Teaching the Dynamic Balanced Scorecard

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Abstract:
Rising variability and complexity in business, force managers to undertake the effort of continuous and effective learning. The process of learning increases the organisation's adaptive capacity and resilience, and it helps to derive a skilful combination of operational effectiveness and strategy. It is essential to identify performance indicators which help to steer towards long-term goals in the presence of short-term turbulence. The Balanced Scorecard has become one of the most popular performance measurement systems in recent years. However, there are some reservations about certain aspects of this technique. Its effectiveness can be increased by application of System Dynamics tools. We report here on methods to teach ways to apply systems tools to the Balanced Scorecard. We integrated a series of lectures, exercises and a simulation game in a workshop setting using the methodology developed by IBM Business Consulting Services as an example of implementation of the Dynamic Balanced Scorecard.

Key words: *Balanced Scorecard, Dynamic Balanced Scorecard, System Thinking, System Dynamics*

Introduction

Accelerating changes and increasing complexity in technology, institutions and environment are becoming dominant business challenges. As managers face the complexity of business environment, their ability to make appropriate and effective decisions is crucial for enterprise performance. Managers' effectiveness is often limited by time pressures, selective perception and short-term horizons. They respond to these pressures with increasing investments in continuous learning by comparing real world data to various goals and taking actions that will eliminate perceived discrepancies. This type of learning, called 'single-loop learning', (Argyris, 1977, 116) sheds no light on the mental constructs from which goals emerge. One should recognise that goals and decisions come from organisation strategy and decision rules which in turn are strongly affected by managers'

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mental models. Learning becomes more effective when it builds a second loop ('double-loop learning') that allows information about the state of real world to alter mental models. This enables managers to consciously modify the whole decision chain leading from their mental models to their goals and the ways they decide and act. The double-loop learning process develops not only awareness and knowledge about the business and its environment but also the way people think, communicate and filter information. This increases the organisation's adaptive capacity and resilience, thereby reducing risk connected with uncertainty and makes managers better prepared to control business operations.
According to Porter (1996, 61) only skilful combination of operational effectiveness and strategy, two elements working in very different ways, enables an enterprise to reach the primary goal, which is superior performance. Operational effectiveness is closely connected with day-to-day management and means doing things right - performing activities better than rivals. All efforts focus on delivery to customers of greater value, comparable value but at a lower cost or both at the same time. Strategy in turn is responsible for doing the right things, which means performing different activities that distinguish one from one's competitors.

Strategy provides the long-term goal for organisation, but how do we know whether we are on the right course? It is essential to specify the performance indicators which help to steer towards the goals and to continue on a chosen direction. The Balanced Scorecard has become one of the most popular performance measurement systems in recent years. However, its usefulness is limited if it supports only single-loop learning – small adjustments to achieve predefined goals. The effectiveness of the Balanced Scorecard can be substantially increased when combined with system dynamics modelling – the discipline which has proven its ability to improve managers' mental models.

This paper reports on the efforts to teach the Dynamic Balanced Scorecard – the strategy and measurement system supported by system dynamics. We start with a short review of the balanced scorecard tool. Then we report on the problems identified in business practice and explain how system dynamics can provide a remedy for some of these problems. Particularly we describe the methodology worked out in IBM Business Consulting Services for the Balanced Scorecard implementation. We follow with the description of the workshop – its design execution. We conclude with the lessons learned concerning how it can be improved.

Balanced Scorecard
The experience gained in the last several years proves that financial measures are not sufficient of business performance and future potential. At the beginning of 1990 Robert Kaplan and David Norton along with representatives from several companies worked on project called 'Measuring Performance in the Organization of the Future' (Norton and Kaplan 1996a). They tried to develop a new approach to enterprise performance measurement. As a result they proposed to consider information appearing in various areas of an enterprise, aside from financial measures in common use. Eventually, they affirmed that for correct assessment of performance, the Balanced Scorecard should comprise

indicators grouped in four perspectives: finance, clients, internal processes and learning & growth. Strategic objectives must be established when an enterprise's vision and strategy are developed, to secure competitive advantage (Kaplan and Norton 1993, 136). The scorecard should make long-run financial objectives explicit and link them to the required activities to be taken with financial processes, customers, internal processes and employees. Tangible goals and actions to achieve those objectives must be carefully planned to avoid the trap of lofty objectives with no concrete path to achieve them. The 15 to 20 defined indicators are supposed to achieve consistency of daily activities with strategic objectives.
Those appointed indicators include performance drivers, which are leading indicators that tend to be unique for a particular business unit, and outcome measures, which are lagging indictors, commonly appearing on scorecards as profitability, market share or employee satisfaction. When grouped in four perspectives indicators should be an element of a chain of cause and effect relationships that culminate in improving financial performance. Cause and effect relationships can be framed as 'if-then statements' that express key elements of the developing strategy of the business unit. It is recommended that the sequence of specified relationships summarized in the strategy map tells the story of the business and, in that way, communicates the meaning of the business unit's strategy to the organization.
The Balanced Scorecard methodology has been improved through experience gained through its implementation with several companies. The mechanism of continuous performance measuring evolved into a strategic management system, which consists of four processes: translating the vision, communicating and linking, business planning and feedback & learning (Kaplan and Norton 1996b, 77). The vision translation process defines the objectives and indicators. Activities in the communication process focus on spreading understanding of strategy across the whole enterprise to all departments and linking it to local and individual objectives. In the process of business planning, managers are responsible for resources allocation and coordination of those initiatives that aim at fulfilment of strategic objectives. The feedback process collects results and compares them with goals. Experience gained allows managers to evaluate strategy according to the most current information.

Problems with the Balanced Scorecard

Due to its holistic approach and simplicity the Balanced Scorecard concept is more and more popular not only among industrial companies but also in other organizations. However, there are some reservations about certain aspects of the Balanced Scorecard. According to Richmond (2001) the strategy mapping system, the bubble diagram, has serious limitations which may result in strategy failure. He points out three main flaws of this system:

- It expresses only one-way relations, cause-and-effect logic, whereas very often factors within strategic initiatives influence each other in a feedback loop pattern.
- It may lead to incorrect conclusions about impact of strategic initiatives because it does not capture delays, fundamental factors of dynamics in any environment. .
- Due to its static nature, the mapping system is unable to answers such questions as 'what will happen, if …?'. Despite much information gained through the performance measurement activities, managers may be still unable to react correctly to changes and

discrepancies between the goal and the result of initiatives undertaken to meet that goal. A more elaborate language is required to help managers check the consistency of their assumptions and actions.

Akkermans and Oorschot (2002, 4) point out further limitations inherent in these flaws:

- Performance measurement based only on few indicators may lead to troubles unless the most relevant indicators are chosen. Balanced Scorecard methodology does not possess any mechanism, which can assess the relevance of defined indicators.
- There are insufficient links between top level, strategic scorecard and operational-level measures, and the Balanced Scorecard does not consider an enterprise in the context of an extended value chain.

Another problem is people's attitude. The Balanced Scorecard's implementation, quite similarly to such other management techniques as reengineering, total quality management or benchmarking, drives the process of change. Employees are very often tired or overwhelmed by new improvement programmes or just prefer the way business operates. The following comments are commonly heard: '*We just hold our breath until they [senior managers] get over it and things get back to normal*' (Hammer 1990, 112) or '*How is it that supposed to fit with the six other things we're supposed to be doing?*' (Kaplan and Norton 1993, 143). A wider, systems perspective is needed to address these problems.

Dynamic Balanced Scorecard

The solution to problems mentioned in the previous section may be a Balanced Scorecard framework extended with System Dynamics tools. Those tools deliver the appropriate language and methodology to represent feedback loop structures underlying specified strategic initiatives as well as delays between cause and effect (Richmond 2001). It gives managers an opportunity to conduct thorough analysis of the whole system. Moreover System Dynamics technique makes it possible to build a quantified model of an enterprise, which can be more rigorously tested, validated and investigated. It makes defining appropriate performance indicators easier. (Akkermans and Oorschot 2002, 5) System Dynamics models allow one to link crucial indicators with the main operational processes, test the relevance of chosen indicators and incorporate delays in the strategy maps distinguishing between short and long-term factors. Furthermore, performing sensitivity analysis to changes in model boundaries makes it possible to choose an adequate scale of analysis and include all the important feedbacks.

David Norton wrote: '*Bob Kaplan and I have long believed that Dynamic Systems Simulation would be the ultimate expression of an organization's strategy and the perfect foundation for a Balanced Scorecard*'. (2000)

Dynamic approach to the Balanced Scorecard design developed at IBM Business Consulting Services

IBM Business Consulting Services developed a dynamic approach to design a system of indicators or measures within the Balanced Scorecard process. This system initially identifies a set of measurement points for the entire organisation that then forms a generic pool of measures from which Business units can select their personalised measure set.

The approach is specifically targeted to provide a holistic (often global) solution for larger corporations, which have several business units with similar profiles, e.g. producing and selling the same products in several geographic markets.

It has a number of benefits for the client, out of which the most important are:

- Provision of a common basis for selecting the measures for each business unit, tailored to their specific strategies
- Minimizing the number of indicators or measures used throughout the organisation
- Removing inconsistency - for example provides a consistent definition so that each indicator is measured in the same way throughout the organisation
- Giving the organisation a Common Language for performance management

Development of the generic pool of measures starts with development of the Cause & Effect model for the enterprise, Figure 1.

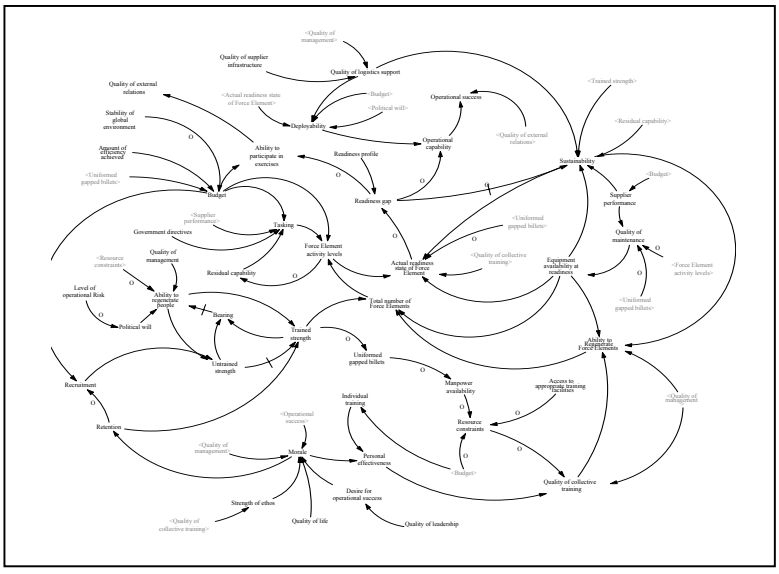

Figure 1. Cause & Effect diagram development

The model is developed in a series of workshops with the management of the organisation and is intended to provide a fairly detailed view on the variables impacting the company's business model. Based on the Cause & Effect Diagram the working group selects measures to be included in the pool of measures, Figure 2.

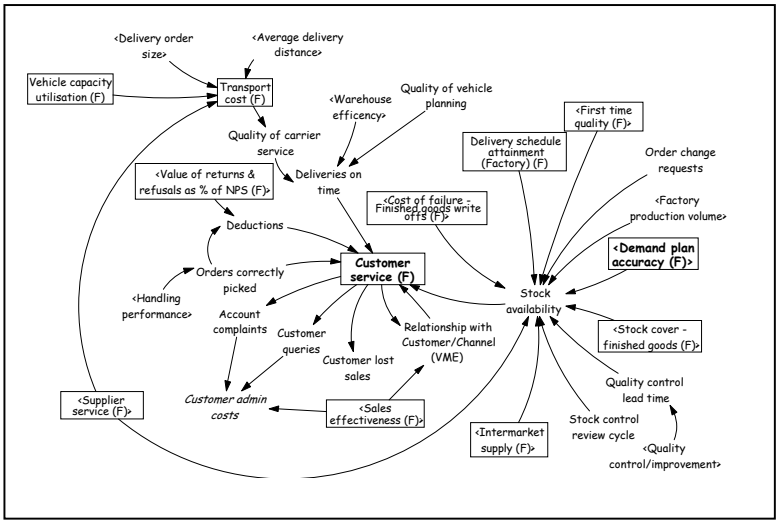

Figure 2. Measures selection

For selected measures detailed definitions are developed and approved.
The business units then use the generic pool of measures to define their Balanced Scorecards. The approach is based very much on the standard Balanced Scorecard development methodology. The key differences are:

- Each business unit uses a predefined set of measures, which are selected based on their impact on the success of strategic objectives and value creation
- The quantified model is built to support better understanding of the impact of the measures and their relations. The model is used for the measures' selection and for on-going performance management, where dynamic simulation facilities help them to adjust the settings for the measures.

The quantified model usually does not cover the whole enterprise. It will be built for those main operational processes that need more detailed investigation of the relevance of the measures.
The entire selection of performance measures should aim to:

- Cover the whole of the business's strategies
- Provide a balanced view of performance now and in future
- Avoid redundancy - coverage without clustering
- Be "the vital few". Achieve the above with the minimum number of measures

Workshop

The concept of the Balanced Scorecard integrated with System Thinking and System Dynamics techniques was the subject of 'Dynamic Balanced Scorecard - strategic tools for management challenges'' workshop, organized in Wroclaw (Poland) by Wroclaw University of Technology in partnership with IBM Business Consulting Services, the International Institute for Applied System Analysis (Laxenburg, Austria) and The Manus Foundation. Participants of the workshop were students, PhD students, researchers and representatives from organizations and companies across Poland.

The workshop began with a lecture and short exercise to introduce the participants to System Thinking. The participants' task was to examine a bubble diagram, presenting one-way cause-and-effect, relations between strategic initiatives and to find out all possible feedback loops in the diagram. Although the initial diagram was rather simplified, the structure revealed by participants looked quite complex, showing that misperception of feedback can significantly distort our perception. This issue was explored in a lecture 'Barriers and Bridges to Learning in Complex Systems'. The participants' attention was drawn to the concept of learning as a feedback loop process by distinguishing between examples of single and double-loop learning. The participants then used a simulation game, a management flight simulator, prepared by the authors, to sharpen their appreciation for these concepts by engaging their perceptions and judgement in responding to a managers' world. It allowed participants to experience the challenges faced by managers overwhelmed by the abundance of data and time pressure. The game was played twice – a first run based on the participants' previous knowledge and intuition and a second run based on the balanced scorecard which the participants worked out. The scenario of the game is presented in Appendix I.

The participants were then divided into three separate groups- each of them representing a management board of an enterprise. The groups did not compete between themselves; each of them operated on a different market simulated in the model. In each group the roles of CEO, Production Director and Human Resource Manager were appointed. Within each group a team of two or three people was engaged to take on roles that required more investigations and data analysis. In the first run they were supposed to act using knowledge and experience they had gained before the workshop.

The time range in the game was 24 months with a time step of 1 month. Each month representatives of a certain role received an extensive list of results, based on which they were supposed to take decisions. In this virtual environment they experienced the complexity of real decision making with much of its unknowns, frustrations and time pressure. The amount of data they had to analyse in each sector made it difficult to make appropriate decisions encompassing the entire enterprise. They were confused when their decisions did not work and they did not know why. They also experienced delays as some of their decisions had effects distributed in time. None of the three groups was able to introduce an effective improvement programme but they gained the motivation for acquiring the tools to manage complexity.

The flight simulator game set the stage for the next part of the workshop, which was presentation of Balanced Scorecard methodology applied by IBM Business Consulting Services. The presentation was followed with practical steps of creating strategy maps and defining performance measures. Participants of the workshop followed the whole process of measures design by themselves. Firstly they were given the opportunity to construct a cause and effect diagram representing the main relations within the system. Because of time constraints and the complexity of the enterprise model, we presented and explained to the participants the major components of a comprehensive model. After they got acquainted with the main structure of the enterprise model, each group specified a final 15 to 20 Key Performance Indicators, which allowed them measure and control enterprise performance according to their chosen strategy. All those measures were grouped in four interrelated perspectives – financial, customers, internal business processes and learning and growth.

The model for each group was amended to compute certain indicators and to deliver to the players only specified measures during the game.
By the second time the final results of each group were more satisfactory. It appears that both experience gained during the first game and the process of building and using the Balanced Scorecard added to their success. They made better decisions regarding the improvement programme and were able to measure effectively the results of decisions they made. Better understanding of the dynamic processes in the company they managed helped them to avoid many problems faced during the first run. They had an opportunity to immediately practice the concepts and tools they have been taught.

The model of the enterprise

The game used in the workshop is based on a case study of the hypothetical company manufacturing electronic components for cars. Four main sources contributed to building a model of enterprise for the purpose of the workshop. They include the concept of reliability improvement presented by Winston Ledet (1999), the issue of erosion of service quality, described by Oliva and Sterman (2001), problems appearing in process improvement presented by Repenning and Sterman (2002) and the model of market growth built by Forrester (1968). The subsystem diagram with main modules is presented on Figure 3.

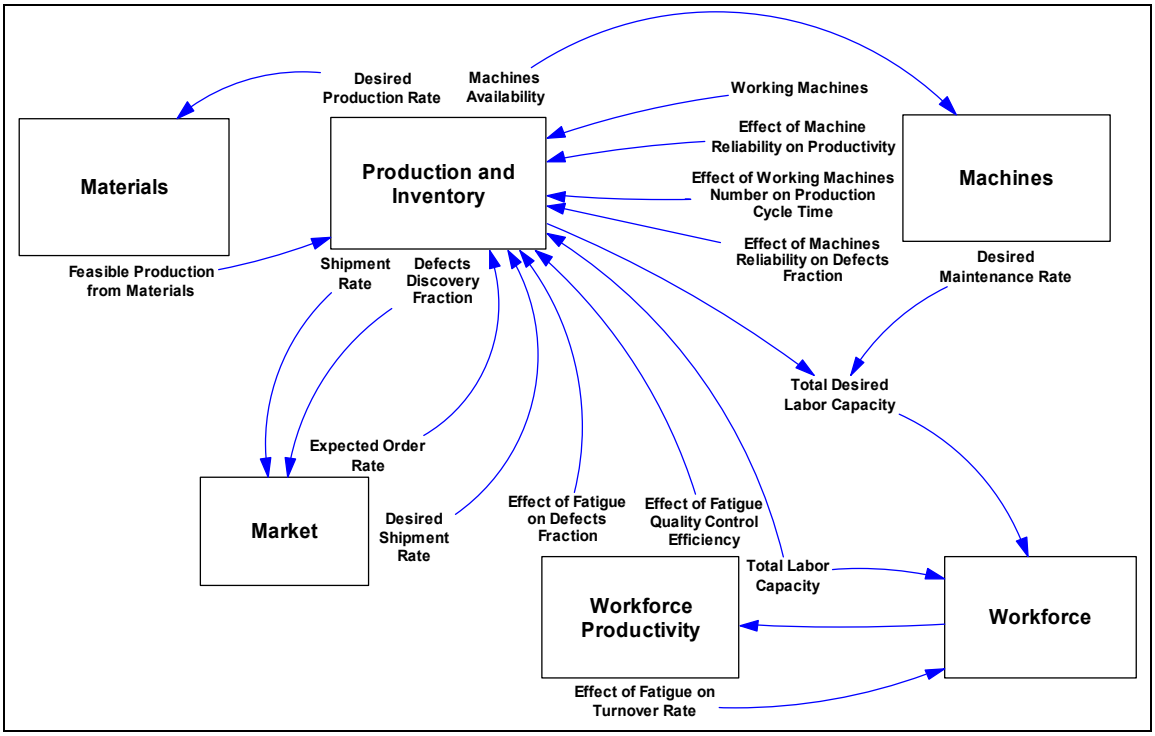

Figure 3. Subsystem diagram for CEC Company

The modelled enterprise was called Car Electronics Company (CEC). The CEC production rate depends, among others, on the number of working machines. Some of them break down and have to be repaired. The repair service is outsourced. Machines are also set

offline for maintenance reasons, which again reduces the number of machines available for production. Production machines come back to the production line again after being serviced by employees. Repairs as well as maintenance operations increase machines' reliability; it is decreased by machines' utilization. During the game the assumption was made that there is no possibility to purchase any additional machines. The simplified diagram based on the full System Dynamics model, presenting the main feedback structure of the machine sector in CEC is shown on Figure 4.

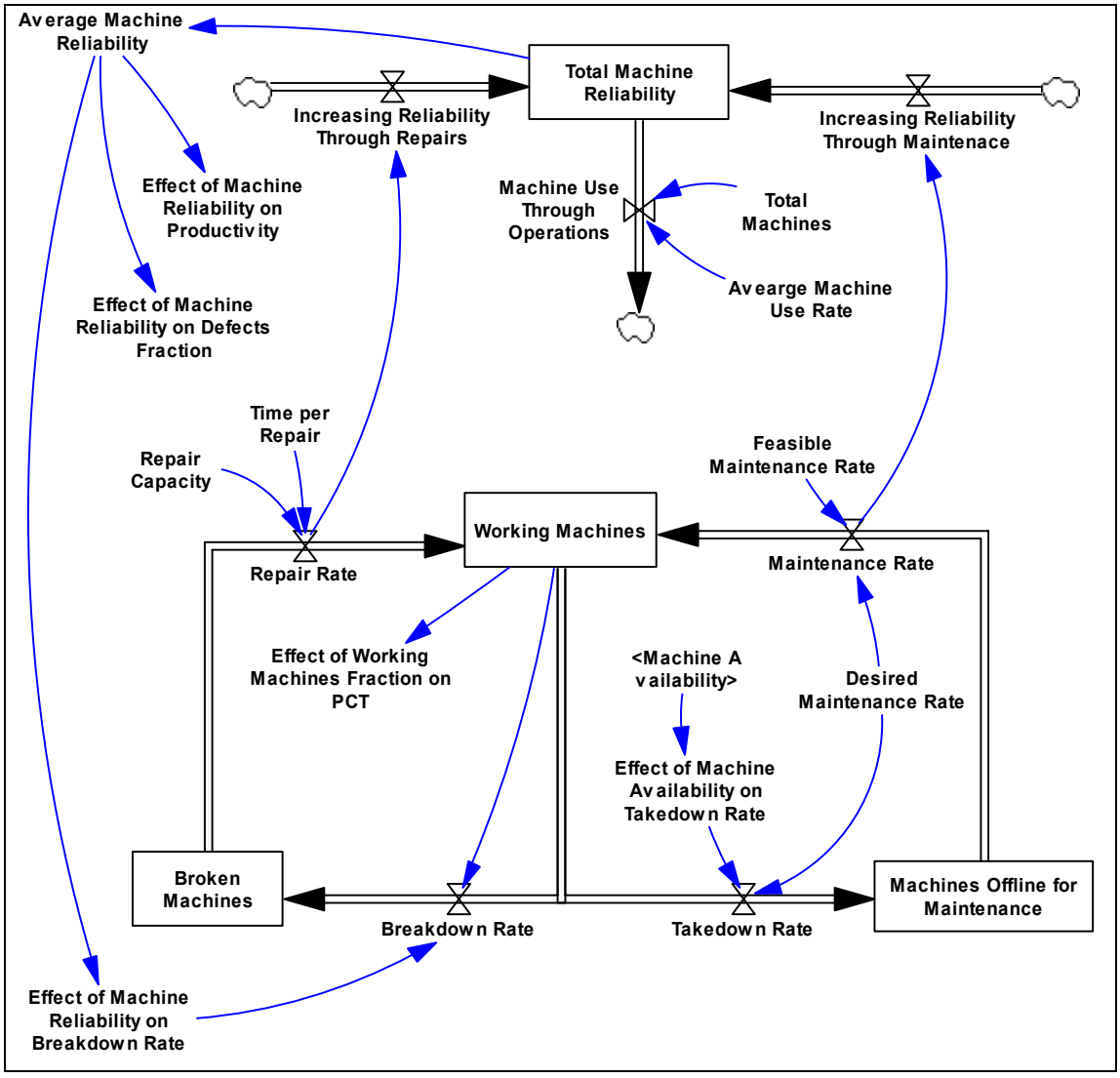

Figure 4. Simplified diagram of the structure of Machines Sector

Machine availability as well as reliability influence the manufacturing process, which also depends on feasible production from materials and labour. Figure 5 shows the feedback structure of production and finished products inventory sector of Car Electronics Company.

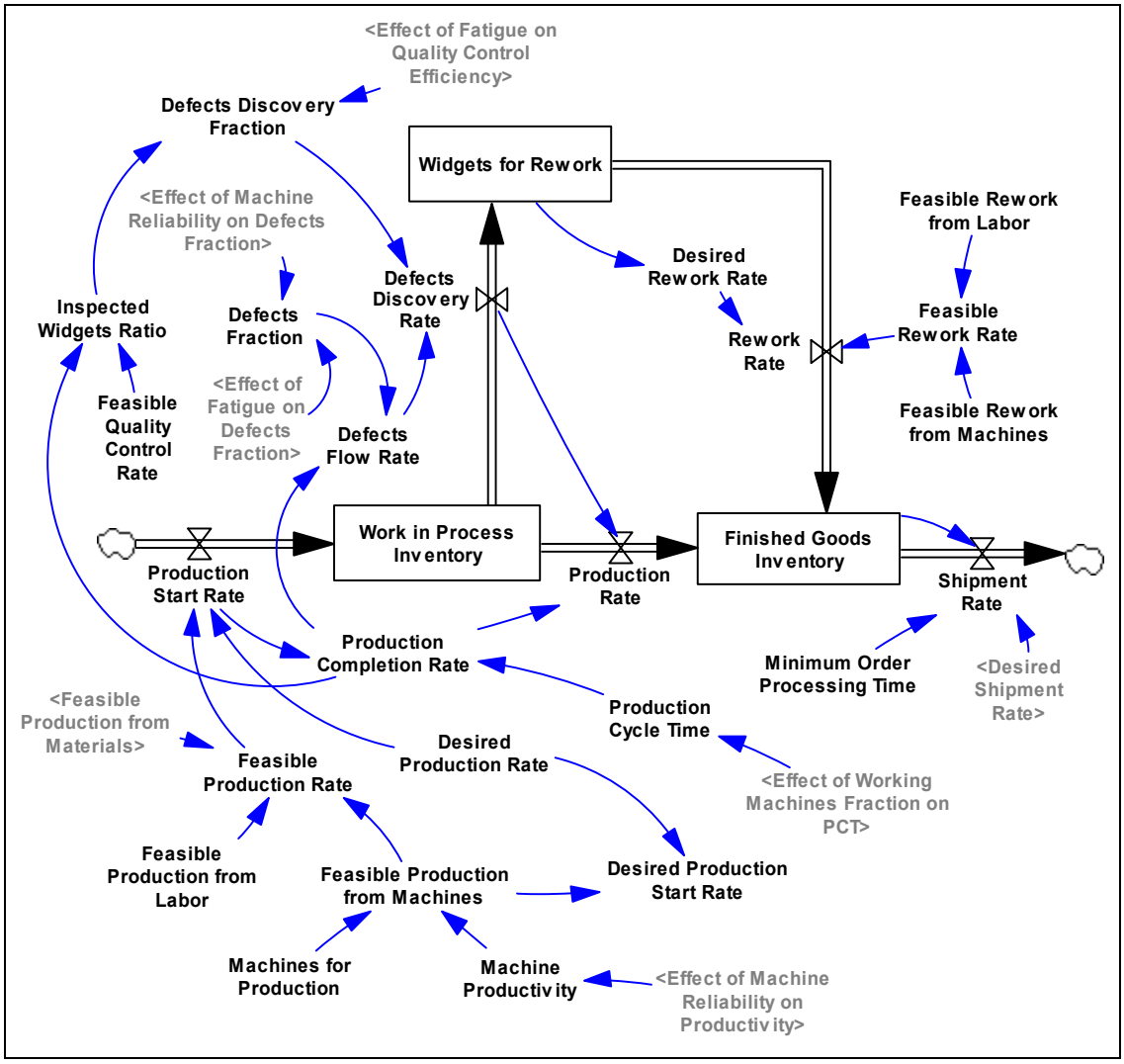

Figure 5. Simplified diagram of the structure of Production and Inventory Sector

Production takes time. Materials for production are shipped from the materials inventory (Figure 6) to the production line where they are processed. Finished products are stored. CEC maintains a stock of finished inventory and fills orders as they arrive, thereby selling the products.

Product quality problems may arise during the manufacturing process. Defects in production are influenced by poor machine reliability and workforce fatigue. Any product with a defect discovered during the manufacturing process is sent for rework. After repair it eventually increases the finished products inventory. However, some products with defects (undiscovered in the quality control process) may be shipped to customers. The amount of defects detected depends on labour fatigue (Figure 7) and the amount of time devoted to quality control.

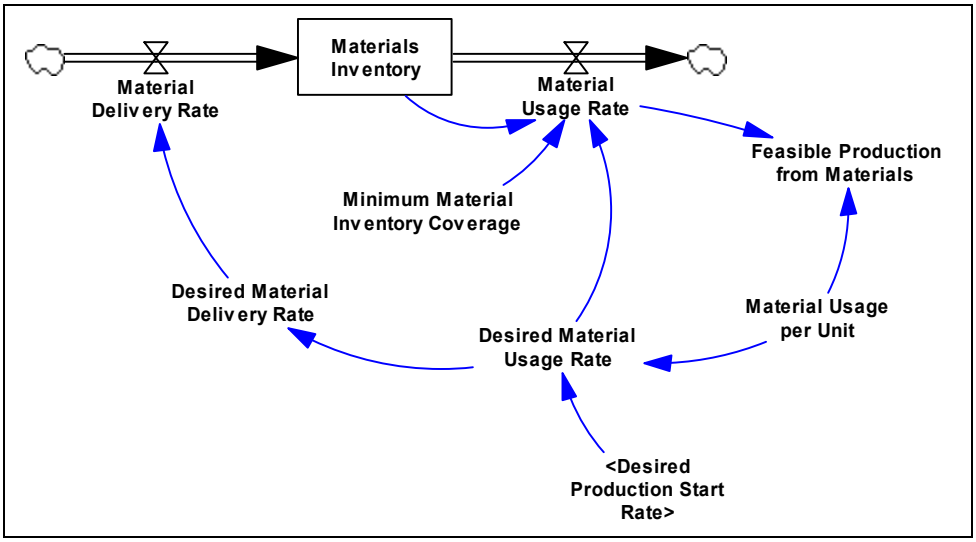

Figure 6. Simplified diagram of the structure of Materials Inventory Sector

Materials for production are ordered from a supplier. Their availability has an impact on production and the filling of orders. An appropriate supply ordering policy maintains inventories adequate to punctually fill sales demands while avoiding excessive storage costs.

The structure of the workforce (Figure 7) is based on a model developed by Oliva and Sterman (2001). Productivity from labour depends on time devoted by them to the production process and on their status. Apart from production duties employees are responsible for machine maintenance, quality control and the process of rework. In all phases of production, inexperienced employees are four times less effective than experienced employees. Workforce productivity is also impaired by fatigue, which is a result of overwork caused by higher work pressure.

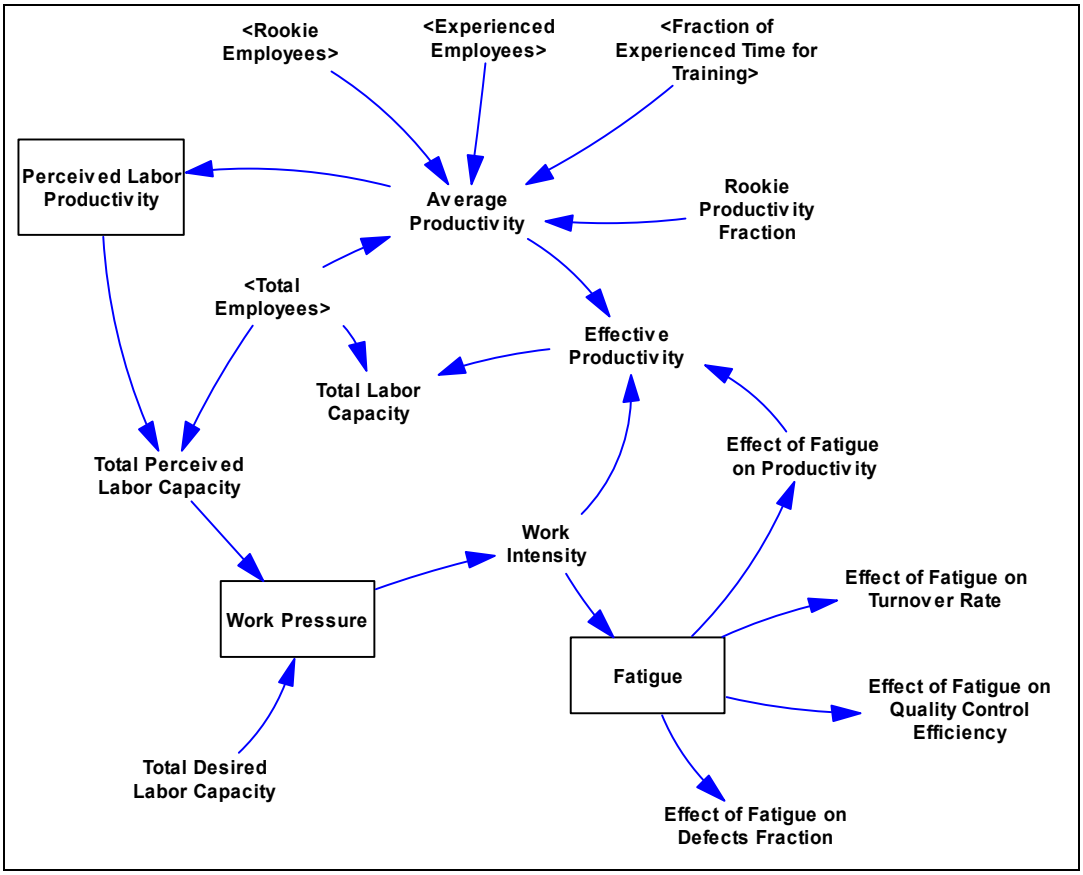

Figure 7. Simplified diagram of the Workforce productivity Sector

The process of hiring and assimilation of new employees was developed according to model of the Promotion Chain and Learning Curve (Sterman 2000, 490). Its feedback structure is presented on Figure 8. The hiring rate depends on the firm's unfilled labour vacancies and a hiring delay. Vacancies represent the labour orders that have not been filled. Hired people increase the number of inexperienced employees. Through the process of mentoring and on-the-job training, they gradually build experience. Inexperienced as well as experienced employees may decide to leave the company. Thus, quitting depletes the stocks of inexperienced and experienced employees.

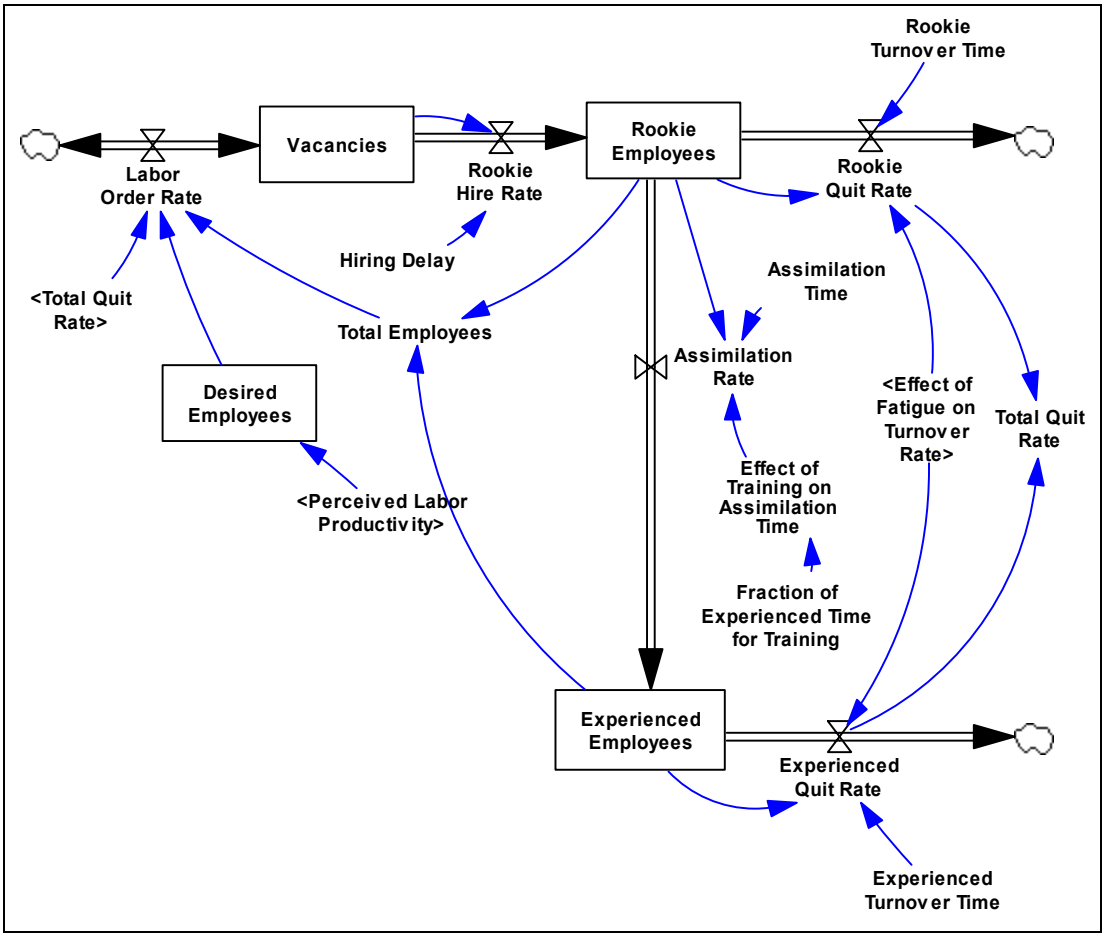

Figure 8. Simplified diagram of the structure of Workforce Hiring and Training Sector

In the model a backlog of unfilled orders is maintained. It accumulates and increases the difference between orders and shipments. This part of the model is based on Forrester's work (1968). The market is characterized by a certain acceptable delivery delay. If delivery of products exceeds this acceptable delay period then financial penalties are imposed on the enterprise. At the same time the customer looks to external suppliers for better shipment reliability. Market demand depends also on price and quality of products. The simplified structure of this sector is presented on Figure 9.

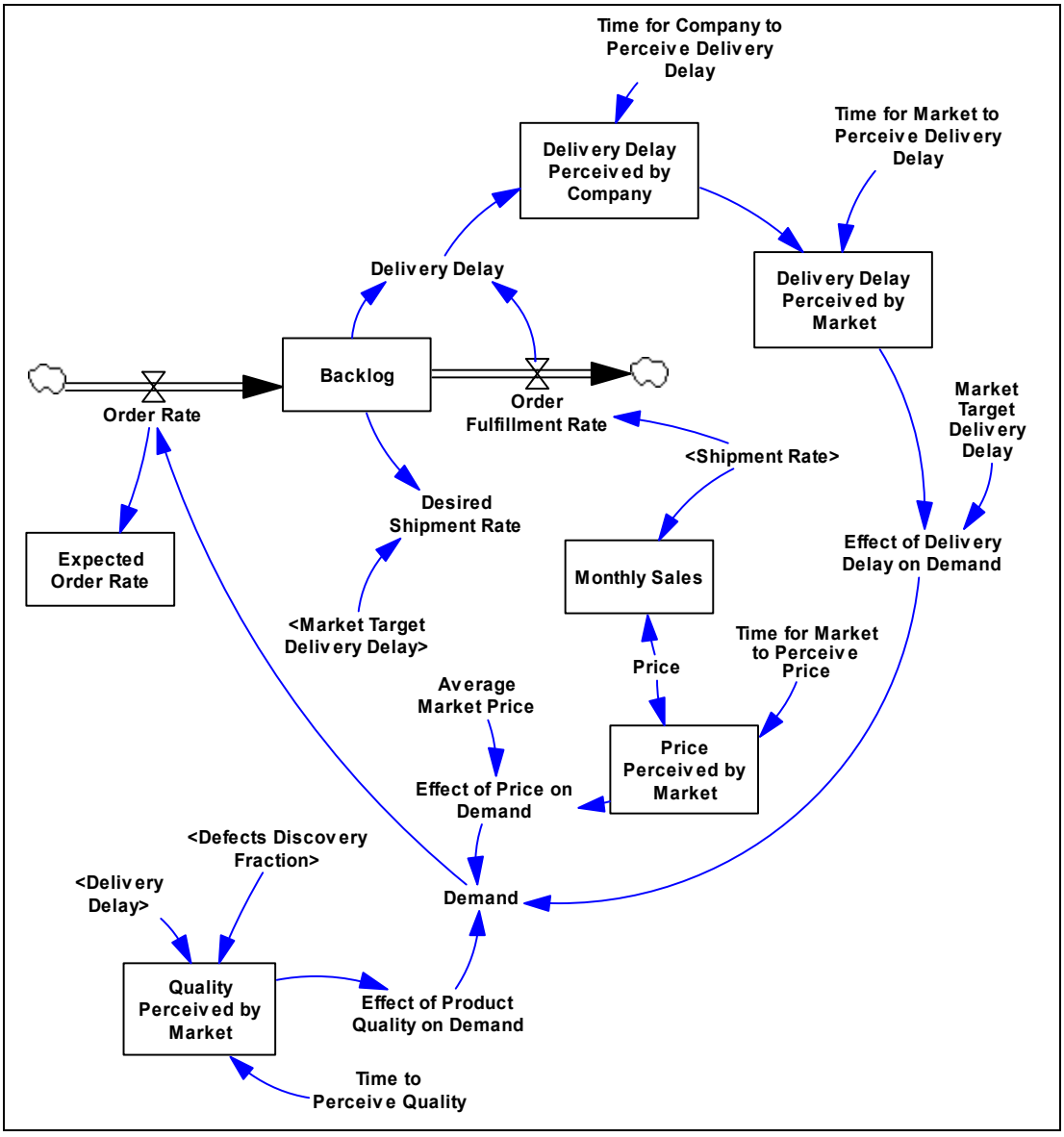

Figure 9. Simplified diagram of the structure of Market Sector

Three integral modules in the model represent the financial sector of the enterprise: a balance sheet and statements of income and cash flow. Financial results were not directly interrelated with other modules, but through decisions of the game players. The model also encompasses allocation of labour and machines, which is done automatically for players, to utilize available resources in the most effective way.

Conclusions

The capacity of managers to innovate and think systematically in a complex and dynamic world has only marginally improved when they are passive recipients of expert advice. Real and profound advances in business thinking and practice emerge when the managers become systems modellers themselves, to an extent practical within their realm of responsibility. This must be based on their personal involvement in developing a systemic overview, defining goals, methods to attain the goals, and measures of success in applying the methods (Senge and Sterman 1994). Managers fortified with such experience can provide the overview of system structure (interactions, delays and long-term side effects) that facilitate business efforts to modernise, devolve over-centralized decision making into more 'empowered' distributed local networks of innovation. Experiments in horizontal decision making structures can quickly dissemble into anarchy without such adept oversight.

The Balanced Scorecard (BSC) offers managers opportunities to learn how to model their business system in close collaboration with their peers as well as with employees at different levels of the enterprise. Decision teams could synthesize a broader view of performance than traditional ones based only on financial data by linking four perspectives: finance, clients, internal processes and learning & growth. A practically small set of 15 to 20 indicators from these four perspectives are integrated into a continuous performance measuring process that recursively checks indicator levels against strategic objectives, goals and, ultimately, the business's vision.

The BSC approach initially appeared systematic in developing an overview of internal relations, but only as one-way interactions. As such it lacked the capacity to account for key elements of systemic structure, such as feedback-loops and delays, and to do so such that managers can check their assumptions and indicators of progress dynamically. We addressed these shortcomings by elaborating the BSC approach with systems dynamics tools. This Dynamic BSC framework allows managers to develop a quantifiable model of the entire business system that can explicitly explore the effects of feedbacks, delays and emergent properties (surprises). Quantifiable models can be more rigorously tested and validated, and offer managers chances to test a range of strategies (even unorthodox and "out of the box" policies) in the more 'forgiving' virtual world. Furthermore, performing sensitivity analysis to changes in model boundaries makes it possible to choose an adequate scale of analysis and include all important feedbacks.

We developed a set of games, exercises and lectures to introduce the Dynamic BSC approach to students and practitioners from a range of scientific and management backgrounds. Within the timeframe of a weekend workshop it is quite challenging to develop a practical focus on the essential elements without trivializing the vast fields of systems applications (conceptual and formal) and the Balanced Scorecard. We addressed this challenge by emphasizing a few key elements against a quickly sketched background of these fields as part of an effort to convey the innovative success and promise of these new approaches. Our main goal was that students would recognize the potential and be inspired to continue to learn, apply and improve these methods, perhaps in collaboration with us. We recognize that learning laboratories do not become fully effective unless

participants can profoundly engage in processes of conceptualisation and reflection (Senge and Sterman 1994). We aim to attain this goal over long-term collaboration with participants that have adjusted their priorities and methods as a result of our introductory efforts.

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Appendix 1 - 'Dynamic Balanced Scorecard' Game

Game Scenario:

Car Electronics Company

The primary goal of the Car Electronics Company (CEC) is to manufacture the electronic content of cars and trucks. Among other products, CEC manufactures electronic engine control modules, electronic steering and suspension systems, air bag diagnostic modules, driver information systems (instrument clusters, etc.), and audio products. Due primarily to the increasing electronic content of automobiles, CEC has grown significantly in the last decade. Currently, CEC has eight manufacturing plants including locations in the United States, Canada, Mexico, Brazil, Spain, Portugal, and Poland. The Polish plant has been added recently and has been operating for two years. Its main area of operation is air bag diagnostic modules manufacturing.

The Customers

CEC's primary customers are the car and truck production lines contained in body and assembly (B&A) plants. B&A plants are very demanding. These facilities require substantial capital investment, and a premium is placed on keeping the production lines running at all times. Shutting down a production line for even one hour can result for B&A in the loss of as much as a half of a million dollars. A supplier's ability to deliver parts on time and in the proper amount is critical. Even a few late shipments can result in lost business for CEC, as the customer looks to external suppliers for better shipment reliability. CEC customers focus also on quality as well as timing. Just as a CEC plant can be 'desourced' (lose its relationship as a "source" for the customer) for poor shipment performance, it can lose business if it ships products that are defective. The price of the product may also influence the market demand.

Improvement Programs

Throughout its history the Car Electronics Company, like most large corporations, has undertaken a large number of 'change' initiatives. The number of these initiatives has increased substantially since the early 1980s. Unfortunately, while some of these programs had a lasting impact, most did not. Many times they were quickly supplanted (replaced) by a new program that offered the promise of improved results. The Car Electronics Company (CEC) has not been immune to such trials. It too tried numerous programs, many of which never took permanent hold.

Challenge

The Polish division of CEC was started by takeover of a Polish electronic company, and CEC has been obliged to maintain a "no layoffs" policy for five years. The perspectives for development of CEC Poland have been very promising. However, after a successful start they encountered substantial troubles. The managers could not keep the critical product characteristics, delivery delay, and product quality on the stable level required by customers. Accordingly they lost some clients, and market share went down. At the end of

the second year the whole management board has been changed. You are one of the new directors. Your main goal is to introduce a successful improvement initiative to remedy the crisis.

Roles in Game:

Chief Executive Officer (CEO)
CEO's responsibility is to supervise the improvement program in the Polish division of CEC. His/her goal is to satisfy all the clients' requirements. The CEO settles the price of the product. He/she also compels the Production Director to secure a certain level of finished products inventories. There is a two month period of tolerable delivery delay to the market. If the delivery delay is greater than this period, the CEC starts to pay financial penalties.

Decision:
Price – the price for finished products offered for the customer;

Production Director
The Production Director is responsible for the whole production sector of the CEC. He/she determines the Desired Production Rate to sustain satisfactory output levels from the manufacturing process. . However, it may happen that after some time the number of manufactured products will differ from the desired value, due to fluctuations in the levels of materials, workforce or working machines. The Production Director tries to avoid this kind of situation.

Decisions:
Desired Production Rate – how many products does CEC plan to manufacture per month. Important: the real production rate depends on materials, machines and workforce availability.
Maximum Machine Productivity is 500 Products/Machine per Month. However, it is influenced by machine reliability.
Productivity from labor depends on time devoted by them to the production process, which is determined as Time Fraction for Production, and on their status. Rookie employees are four times less effective then experienced employees. Workforce productivity is also impaired by fatigue, which is a result of higher work pressure causing overwork (standard value is equal to 175 Hours/Person per Month). Production of one product by an experienced employee takes 20 minutes.
Desired Material Delivery Rate – this is the number of materials necessary to carry on the manufacturing process per month. Production cannot be conducted without materials. One product requires five pieces of materials for its production.
Important: CEC pays for storing any materials surplus.
Takedown Rate – the number of machines set offline per month for maintenance reasons. This rate increases machine reliability but it decreases the number of machines available for production.

Human Resource Manager

The HR Manager mainly analyzes the workforce demand in the CEC. He/she decides how many people should be employed to carry on the production process. In accordance with the undersigned agreement CEC has to maintain a "no layoffs" policy for five years.

Moreover the HR Manager determines the percentage of time experienced employees spend training rookies (inexperienced).

However, vacancies do not have to be made in every case. HR Manager may increase the pressure on employees to make them work harder and more effectively.

Decisions:

Labor Order Rate – how much do you want to increase or decrease the number of people whom the CEC plans to employ (vacancies). People quit the company for their own reasons, such as fatigue, which may be caused by higher work intensity. People who leave have to be replaced by new employees, who will carry on production, rework, quality control and maintenance in CEC.

The hiring process takes time. Furthermore, only rookies can be employed. They have to be trained before they reach the effectiveness level of experienced employees. Assimilation time depends to some degree on the training intensity (see Fraction of Experienced Time for Training).

Fraction of Experienced Time for Training – percentage of experienced employees' time devoted to training rookies. Greater intensity of the training makes experienced workers less effective in their work. They have to answer questions and work at a slower rate.

Work Pressure – the pressure management put on employees to make them work harder. This pressure rise in work intensity causes workforce fatigue. The range of the value of this variable may change between 0 and 1.

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