Corporate Restructuring Dynamics: A Case Study Analysis

Andreas Kemper
European Business School
Schloß Reichartshausen
65375 Oestrich-Winkel,
Germany
+49 6723 602710
Andreas.Kemper@ebs.de

and

Florian Khuen
European Business School
Schloß Reichartshausen
65375 Oestrich-Winkel,
Germany
+49 172 5622558
Florian.Khuen@ebs.de

ABSTRACT
Corporate restructuring has recently faced widespread criticism due to its low-turnaround success rate and the sharp increase in insolvency filings. Our analysis extends beyond this discussion by investigating the inherent complexity of restructurings as a critical success factor with a particular focus on portfolio restructuring. Based on theoretical findings, we develop a System Dynamics model for a case study in portfolio restructuring. Thereafter, we evaluate this research approach in an outlined context and devise a roadmap for subsequent research. Results of the analysis indicate that the restructuring process can be reasonably simplified with a System Dynamics model. Further, this model enables a comprehensive sensitivity analysis that allows management to develop an understanding of the underlying dynamics. The key implication is that managers should consider a System Dynamics model as a complement to conventional modeling, as the conceptual and numerical benefits can outweigh the related costs.

Keywords
Corporate Restructuring, Portfolio Restructuring, System Dynamics, Modeling, Simulation.

1. MOTIVATION AND BACKGROUND

Corporate restructuring is a key area in strategic management, finance, and organizational theory. Although various fields have contributed to the literature, numerous restructurings have failed in practice, which has resulted in vast criticism of the process.[1] Results from empirical performance investigations of restructurings reveal a diverse spectrum of conclusions. While some companies have been very successful in their restructuring efforts, others have destroyed shareholder value.[2]

This article examines the hypothesis that the tension between the need for a rigorous business analysis and the urge to deliver vital performance enhancements is crucial for this ambiguous performance. The reasoning coincides with Bowman and Singh's findings that define the process's complexity as a key characteristic of corporate restructurings.[3] Consequently, prudent corporations have approached the reconfiguration with a suitable approach to complexity management.

Recently, information technology and computational resources have become more powerful and widely used by corporations.[4] A variety of modern modeling and simulation (M&S) techniques provide management with

[1] Singh (1993).

[2] Müller-Stewens, Schäfer, and Szeless (2001).

[3] Bowman and Singh (1993).

[4] Hammer and Champy (1993).

new forms of information, but research indicates that the mere use of computational power is only one component of a valuable decision-support tool.[5] In addition, it should be based on sound concepts that enable efficient communication.[6] The System Dynamics approach is one of the most prominent and effective modeling approaches that meets this requirement.[7]

By combing both research areas, the goal of this article is to close the gap in the literature by analyzing a System Dynamics approach to portfolio restructuring.

Two elements focus this study. First, the analysis is restricted to portfolio restructuring although corporate restructuring includes a broad spectrum of activities.[8] However, because several examples of successful applications of System Dynamics for accounting-based models exist, portfolio restructuring is the most promising branch in corporate restructuring due to its accounting-related nature.[9] The second focus is a case study by which we investigate a spin-off.

This article contains four sections following this introduction. Section 2 contains an overview on modeling, while Section 3 provides background information and theory on restructuring. The System Dynamics approach is applied to an illustrative case study in Section 4. Finally, in Section 5, we discuss the implications of our findings and provide suggestions for further research.

2. MODELING AND SIMULATION

As humans are constrained by cognitive limitations, effective decision making in an uncertain environment requires simplifications.[10] This can be achieved by reducing the complexity of models and assessing different scenarios via simulations.[11] The effectiveness of these approaches depends on several critical factors.

2.1 A Relational Framework for Modeling and Simulation

A generic framework for integrating M&S includes the source system, the experimental frame, the model, and the simulator as depicted in Figure 1.[12]

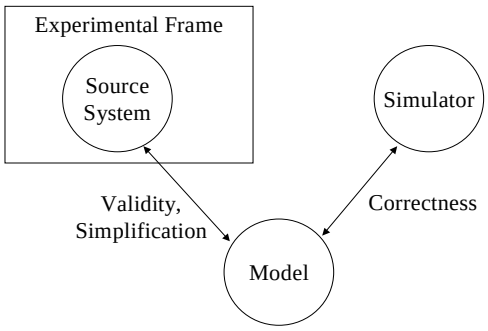

Figure 1: Entities and Relationships in Modeling and Simulation. Based on Zeigler, Praehofer, and Kim (2000).

While all entities are interrelated, the most relevant relationships are the simplification of the source system in the model, the validity of the model with respect to the source system, and the simulator's adequate behaviour with respect to the model. Hence, the key to modeling is to solve the dilemma of valid simplifications. Both aspects — simplification and validity — are prerequisites for deriving reliable policy implications.

[5] Forrester (1956).

[6] Sterman (2002), Senge (1990).

[7] Sterman (2000).

[8] Bowman and Singh (1993).

[9] Bianchi (2002).

[10] Odum and Odum (2000), Van den Bosch and Van der Klauw (1994).

[11] Steinhausen (1994), Hannon and Ruth (1994), Ruth and Hannon (1997), and Van den Bosch and Van der Klauw (1994).

[12] Zeigler, Praehofer, and Kim (2000).

Based on this theoretical framework of the relationships between modeling and simulation, the respective definitions can be derived.

Modeling is generically defined as the process of designing an image of reality with required characteristics.[13] Hannon and Ruth (1994) characterize modeling as an iterative process that is initiated by real-world events or virtual events. The underlying interactions are combined to enable a higher level of observation by identifying key elements and processes.

Next, the model is further constructed by defining the underlying variables and their relationships. At this stage, the model enables the simulation of different paths that allow us to derive predictions and appropriate policy implications. The comparison of these predictions with real-world observed events leads to a revision of the model, which initiates a new iteration of the modeling process.[14]

Another aspect of modeling is emphasized by Van den Bosch and Van der Klauw (1994) who claim that modeling is "the art of creating mathematical descriptions of … phenomena which appear in reality."[15]

All these aspects have shaped the view on modeling in this article which defines modeling as the process of creating a sound and valid simplification of a source system in a relevant experimental frame.

Simulation is defined as a "tool for obtaining responses of … models to understand their dynamic behavior," thus emphasizing the dynamics of models.[16]

[13] Voit (1999).

[14] Hannon and Ruth (1994).

[15] Van den Bosch and Van der Klauw (1994).

[16] Ruth and Hannon (1997), Odum and Odum (2000), Van den Bosch and Van der Klauw (1994).

2.2 The Motivation for Modeling and Simulation Techniques

After outlining the genesis of M&S, the next logical step is to analyze its potential for enhancing decision making. Van den Bosch and Van der Klauw (1994) identify two predominant motives of M&S: Designing control systems and enhancing decision quality.[17]

Models can be used as controls to monitor actual systems. As it is easy to update these models with new data, a subsequent risk-management strategy can readily be developed.[18] The calculation of the Value at Risk (VaR) is an example of a successful risk management simulation.[19]

In the corporate restructuring context, the quality enhancement of decisions is more important than the controlling function. Thinking ahead of the current situation or crisis has become a necessary step and a competitive advantage in the dynamic environment of corporations.[20] M&S allows management to develop hypotheses, to make decisions, and to evaluate the respective consequences without actually having to bear any negative effects.[21] M&S can reveal even unintuitive relationships and assist organizations in making optimal decisions for a given information set.[22]

2.3 Classification of Modeling and Simulation Techniques

The various M&S methods can be clustered by different parameters.[23] As the model's underlying time horizon is of particular interest in the corporate restructuring context, it is useful to

[17] Van den Bosch and Van der Klauw (1994).

[18] Zhu and Backx (1993), Chongfu (2001).

[19] Hull (2003), Linsmeier and Pearson (2000).

[20] Hartmann (1996).

[21] Steinhausen (1994).

[22] Ruth and Hannon (1997).

[23] Dillerup (1998).

distinguish static, comparatively static, and dynamic models.[24] Depending on the research perspective, models are furthermore separated into deterministic and stochastic models.[25] The combination of both characteristics allows us to develop a classification of M&S techniques; some representative techniques are outlined in Figure 2.

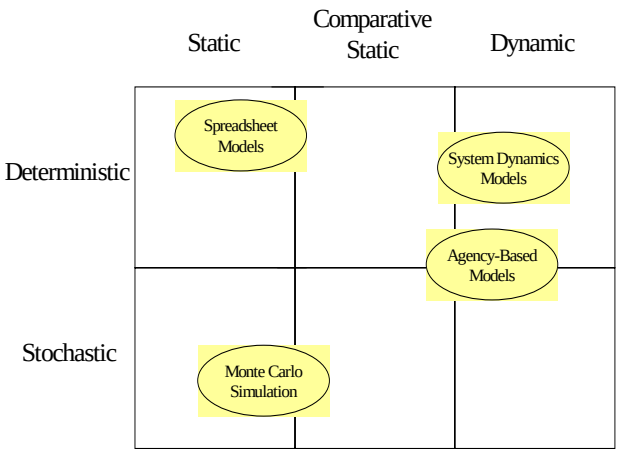

Figure 2: Types of Modeling and Simulation Techniques. Based On Ruth and Hannon (1997) and Hartmann (1996).

While complex stochastic simulations account for uncertainty in the decision-making model, they require a vast amount of computation power, whereas deterministic simulations quickly deliver intuitive results;[26] the required computational power is a disadvantage of stochastic methods, even though recent developments in the IT industry have resulted in an enormous processing capacity even on home computers.[27]

With this classification in hand, managers can choose the appropriate M&S technique depending on their concerns, underlying assumptions and the idiosyncratic decision context.

2.4 The Ideal Modeling and Simulation Process

Steinhausen (1994) recommends a seven-step procedure for model design. According to this procedure, identifying a problem is the basis for all further steps, which implies that the source system and the examination frame are defined.[28] In the next phase, relevant characteristics of the real world are abstracted by tools such as causal diagrams, flowcharts and mathematical descriptions.[29] Relevant information and their interaction patterns, which include input and output variables, are identified.[30] In the next step, data is collected to calibrate the parameters.[31] Then the abstract model is converted into an executable program with the help of an M&S technique that is chosen according to the classification scheme.[32] Step five is the validity check of the model, which is achieved by a reconstruction of historic developments.[33] Once the validity of the model is confirmed, scenarios are simulated and validated in a sensitivity analysis.[34] The last step is an analysis of the results and their interpretation.

2.5 System Dynamics Modeling

After having outlined the theoretical process of modeling, we now focus on System Dynamics. System dynamic models provide a wide range of opportunities to model variables and their

[24] Ruth and Hannon (1997), Zeigler, Praehofer, and Kim (2000). Troitzsch (1990).

[25] Steinhausen (1994). Hartmann (1996) adds chaotic models as a third group.

[26] Kautt and Hopewell (2000).

[27] Papageorgiou and Paskov (1999).

[28] Ruth and Hannon (1997).

[29] Dillerup (1998).

[30] Ruth and Hannon (1997).

[31] Odum and Odum (2000).

[32] Steinhausen (1994).

[33] Voit (1999), Dillerup (1998).

[34] Hannon and Ruth (1994) emphasize the iterative nature of modeling.

relationships. Accordingly, we can set state variables, control variables, and transforming variables.[35] The relationships between these variables are mainly dominated by feedback loops in which reinforcing positive processes are distinguished from rebalancing negative ones.[36]

The variables and feedback processes are integrated within a model to simulate a system's behavior over time. Basic model types are stimulus-response, self-referencing, goal-seeking, and goal-setting models.[37]

Due to the fact that many relevant elements and relationships can be integrated, System Dynamics models offer a scalable complexity, which is valuable for modeling corporate restructuring decisions and their implications.

3. MOTIVATION, THEORY, AND CONCEPTS OF PORTFOLIO RESTRUCTURING

This chapter provides background information on motives, theories, and concepts of the experimental frame of corporate restructuring in general, and portfolio restructuring in particular.[38]

3.1 Corporate Restructuring

Corporate restructuring is one of the most complex and fundamental phenomena that management confronts.[39] Each company has two opposing strategies from which to choose: to diversify or to refocus on its core business. While diversification represents the expansion of corporate activities, refocusing characterizes a concentration on its core business. From this perspective, corporate restructuring is a reduction in diversification.[40]

Corporate restructuring entails a range of activities including portfolio restructuring, financial restructuring, and organizational restructuring.[41]

Accordingly, portfolio or asset restructuring involves the redeployment of corporate assets through divestitures of business lines that are considered peripheral to the core business strategy. Significant changes in a corporation's capital structure are termed financial restructuring. In organizational restructuring, the focus of change is on management and internal corporate governance structures.

This study primarily focuses on portfolio restructuring which is construed as the elimination of elements from a business portfolio.[42] It is important to note, however, that the effects of restructuring activities are not restricted to one class of restructuring. In contrast, although portfolio restructuring primarily affects the asset side of the balance sheet, it cannot be accomplished without adjusting the liability side. Therefore, portfolio restructuring should not be seen as an isolated process, but rather as a multidimensional and long-term process in a series of corporate restructuring activities.[43]

3.2 Motives for Restructurings

The motivations for restructuring are manifold and depend on the particular set of problems and circumstances facing firms. Nevertheless, we can identify the shareholder value principles as a common rationale for all restructuring processes. Therefore, we analyze the particular motives in greater detail after

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[35] Ruth and Hannon (1997).

[36] Sterman (2000), Forrester et al. (2000) point out that the feedback loop is the basic structural element of systems.

[37] Hannon and Ruth (1994).

[38] Bowman and Singh (1993), Singh (1993), Räss (1993), Markides (1995), Basty (1988), Brüchner (1999), Gaughan (1999).

[39] Achleitner (2000).

[40] Markides (1995).

[41] Bowman and Singh (1993).

[42] Weston, Chung, and Siu (1998).

[43] Bowman and Singh (1993).

outlining the underlying shareholder value paradigm.

The genuine function of a corporation is the subject of ongoing scholarly debate.[44] While some researchers support the stakeholder value rationale, others favor the shareholder value rationale. Three factors support the shareholder view within this analysis. First, shareholders exert a high degree of influence on corporations via corporate governance mechanisms.[45] Therefore, we can reasonably assume that management decisions are focused on shareholder interests. A second factor supporting the shareholder-value perspective is that shareholder dividends are the residual after all other stakeholders' needs are satisfied. Therefore, optimal shareholder-value management implies the maximum value creation for all stakeholders. Finally, empirical evidence supports the hypothesis that shareholder-oriented firms outperform others.[46]

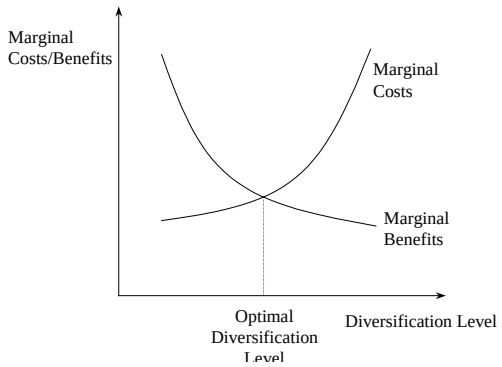


Figure 3: The Optimal Point for Diversification. Based on Markides (1995).

Following the shareholder-value perspective, portfolios should be restructured and some divisions must be suspended, if they contribute no value.[47] Alternatively, a change in the corporate strategy might require an optimization of the corporate structure, since empirical evidence suggests that even profitable business units should be sold if they do not directly support a corporation's general strategy.[48] In both cases, the focus on core competencies creates value if the marginal benefits of the diversification are below marginal costs.[49]

Beneficial synergies result either from an enhancement of revenues or from a reduction of costs.[50] Both can be accomplished by economies of scale, economies of scope, learning effects, and other effects that improve a firm's profitability.[51] Negative synergies, in contrast, destroy shareholder value due to inflexible structures or high overhead costs.[52] The most important drivers of such disadvantages are coordination, compromise, transaction, and inflexibility costs.[53]

Dismantling a value-negating conglomerate in which the benefits fail to outweigh the costs is a central motive for corporate restructuring.[54]

3.3 Concepts of Corporate Restructuring

To achieve the outlined shareholder value goals in a corporate restructuring transaction, firms have three major options:[55] arranging a sell-off to a strategic buyer, externalizing an independent entity, and liquidating.

Divestitures, or sell-offs as they are called, describe the sale of an affiliate company or business unit to a strategic buyer. In these cases

[44] Copeland, Koller, and Murrin (2000).

[45] Shleifer and Vishny (1997).

[46] Perridon and Steiner (1999).

[47] Porter (1987), Bruppacher (1990).

[48] Drucker (1999), Müller (1999), Waldecker (1995).

[49] Markides (1995).

[50] Gaughan (1999).

[51] Oehlrich (1999). Jansen (1999), Petersen (1995).

[52] Gaughan (1999).

[53] Oehlrich (1999).

[54] Porter (1987).

[55] Achleitner (2000), Charifzadeh (2002), Gaughan (1999), and Weston, Chung, and Siu (1998).

the buyer normally purchases the whole business unit in order to exert full control.[56]

The second group of restructuring concepts involve the separation of an independent entity, and include spin-offs, split-offs, split-ups, subsidiary initial public offerings (IPOs) and equity carve-outs.

Spin-offs describe the change in ownership of the affiliate company from the parent corporation directly to its shareholders. Each owner receives a stake in the affiliate, which depends on the equity participation in the holding corporation. After the transaction, the shareholders own two different corporations and the subsidiary is legally independent from the holding corporation.

Split-offs differ from spin-offs in that shareholders must choose between participating in the original corporation or in the newly independent subsidiary. Split-ups describe the break-up of a firm into two or more independent companies. While the holding corporation is liquidated, its former shareholders receive a participation in the new companies. Subsidiary IPOs describe the partial sale of an affiliated company via sales of shares in the stock market in which the holding corporation may lose its control over the affiliate.[57] Equity carve-outs describe the sale of a minority participation of an affiliate on the stock market. After this transaction, the holding firm remains in control of the affiliate.[58]

Finally, the third class of restructuring options is liquidation, which is different from the first two options because the individual assets of the unit are sold and the proceedings are distributed among its shareholders.[59]

[56] Achleitner (2000) and Charifzadeh (2002).

[57] Clark, Gerlach, and Olson (1996) argue that a subsidiary IPO might yield a higher return than a sell-off.

[58] Clark, Gerlach, and Olson (1996), Brealey and Myers (2000).

[59] Gaughan (1999), Weston, Chung, and Siu (1998), Basty (1988), Brüchner (1999).

3.4 Empirical Evidence of Restructuring Potential

The two most important theories to prove the value potential of corporate restructurings are the management efficiency hypothesis and the information hypothesis.[60]

The management efficiency hypothesis posits that the management of large corporations is generally unable to address the unique peculiarities of each segment in diversified corporations. Its performance is therefore inferior to smaller specialized firms. Consequently, management should restructure the corporation by bundling corporate resources in its core expertise.

The information hypothesis posits that the information that investors get about the separate businesses of conglomerates is low.Consequently, financial market participants often penalize them with a conglomerate discount in the valuation.[61] After a restructuring, more information about the individual business unit is processed, which lowers the conglomerate discount and increases shareholder value.[62]

These two hypotheses have been tested extensively by a variety of researchers in the financial fields, indicating that corporate restructuring offers an opportunity for companies to create shareholder value.[63]

First, Achleitner (2000) and Charifzadeh (2002) summarize a cluster of studies that confirm both hypotheses. Similarly, Bowman, Singh, Useem, and Badhuri (1999) summarize a set of studies and find positive effects of portfolio restructuring based on both hypotheses. However, following them, spin-offs create more

[60] Achleitner (2000), Charifzadeh (2002), Weston, Chung, and Siu (1998).

[61] Weston, Chung, and Siu (1998).

[62] Huemer (1991).

[63] Gouillart and Kelly (1999).

value than sell-offs. Diverging from this school of thought, Gaughan (1999) summarizes studies that indicate abnormal returns result from sell-offs, spin-offs and voluntary liquidation. Finally, Weston, Chung and Siu (1998) arrive at similar conclusions in their review of studies on divestitures, spin-offs, split-ups, and equity carve-outs.

Müller-Stewens, Schäfer, and Szeless (2001) confine the outlined findings by emphasizing that the effects from restructuring vary substantially depending on the given context. This insight is the trigger for analyzing the opportunities and limitations of idiosyncratic restructuring options with System Dynamics modeling.

4. SYSTEM DYNAMICS MODELING IN CORPORATE RESTRUCTURING

The previous sections have outlined the theoretical framework. Based on these insights we develop a System Dynamics model for a spin-off. The analysis is therefore limited to the case of a spin-off, i.e., the case of running a business unit separately. It is furthermore abstracted from other factors that exist in reality, such as debt financing. Once the general idea is clear, we can extend the model and include more details.[64] Thereby, we elucidate the general application of System Dynamics in the outlined research context and devise a roadmap required for subsequent research projects.

4.1 Case Study Description

In the following analysis we apply data from industrial corporation A, which consists of two business units X and Y. Although the corporation is profitable, it operates in a difficult environment. Therefore, its management is considering a spin-off in order to concentrate on its core competencies. As a consequence, the CEO of corporation A initiates a consulting project based on a System Dynamics approach to evaluate the portfolio restructuring strategy. Management uses a simplified discounted earnings approach to determine the alternative corporate values.[65]

Following the ideal modeling process, we have formulated the underlying problem and continue our analysis by identifying the vital variables, relationships, and dynamics to design the model.[66] Once the model is validated, we must run the sensitivity analysis to derive the respective implications for the outlined decision problem.

In corporation A, the two business units exhibit three vital relationships. X and Y share the same general administration. Hence, both benefit from savings in administrative overhead costs. Similarly, they work with the same marketing department, which has ambiguous implications. On the one hand, this cooperation reduces marketing expenses, but it negatively affects the market share due to imperfectly adapted marketing strategies. Finally, both divisions purchase the raw materials from the same supplier, which lowers their costs through combined purchasing power. In this basic setting of the restructuring model, we assume that all other departments such as production are the responsibility of each unit.

4.2 Limiting Variables

To select the variables for the model's design, the complexity of the decision conditions must be reduced.

Since shareholder value is defined as the ultimate corporate goal, the modeling must identify all variables that greatly impact company value.[67] In this case, it is important to compare the earnings and the related value of both

[64] Further extensions of the model include other restructuring concepts, such as divestitures, liquidations and others (cf. section 3.3).

[65] Brealey and Myers (2000).

[66] Please confer 2.4.

[67] Copeland, Koller, and Murrin (2000) analyze and point out the importance of value drivers.

alternatives. These are assumed to be affected by raw materials, production costs, market size, market share, and the discount and constant-growth rates. In the given experimental frame, the most important relationships influencing the value drivers are those that result from the potential externalization of a business unit: the costs of raw materials and the business unit market shares. In addition, the changes in administration costs and marketing expenses must be included in the model since they are also affected by a restructuring decision. Other costs and expenses are assumed to indirectly impact the final decision. Since both units are equity financed, no interest is paid. All earnings are distributed to shareholders as dividends and no taxes are paid. [68]

4.3 The System Dynamics Model for Portfolio Restructuring

In this section, the System Dynamics model is presented to derive reasonable estimations on alternative earnings and the respective company values. Therefore, the earnings and the equity values of the two business units and the entire corporation are calculated for a seven-year horizon.

The core of the model is the distinction between a spin-off restructuring and a conglomerate performance mode.[69] In the designed model it is possible to use the restructuring button at the top of the model to switch between the two situations before and after a restructuring. This will automatically show changes in the variables affected by a restructuring decision. The model allows us to change some of the underlying variables that are not directly affected by a restructuring in order to analyze the decision under different scenarios. To perform a sensitivity analysis, the annual total demand of market X can be varied between $0 and $4 million, while the annual demand of market Y can be changed between $0 and $2 million. Production costs can range between 25% to 50% of sales revenues.

Based on empirical market surveys, the most realistic setting for A is to assume that the size of X's market is $2 million, the size of Y's market is $1 million and all production costs are 35% of sales revenues. If we analyze this base case scenario with a discounted earnings approach, the model derives the following results.

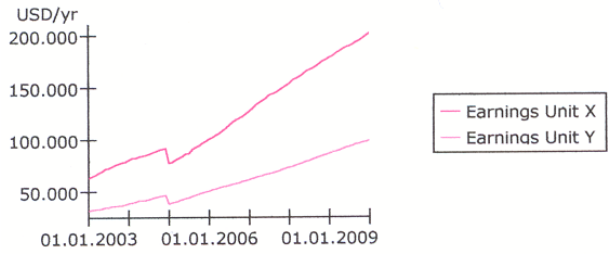


Figure 4: Earnings Forecast for the Business Units. Based on own analysis.

In the earnings forecast, the upper line represents the annual earnings of unit X, which in the first two years is a part of the corporation and the following five years, an individual entity. In contrast, the lower line reveals the development of unit Y. Under our assumptions, we can identify a linear increase in earnings until the restructuring date. The spin-off leads to a decrease in earnings and to an increase in earnings growth for both units after the restructuring. The decrease results from an immediate increase in administration and marketing expenses, whereas the increase in earnings growth derives from higher growth rates.

In the representation of the residual equity value, the upper line represents the sum of the values of unit X and unit Y at each point in time in the future. The line in the middle of the chart indicates the equity value of unit X, whereas the

[68] The chosen parameter settings, the results and the equations of the model are presented in the Appendix.

[69] Extensions of the model can distinguish further restructuring concepts in order to account for the variety of restructuring concepts illustrated in section 3.3.

line closest to the bottom of the graph illustrates the equity value of unit Y. In the first two years the cumulative value represents the value of the conglomerate corporation, whereas after the second year it represents the value of two independent entities.

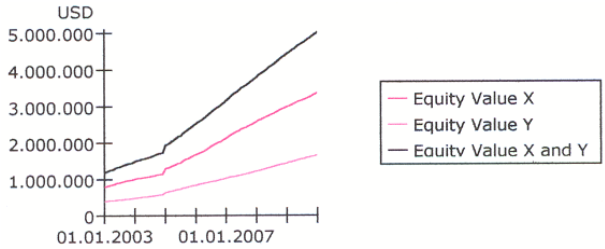


Figure 5: Equity Value Forecast for the Business Units

We can see that the equity value of the corporation increases slowly before the restructuring. Then, in the second year, the restructuring leads to an instantaneous increase in the corporate value because of a higher growth rate and greater market share.

4.4 Policy Recommendations from the Model

This basic model illustrates the general mechanics that support the decision-making process in corporate restructuring. In the specified configuration, the restructuring decision is the superior alternative based on an analysis of the created value. Consequently, based on this systems dynamics analysis the dominant strategy is to pursue the spin-off restructuring.

In a next step, we can extend the basic model to a more realistic version by introducing further deterministic or new probabilistic and stochastic elements. Although these specifications might increase design costs, they increase the robustness and the explanatory potential of the model.

4.5 Evaluation of System Dynamics Modeling in Corporate Restructuring

After an analysis of the theory and the case study, we can obtain the most relevant opportunities and limitations of the application of System Dynamics modeling to portfolio restructuring.

4.5.1 Opportunities

A general advantage of modeling results from the comparison of the outcomes of different scenarios. Hence, it is possible to run a bulk of scenarios and to determine which decision is most advantageous under a given set of data. This valuable experience improves the quality of the decision-making process.[70] System Dynamics are particular with respect to this aspect, because they foster an understanding of the underlying feedback loops affecting the situation. Thereby, the System Dynamics model mimics the complex interactions that take place in the real world far better than spreadsheet models.

A further vital advantage of modeling techniques is closely related to the first aspect of understanding the dynamics of the situation: the process of setting up a reliable model forces management to cooperate and to communicate. Only if all functional experts contribute to the design process will the resulting models represent the underlying mechanisms. This prompts management to develop a common representation of reality.[71] Communication is a particular advantage of the System Dynamics approach, as the technique works with a refined set of tools that support the conflict-oriented development of models such as causal loop diagrams.[72] These facilitate efficient communication between members of the management team and other experts, which is vital to corporate restructuring.

A third advantage of the System Dynamics approach is its scalability, which is of particular

[70] Hartmann (1996).

[71] Dillerup (1998).

[72] Sterman (2000).

interest in corporate restructuring. Making decisions requires a comprehensive analysis of the situation within a short period of time. System Dynamics modeling closes this gap and provides a trained analyst within a short period of time with reliable information, if the model design and the input data are accurate.

4.5.2 Limitations

Despite these advantages, modeling approaches in general, and System Dynamics in particular, have specific limitations.[73]

In the development of any model, the designer should be reminded that a perfect replication of the complexity of a process or situation, in reality, is inefficient and useless. A perfect model that contains all relevant information of the original system is not easier to analyze than reality. It ignores the cognitive limitations of humans and does not help simplify the system's complexity.[74]

This observation concerning the optimal level of complexity in designing a model is at the core of modeling. The process of restructuring, in particular should not be seen as an isolated event, but as a multidimensional and long-term process leading to a series of transactions.[75] The simplification process must be addressed with the required respect as it represents a form of art, which should balance the minimum required level of complexity and the maximum level of simplification.

A second disadvantage of modeling is the problem of ex-ante assumptions about the underlying system before a model is designed. These assumptions often bias the model and influence the final outcome of the analysis towards the desired outcome.[76] Therefore, corporate restructuring decisions should not be based solely on one model. Furthermore, the System Dynamics approach should be viewed as a complementary tool that enhances the quality and effectiveness of conventional approaches.

Finally, modeling processes require considerable time and monetary resources.[77] Therefore, a cost-benefit analysis should be the first step in the design of a model so as to clarify the goals, upside potential, and costs. This evaluation is a key step to convince the top management to support the project. Corporate management's participation, in turn, is vital for the overall success of the restructuring and determines the related level of trust

This analysis demonstrates the high potential for System Dynamics modeling for corporate restructuring if the limitations outlined here are respected.

5. CONCLUSIONS AND OUTLOOK

This final section summarizes the main findings of the research based on the theoretical analysis and concludes with suggestions for subsequent research questions.

5.1 Conclusions

This article outlines the potential role of System Dynamics modeling in the context of portfolio restructuring. The goal of this research has been to determine whether and how the System Dynamics approach can be applied in corporate restructuring processes in order to improve the quality of decision making. After establishing the theoretical background, the System Dynamics model was applied to a portfolio restructuring strategy.

The analysis demonstrates that sophisticated decision-support tools can be required in portfolio restructuring and that the System Dynamics approach fulfills this requirement for a

[73] Dillerup (1998).

[74] Sommer (1996).

[75] Bowman and Singh (1993).

[76] Dillerup (1998) criticizes the subjectivity of modeling.

[77] Dillerup (1998), Kaufmann (1994).

variety of reasons.[78] It allows the simple implementation of a comprehensive sensitivity analysis for different sets of assumptions and alternative decisions.[79] Thereby, it assists management in developing an understanding of nonlinear dynamics in restructuring.[80] Finally, the analysis of the opportunities and limitations identifies the scalability and the communication potential of the System Dynamics approach.

Consequently, a key part of the complexity of the restructuring process can be reduced to a minimum required level with a System Dynamics model. On the other hand, the system analyst must consider the increasing marginal costs for the information that must be compared to the decreasing insights resulting from more complex models. This trade-off is outlined in the case study and determines the optimal level of complexity for the model design.

Overall, System Dynamics models should be regarded as complements to conventional instruments in corporate restructuring as they enhance the quality of the decision-making process.

5.2 Outlook

The scope of this paper is limited to specific research aspects to enable a detailed analysis of System Dynamics modeling in portfolio restructuring. This focus and the findings of the analysis should inspire similar research avenues.

Although several advantages of the System Dynamics approach have been outlined in this analysis, direct benchmark analyses with other tools would be of great value for managers. Such an analysis should particularly investigate the compatibility of different modeling approaches as it is of great interest for the practice, whether it is possible to import and export data from conventional applications.

Within the research on corporate restructuring, this article has emphasized the portfolio perspective. Subsequent investigations should assess whether the insights can be transferred to financial and organizational restructuring.[81]

Despite of the strength of the outlined discounted-earnings approach, it can be difficult to implement it in a highly uncertain environment.[82] In such a setting, the capital budgeting literature suggests the application of the real options theory.[83] Thereby, it is possible to quantify flexibilities with a marked-based approach, if the required data is available.[84] In consequence, further research should investigate the possibility of combining the option pricing valuation methodology with systems dynamics modeling.

Finally, an empirical study could contribute invaluably to the research in this area. A survey could examine whether the managers in corporate restructurings have recognized the potential of modeling in general and of System Dynamics in particular. Moreover, such an empirical analysis might be able to identify some hurdles that prevent managers from applying the System Dynamics approach.

A common problem of all outlined research projects is data availability. While it should be relatively easy to conduct a survey with a representative sample size, other information, such as details on the restructuring strategy and motivation, are difficult to obtain. Particularly, as managers in restructuring projects are extremely short of time for obvious reasons, they might not

[78] Kahraman (2001).

[79] Hartmann (1996).

[80] Steinhausen (1994), Grzegorzewski and Hryniewicz (2001).

[81] Berztiss (1996) and Leinenbach (2000).

[82] Trigeorgis (1996).

[83] Brealey and Myers (2000).

[84] Trigeorgis (1996), Brealey and Myers (2000), Hull (2003).

be willing to participate in a mail survey. On the other hand, possibly, the advantages and research projects outlined here could induce a broader audience to apply System Dynamics models to corporate restructuring. Consequently, positive feedback dynamics might foster the further distribution of the underlying concepts in management practice and thereby facilitate access to important, required data.

6. REFERENCES

Achleitner, A.-K. 2000. Handbuch Investment Banking. Wiesbaden: Gabler. 2000.

Basty, G. 1988. Die Interessen der Gläubiger in einem künftigen Sanierungs-/Reorganisationsverfahren. Munich: VVF. 1988.

Berztiss, A. 1996. Software Methods for Business Reengineering. New York: Springer. 1996.

Bianchi, C. 2002. Introducing SD modeling into planning and control systems to manage SME´s growth: a learning-oriented perspective. System Dynamics Review. 18. 3. Fall. 2002.

Bowman, E.H., H. Singh, M. Useem, and R. Badhury 1999. When does Restructuring Improve Economic Performance?. California Management Review 2. 33-54. 1999.

Bowman, E. H. and H. Singh 1993. Corporate Restructuring: Reconfiguring the Firm. Strategic Management Journal 14. 5-14. 1993.

Brealey, R.A. and S.C. Myers 2000. Principles of Corporate Finance. New York: McGraw-Hill. 2000.

Brüchner, T. 1999. Reorganisationsstrategien für insolvenzbedrohte Unternehmen. Frankfurt am Main: Lang. 1999.

Bruppacher, P.R. 1990. Unternehmensverkauf als strategischer Erfolgsfaktor. In: H. Siegwart, J.I. Mahari, I.G. Caytas and B.-M. Rumpf. Meilensteine im Management: Mergers and Acquisitions. Stuttgart: Schäffer. 1990.

Charifzadeh, M. 2002. Corporate Restructuring: Ein wertorientiertes Entscheidungsmodell. Lohmar: Josef Eul Verlag. 2002.

Chongfu, H. 2001. Fuzzy Risk Analysis Vs. Probability Risk Analysis. In: D. Ruan, J. Kacprzyk and M. Fedrizzi. Soft Computing for Risk Evaluation and Management: Applications in Technology, Environment and Finance. Heidelberg: Physica. 2001.

Clark, J.J., J.T. Gerlach, and G. Olson 1996. Restructuring Corporate America. Fort Worth: Dryden Press. 1996.

Copeland, T., T. Koller, and J. Murrin 2000. Valuation: Measuring and Managing the Value of Companies. New York: John Wiley & Sons. 2000.

Dillerup, R. 1998. Strategische Optionen für vertikale Wertschöpfungssysteme. Frankfurt am Main: Lang. 1998.

Drucker, P.F. 1999. Management im 21. Jahrhundert. Munich: Econ Verlag. 1999.

Fogel, D.B., K. Challapilla, and P. J. Angeline 2002. Evolutionary Computation and Economic Models: Sensitivity and Unintended Consequences. In: Shu-Heng Chen. Evolutionary Computation in Economics and Finance. Heidelberg: Physica. 2002.

Forrester, J.W. 1956. Dynamic models of economic systems and industrial organizations. In: System Dynamics Review. 19. 4. 2003.

Forrester, J.W. and others 2000. Road Maps: A Guide to Learning System Dynamics. Cambridge: MIT. 2000.

Gaughan, P.A. 1999. Mergers, Acquisitions, and Corporate Restructurings. New York: Wiley & Sons. 1999.

Gouillart, F.J. and J.N. Kelly 1999. Business Transformation : Die besten Konzepte für Ihr Unternehmen. Vienna: Ueberreuter. 1999.

Hammer, M. and J. Champy 1993. Reengineering the Corporation: A Manifesto for Business Revolution. New York: HarperCollins. 1993.

Hannon, B. and M. Ruth 1994. Dynamic Modeling. New York: Springer. 1994.

Hartmann, C. 1996. Mathematische Modelle der Wirklichkeit: Von der Theorie zum Computerexperiment. Thun: Deutsch. 1996.

Huemer, F. 1991. Mergers & Acquisitions : Strategische und finanzielle Analyse von Unternehmensübernahmen. Frankfurt am Main: Lang. 1991.

Hull, J.C. 2003. Options, Futures and Other Derivatives. Upper Saddle River: Prentice Hall. 2003.

Jansen, S.A. 1999. Mergers and Acquisitions. Wiesbaden: Gabler. 1999.

Kahraman, C. 2001. Capital Budgeting Techniques Using Discounted Fuzzy Cash Flows. In: D. Ruan, J. Kacprzyk and M. Fedrizzi. Soft Computing for Risk Evaluation and Management: Applications in Technology, Environment and Finance. Heidelberg: Physica. 2001.

Kaufmann, A.H. 1994. Software Reengineering: Analyse, Restrukturierung und Reverse-Engineering von Anwendungssystemen. Munich: Oldenbourg. 1994.

Kautt, G. and F. Wieland 2001. Modeling the Future: The Full Monte, the Latin Hypercube and Other Curiosities. Journal of Financial Planning 12. 78-88. 2001.

Kautt, G. and L. Hopewell 2000. Modeling the Future. Journal of Financial Planing 10. 90-100. 2000.

Leinenbach, S. 2000. Interaktive Geschäftsprozessmodellierung: Dokumentation von Prozesswissen in einer Virtual Reality-gestützten Unternehmensvisualisierung. Wiesbaden: Gabler. 2000.

Linsmeier, T.J. and N.D. Pearson 2000. Value at Risk. Financial Analysts Journal 2. 47-67. 2000.

Markides, C.C. 1995. Diversification, Refocusing and Economic Performance. Cambridge: MIT Press. 1995.

Müller, M. 1999. Prozessorientierte Veränderungsprojekte: Fallbeispiele des Unternehmenswandels. St. Gallen: Universität St. Gallen. 1999.

Müller-Stewens, G., M. Schäfer and G. Szeless 2001. Wertschaffung durch strategische Desinvestitionen. Mergers and Acquisitions 1. 13-18. 2001.

Odum, H.T. and E.C. Odum 2000. Modeling for all Scales: An Introduction to System Simulation. San Diego: Academic Press. 2000.

Oehlrich, M. 1999. Strategische Analyse von Unternehmensakquisitionen: Das Beispiel der pharmazeutischen Industrie. Wiesbaden: Gabler. 1999.

Papageorgiou, A. and S. Paskov 1999. Deterministic Simulation for Risk Management. Journal of Portfolio Management 5. 122-127. 1999.

Perridon, L. and M. Steiner 1999. Finanzwirtschaft der Unternehmung. Munich: Vahlen. 1999.

Petersen, M.C. 1995, Erfolgreiche Unternehmensakquisition durch strategisches Wert-Management: Analyse, Planung und Steuerung von Unternehmenskäufen. Zürich: Füssli. 1995.

Porter, M.E. 1987. Diversifikation – Konzerne ohne Konzept. Harvard Manager 4. 30-49. 1987.

Räss, H.E. 1993. Die Restrukturierung von Unternehmen aus der Sicht der kreditgebenden Bank. Bern: Haupt. 1993.

Ruth, M. and B. Hannon 1997. Modeling Dynamic Economic Systems. New York: Springer. 1997.

Safavi, A. 2000. Choosing the Right Forecasting Software and System. The Journal of Business Forecasting Methods & Systems 3. 6-11+14. 2000.

Scott, R.W. 2000. Betting on Monte Carlo. Accounting Technology 9. 67-71. 2000.

Senge, P. M. 1990. The Fifth Discipline: The Art & Practice of The Learning Organization. New York: Currency Doubleday. 1990.

Shleifer, A. and Vishny, R. 1997. A survey of corporate governance. Journal of Finance. 52. 737-783. 1997.

Singh, H. 1993. Challenges in Corporate Restructuring. In: Journal of Management Studies. 30. 1. 147-172.1993.

Sommer, E. 1996. Theory Restructuring: A Perspective on Design & Maintenance of

Knowledge-Based Systems. Dortmund: Universität Dortmund. 1996.

Steinhausen, D, 1994, Simulationstechniken. München: Oldenbourg. 1994.

Sterman, J. 2000. Business Dynamics: Systems Thinking and Modeling for a Complex World. New York: Irwin/McGRaw-Hill. 2000.

Sterman, J. 2002. All models are wrong: reflections on becoming a systems scientist. System Dynamics Research. 18. 4. Winter. 2000.

Trigeorgis, L. 1996. Real Options: managerial flexibility and strategy in resource allocation. Cambridge MA: MIT Press. 1996.

Troitzsch, K.G. 1990. Modellbildung und Simulation in den Sozialwissenschaften. Opladen: Westdeutscher Verlag. 1990.

Van den Bosch, P.P.J. and A.C. Van der Klauw 1994. Modelling, Identification and Simulation of Dynamical Systems. Boca Raton: CRC Press. 1994.

Voit, F. 1999. Methodik zur ereignisdiskreten Modellierung und effizienten Simulation komplexer Systeme. Düsseldorf: VDI. 1999.

Waldecker, P. 1995. Strategische Alternativen in der Unternehmensentwicklung: Interne Entwicklung und Unternehmensakquisition. Wiesbaden: Gabler. 1995.

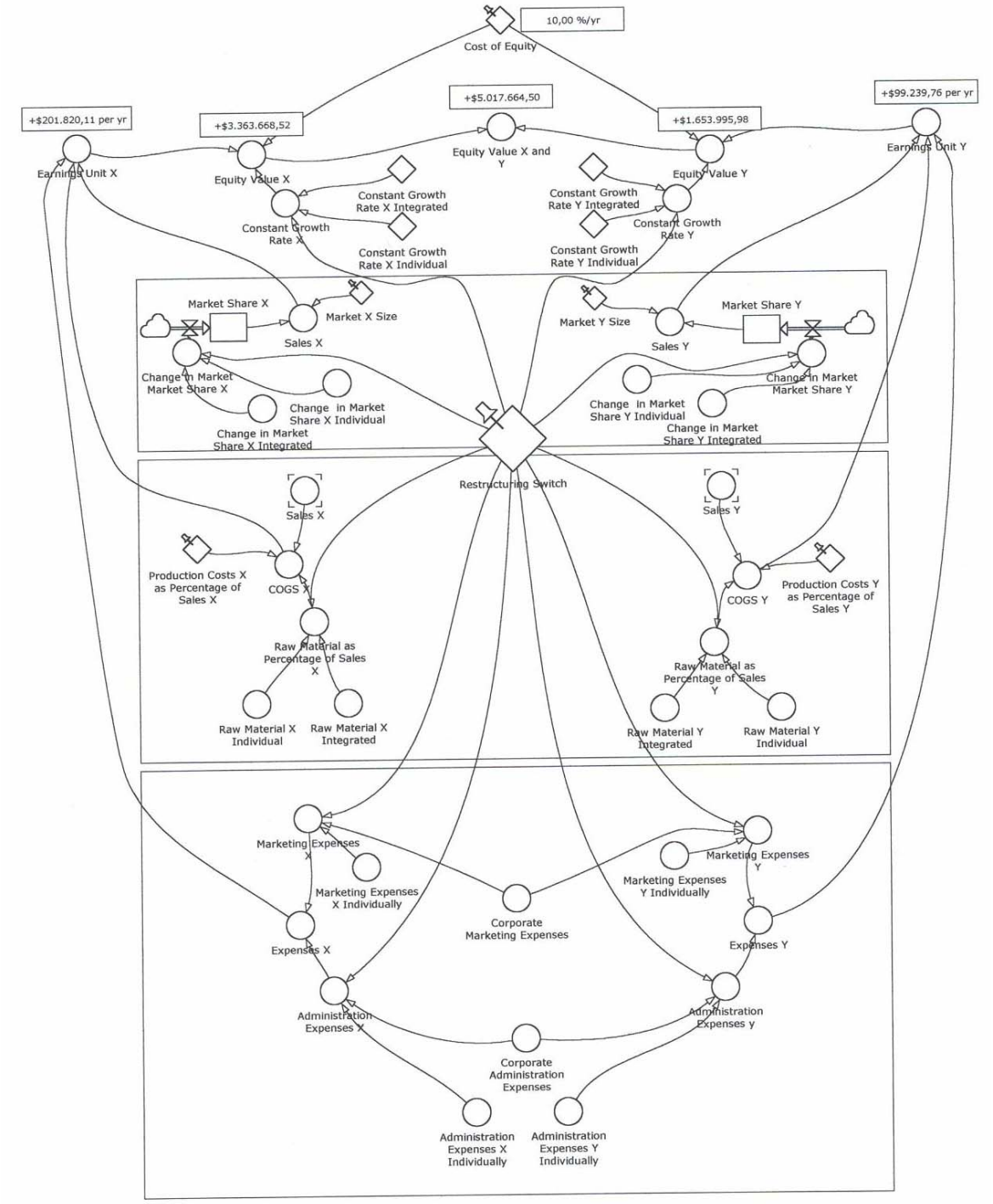
Weston, J.F., K.S. Chung, and J.A. Siu 1998. Takeovers, Restructuring, and Corporate Governance. Upper Saddle River: Prentice-Hall. 1998.

Zeigler, B.P., H. Praehofer and T.G. Kim 2000. Theory of Modeling and Simulation: Integrating Discrete Event and Continuous Complex Dynamic Systems. San Diego: Academic Press. 2000.

Zhu, Y. and T. Backx 1993. Identification of Multivariable Industrial Processes for Simulation, Diagnosis and Control. London: Springer. 1993.

7. APPENDIX

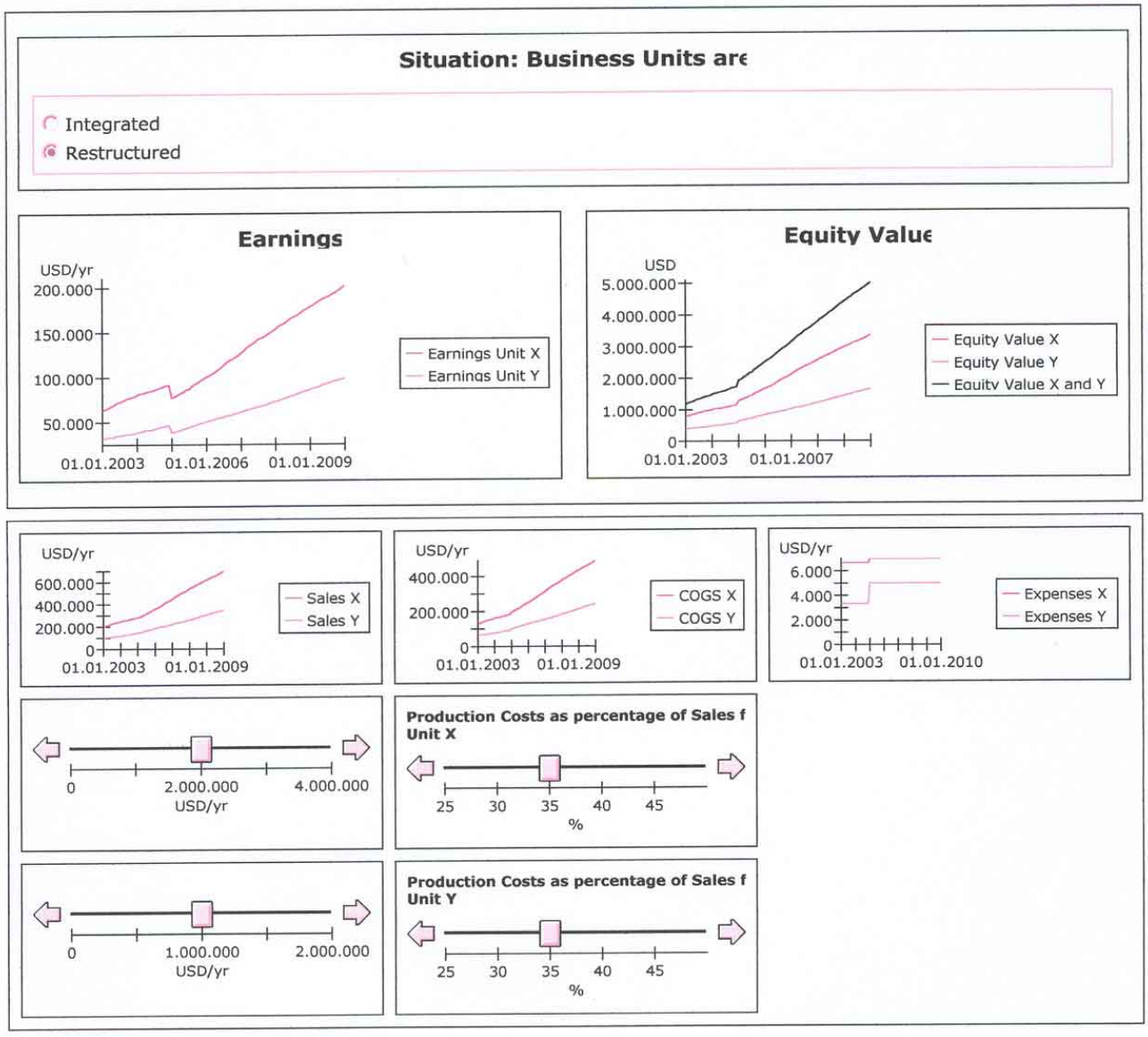
Appendix 1: The System Dynamics Model of the Case Study



Appendix 2: Assumptions of the Case Study

Today's Market Share	Unit X	10%	
	Unit Y	10%	
Annual Growth in Market Share	Unit X	2%	4%
	Unit Y	2%	4%
Raw Material Costs as Percentage of Sales Revenues	Unit X	30%	35%
	Unit Y	30%	35%
Production Costs as Percentage of Sales Revenues	Unit X	variable	
	Unit Y	variable	
Administration Expenses	Unit X	$5000	$3500
	Unit Y		$2500
Marketing Expenses	Unit X	$5000	$3500
	Unit Y		$2500
Cost of Equity	Unit X	10%	10%
	Unit Y		10%
Long-term Earnings Growth Rate	Unit X	2%	4%
	Unit Y	2%	4%

Appendix 3: User Interface of the Case Study



Appendix 4: Source Code of the Case Study

```
mainmodel Komponente 1 {
    aux Administration Expenses X {
        autotype Real
        autounit USD/yr
        def {'Corporate Administration Expenses'*2/3;'Administration Expenses X Individually'} [INDEX
            ('Restructuring Switch')]
    }
    aux Administration Expenses X Individually {
        autotype Real
        autounit USD/yr
        def 3500<<USD/yr>>
    }
    aux Administration Expenses y {
        autotype Real
        autounit USD/yr
        def {'Corporate Administration Expenses'*1/3;'Administration Expenses Y Individually'} [INDEX
            ('Restructuring Switch')]
    }
    aux Administration Expenses Y Individually {
        autotype Real
        autounit USD/yr
        def 2500<<USD/yr>>
    }
    aux Change  in Market Share X Individual {
        autotype Real
        autounit %/yr
        def NORMAL(4<<%/yr>>;1<<%/yr>>)
    }
    aux Change  in Market Share Y Individual {
        autotype Real
        autounit %/yr
        def NORMAL(4<<%/yr>>;1<<%/yr>>)
    }
    aux Change in Market Market Share X {
        autotype Real
        autounit %/yr
        def {'Change in Market Share X Integrated';'Change  in Market Share X Individual'} [INDEX
            ('Restructuring Switch')]
    }
    aux Change in Market Market Share Y {
        autotype Real
        autounit %/yr
        def {'Change in Market Share Y Integrated';'Change  in Market Share Y Individual'} [INDEX
            ('Restructuring Switch')]
    }
    aux Change in Market Share X Integrated {
        autotype Real
        autounit %/yr
        def NORMAL(2<<%/yr>>;1<<%/yr>>)
    }
    aux Change in Market Share Y Integrated {
        autotype Real
```

```
    autounit %/yr
    def NORMAL(2<<%/yr>>;1<<%/yr>>)
}
aux COGS X {
    autotype Real
    autounit USD/yr
    def 'Sales X'*('Raw Material as Percentage of Sales X'+'Production Costs X as Percentage of Sales X')
}
aux COGS Y {
    autotype Real
    autounit USD/yr
    def 'Sales Y'*('Raw Material as Percentage of Sales Y'+'Production Costs Y as Percentage of Sales Y')
}
aux Constant Growth Rate X {
    autotype Real
    autounit %/yr
    def {'Constant Growth Rate X Integrated';'Constant Growth Rate X Individual'} [INDEX ('Restructuring
        Switch')]
}
const Constant Growth Rate X Individual {
    autotype Real
    autounit %/yr
    init 4<<%/yr>>
}
const Constant Growth Rate X Integrated {
    autotype Real
    autounit %/yr
    init 2<<%/yr>>
}
aux Constant Growth Rate Y {
    autotype Real
    autounit %/yr
    def {'Constant Growth Rate Y Integrated';'Constant Growth Rate Y Individual'} [INDEX ('Restructuring
        Switch')]
}
const Constant Growth Rate Y Individual {
    autotype Real
    autounit %/yr
    init 4<<%/yr>>
}
const Constant Growth Rate Y Integrated {
    autotype Real
    autounit %/yr
    init 2<<%/yr>>
}
aux Corporate Administration Expenses {
    autotype Real
    autounit USD/yr
    def 5000<<USD/yr>>
}
aux Corporate Marketing Expenses {
    autotype Real
```

```
    autounit USD/yr
    def 5000<<USD/yr>>
}
const Cost of Equity {
    autotype Real
    autounit %/yr
    init 10<<%/yr>>
    permanent
}
aux Earnings Unit X {
    autotype Real
    autounit USD/yr
    def 'Sales X'-'COGS X'-'Expenses X'
}
aux Earnings Unit Y {
    autotype Real
    autounit USD/yr
    def 'Sales Y'-'COGS Y'-'Expenses Y'
}
aux Equity Value X {
    autotype Real
    autounit USD
    def 'Earnings Unit X'/('Cost of Equity'-'Constant Growth Rate X')
}
aux Equity Value X and Y {
    autotype Real
    autounit USD
    def 'Equity Value X'+'Equity Value Y'
}
aux Equity Value Y {
    autotype Real
    autounit USD
    def 'Earnings Unit Y'/('Cost of Equity'-'Constant Growth Rate Y')
}
aux Expenses X {
    autotype Real
    autounit USD/yr
    def 'Administration Expenses X'+'Marketing Expenses X'
}
aux Expenses Y {
    autotype Real
    autounit USD/yr
    def 'Administration Expenses y'+'Marketing Expenses Y'
}
level Market Share X {
    autotype Real
    autounit %
    init 10<<%>>
    inflow { autodef  'Change in Market Market Share X' }
}
level Market Share Y {
    autotype Real
```

```
    autounit %
    init 10<<%>>
    inflow { autodef  'Change in Market Market Share Y' }
}
const Market X Size {
    autotype Real
    autounit USD/yr
    init 2000000<<USD/yr>>
    permanent
}
const Market Y Size {
    autotype Real
    autounit USD/yr
    init 1000000<<USD/yr>>
    permanent
}
aux Marketing Expenses X {
    autotype Real
    autounit USD/yr
    def {'Corporate Marketing Expenses'*2/3;'Marketing Expenses X Individually'} [INDEX ('Restructuring
        Switch')]
}
aux Marketing Expenses X Individually {
    autotype Real
    autounit USD/yr
    def 3500<<USD/yr>>
}
aux Marketing Expenses Y {
    autotype Real
    autounit USD/yr
    def {'Corporate Marketing Expenses'*1/3;'Marketing Expenses Y Individually'} [INDEX ('Restructuring
        Switch')]
}
aux Marketing Expenses Y Individually {
    autotype Real
    autounit USD/yr
    def 2500<<USD/yr>>
}
const Production Costs X as Percentage of Sales X {
    autotype Real
    autounit %
    init 35<<%>>
    permanent
}
const Production Costs Y as Percentage of Sales Y {
    autotype Real
    autounit %
    init 35<<%>>
    permanent
}
aux Raw Material as Percentage of Sales X {
    autotype Real
```

```
        autounit %
        def {'Raw Material X Integrated';'Raw Material X Individual'} [INDEX ('Restructuring Switch')]
    }
    aux Raw Material as Percentage of Sales Y {
        autotype Real
        autounit %
        def {'Raw Material Y Integrated';'Raw Material Y Individual'} [INDEX ('Restructuring Switch')]
    }
    aux Raw Material X Individual {
        autotype Real
        autounit %
        def 35<<%>>
    }
    aux Raw Material X Integrated {
        autotype Real
        autounit %
        def 30<<%>>
    }
    aux Raw Material Y Individual {
        autotype Real
        autounit %
        def 35<<%>>
    }
    aux Raw Material Y Integrated {
        autotype Real
        autounit %
        def 30<<%>>
    }
    const Restructuring Switch {
        type Integer
        init 1
        permanent
    }
    aux Sales X {
        autotype Real
        autounit USD/yr
        def 'Market X Size'*'Market Share X'
    }
    aux Sales Y {
        autotype Real
        autounit USD/yr
        def 'Market Y Size'*'Market Share Y'
    }
}
unit USD {
    def __CURRENCY("USD")
    doc US Dollars
}
```

Back to the Top