How Managerial Incentive Systems influence the Company's Business performance - A System Dynamics Model and its results

Frank Schoeneborn
Heidelberger Druckmaschinen AG
Business Unit Customer Support
Dep. Management Accounting and Control Systems
Kurfuersten-Anlage 52-60, D-69115 Heidelberg, Germany
Tel.: ++49-6221-1342803, Fax: ++49-6221-1342809
E-mail: frank.schoeneborn@de.heidelberg.com

Abstract

The paper discusses the use of introducing a premium system and its impacts to company's business performance. First a basic causal-loop-diagram will be developed to describe the complex structures how a manager with various motivation influences the financial success of his company. Based on that system conditions a system dynamics model will be developed for a company to realize and measure the additional use of incentive systems.

The model analyzes financial performance and development of market share for a special unit by modeling complete production, finance, market conditions and the manager's behavior as the most important section of the model. Various simulation runs show that through a premium system the risk of a decrease in business performance because of false decisions made by the manager can be reduced.

Introduction

In practice you can find an increasing number of companies in which managers can earn an extra incentive pay for a special result depending on their everyday actitivity. That means instead of traditional fixed compensation the manager compensation may be various. First the focus was on chief executive officers (CEOs) when they got bonus, stocks, options and other forms of monetary income to maximize the shareholder value. The shareholder's reason for introducing new compensation schemes was that by delegating decision-making tasks to the management the management has an incentive to select actions which maximize its own expected utility, even if these actions are not in the best interests of shareholders. Recent years have shown that more and more middle and lower-level managers get contracts in which their compensation does not only consist of one salary but more components, too.

The following examination describes an first approach for studying and analyzing the contractual relationship between manager and shareholder by modeling the incentive system with System Dynamics and measuring the additional use of introducing.

Defining the Problem: Separation of Ownership and Control

In most large companies production decisions are delegated to managers who specialize in gathering and processing information. Because of these undertakings are large and risky, managers are unwilling to bear the entire final consequences of their actions. They want to share some of the risk with shareholders. In such situations managers may have opportunities to misrepresent their information so as to blame

events beyond their control for their own failure to take the appropriate action. The shareholders tried to tackle the problem by designing and introducing a contract which pays the manager depending from verifiable results of their work. Through these contract the shareholders want the manager to decide in their interest and to choose the optimal factor inputs.

In the literature there are a lot of papers discussing such kind of relationships as agency relationships. Whenever one individual depends on the action of another, an agency relationship arises. BAIMAN defines an agency relationship as follows: an agency relationship exists when one or more individuals (called principals) hire others (called agents) in order to delegate responsibilities to them. The rights and responsibilities of the principals and agents are specified in their mutually agreed-upon employment relationship. In principal-agent-relationships the principal „enjoys" the outcome of the activity of the agent. The agent's actions together with a random element determines the outcome. In all agency models, individuals are assumed to be motivated by self-interest. An problem arises if the agent chooses in a decision situation an alternative which maximizes its own utility instead of taking shareholder's interests into consideration. The agent has decision-related information the principal does not have, so the principal can not verify what the agent is actually doing. Many authors describe this fact as 'hidden action' and 'hidden information'. To solve the problem of opportunistic behavior (moral hazard) the principal pays the manager an extra bonus after investigating the results of manager's actions, which is exactly specified in the contract between principal and agent.

Decentralization, Managerial Incentive and Performance

The organization structure of large companies can be described by some characteristics. The company's divisions have become unable to be overviewed by their management. The objectives of single divisions of the company could become different and do not any longer fit together. The larger companies are the more problems the management will have when controlling the company's performance. One possible, and in reality often chosen, solution to the problem of physical growth is decentralization of the company. Decentralization can be defined as the process to split one organization into several more or less independent units which have at least one remaining relationship - they are owned directly or indirectly by the same shareholders.

The advantages of decentralization are an increase in motivation and flexibility. In addition decisions are made by people with the highest competence for the special situation. The most important disadvantages of decentalized companies are the increase of asymmetric information distribution and the tendency to optimization of sub-objectives instead of global objectives. To keep a decentralized unit close to the general objectives and policy of the supervising management the top management introduces incentives for the middle management to avoid opportunistic behavior.

There are some opportunities for the top management (principal) to give the managers an incentive. The most significant incentives are financial incentives e.g. bonus, stock options, company car. But social incentives might be important too. Having contact with colleagues or an attractive company-location could be an further utility for the agent.

In the following examination a single unit of a fictitious company with special characteristics illustrates the interactions between managerial incentive, opportunistic behavior and business performance. These characteristics the unit has:

The unit produces one product and the manager is responsible for purchase, production, sales and the daily routine in the unit. He decides about personnel, investment and princing. He gets his objectives directly from the top management (principal) and he has the insight into the special problems of the unit. Therefore the unit is called as 'profit center'. The top management expects a profit percentage of revenues of at least 8 % and a market share of at least 20 % for the future. These objectives were derived from the current performance in the market and their strategic expectations for the product. If these objectives are failed clearly in the future the manager could be transfered or even fired. Because of his position the manager can influence the production waste rate by observing workers more often. He can determine the quality of his investment planning results by analyzing the market structure more intensive. An increase in any activity causes an decrease in manager's utility. Therefore his superior objective is to minimize his activities by fulfilling the top management's requirements. As a consequenz the manager will not take all measures which are possible to maximize the profit of his unit. This is a problem for the top managment because they do not have information about the manager's activity level and the opportunity of boosting profit by lowering the waste rate. In addition the risk of loosing market share in future will rise because the manager does not make an appropriate market analysis and investment/capacity planning. So the unit might be unprepared in case of sudden market growth. In this case the top management can not verify the qualitative activity level the manager has.

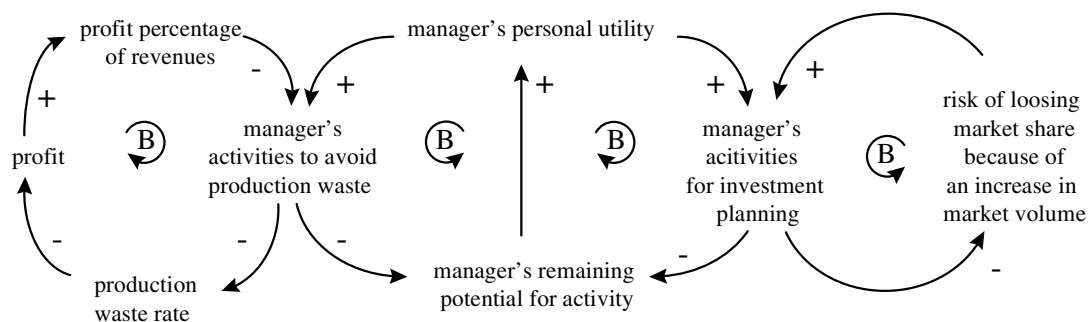Figure 1 shows a causal loop diagram, which describes this concret situation.

fig. 1: causal loop diagram without bonus system

When looking at this causal loop diagram the balancing system behavior is easy to identify. Profit and profit percentage of revenues vary but there is no tendency for maximizing profit or minimizing the risk of loosing market share. In general the manager will maximize his own utility.

To solve the problem the top management introduces a premium system for the manager. According to the new contract the manager gets an extra bonus in addition to his salary if the profit percentage of revenues reached by the profit center will be about 8%. The bonus will rise with the rise of the profit percentage of revenues. Another bonus depends on the unit's market share and is designed in the contract like the other bonus. The objective of these incentives is a higher motivation of the manager. When it is possible to get more compensation by doing more or better activity the manager has an incentive because an increase in his compensation leads to an increase in his utility. This positive influence will be stopped when the additional

utility of the manager caused by more compensation is not high enough to cover the decrease in utility caused by more activities. That system behavior is known in the system dynamics literature as limit to growth.

Figure 2 shows a causal loop diagram, which describes this concret situation after introducing a bonus system.
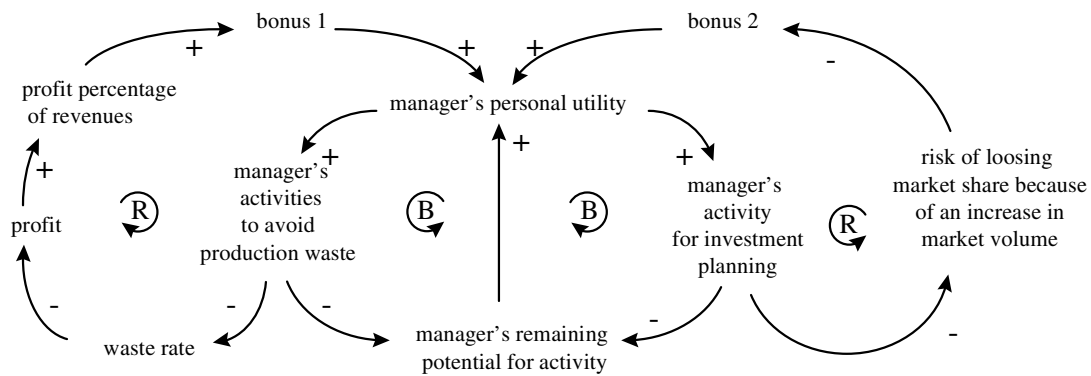

fig. 2: causal loop diagram with bonus system

The basic structure has not changed but as the significant difference when introducing a premium or bonus system two reinforcing loops were generated in the diagram. Now an increase in profit and profit percentage of revenues leads to an higher bonus and therefore to a higher personal utility. These positive links change the system behavior in a considerable way. Now the manager takes the interests of the top management and his own into consideration. That is an significant advantage of bonus systems. They are a way of solving problems caused by agency relationships. But there are disadvantages, too. One the one hand, they are expensive because the process of introducing and using such systems is costly. On the other hand, the utility for the top management is difficult to quantify. A further question which is necessary to answer is the choice of suitable evaluation basis for the bonus. The manager must be able to influence the evaluation basis and it must be possible to measure the success influenced by manager's performance.

In the described situation of the profit center manager there are a lot of other influnces which are important to know before modeling and analyzing with system dynmics.

Therefore the causal loop diagrams were extended. Through additional variables which are given in reality the model will get a more fundamental content to show the realistic approach of the examination. In this way the understanding how business works becomes more important.

Figure 3 shows a complex causal loop diagram without premium system. As it is to be seen there are some complex links between profit and investment activities so that dividing the system in two separate systems would not be correct in order to allow an appropriate analysis of the system. When looking at that diagram the complexity of controlling a business will become obviously.

In addition a second causal loop diagram based on the diagram shown in fig. 2 with an integrated incentive system was developed in fig. 4.
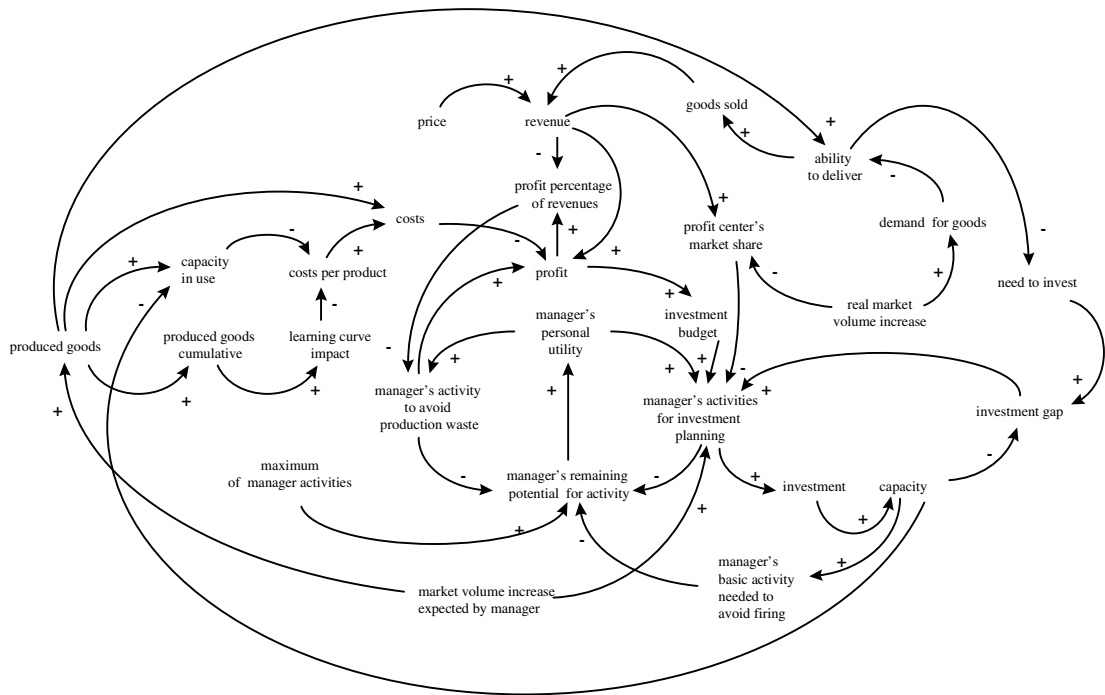
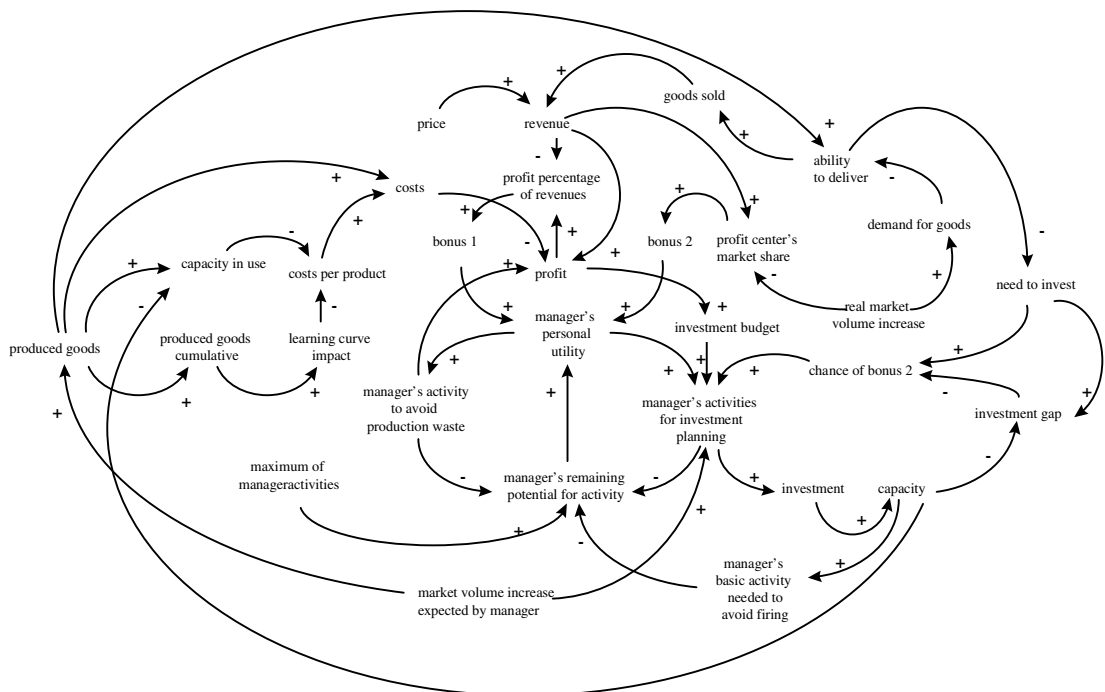fig. 3: complex causal loop diagram without bonus system

fig. 4: complex causal loop diagram with bonus system

Modeling the Managerial Environment and Managerial Behavior

To analyze the complex feedback structure a system dynamics model was developed. In order to get an overview about the system's elements modelled the whole model should be analyzed in four parts: production section, financial section, market section and activity section.

Production section

The production section of the model shown in fig. 5 consists of production and capacity variables and describes the quantitative conditions in the given profit center.
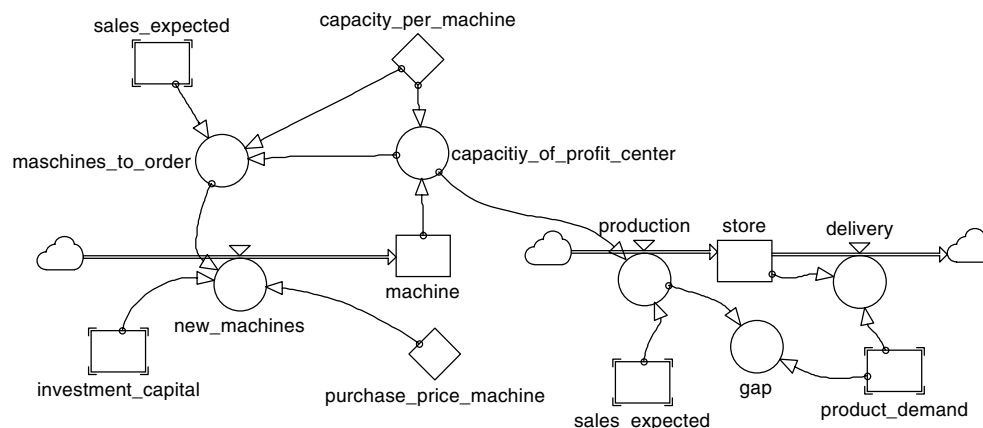
fig. 5: production section

The basic capacity of the profit center depends on the number of machines used and their special capacity. If it will become necessary to invest in new machines because of an expected increase in market volume the manager can purchase new machines by spending money from the investment capital in which the profit was transferred monthly. Any new credit will not be allowed by the top management. The profit-center's production depends on the capacity which is determined by the number of the machines and the sales expected by the manager for the next month. In addition there is a market demand for profit-center's products because of a delivery delay in the last period. The reason could be an from the profit center manager unexpected increase in demand. In the opposite situation there are some products in store because an overexpected increase in market volume. In both situations the basic reason was the estimation of the market volume increase by the manager. This expectation represents the quality of investment planning and market observation done by the manager before next month. In the activity section the generation of the manager's market volume expection will be modelled.

Financial Section

In the financial section the financial impacts of manager's decisions and environmental influences are modelled. So revenue, total costs and profit are the most important variables in this section. Depending on managers's activities the consum of purchased parts influences the production costs directly. Any additional costs like using new machines and hiring new workers will lead to an increase in total costs which lower total profit of the profit center. On the other hand, an increase in sales will lead to an increasing revenue. Because of the constant product price in the model any increase of sales will generate more profit because of the positive product margin given in the model. The profit from every period is remitted to an investment account on which interests are paid by the capital market. The financial section is shown in figure 6.
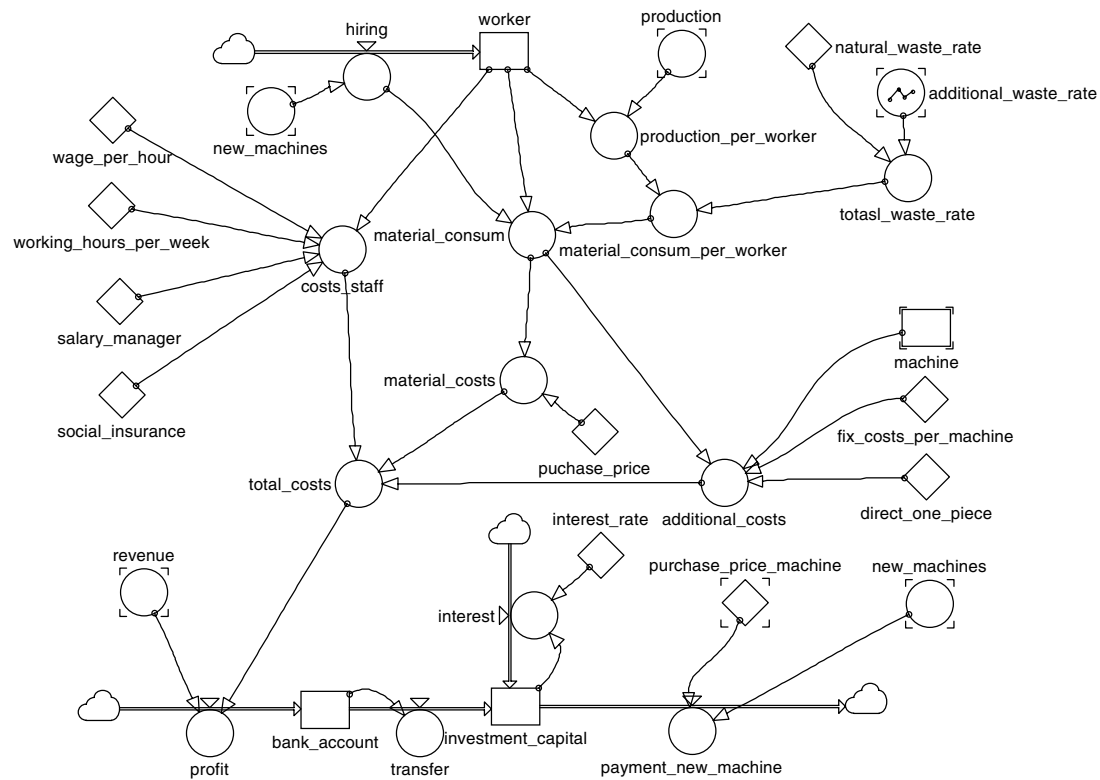

fig. 6: financial section

Market section

In this section the market section of the model is modelled in view of any market changes. The manager can not influence the real market volume increase. Therefore a random function will generate various market volume increase. Depending on the market volume increase the market share from the profit center will change. In order to keep up profit center's market position sales have to increase with the same rate. To allow more sales the production has to be extended, otherwise the profit center will lose market share to competitors. By using the variables sales and price revenue can be modelled. Revenue is the basic variable to find out the profit percentage of

revenues and the market share reached by the manager to evaluate his activity every month.
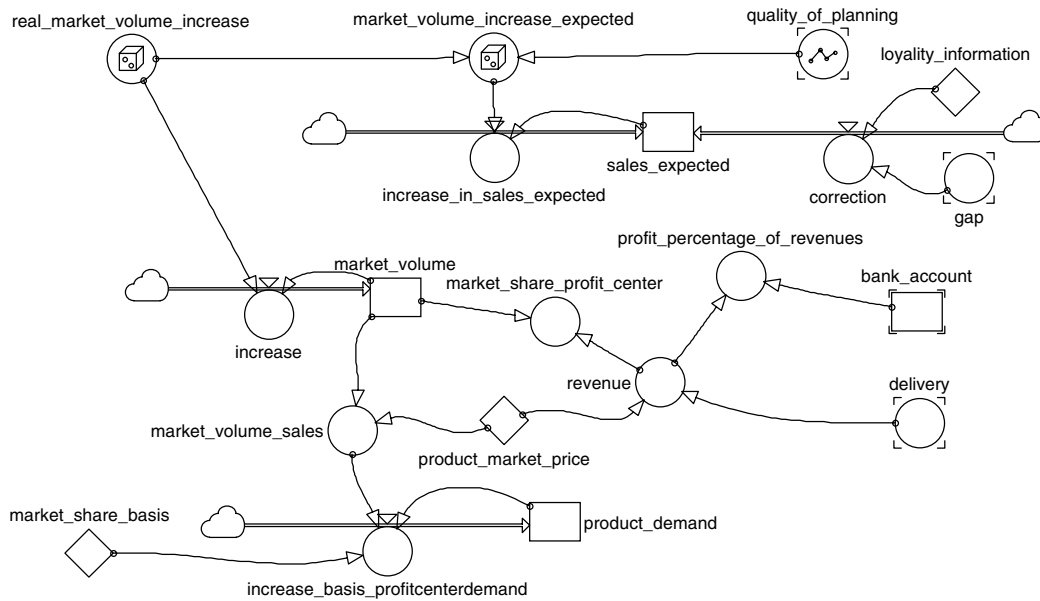
The market section is shown in figure 7.

fig. 7: market section

Activity Section

In this section manager's behavior and activities are modelled. The manager observes the results form the previous month and will act in the new period in consideration of his own preferences. The level of his activities will influence the additional waste produced by the worker because of less or more observation/ motivation and the quality of the planning results because of his engagement during the planning process. The more he observes or motivates his employees the lower the additional waste rate will be. The more activities in planning the manager does the better his estimation or expection of future market volume development. The variable incentive system in the model allows to switch the bonus system on or off to generate various situations.
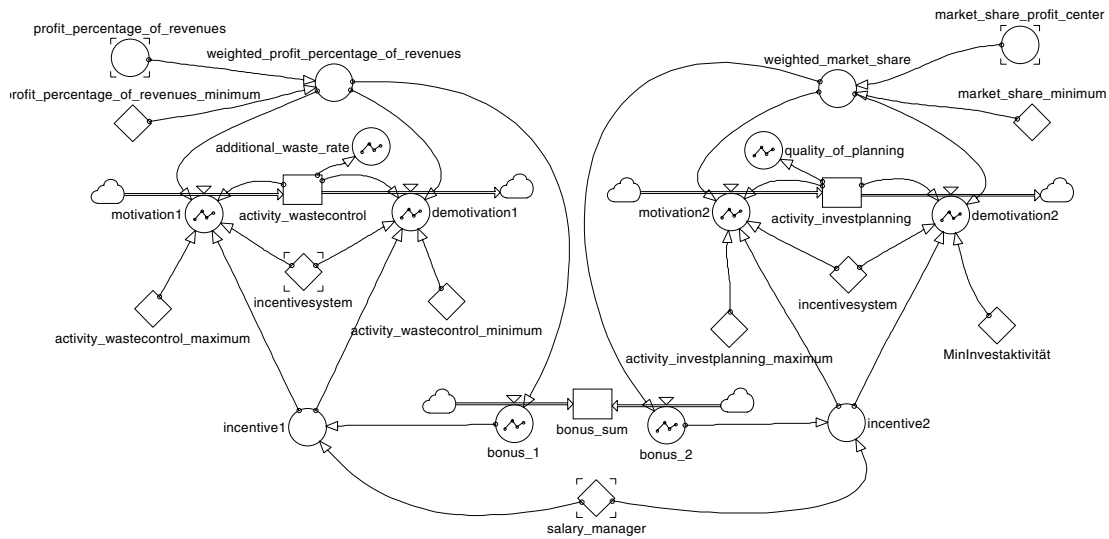
fig. 8: activity section

Simulation results without bonus system

In the following the simulation results without bonus system are analyzed. As shown in the causal loop diagrams the manager tries to maximize his own utility. He will control his activity level when the results reached last month are not congruent to his individual objectives. If there is no incentive for the manager to take more action for maximizing profit and in that way the utility of the top mangement he tries to lower his activities to a minimum level which ensures him not to be fired. The profit percentage of revenues varies around 8% and the market share falls to about 18%. In figure 9 is a typical simulation result to be seen. Both variables lead to an equilibrium.
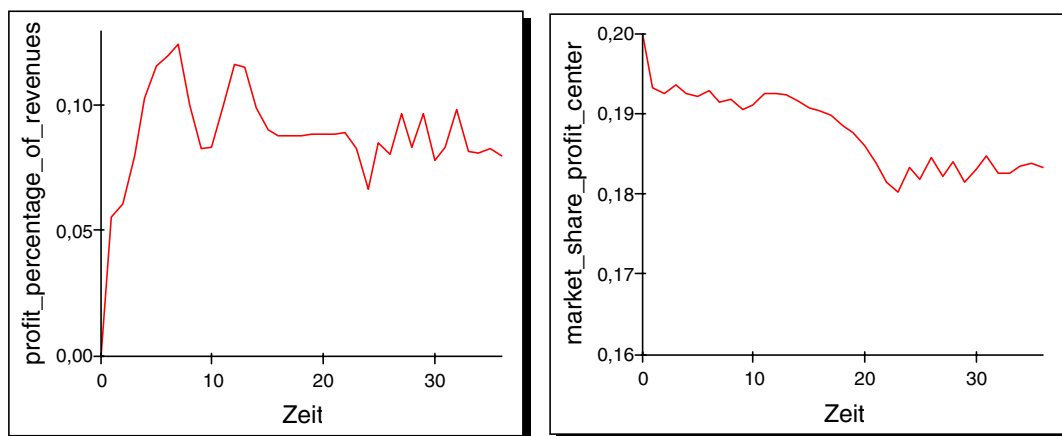

fig. 9: simulation result without bonus system

Because of random influences it is important to verify the simulation result by further simulation runs. The results are shown in figures 10 and 11 below.
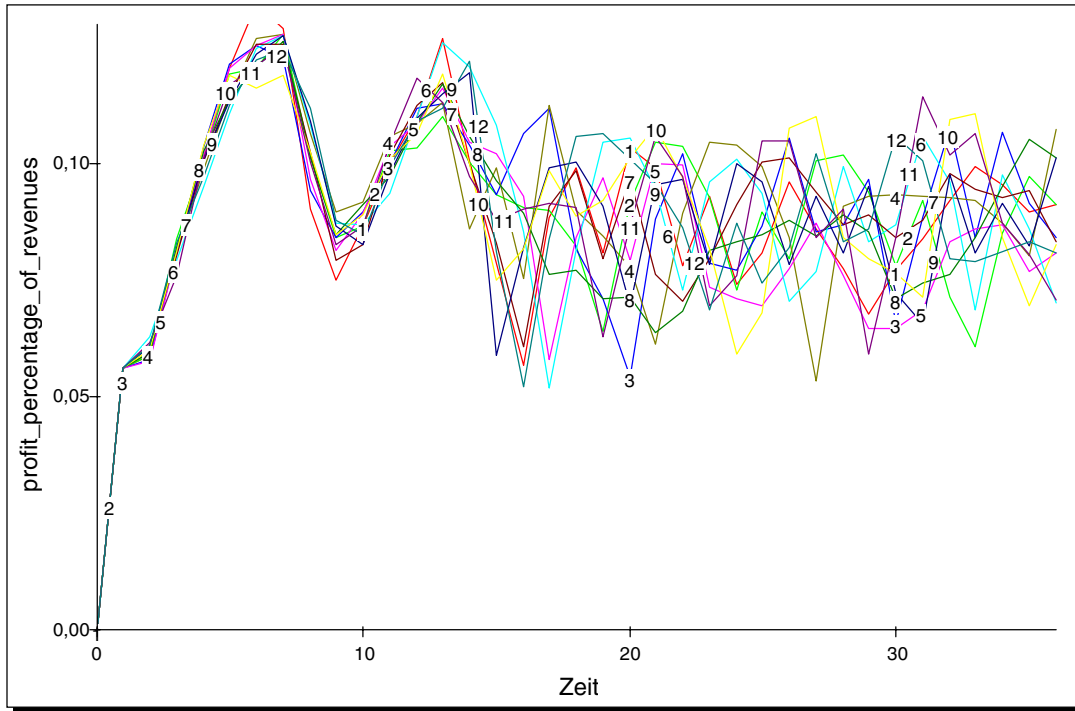
fig. 10: simulation results for profit percentage of revenues without bonus system
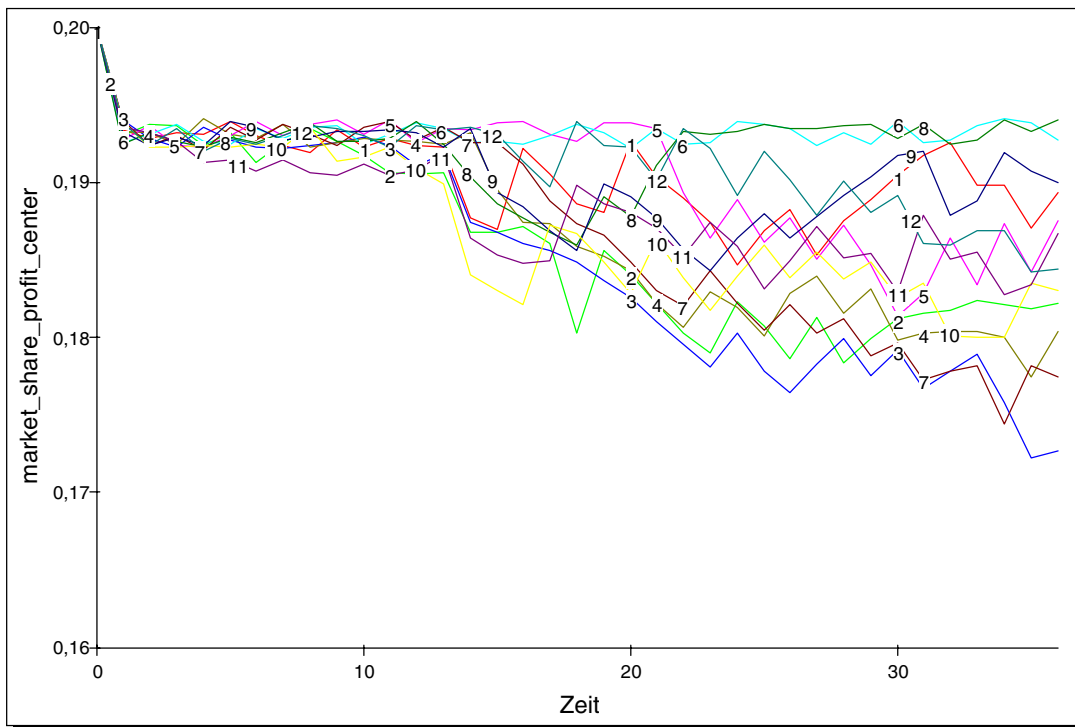

fig. 11: simulation results for market share without bonus system

Simulation results with bonus system

When introducing an bonus system for the profit center manager he gets an incentive to maximize profit and market share to its maximum. The increase of his individual utility will be stopped when additional use generated from received bonus is not as high as the loss of individual utility generated by more activities, more stress etc..

In figure 12 a typical simulation run after installing an bonus system is shown. The profit percentage of revenues will rise to a maximum of about 26%. The market share will reach 19%. Compared with the simulation results without bonus system there is an enormous difference. After approximately 12 months an equilibrium will adjust too, but on very high level. When looking at these simulation results the additional use for the top management
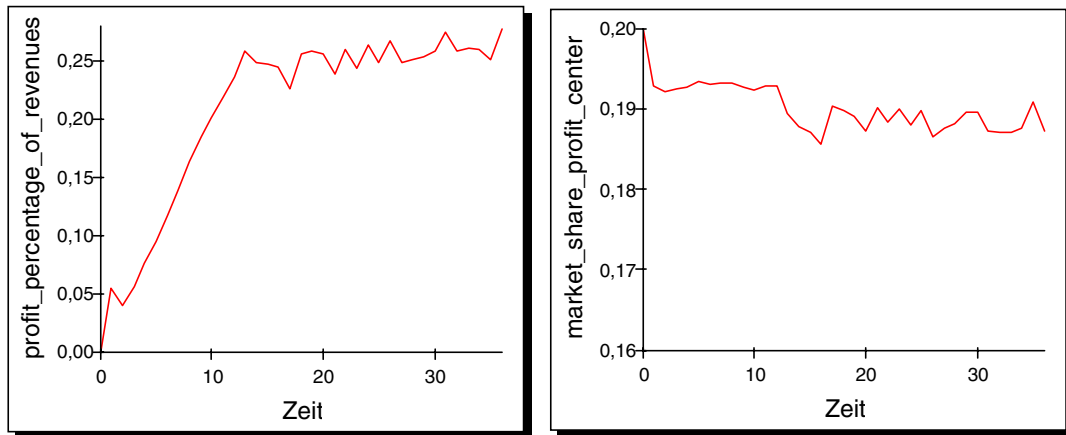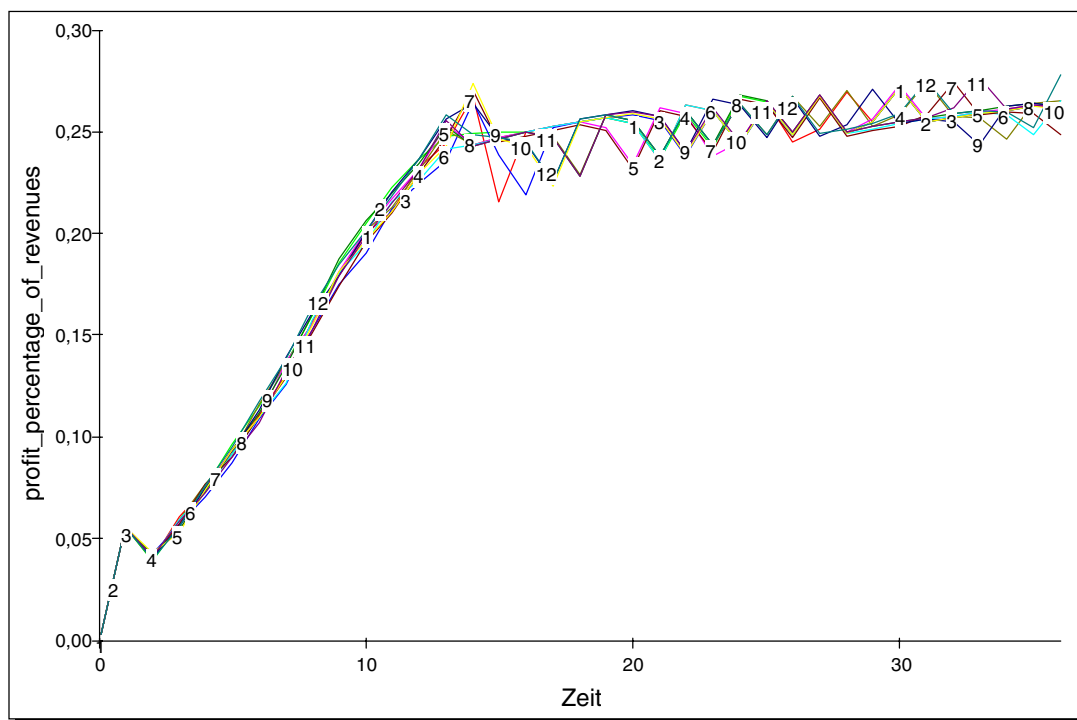

fig. 12: simulation result without bonus system

fig. 13: simulation results for profit percentage of revenues with bonus system
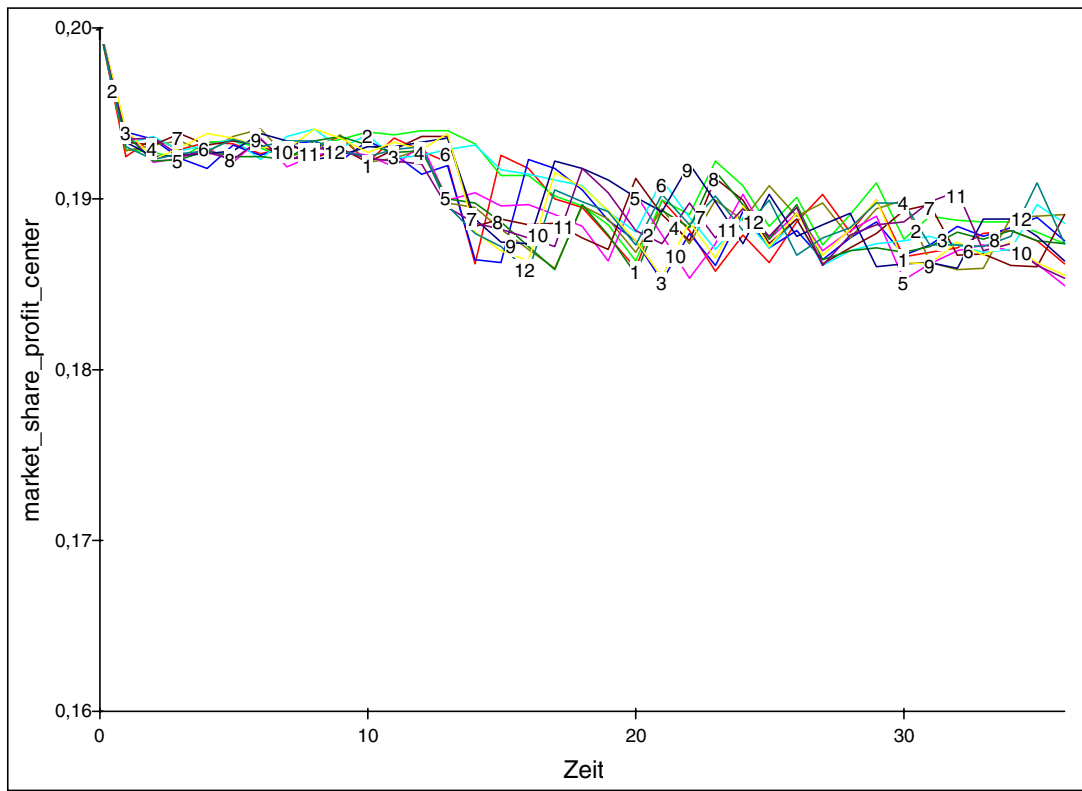
fig. 14: simulation results for market share with bonus system

Conclusions

Decentralization of large companies into several units creates new problems in controlling businesses because of an increased asymmetric information distribution. In the paper especially the owner-manager conflict as a form of agency was discussed. With causal loop diagrams the impact of manager activity and opportunistic behavior in a complex company environment was analyzed and based on realistic business structures a system dynamics model was developed first. Various simulation runs for significant financial and market variables showed that through a bonus system the risk of a decrease in business performance can be reduced. Instead business performance could become even better by introducing incentive systems. Based on profit simulation the additional profit generated by more manager acitivity can be compared with costs arisen through incentive system implementation. Therefore the top management will be enabled to find right decisions and control the business performance with focus on maximum success.

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Schoeneborn, F. (1998). Das Principal-Agent-Problem als System Dynamics Modell, Master thesis, Brandenburg Technical University of Cottbus. Copies are available: Frank Schoeneborn, Belfortstrasse 11/1, D-69115 Heidelberg, Germany. E-mail frank.sch@okay.net