, among other purposes (dissemination of the knowledge about method approaches for enterprise management in actual situation), had one main goal: to create a methodology for overall enterprise restructuring. The name of the methodology is COMPASS (COmpany's Management Purpose ASSistance), which clearly shows its main intention - to offer aid in the key decision making points in the complex process of enterprise restructuring. This model should generate actions for improvement of the current situation in the enterprise. The model should take into consideration the specifics of the country, as a country in transition, but it is still general approach and it is aimed to be implemented in every situation. The definition of the basic idea of this model is following:

The basic idea of the model is to utilise a (sub)model of performance measurement, which will enable determination of the inconsistency of the importance and performance of all segments of the enterprise and on that basis to generate quantified alternative and then optimal actions for partial or overall (depending on the defined task) improvement of the situation (fig. 1).

Different segments of the enterprise are described through 18 variables called subkey elements of success (subKEs) provided by the (sub)model for performance measurement. The PMS (sub)model tries to trace the logic of one profit-oriented enterprise, summarised like: finding out optimal

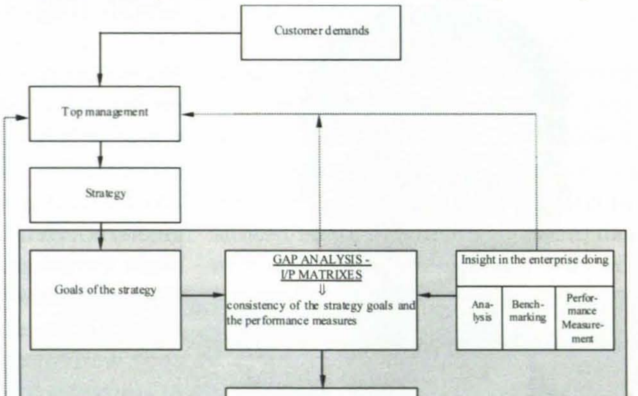

Fig. 1. The basic idea/mission of the model

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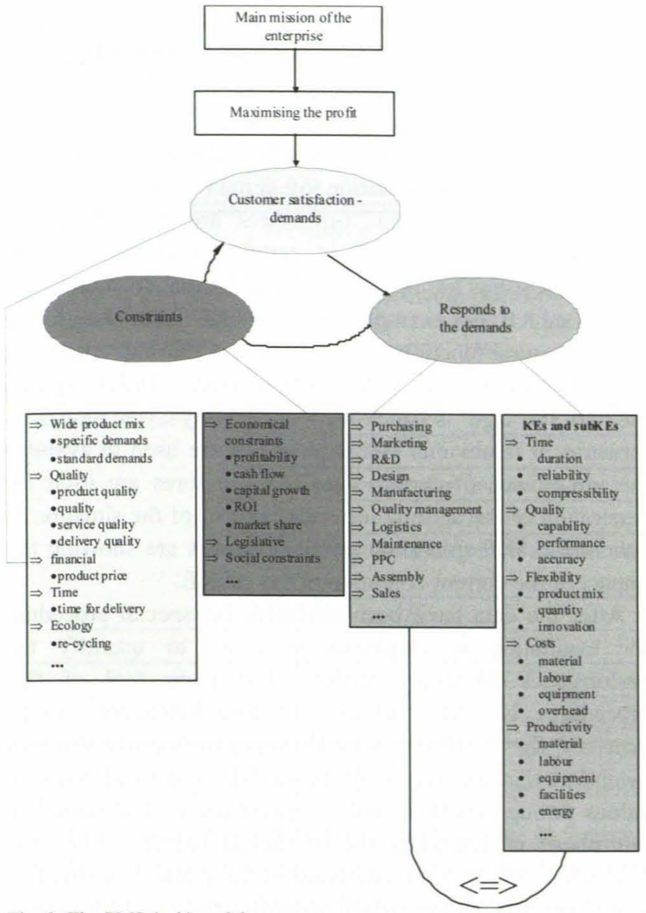

Fig. 2. The PMS (sub)model

ways for putting in practice customer demands in order to maximise the profit by considering the constraints of the environment in the same time. Namely, the stand presented here is that fulfilment of the main goal of the enterprise (maximising the profit) should be accomplished through customer satisfaction, as a driving force of all actions of the enterprise. The enterprise should undertake appropriate actions to respond to those customer demands, respecting the actual constraints of the environment. So, when analysing the various segments of the enterprise, we are analysing these responds to the customer demands. Here they are called Key Elements of Success - KEs. In this research five KEs are determined - time, quality, flexibility, costs and productivity. The problem with these KEs is that they are not focused enough. There are several aspects of every KE which provokes several measures for determination of every aspect. That is why they are additionally decomposed to their elements, subkey elements of success - subKEs. Examples of subKEs, fig. 2, are: Time-Reliability, Quality-Capability, Flexibility-Product mix, ... These subKEs have the needed broadness in the view - to represent one aspect for the whole enterprise and they are concrete enough - they can be measured even with a single measure for the whole enterprise and are able to show the directions for further improvement.

In such way, the PMS (sub)model is making the straight connection between the main goal of the enterprise and the operative measures.

It should be stressed that these variables are describing the enterprise from the beginning to the end of the analysis - they are analyzing the enterprise from three main aspects: the strategic importance, actual performance and generated actions for improvement of the situation. They are the framework of the analysis, which is dictating the analysis of the enterprise.

Content of the phases in the model	**Some of the utilized method approaches**
1. Elucidation of the present situation of the enterprise in a measurable form from strategic importance point of view. The measurement of this issue is done through subKEs. AHP method is implemented [Saaty 80].	• AHP method • Team work (Workshop with the top management)
2. Explanation of the present situation of the enterprise in a measurable form from actual performance point of view. The measurement of this issue is done through subKEs. Specific methodology for auditing is created - SAudit [Minovski 98], which is followed by a specially created procedure for evaluation.	• SAudit • SWOT • Interview
3. In order to determine the inconsistency of the subKEs from strategic and actual performance point of view I/P matrixes are employed. The result of this phase is the list of Critical Elements - subKEs which have unbalance between their importance and performance.	• I/P matrixes (Gap analysis) • Team work (Workshop with the top management)
4. The beginning of the action generation is in the fourth phase. For every Critical Element (CE), appropriate Success Factor (SF) is induced. Examples for Success Factors are: shortening the cycle time, smaller lots, layout optimization, more intensive education and training in some/all departments, standardization, automation ... So, SFs can be defined as various kinds of actions which should lead to improved situation in the enterprise. The generation of the SFs is done heuristically.	• Structured knowledge about method approaches • Forms for performance measures • Matrixes KE -functional areas
5. This phase should structure the bunch of SFs. The idea is to simulate the situation after the implementation of every possible set of SFs through the implementation of the particular procedure for scenarios generation and analysis.	• Scenario technique • Qualitative MICMAC method • Simulation
6. Selection of the optimal solution is determined in the sixth step. Previous phase gives the situation where certain scenario leads, concerning only subKEs. In this phase, the financial effect of every action is estimated.	• Team work • Pay-back method • Costs/Gain diagram
7. The seventh phase covers the implementation of the optimal action - no specific methods or procedures, but team work are foreseen for this phase in the present stage of development of the model.	• Team work

Fig. 3. Phases of the model for enterprise restructuring (Minovski *et al.* 2000)

A. Phases of the model implementation and some utilised methods

The phases of the model are practically representation of the basic idea of the model - first two steps should measure the strategic importance and actual performance through subKEs, than in the third phase the inconsistency between strategic importance and actual performance should be measured. After that, the actions should be generated (fourth step), quantified (fifth step) and optimal solution should be determined (step 6). At the end, in the seventh phase, the optimal action should be implemented. Those phases are presented in fig. 3, together with the implemented methods in every phase (Jovanoski *et al.* 2000).

The first phase should determine the importance of the KEs and subKEs. This importance is from the strategic point of enterprise view, taking into consideration the customer demands. For this purpose the AHP- Analytical Hierarchy Process, (Saaty 1980) is utilised. It is a method for multi-criteria optimisation. Participation of the top management of the enterprise is dominant in this phase, as a source for the enterprise strategic goals.

The reasons why this method is implemented are following:

- included consistency control - for every comparison matrix consistency ratio is calculated, which gives bigger reliability to the decision making
- structured evaluation process - complex multi-criteria decision making process is decomposed, with clearly defined goals, criteria and alternatives
- instead cumulative decision making, this method first compares separately the criteria, and after that alternatives concerning every criterion, on the basis of the aforementioned structure of the problem
- specifically for this area - implementation procedure insists on active participation of the top-management, which gives extra value to the results

The goal of the second phase is to determine the technical and economical capabilities of the company. For that purpose, a specially structured questionnaire, called SAudit is used to audit the company. It contains 98 questions. Example of one question is shown in the fig. 4. Those questions should gather necessary qualitative and especially quantitative data for determination of over 200 measures. Interesting feature of the approach is the structure of those measures, organised as R-, I- and B- measures. R-measures are representing the situation of certain subKE in certain structural/functional area. I-measures are influencing the situation of certain subKE in certain structural/functional area. B-measures are being influenced by the situation in the certain subKE. For example, for the subKE Time-Duration in the structural/functional area Manufacturing, measure "Manufacturing Cycle Time" is R-measure, "Delays Due to the Part Shortage" is I-measure and Delivery Cycle time is B-measure. It is obvious that R-measures are used to evaluate the importance of certain subKE, I-measures are used for generation of the actions for improvement of the situation in concrete subKE (phase 4) and B-measures are showing the impact of the current condition of the subKE.

After the data have been obtained, the special procedure for evaluation is employed in order to quantify the performance of every subKE. The main tool of this procedure is the "subKEs-structural/functional areas" matrixes, fig. 5, filled in with R-measures. Namely, the idea behind is that the value of one subKE is derived from its values through all structural/functional areas. The output of this phase is quantified list of ranked subKEs. The only difference with the list generated in the phase 1 is that that now these subKEs are ranked according their performance in the enterprise.

Phase three of the methodology tries to translate the market demands on the enterprise. In order to determine the inconsistency of the subKEs from strategic importance and actual performance point of view I/P matrixes are employed, fig. 6. The output of this phase is the list of Critical Elements - subKEs which have unbalance between their importance and performance (here the accent is on the gaps, although and false alarms has a great potential for improvement of the enterprise situation).

This analysis, although simple, gives an overall picture of the enterprise performance and the possibilities for

R&D.2. Introduction of the improvements

New improvement (short info)	Date of		Level of improvement [1)]			Source of improvement		
	initialisation of the improvement	introduction in production	small	medium	great	employee suggestion	customer suggestion	engineering
1.								
Total								

[1)] - The main criterion is whether they leads to a new product or not, which can be described as the change in the shape and functions in the Key Constructive Groups (KCG) of the product. So:

Small improvements - they don't lead to new product (small improvements in the shape or functions of the KCGs OR improvements in less than 20% of the KCGs)

Medium improvements - they lead to new/variant product (medium improvements in the shape or functions of the KCGs OR improvements in less than 60% of the KCGs)

Great improvements - they lead to new product (great improvements in the shape or functions of the KCGs OR improvements in more than 60% of the KCGs)

Fig. 4. Example of one question in SAudit (Minovski *et al.* 1998)

Structural-functional area	Sub-area	TIME Duration W	Duration Value	Reliability / Dependability W	Reliability / Dependability Value	Flexibility W	Flexibility Value
R&D	*R&D of new technologies*	0,1	0,6	0,1	0,4	0,1	0,8
	R&D of new products	0,2	0,2	0,1	0,1	0,1	0,3
DESIGN	*Technical documentation - new products*	0,2	1,2	0,2	0,9	0,1	1,4
	Technical documentation – adaptations	0		0			
SALES AND DISTRIBUTION	*Packing*	0		0		0	
	Distribution	0,1	0,8	0,1	0,6	0,2	1,1
	Making order for production	0,1	1,1	0,2	1,2	0,1	1,5
	Customer management	0		0		0	
	Servicing and technical support to the customer	0		0		0	
	Making an offer	0		0		0	
	TOTAL	1	4,8	1		1	
	VALUE of the subKEi	0,2	**0,8**	0,35	**0,5**	0,45	**1,2**
	VALUE of the KE	**0,875**					

Fig. 5. Example of "subKEs-structural/functional areas" matrixes (Minovski *et al.* 2002)

improvement. Theoretically, it can be even done in 5 minutes by the managers who are working for some time in the enterprise and it would still help them in gaining a good picture of where the company is and what is "lacking". From there, they can generate list of actions for improvement. Of course, usage of methodologies and techniques can improve the analysis, and this is highly suggested.

The beginning of the action generation is in the fourth phase. For every Critical Element (CE), appropriate Success Factor (SF) is induced. Examples for SFs are: shortening the cycle time, smaller lots, layout optimisation, more intensive education and training in some/all departments, standardisation, automation ... So, SFs can be defined as various kinds of actions which should lead to improved situation in the enterprise. The generation of the SFs is done heuristically.

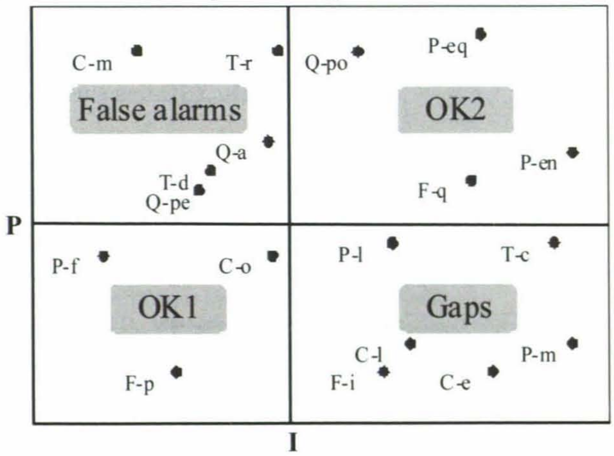

Fig. 6. Importance/Performance (I/P) matrixes (Minovski *et al.* 2000)

Previous phases determined the domain of the process of restructuring, by determining the Success Factors which should improve the situation in certain Critical Elements.

The fifth phase should structure that bunch of SFs. For this purpose, scenario technique is employed. The idea is to simulate the situation after implementation of every possible set of located Success Factors (if there are 3 Success Factors and they have only one way to be improved, number of possible sets is equal to the combinations without repeating - 7: SF1; SF2; SF3; SF1+SF2; ...; SF1+SF2+SF3). The need to examine every set of Success Factors brought to the utilisation of the simulation technique. The situation is pictured with the CSM (Comprehensive Situation Mapping), (Georgantzas *et al. 1995*). In that order the relationships between Success Factors, between Success Factors and Critical Factors and between Critical Factors should be established. It is clear that is very difficult, but necessary task, because those kind of analysis are contributing with deeper understanding of the situation, both the present and the future one. Additional to this thesis it may be added that CSM attributes the relationships with: coefficients of influence which one element is transferring to another one and needed time for the transfer of influence. In the utilisation of CSM, we are adding also the costs needed for this transfer.

After the simulation, the basis for the analysis performed in the next phase (sixth) is established. Namely, the frame for monitoring the impact of every set is fixed. This frame practically determines the scenarios for the future situation (Minovski *et al.* 1999).

II. Simulation Model

In order to create a successful implementation and for everyone to be "sure" that the best possible solution is going to be implemented, a series of simulation test-runs have to be undertaken. From the whole list of subKEs, three were selected to be included in the simulation model (Quality-performance, Productivity-equipment and Costs-overhead) in order to operate much easier in the model itself. It would have been much relevant simulation model if ALL subKEs are taken in consideration, but the chances of errors would have been greater, as well as the number of scenarios and simulation runs.

In fig. 7, a basic scheme of relationships between the selected subKEs and the designated SFs is shown. As it can be seen, all possible relationships exist. The selected set of SFs is the one that can influence most under the given conditions and the selected subKEs.

The influence (the quantity) between each of the six elements is shown in the fig. 8. These numbers are taken heuristically and used in the formulas when creating the simulation model. They are indicated as percentages how much the improvement of one will effect the other. The negative expression by the relation Productivity-equipment to Quality-performance means that it has a negative influence on it (it decreases the Quality-performance value).

The final version of the simulation model, with its elements and connections can be seen at fig. 9. As it can be seen, not only the subKEs and SFs are presented here; additional elements have to be inserted in order the simulation to function properly and to better represent the real situation.

All together 8 different simulation runs were done (one with the current situation and seven with the proposed implemented SFs). There are differences and improvements as soon as a SF is included in the possible improvement scheme. The values can be compared in the following table as normalised values (tab. 1). Of course, even the novice can see that the best performance of the enterprise will be achieved if all SFs are implemented (in this version – all three). But, would that implementation (speaking about the

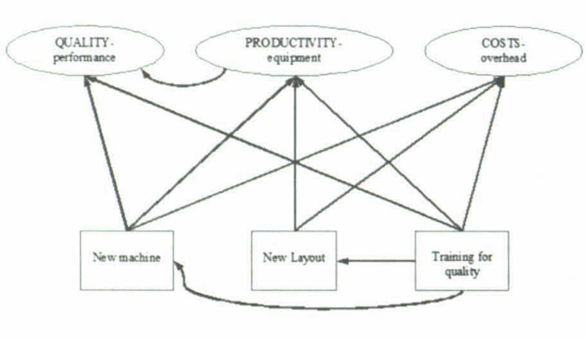

Fig. 7. Relationships between the subKEs and SFs

from \ to influence	QUALITY-performance	PRODUCTIVITY-equipment	COSTS-overhead	New machine	New Layout	Training for quality
QUALITY-performance						
PRODUCTIVITY-equipment	- (1÷3)					
COSTS-overhead						
New machine	20	10	5			
New Layout		30	10			
Training for quality	30	5	1	20	30	

Fig. 8. Influence of the elements in the model, in percentages

costs of course) be reasonable, cost-effective? That is why the prism with all possible scenarios is done at the end (Minovski *et al.* 1999) – to give the managers, and the people who decide with which scenario to continue, a better overview of the possible solutions.

This means that at this stage of development COMPASS does not select optimal scenario. It only offers the most prospect scenarios with the caused improvements and the needed costs for implementation of each scenario. In ideal situation, the improvements should determine the improved customer satisfaction and at the end the increased profit. Than the ROI can be determined and all scenarios be compared. Although there are some research activities for establishing the relations between customer satisfaction and profit of the enterprise, we have decided that establishment of

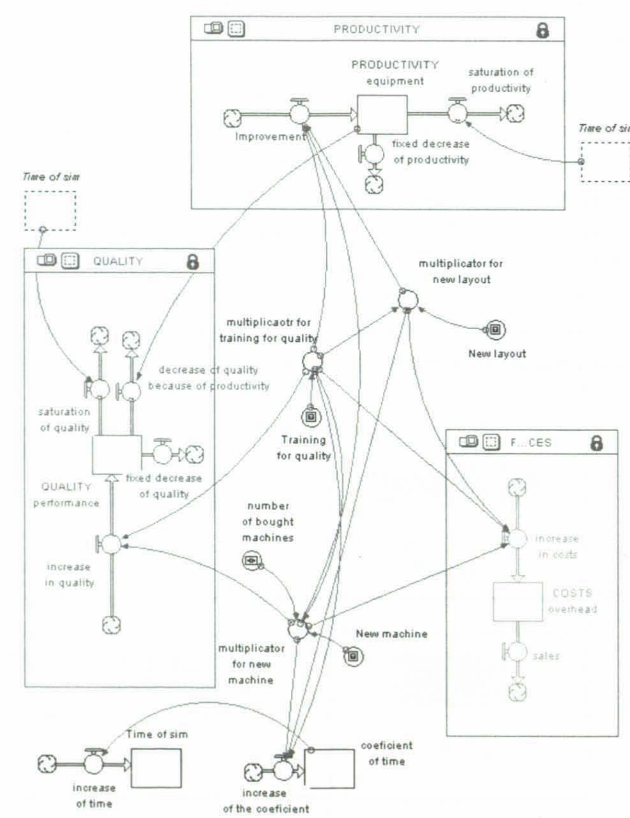

Fig. 9. Final version of the simulation model

Table 1. Compared values of all scenarios after the 24 month simulation run

	QUALITY-performance	PRODUCITVITY-equipment	COSTS-overhead
current state	0	0	0
with new machine	5,2	-3,1	5
training for quality	19,2	2,9	5
with new layout	-5,3	16,9	10
new machine + training	39	12,9	10
new machine + layout	3	26,9	15
training + layout	15,9	32,9	15
machine+training+layout	33,3	42,9	20

such relations is very difficult at the moment.

One of the biggest problems of this simulation (but with all simulations in general) is the verification that needs to be done. In this case, big restructuring changes are foreseen in the enterprise and it needs time for those to have a full effect. That is why the simulation run is configured as 24 months, an optimal time to have effect from the changes, but also not to fade too much. In order to validate the simulation model, the parameters need to be benchmarked before the implementation of the SF and after 24 months.

III. Conclusion

The idea of using the simulation arises when the help of the computer is needed in generating number of scenarios there are for a given situation, in a shorter time span. This simulation model only consists of three subKEs, which surely cannot represent the enterprise as it is. Even with that small number of subKEs, a lot of additional elements needed to be included in order the simulation model to be as realistic as possible. The goal is to make one general simulation model that can be used in the enterprises and tweaked for a given situation. However, in order to do so, a decreased in the number of subKEs would be very helpful (maybe combining two in one etc.).

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