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BALANCED SCORE CARD MEASUREMENT APPLICATIONS AT A CAR MANUFACTURER SUPPLIER COMPANY

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SUMMARY
The traditional controlling index tables and performance measurement system indicators are considering mostly the financial parameters of production processes. For better understanding the relations not only on the operational, but also on tactical and strategic levels the use of Balanced Score Card measurement system is widely accepted: it is operating on the financial, marketing (customer-related), operational (internal-business processes) and strategic dimensions (learning and growth).
Using the BSC method at a car manufacturer supplier company can highlight many new factors of the production system behaviour, and can help in the analysis of production plan deviations.

Keywords: Operational logistics, Balanced Score Card

1 INTRODUCTION

The manufacturing process of an automotive supplier factory is a very complicated production system. There are many challenges on the fields and time horizons of operational, tactical and strategic decisions: fluctuating demand, jobs with various product types and priorities, un-balanced capacity, bottleneck machines, hundreds of processing steps, alternative machines with unequal capacity, etc. [1].

There are more than 200 types of products in the company's production assortment, with different distribution in time and in batch and serial sizes – mostly made by aluminium parts. These products are long-life series, especially for premium type cars, where there are no significant changes in the design of these elements for 5-7 years. There are several operations, labour activities related to these products: The preparation of materials are the cleaning and cutting (cut to size) phases. The labour works involve the bending, traction, draw-bending, cut-out and squeeze operations. The milling, heat treatment and the starch processes are in the final production phase. There are several failures and significant amount of supplementary work related to these failures today – this paper is an attempt to discover the relations between them.
Supplementary work hours have significant impact on the company performance. It is crucial to get experience and forecast-ability for future series. The objective of the research is to

reveal the nature of production processes, to determine the prospective failures, to forecast the supplementary work hour demands, for reaching the minimal failure level in the production system at a car manufacturing supplier company.

2 PRODUCTION PLANNING AND PROCESS PLANNING

Production planning and predicting the completion time and supplementary work hour demand for every job is a critical task not only to the factory itself, but also to its customers. Predicting the time demand of a complete job is equivalent to estimating the cycle (flow) time of the job – we should discover the behaviour of this complex system. One outcome of the project can be a pre-classifying method of jobs for better and quick resource estimations [2].
The estimation of future production costs is a key factor in determining the overall performance of a new product development (NPD) process: the earlier this information is known, the better the trade-off between costs and product performances will be managed. Typically, the cost per unit of a given finished good is the sum of different kind of resources - raw materials, components, energy, machinery, plants, etc. - and the quantification of the use of each resource is extremely difficult in the first stages of the life cycle (and particularly in the early phases of the product development process), given the reduced amount of information and the low level of definition of the project.

The goal of process planning in a production environment is to select and define, in detail, the process involved in transforming raw material into a specific end product with a given shape and certain specifications. The purpose of production planning and control (PPC) is optimising the flow of material and the use of the machines involved in manufacturing, taking into account various management goals like reducing the work in progress, minimising shop floor throughput and lead times, improving responsiveness to changes in demand and improving delivery date adherence. Typical production planning and control system functions include planning material requirements, demand management, capacity planning and the scheduling and sequencing of jobs. Process planning concerns and requires detailed information about the process – it is crucial to develop an appropriate model that can be applied in the integrated process planning and scheduling. The usual way to divide up process planning tasks in manufacturing companies is to hand over the plans to the manufacturing process experts who then specify the procedures to make the product: the planner's knowledge of production planning is fundamental [3].

3 THE BALANCED SCORE CARD SYSTEM AS PERFORMANCE MEASUREMENT APPROACH

In everyday operations there are many factors in the background of production plan deviations: external (incoming order with extra-high priority, changing market demands, etc.) and internal factors (machine failures, in-sufficient information flow or resource allocation, etc.) The accuracy and effectiveness of production planning can be evaluated by using performance measurement tools.

The Balanced Score Card was first proposed by Kaplan and Norton as a methodology aimed at revealing problem areas within organizations and pointing out areas for improvement. It was also promoted as a tool to align an organization with its strategy, by deriving objectives and measures for specific organizational units from a top–down process driven by the mission and strategy of the entire organization.
The BSC is a management tool composed of a collection of measures, arranged in groups, and denoted as cards [4]. Using BSC method enables an organization to clarify its vision, develop and communicate a strategy to achieve that vision and translate that strategy into action [5].

Founding BSC was motivated by the realization that traditional financial measures by themselves are inadequate in providing a complete and useful overview of organizational performance. The typical BSC consists of four perspectives - financial and nonfinancial measures to guide implementation and evaluation: financial, customer, internal/process, and learning and innovation.

Applying Balanced Score Card performance measurement frame involves the identification, appreciation, documentation, evaluation, and consolidation of existing local knowledge and experience with respect to quantitatively capturing and reporting relevant aspects of performance. One of the reasons for the success of BSC is that the BSC is not just an evaluation method, but also a strategic planning and communications device. A lot depends on the communication and acceptance of BSC method – having motivated workforce behind new measurement system implementation is inevitable.

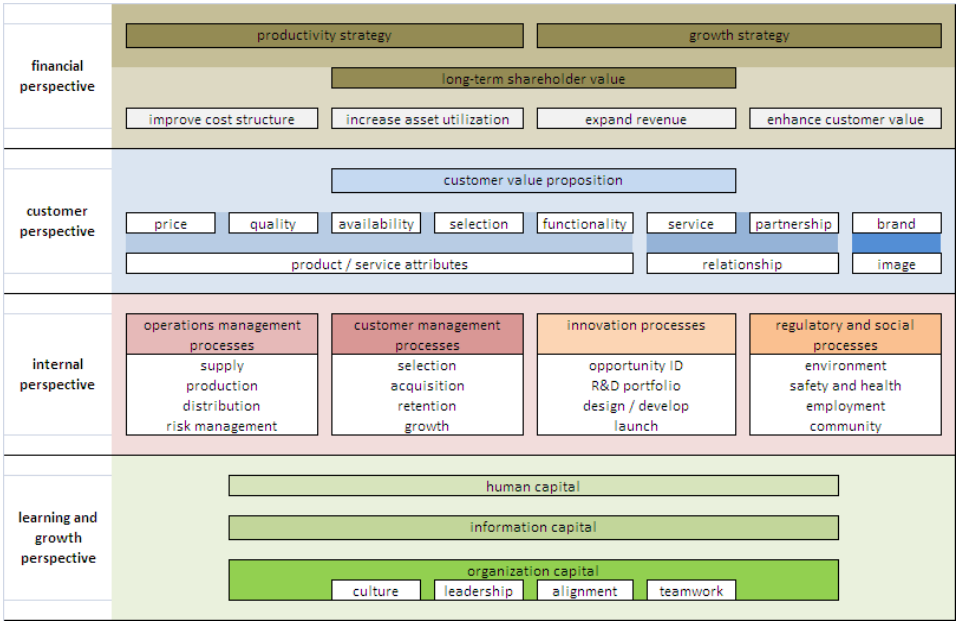


Figure 1. The Pyramid-type strategy map of Kaplan and Norton [5]

At the following parts of the essay we are considering all the so-called cards [6], with illustrative examples from our research.

3.1 BSC – financial perspective

The financial perspective examines the bottom-line contribution of the project in monetary terms. It reflects the profitability, cash flow, cost vs. budget, etc. The financial objectives serve as the focus for the objectives and measures in all the other scorecard perspectives. Every measure in the scorecard should be part of a cause-and-effect relationship to improve financial performance. Typical financial goals deal with profitability, return on investment, and growth. In our case these types of measurements are related to the quantities, productivity rates, active and inactive time intervals, etc.

3.2 BSC – customer perspective

The customer perspective looks at the market value of the project deliverables, as well as stakeholder satisfaction with the final outcomes. The customer is interested in the responsiveness, timeliness, service and quality that the project provides. The customer perspective translates an organization's customer service mission into specific objectives and consists of metrics that are customer focused. Examples are consumer satisfaction indices and market share. In our case these types of measurements are related to the delivery time accuracy and flexibility, supplementary work hour demand, distribution of shipment failure codes, etc.

3.3 BSC – internal perspective

A third, internal perspective focuses on defining critical internal operations (and objectives) that enable a company to increase shareholder value over time. As in the customer perspective, the related metrics may be quantitative, qualitative, financial or non-financial. In our case these types of measurements are related to the material supply problems, predictive and accidental maintenance events, trace-ability of material flow, etc.

3.4 BSC – learning and growth

The fourth and final perspective, therefore, deals with learning and innovation – the infrastructure that supports the strategic goals in each of the other perspectives. The metrics for this perspective may also be quantitative or qualitative, and financial or most often, non-financial. Examples are technology adoption indices and employee development indices. When the evaluation is solely based on the short-term financial perspective, it is often difficult to sustain investments to enhance the capability of the human resources, systems, and organizational processes. In our case these types of measurements are related to the machine set up times with focusing on batch sizes, breakdown time quota for consultancy and measurements, distribution of prototype fail codes during new product development or new product series start, etc.

4 APPLYING THE BALANCED SCORE CARD APPROACH IN NEURAL NETWORK MODELLING OF THE PRODUCTION SYSTEM

Artificial neural networks are able to help in understanding the nature of relations between production process parameters.

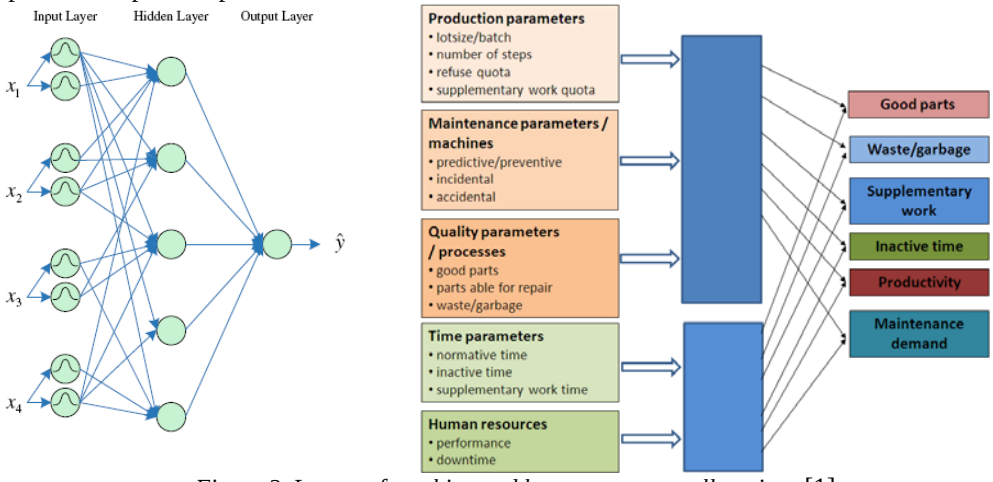
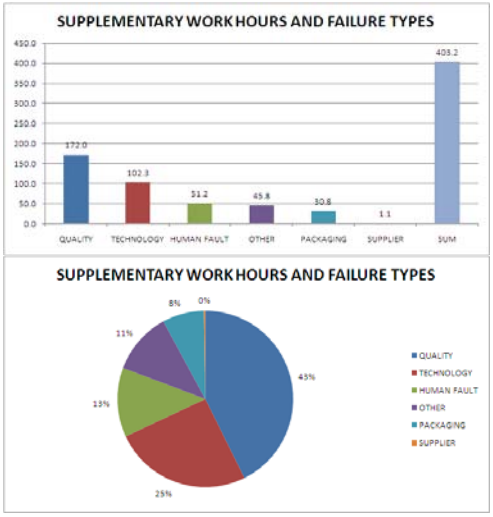


Figure 2. Layers of machine and human resource allocations [1]

At a car manufacturer supplier company there are many available measures on the fields of productivity, efficiency, etc. and we have also some foreknowledge about these relations - would be fruitful to prove. Identifying the critical factors have key role in constructing the appropriate neural network architecture – considering only the really important Balanced Score Card parameters could provide the best tool for investigation and forecast.

Neural networks are typically characterised by the number of hidden layers, the number of hidden neurons and the training algorithm. Those design parameters determine to a large extent the performance of the ANN and will differ depending on the field of application. If the number of hidden neurons is too small, not all necessary dependencies between the variables might be captured, resulting in a poor modelling of the observed process. On the other hand, if the number of hidden neurons is too large, spurious relations and noise are included in the model. By a trial–error process the number of hidden neurons that best fits the specific purpose is determined. The training algorithm will be chosen in function of the specific application.

Demonstrating the obstacles and possible promises of such applications - as case study – the current supplementary work hour demand investigation provides the best field of illustration. In January 2011 the following production failure types required more than 400 hours of supplementary work.



SUPPLEMENTARY WORK HOURS - CLUSTERING (HRS)				
GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
126.7	32.2	16.5	7.9	2.3
77.4	28.8	15.0	7.3	1.5
50.8		10.2	5.6	1.4
		9.3	3.8	1.1
			3.7	1.0
				0.3
				0.3
254.8	**61.0**	**51.0**	**28.3**	**8.0**

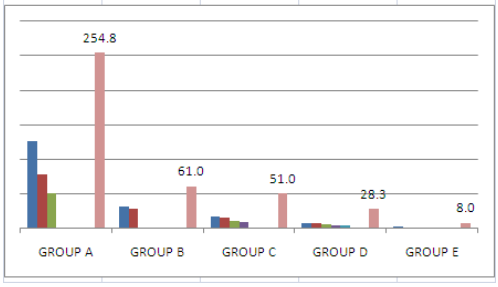


Figure 3. Supplementary work hours and failure types related to different part types

Considering the distribution between different products (parts) we can identify 5 groups (in the GROUP A section there are 3 products – these 3 was responsible for 254.8 hours of supplementary work, what is more than half of the current demand)

The questions are:

- How it is possible to forecast these parameters?
- Where are the relations between production and operational logistics parameters?
- Which factors are critical in the process?
- How to improve these critical circumstances?

As pre-condition or hypothesis we can say that probably the products in the A Group manifests the most difficult and complex production process or the biggest visible surface (from previous analysis it is clear that the most important fault are surface errors).

5 CONCLUSION

The Balanced Score Card performance measurement system has the flexibility for providing appropriate forecasts in future production planning tasks. The continuous feedback of the results can help in discovering the real background factors of deviations – and helping the company in the improvement of competitiveness.

Based on the Balanced Score Card approach in constructing neural network (hidden) layers it seems possible to prove our foreknowledge and insights and get an attractive tool for forecasting.

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