Master's Thesis in Informatics

Strategic understanding of a complex customer system

A field experiment at UNOSAT

Johan Jönsson
Geneva, Switzerland 2004

IT University of Göteborg
CHALMERS | GÖTEBORGS UNIVERSITET
Business Technology

REPORT NO. xxxx/xxxx

Strategic understanding of a complex customer system

A field experiment at UNOSAT

Johan Jönsson

Department of Informatics
Göteborg University

IT UNIVERSITY OF GÖTEBORG
GÖTEBORG UNIVERSITY AND CHALMERS UNIVERSITY OF TECHNOLOGY
Göteborg, Sweden 2004

Strategic understanding of a complex customer system

A field experiment at UNOSAT

Johan Jönsson

Report no xxxx:xx
ISSN: 1651-4769
Department of Business Technology
IT University of Göteborg
Göteborg University and Chalmers University of Technology
P O Box 8718
SE – 402 75 Göteborg
Sweden
Telephone + 46 (0)31-772 4895

Chalmers Repro
Göteborg, Sweden 2004

Strategic understanding of a complex customer system

A field experiment at UNOSAT

Johan Jönsson

Department of Informatics, Göteborg University

IT University of Göteborg

Göteborg University and Chalmers University of Technology

SUMMARY

Decision making today frequently fail because of an insufficient knowledge about the consequences decisions involves. Instead of experiencing identified effects from actions unexpected side effects occur. UNOSAT is an organization facing many challenges which forces the managers to accomplish several actions. One area where actions will be carried through is in their complex customer system. In order to learn more about this complex system the method System Dynamics has been used at UNOSAT. The purpose of this thesis is to study the effects of SD modeling and simulation on the strategic understanding of a complex customer system at UNOSAT. This research was carried out by identifying advantages and disadvantages of using the method in this environment. The study was completed within the boundaries of a field experiment at UNOSAT. Two interviews with decision makers in UNOSAT were made in this field experiment. The result of the study was an increased strategic understanding of interconnectivity among parameters, long term effects and change over time. Constraints of this increased strategic understanding derived from quantification of parameters and simplifications in the model.

This report is written in English.

Keywords: strategic understanding, complex systems, System Dynamics

Strategic understanding of a complex customer system

A field experiment at UNOSAT

Johan Jönsson

Department of Informatics, Göteborg University

IT University of Göteborg

Göteborg University and Chalmers University of Technology

SUMMERING

Beslutsfattande idag misslyckas ofta på grund av otillräcklig kunskap om konsekvenser som uppstår av beslut. Istället för att erfara redan kända effekter av beslut uppstår oplanerade sidoeffekter. UNOSAT är en organisation med många utmaningar framför sig som tvingar beslutsfattarna att genomföra flera beslut. Ett område där beslut kommer att fattas behandlar deras komplexa kundsystem. För att lära sig mer om detta komplexa system har metoden System Dynamik (SD) använts på UNOSAT. Syftet med den här studien har varit att studera effekterna av SD modellering och simulering på den strategiska förståelsen av ett komplext kundsystem på UNOSAT. Studien genomfördes inom ramen för ett fält experiment på UNOSAT. Två intervjuer med beslutsfattare i UNOSAT utfördes i detta fältexperiment. Resultatet av utvärderingen var en ökad strategisk förståelse för samband mellan parametrar, långsiktiga effekter och förändring över tid. Begränsningarna för den strategiska förståelsen identifierades som kvantifiering av parametrar och förenklingar i modellen.

Rapporten är skriven på engelska.

Nyckelord: strategisk förståelse, komplexa system, System Dynamik

Acknowledgements

After seven months this thesis is completed. I have experienced a period of continuous learning surrounded by excellent people. This knowledge frenzy makes me feel very privileged and truly grateful. The people who made this possible were Martin Börjesson, Olivier Senegas and Maria Poutilova. Also many thanks to Alain Retiere, Einar Bjørgo, Ian McClellan, Tim Gahnström, Francois Grey and Andreas Hirstius.

I give you my deepest gratitude. Thank you!

Johan Jönsson
masterthesis@johanj.se

Table of content

TABLE OF FIGURES

APPENDIXES

1. Introduction

This chapter introduces the thesis. It presents the problem and its background. The research problem with research questions are also presented together with delimitations, target group of the thesis, an outline of the chapters and some key concepts.

1.1 Background

Implemented policies in today's decision making often fail. One major reason for these failures is lack of knowledge about the consequences that policies create. Usually side effects (which are only unanticipated effects) occur and produce a behavior that is not wanted in systems. To avoid these unanticipated effects managers need to find a tool which can unfold and test the structure of systems causing the unwanted behavior. (Sterman, 2000)

For many years the exclusive paradigm in the world has been studying parts of a system in great detail. The last forty years a new method has been developed contrasting this paradigm. It uses computer simulation to study the whole and the dynamics in complex systems. This method, called System Dynamics (SD), works with conceptual modeling and simulation and has the possibility to change mental models of people. SD does this through identifying the dynamic characteristics and the major constraints in a system and also through understanding the consequences of alternative scenarios (Olofsson & Sixtensson, 1997). Different variants of perspectives have developed from SD. One of these perspectives is the field studying how dynamics of resources can improve strategy development. (Warren, 2002) SD and dynamics of resources are tools with the potential of increasing knowledge about complex systems and their structure.

1.2 Problem area

Many organizations act in highly volatile environments where internal business and market changes occur which demand a good *strategic understanding*. These problems are found in UNOSAT. In order to face future years' changeable context it's most important for UNOSAT to be prepared. One way of doing this preparation is to plan for the future. Planning includes using formalized procedures and articulated results specifically concerning an integrated system of decisions (Mintzberg, 1994). In order to support this *strategic understanding* in UNOSAT this study intends to use SD and create an interactive learning environment where managers can try different decision policies. From this description of the problem the following research problem is defined.

1.3 Research problem

The purpose of this thesis is to study the effects of SD modeling and simulation on the strategic understanding of a complex customer system at UNOSAT.

Three research questions are identified from the research problem:
- Can SD increase the *strategic understanding* of the *complex customer system* at UNOSAT?
- Which are the advantages of using SD at UNOSAT?
- Which are the obstacles of using SD at UNOSAT?

1.4 Research object

After this introduction of the background and problem areas that are connected to the research problem a presentation of the research object is made. It is divided into three subsections which present first United Nations second UNOSAT and last UNOSAT's perspective on their customers.

1.4.1 United Nations System

After two world wars the organization United Nations (UN) was founded. More exactly the UN was founded on the 24th October 1945. The purposes of UN are:

> *"…are to maintain international peace and security; to develop friendly relations among nations; to cooperate in solving international economic, social, cultural and humanitarian problems and in promoting respect for human rights and fundamental freedoms; and to be a centre for harmonizing the actions of nations in attaining these ends." [Internet, 1]*

Today the UN is a very large organization with a budget of $ 2,535 million for the years 2000-2001. The UN has six principal organs and a lot of programs and agencies within these organs. The organ of interest for this thesis is the General Assembly (GA). Within the GA one can find the organizations UNITAR (United Nations Institute for Research and Training) and UNOPS (United Nations Office for Project Services).

UNITAR works towards enhancing the effectiveness of UN through training and research [Internet, 2]. UNOPS is dedicated to project management in all the fields were UN is active. It can range from landmine awareness to informatics solutions [Internet, 3]. An overview of the UN-system in the shape of an organization chart is provided in appendix 8.

1.4.2 UNOSAT

In the beginning of 1999 the UNOSAT project was initiated by UNOPS. The reason for initializing UNOSAT at this time was the Brahimi report. The Brahimi report was ordered by general secretary Kofi Annan and states the need to improve the performance of missions within the UN. The report also recommends an increased use of geographical information and related management tools in the UN agencies. (UNOSAT, Business Plan)

From this need of geographical information UNOSAT was born. The goal of UNOSAT is to provide satellite imagery (standardized and customized) and geographic information to the UN humanitarian community in the most straightforward, efficient and cost-effective manner possible. UNOSAT employs ten persons, each of them specialists in their specific area, from countries all around the world. (UNOSAT, Business Plan)

Two main ideas dominate the offers of UNOSAT. The first idea is described as making access to Earth Observation (EO) derived products through a central portal. The second idea is mutualising the cost of using EO-derived products among users. (UNOSAT Business Plan) An example of non-mutualising costs occurred during the invasion of Iraq last year. Four different UN-organizations bought the same kind of satellite images covering Iraq at ordinary prices from data providers. (Alain Retiere, 2 January 2004)

1.4.3 UNOSAT's customer strategy

In order to fulfill the research problem of this thesis it is important to describe the level of understanding of the customer system, within UNOSAT, as it was before this thesis was initialized. Following information in this section is collected from UNOSAT's business plan.

The marketing strategy of UNOSAT was mainly divided into three parts. A first part described how UNOSAT aimed to market its organization within certain domains. This marketing was going to be carried through by presence on seminars and conference within UNOSAT's sphere of interest and brochures etc. Research publications were also considered to support the marketing. The background for this marketing is made since UNOSAT is a young organization and not well known.

The second part consisted of training for targeted customers. Targeting customers with special training was done in order to increase the awareness level. This level was particularly low since satellite imageing is a new technology that is not well known. The training was formed as project oriented direct support and later training through packages and tutorials.

The third part of UNOSAT's marketing strategy contained their web portal. This was built in purpose of being an important interface towards the customers. In some cases the most important interface. Another technological tool (a database) was built in order to collect relevant information about customers.

A segmentation of the customers was made within UNOSAT in order to provide different services and products. The customers were categorized in certain homogenous groups due to three different criteria. These were objectives of the customer, which phase the customer had reached in his work and the thematic to be approached by the customer. Nine different groups of customers were created in order to describe UNOSAT's target groups. In addition to the marketing strategy and customer segmentation completed at UNOSAT a SWOT analysis was fulfilled.

1.5 Delimitations

Due to different constraints me and my clients at UNOSAT have had, delimitations of this thesis were necessary.

- The use of SD has been focused mainly on the complex system of customers.
- My study has been focused on the management of UNOSAT. Mainly three managers have been targeted by the study.
- Customer interviews have been omitted both due to time and lack of relevance in the model.

1.6 Outline of chapters

The introduction chapter of this thesis describes the background of this research area and presents the problem. It also contains the research problem, delimitations, the target group and key concepts. Chapter two describes the methodology and methods used in this thesis. The third chapter which presents the theoretical framework contains of four major sections. These four sections are an introduction to *strategic understanding*, a presentation of dynamic modeling, SD contrasted against another method and a section about how to apply SD. Chapter four contains the empirical result presented as the project process, interview responses and the modeling process. The fifth chapter presents the analysis of this thesis

where the empirical result is analyzed from the theoretical framework. The analysis is divided into four sections which are named initial understanding, effects of SD on the strategic understanding, the modeling process and key effects. Chapter six contains personal reflections and interpretations of the thesis and the seventh chapter contains the final conclusions and suggestion for further research.

1.7 Key definitions

A complex system is defined as complex when one or more of the following three components are involved; feedback processes, nonlinearities and delays. (Sterman, 2000 & Senge, 1990) In this thesis is a customer system studied where all three components are involved. The customer system is consequently called a *complex customer system*.

Strategic understanding is different from, for example, operational understanding. Strategies aim for a longer term planning of actions in organizations. (Mintzberg, 1994) *Strategic understanding* is considered in this thesis to be the understanding of UNOSAT's *complex customer system* in a longer term perspective.

System Dynamics is a method used for enhancing the understanding of complex systems. The method is used as a conceptualization tool and to be able to perform computer simulations. (Sterman, 2000) In this thesis the method has been used for building a model of UNOSAT's *complex customer system* together with simulations of this model.

2. Method

This chapter aims at putting this study in a broader context and describing the path to answer the research problem. It describes the methodology, gives an explanation of the methods, discusses the quality standards and reports about method problems.

2.1 Methodology

In this study field experiment has been used. An experiment can be defined to:

> *"…draw conclusions about cause-and-effect relationships – to be able to say with confidence that variable X caused or influenced variable Y." (Sacket and Larson, pp 443)*

This experiment was defined following the quotation mentioned above. This study's experiment did not have any specifically created context for its purpose and is therefore considered to be a field experiment and not a laboratory experiment. Three criteria are commonly agreed upon in order to draw cause-and-effect relationships which is a part of field experiments. When applying the first two criteria on this study no particular issues arise. But when applying the third criteria one of the major drawbacks with field research occurs. This problem is described in method problems. The first criterion is described as the assumed cause (independent variable) must systematically change the corresponding dependent variable. The second criterion is that the independent variable must precede the dependent variable. The third criterion states that all plausible alternative causal relationships must be ruled out. (Sacket and Larson, 1990) The independent variable in this study has been defined as SD. The dependent variables have been defined as the *strategic understanding* of UNOSAT's dynamic customer system.

One of the advantages of doing this study as a field experiment is the long time span (six months) during which the work has been accomplished in comparison to laboratory experiments. This long time span entails generalizability to longer time spans (Sacket and Larson, 1990). This study has been accomplished in the context of UNOSAT and because of that it creates a more meaningful attitude among the subjects according to Sacket and Larson. This attitude made the subjects more involved than they would have been in another context. The combination of above mentioned strengths created another advantage because it made the subjects be less aware of the experiment (Sacket and Larson, 1990). This increased the probability of the subjects to act naturally. The impact this field experiment has had on the reality is also considered to be a strength by Sacket and Larson (1990). An example of an impact this study has had is increased *strategic understanding* of UNOSAT's dynamic customer system.

During this study a qualitative perspective on data collection and analysis was used (Davidsson & Patel, 1994). A deeper and more holistic understanding of this studies research problem has been strived for. During the study I was also part of the environment where the research object was located. Throughout the research process awareness about my effect on the research object has been present. (Davidsson & Patel, 1994 and Backman, 1998)

This study follows the path of hermeneutics. Hermeneutics derives from the Greek word hermēneutikos which means "related to explaining" in the sense of making the unclear clear (Bauman, 1992). The attributes of hermeneutics from which this study is conducted are

understanding and interpreting people and their lives. A hermeneutic researcher approaches his research object with his own understanding as an advantage, not an obstacle as in positivism. Hermeneutics also brings out the importance of studying the whole in relation to the parts. (Davidsson & Patel, 1994)

While conducting this study the hermeneutic spiral has been constantly used as inspiration and a reference mode for learning. The hermeneutic spiral consists of an endless recapitulation and reassessment of collective memories (Bauman, 1992). According to Eriksson and Wiedersheim-Paul (1999) the hermeneutic spiral is based on pre-understanding. From this pre-understanding questions etc. are generated and create a link to the research object. From the interview questions asked a better understanding has been gained and generated new questions.

This study didn't intend to change the environment where it was performed in. Dick (2002) states that this is one main characteristic of action research. This characteristic was one of the main reasons to not choose action research. The change in UNOSAT shall be generated by the people in UNOSAT. Another reason was the co-decision making between deciders and doers that is characteristic for action research (Dick, 2002). In this study the decision making has been carried through by me as researcher. According to Yin (1984) is case study the method to choose when the phenomenon under study is not readily distinguishable from its context. In this study it has been easy to distinguish UNOSAT as the research object. The organizational borders are the natural frame of this research object.

2.2 Methods

In the previous section a description of the methodology used in this study was given. Methodology has a general and philosophical meaning while method is described as the tools being used for data collection. (Blaxter, Hughes and Tight, 1996) This section will deal with the method used in this study.

2.2.1 Problem identification

From the idea of this study to a relevant research problem discussions have been intense. The problem identification was made in discussions with Mr. Retiere (UNOSAT), Mr. Senegas (UNOSAT) and Mr. Bjorgo (UNOSAT). The identified problem was then developed and verified in cooperation with the supervisors of this study, Martin Börjesson and Maria Poutilova.

2.2.2 Literature study

In order to develop the research problem and create a theoretical framework this study has collected literature mainly from the areas of SD, Systems Thinking and Strategy Development. The literature for this study was collected primarily from Geneva University Library and Gothenburg University Library's electronic resources.

2.2.3 Empirical study

In this study both secondary and primary data were collected. The modeling process, interviews and observations are all sources of primary data. The secondary data has been collected through organization specific documents.

System Dynamics

In order to study the *strategic understanding* when using SD it's elementary to work according to recognized methods in the area of SD. An extensive description of SD can be found in section 3.2.2. The work of SD in relationship with the development of UNOSAT strategic knowledge creates the base of this study. In order to study the effects of SD modeling and simulation on the strategic understanding UNOSAT management, interviews have been made.

Interviews

The interviews performed have been qualitative and focused. According to Darmer and Freytag (1995), several different qualitative interviews exist with different levels of structure. The interview chosen in this study is the focused interview which is similar to semi structured interviews. With focused interviews it's important to ask planned questions during the interview without losing the flexibility of following interesting side lines. The area of response has been large but not unlimited for the respondent. While commencing the interviews, confidence was already created with the respondents during the modeling process. The interview questions can be found in appendix 1 and 2. Interviews were made with two decision makers at UNOSAT. In UNOSAT were totally three persons relevant to interview due to their working tasks and position in the organization. Of these three decision makers, one respondent was not available for an interview.

Observation

Throughout the study direct observations have been carried through while working with UNOSAT. UNOSAT is characterized by its small and familiar organization. It has therefore been easy to take part in the daily activities at UNOSAT. These direct observations have given an increased understanding of the context and complexity of UNOSAT.

Documents

This secondary data derives from various documents in UNOSAT. The documents used in this study are amongst others UNOSAT's business plan. The documents are categorized as organization specific documents and are not public. The documents have provided an increased understanding of the organization.

2.2.4 Data analysis

The interviews have been analyzed with a qualitative perspective from the literature collected for this study. In order to manage the collected data these were labeled and selected before they were summarized in the documentation. The labeling was made with certain quotations in order to easily compare between the interviews. The selection of quotations was also made in order to facilitate the comparison between the interviews. From this work a summary of the empirical data was documented in the thesis. The documents analyzed in this study have been regarded in their context and with the awareness of their purpose and their underlying assumptions. The interviews have been examined with awareness of the context the interviews have been completed in. Finally observations have also been made. These observations have mainly been regarded in the analysis as contextualizing support. (Blaxter, Hughes and Tight, 1996)

Interpreting the data from the modeling process is an extensive process which will be documented in a separate report. This report can be requested from the author of this thesis. A summary of the conclusions of the model analysis is presented in appendix 5.

2.3 Quality standards

The intention of this study was to study the effects on the *strategic understanding* of the *complex customer system* at UNOSAT when using SD modeling and simulation. This goal was completed and therefore the study can be considered to have high validity according to Holme & Solvang (1997).

The selection of respondents was made by asking the three potential interviewees for interviews. Two of them were able to attend an interview. The third cancelled interview was a problem. Reliability deals with the question if the collected data is reliable (Holme & Solvang, 1997). Because one interview is missing, this study has a problem with the reliability. According to Holme & Solvang (1997) is this not a grave problem since this study aims for better understanding of certain factors and therefore are the statistical representatives not essential.

In order to improve the interviews as much as possible these were analyzed immediately after completion. From this analysis it was then possible to identify at least two more important questions appearing during the first interview. According to Davidsson and Patel (1994) is it important to perform a dynamic analysis. When analyzing immediately after the interviews one gains the advantage of being able to rework the interview for the next respondent and one also has the responses in fresh memory.

Since the effects of soft factors have been measured in the modeling process certain issues were faced which needed to be solved. One issue was if the answers from the respondents were going to be quantified. This was not done because the relevance of doing so was too low. If the quantification would have been carried through before the modeling process it would have probably been useful to use this after the modeling process also.

2.4 Method problems

Controlling plausible alternative causal relationships to not interfere with the studied variables has been a very difficult task in this study. Sacket and Larson (1990) emphasize this problem as the major drawback of field research. When drawing conclusions about cause and effect the risk of ambiguity increased since a complete control of all plausible alternatives didn't exist.

One issue during the study has been the impact on the modeling process from me, my supervisors and UNOSAT. This impact has been both an advantage and a disadvantage. The advantage has been accentuated in the perspective of creating a high quality model. This discussion is unfolded in section 4.3.1. The impact has been a disadvantage in the sense of interfering with the research object. This interference occurred only while modeling with SD, which was necessary. When studying the effects of SD modeling and simulation no interference occurred. In order to increase the transparency in the modeling process the strongest impacts are documented in section 6.2.2.

The last problem during the study was lack of one interview. This interview represented the third and last person involved in the modeling process. The implications of this missing interview are uncertain.

2.5 Summary

This study has used a research approach named field experiment. The reason for this choice was the need of studying changes in *strategic understanding* of the *complex customer system* in UNOSAT. Throughout the study a qualitative perspective has been used on data collection and analysis.

The data collection methods used were a SD process, interviews, observations and documents. The selection of the interviews was made from the involved clients in the SD process. The interviews were qualitative and focused. In order to understand the method SD is it useful to contrast it with, for example, SSM (soft systems methodology, see section 3.3). The biggest differences are a stronger focus on learning in SD, a resource dynamics perspective and interactive learning environments in SD.

The biggest methodical problem has been lack of a third interview with the last client. This interview would have probably contributed important information. Unfortunately were the circumstances of this omitted interview exogenous of this thesis.

3. Theoretical framework

In this chapter strategic perspectives on customers are presented together with a presentation of SD connected to strategy development. After this presentation the basics of SD are evolved together with a contrasting methodical section. Finally is a section on how to use SD introduced.

3.1 Strategic understanding

The purpose of this thesis is to study the effects on *strategic understanding* of the *complex customer system* when using SD modeling and simulation in UNOSAT. Studying effects of a *strategic understanding* separates it from an operational understanding which is a level of understanding close to the work tasks accomplished in an organization (Mintzberg, 1994). In order to understand the concept of *strategic understanding* it is necessary to unfold the meaning of a strategy. In this section strategy will also be related to SD.

A strategy is a dynamic concept which has changed over time and different definitions exist. According to Nordstedts Swedish dictionary and Collins English dictionary is a strategy a long term overarching procedure or plan. The word strategy derives from the ancient Greeks where the word meant a general in the army. In the business context the word strategy has only been used since the twentieth century. (Ghemawat, 2002)

Ghemawat (2002) provides an extensive description of different views on strategy during the second half of the twentieth century. One of the concepts during the sixties was matching the strengths and weaknesses of an organization with the threats and opportunities of the market. This framework is commonly called SWOT analysis and is popular even today. Warren (2002) claims SWOT to be obsolete and useless since it lacks the ability of understanding accumulation and dependency in and between resources. During the eighties Michael Porter developed a framework with five different forces for analyzing an industry. The five forces were substitutes, new entrants, suppliers, buyers and industry competitors. During the nineties a resource based view on strategy has been developed and later extended with a dynamic perspective (see section 3.2.3)

3.1.1 Customer strategies

Since a *complex customer system* is studied in this thesis it is interesting to unfold different ways of approaching customers. Two commonly discussed categories of marketing strategies are one-to-one marketing and mass marketing. These two strategies will be extended below.

One-to-one marketing and mass marketing

One-to-one marketing is basically about eliciting needs and preferences from the customer and provide him/her with customized products or services. Mass marketing on the other hand is a product oriented strategy where global campaigns are made in order to promote a product. (Pine, Peppers and Rogers, 1995) Pine, Peppers and Rogers define mass customization and one-to-one marketing as part of a learning relationship since the vendor learns more and more about its customer. The more knowledge a vendor can learn from the customer the stronger his competitive advantage grows. The threshold for changing a vendor is consequently increased over time. In a mass market strategy several alternatives are produced and offered to the customer by pushing out the products into distribution channels. The customer must then

choose from several standardized products. The threshold for changing a vendor is naturally lower for a customer approached by a mass market strategy. (Pine, Peppers and Rogers, 1995)

An example of a learning relationship is online news distributors where organizations customize what customers want to read about. Digitized products and services are particularly suitable for this mass customization since they are easily configured to suit personal needs. According to Dewan, Jing and Seidmann (1999) this type of marketing strategy (learning relationships or one-to-one marketing) has only been feasible between businesses, and not between businesses and consumers, until today. With the development of Internet the situation has changed. Internet is an enabling technology facilitating collection of information about customers. In the concept Internet are technologies like the following included (Dewan, Jing and Seidmann, 2000??):

- IP addresses
- Log files
- User registration and authenticated access
- Cookies
- Collaborative filtering

In order to have a learning relationship with customers it is necessary for a company to consider four different components. These are information strategy, production/delivery strategy, organizational strategy and an assessment strategy. An information strategy shall increase an organizations possibility of collect and manage information about customers. Privacy issues are not considered to be a constraint for a learning relationship. According to the production/delivery strategy it is necessary to create modules and processes which can be assembled in different ways and thereby creating cost-efficient customized products and services. Furthermore a design tool is necessary in order to use this information about the customer requirements in the best possible way. The organizational strategy is emphasizing the use of customer managers instead of product managers. The customer manager is responsible for a certain number of customers with similar needs. In addition to the customer manager a capability manager should work with executing processes in order to fulfill requirements from customers. Finally an assessment strategy is needed in order to judge which customers are worth building learning relationships with. A proposed way of judging this is studying the life time value of a customer. That would be the sum of all profits in the future of this customer discounted back to its present value. (Pine, Peppers and Rogers, 1995)

One way of working with mass marketing is to initialize global campaigns aiming for many people with a standardized product but with customized distribution and/or communication. This action assumes the people targeted to be fairly homogenous. A mass marketing strategy is expensive and entails therefore a high risk. Successful mass marketing strategies today often use cross national segments in order to create homogenous groups targeted by their marketing. That's why it is important to remember that market segments or groups are created by managers in order to ease the understanding of their customers. (Wedel & Kamakura, 2002)

3.1.2 E-Strategies

This section will describe interactions between strategy and electronic businesses. Both e-commerce and e-business are used for describing business relationships between companies and consumers via Internet.

E-commerce strategies are sustainable in small and medium sized young enterprises when the entrepreneurs have a systemic view of certain critical success factors. All critical success factors are dynamically connected and derive from accumulation and depletion processes of strategic resources. Because of this dynamic environment a company must cultivate their accumulation and depletion processes in order to have a sustainable advantage. These accumulation and depletion processes derive from feedback loops. Consequently it is highly important to study these accumulation and depletion processes derived from feedback loops in order to have a solid e-commerce strategy.(Bianchi & Bivona, 2002)

Another e-business strategy, for companies selling to consumers, called "get big fast" (GBF), is discussed by Oliva, Sterman and Giese (2003). This strategy implies higher awareness of positive feedback loops as strategic advantages. Examples of these positive feedback loops are network effect, scale economies and learning curves. The suggested strategy according to GBF loops is to grow as rapidly as possible in order to obstruct competitors. This growth involved lowered prices, alliances between organizations and aggressive marketing. Oliva, Sterman and Gieses explanation of many e-business firms failure is based on the fact that positive feedback loops were triggered mistakenly in the wrong direction and became negative feedback loops. The GBF works under the condition that reinforcing feedback loops exist and that these loops have enough time to develop. In order to avoid earlier mentioned failures it is very important to balance between attracting customers (low prices and aggressive marketing) and expanding existing infrastructure (more staff handling customer service etc).

A policy recommendation is given by Oliva, Sterman and Gieses (2003) to organizations which consider GBF. This recommendation is:

> *"…balancing investment in different resources so that overall attractiveness remains high, using price to ensure that demand growth does not outstrip the ability to build key organizational capabilities, and ensuring a transition to profitability before the capital markets demand it." (Oliva, Sterman and Gieses, 2003, pp. 113)*

A highlight is given to the service quality as an important driving force for attractiveness. Oliva, Sterman and Gieses (2003) even argue for deliberate overstaffing in order to avoid making the reinforcing feedback loops act in opposite direction. A successful case mentioned is the telematics system OnStar from General Motors. In this case reinforcing feedback loops were identified and tackled with overstaffing in call centers in order to foster growth.

Two perspectives on e-business strategies were given above. An argument not to talk about e-business strategies at all is found in Porter (2001). He argues that Internet is an enabling technology, or a set of tools, which can be used in almost any strategy. Porter believes that Internet technology shall be built on the existing strategy and thereby become a complement to already existing advantages.

3.1.3 Strategy and System Dynamics

Strategy analyses often rise from problems needed to be solved. The circumstances are analyzed and options are evaluated before decisions are taken about what action to implement. These actions are the result of the strategic analysis. The role of SD in this work is facilitating the understanding of the problem, determining the consequences of actions

planned to be implemented and testing alternatives in different plausible outcomes for the future. (Lyneis, 1999) Lyneis believes SD is an effective tool in supporting business strategy development. Detailed calibrated models are necessary in order to provide the best support.

Goals of developed strategies are sometimes impossible to fulfill for a company even if the strategy itself is followed and achieved. When developing goals for a strategy a question of feasibility is often forgotten. This is emphasized by Richmond (1997) who suggests an increased use of strategic forums to stress the question of feasibility of goals set. These strategic forums have two purposes that depend on time scales. The short term purpose is enabling a cross functional management team to build a shared understanding of the business and thereby fulfilling the goals already set. The long term purpose is to introduce Systems Thinking and SD in order for the members of the management team to understand their business as one system where the pieces are related to each other.

Lyneis (1999) considers the development of strategic work with SD to have evolved from a product perspective to a process perspective. The product perspective was focused on solving the customers' problem and to deliver a solution even if it was not always implemented. During the 1980s an increased focus was directed to using models in order to support strategies. Morecroft (1984) describes this support as the interaction between decision makers and model builders in order to challenge the preconceptions of management. Morecroft emphasizes the importance of creating clear scenarios which can be debated. The strategy support described by Morecroft is illustrated in the following figure.

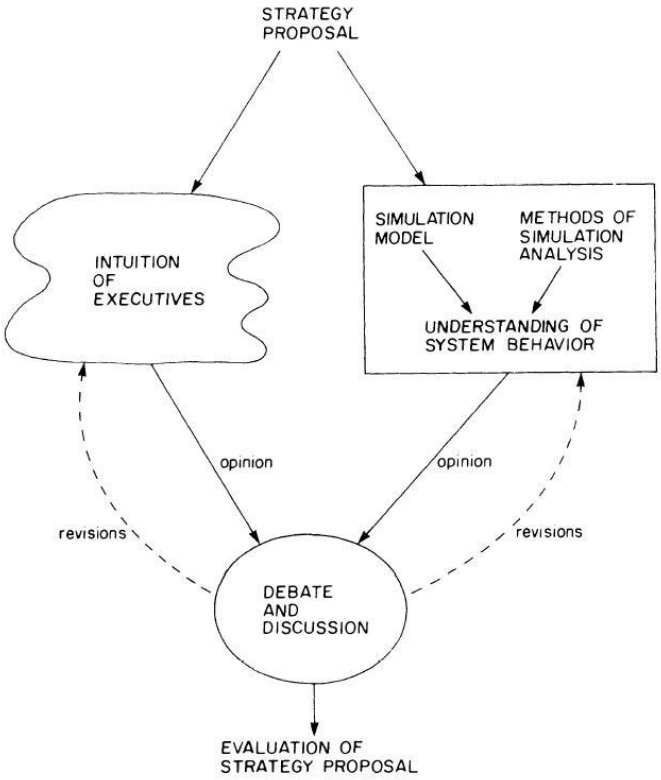


Figure 1: SD supporting strategy development Source: Lyneis (1999)

Lyneis (1999) proposal is described as a balance between process and product. It contains four phases which are:

1. Business structure analysis
2. Development of a small insight-based model

3. Development of a detailed calibrated model
4. On-going strategy management

These phases are aimed to fulfill the four particular outcomes. One outcome is the understanding, structure and the analysis of the customers' problem. Another outcome is educating the customer about their organizations dynamics and making the client participate in order to avoid black box modeling. The third outcome is to sell the decided actions that are planned to be taken within the organization to the members of the organizations itself. The last outcome is to secure long term learning by providing means of learning and planning through the model. (Lyneis, 1999)

Business structure analysis is mainly about identifying and defining the problem and its causes. The goals of the clients are also mapped as the internal structure and other data gathering activities. This phase builds on the foundation of Systems Thinking which Lyneis (1999) defines as behavior-over-time graphs (reference modes), causal loop diagrams (mixed with stock and flow), system archetypes and mental simulation. Two limitations are highlighted by Lyneis. It is the fact that causal loop diagrams are narrow and drawing conclusions from these might be dangerous since other affecting factors might exist. The second problem is that the complexity of modeling more than two or three feedback loops in a causal loop diagram entails difficulties for the human mind to grasp.

According to Lyneis (1999) one of the biggest advantages with SD is to build and analyze formal computer models. This is best done in two different steps. The first step is to build a small insight-based model which is then, in the second step, developed into a detailed quantified model. Building small insight based models are characterized by exploring the relationship between system structure and problem behavior and also by only containing the structures needed to create this problem behavior. Small insight based models have naturally an high aggregation. These models are also part of what Lyneis states as phase number two. Phase number three on the other hand contains the development of a detailed calibrated model. This phase is the last building step and the purpose is to add structure that is missing in the small model in order to recreate the problem behavior and studying the cost-benefit of alternative choices. Since information is gathered often on a very detailed level the model shall reflect this information. This is the third purpose of creating a detailed model while the fourth and last purpose is to sell results of the modeling to people not close to the modeling.

3.2 Dynamic Modeling

In this section a presentation of the tools is done. This section also contains a presentation of the resource perspective which can be successfully used with SD.

3.2.1 Introduction

> *"From a very early age, we are taught to break apart problems, to fragment the world. This apparently makes complex tasks and subjects more manageable, but we pay a hidden, enormous price. We can no longer see the consequences of our actions; we lose our intrinsic sense of connection to a larger whole." (Senge, 1990 p. 3)*

With these words Peter Senge introduces his book "The fifth discipline". "The fifth discipline" is, except for the book title, a conceptual framework described as Systems

Thinking. Systems Thinking consists of a body of knowledge and tools aiming at making patterns clearer and helping to change the patterns. (Senge, 1990)

The other four disciplines are personal mastery, mental models, building shared vision and team learning. With these disciplines Senge discusses learning organizations.(Senge, 1990)

Systems Thinking

Systems Thinking aims at seeing the whole. It's a discipline characterized by identifying interrelationships and patterns of change. Systems Thinking help users see the underlying structure of complex situations. (Senge, 1990) When studying the whole, variables in a system might be exogenous or endogenous. Exogenous variables are factors not possible to affect, for example the weather. Endogenous variables are variables within a system which are affected by the system. A common mistake is to consider endogenous variables to be exogenous. Then variables which are possible to affect are considered to be out of control for the system. SD seeks endogenous explanations for a phenomenon. (Sterman, 2000)

Senge also states that the core of Systems Thinking lies in a shift of mind from

> *"Seeing interrelationships rather than linear cause-effect chains, and seeing processes of change rather than snapshots." (Senge, 1990 p. 73)*

Dahlbom (1996) argues against Systems Thinking as a way of understanding the complex system of information technology. He stresses that one should not give up System Thinking for reductionism. The essence is instead that the notion of System Thinking is not useful when it comes to information technology. Dahlbom (1996, p. 18) believes that,

> *Systems thinking is the perspective of machine technology, network thinking is the perspective of information technology.*

Sterman (2000) introduces a concept called policy resistance. Policy resistance is a behavior in a situation when unexpected effects occur due to implemented policies. These unexpected effects are often negative for the purpose of the policy and might destabilize a situation needed to be stabilized. Common ways of describing these unexpected effects are "side effects". Sterman states that side effects don't appear in reality; only effects do.

Often side effects and consequently policy resistance occurs due to an event-oriented approach to complex systems. Decisions are also made as if cause and effect were closely linked in time and space. This belief entails unanticipated effects to occur because of too narrow time frame. An example of event-oriented approach is described in figure 1. (Sterman, 2000)

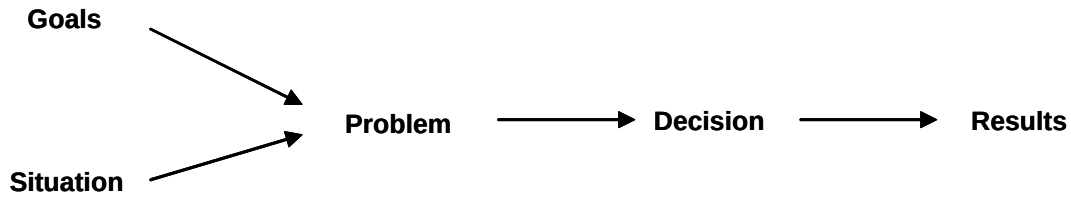


Figure 2: Event-oriented view of the world. Source: Modified from Sterman (2000).

Both Sterman (2000) and Senge (1990) argue in favor of a perspective studying reality from circles of causality instead of linearity. The linearity perspective is one of the largest

limitations for systems thinkers according to Senge (1990). One example of the difference between linear and causal circularity thinking is filling a glass of water. When describing this situation you usually say "I'm filling a glass of water".

Figure 3: Linear causality

If you would have used a circular causality approach you could have described the situation as follows: "My intention to fill the glass with water creates a system causing the water to flow when the level is low and stops the flow when the glass is full". (Senge, 1990)

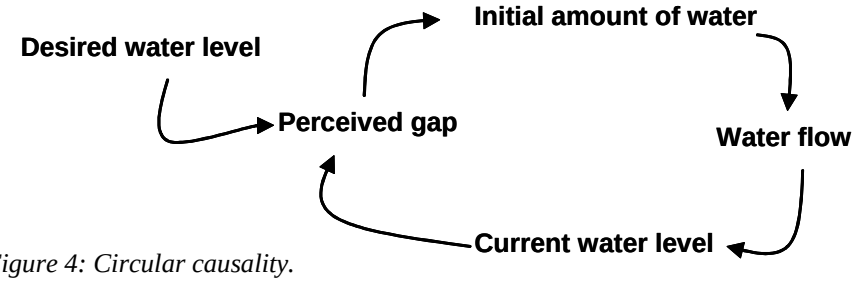


Figure 4: Circular causality.

With this example two very important concepts are presented. The first is the importance of feedback processes which is the difference between an event-oriented approach and circular causality. The second is the idea of a human actor as the center of reality. In Systems Thinking the human actor is regarded as a part of the feedback processes and not as a single part standing alone (Senge, 1990).

Systems Thinking and System Dynamics

A similar concept to Systems Thinking is SD. SD is the method taking the user from generalization about learning and Systems Thinking to tools and processes helping him/her understand complexity, design better operating policies and guide change in systems. (Sterman, 2000)

> *"Systems thinking looks at exactly the same kind of systems from the same perspective. It constructs the same causal loop diagrams. But it rarely takes the additional steps of constructing and testing a computer simulation model, and testing alternative policies in the model." (http://www.systemdy-namics.org/, 2003-12-23 14:03)*

In the context of students learning for the 21st century Systems Thinking is thinking about systems, talking about characteristics of systems, acknowledging that systems are important and discussing system archetypes. Systems Thinking can be both incentives and a door opener to study systems further. But it doesn't change the students' mental models and is considered to be five percent of the systems education. SD on the other hand is learning by doing. Since Systems Thinking is a participative activity it's likely for students to change mental models while absorbing in SD.(Forrester, 1994)

3.2.2 System Dynamics

> *"System Dynamics is a method to enhance learning in complex systems", (Sterman, 2000 p. 4)*

The main objectives of SD are learning about dynamic complexity, understand the sources of policy resistance and design more effective policies (Sterman, 2000). Sterman also states the importance of feedback processes in the determination of the dynamics of a system. In addition to the feedback processes are the time delays and nonlinearities. Time delays and nonlinearities will be unfolded further in this section.

Feedback

In this chapter Systems Thinking feedback processes have been introduced. The concept will be further discussed below. The term feedback is often used in situations where criticism is involved. This is not the case when discussing SD. Feedback in this study is consequently not something you receive from your boss or a friend.

The interaction of two types of feedback processes creates all dynamic in a system. These feedback processes are usually named positive and negative feedback loops. The positive feedback loop is self reinforcing while the negative feedback loop is self correcting. (Sterman, 2000 & Senge, 1990)

Positive feedback loops are the engines of growth. It's a process of reinforcing objects amplifying each other. An example of positive feedback loops is the cold war and the nuclear weapons reinforcements. The more nuclear weapons NATO built the more nuclear weapons Soviet Union built. The more nuclear weapons Soviet Union built the more nuclear weapons NATO built. (Sterman, 2000) Another example of a positive feedback loop is Microsoft Windows. The more desktop computers using Microsoft Windows the more applications will be developed in compliance with this environment. The more applications available for Microsoft Windows the more desktop computers will have Microsoft Windows installed.

Positive feedback loops are also the engines of accelerating decline.(Senge, 1990) If Microsoft Windows declines in numbers on desktop computers the software development will be less and it will decline even further. Nothing can grow forever because at some moment limiting effects will enter the situation. These limiting forces are the negative feedback loops.

Negative feedback loops are counterintuitive and oppose change. They describe processes that are self limiting and seeking balance or equilibrium. An example of negative feedback loops is an attractive neighborhood that generates large immigration. With the immigration comes larger unemployment, crowded schools etc. causing the neighborhood to be as attractive as other neighborhoods and decreases immigration.

According to Sterman (2000) do all dynamics of a system arise from the two mentioned types of feedback loops. With multiple loops it's necessary to model them in order to survey the situation. For this purpose causal loop diagrams or stock and flow structure might be used. An example of positive and negative feedback loops, modeled with causal loop diagram, are shown in figure 4.

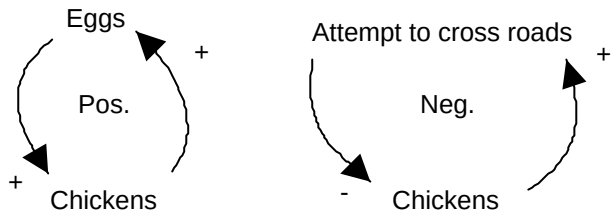


Figure 5: Positive and negative feedback loops. Source: Modified from Sterman (2000)

Causal loop diagrams are an effective tool for capturing mental models and communicating important feedback loops. It's also useful when quick hypothesis capturing is needed. In a causal loop diagram arrows connect the different variables affecting each other. Each arrow, or causal link, is assigned with a polarity. The polarity are either plus or minus where plus stands for a reinforcing (positive) link and minus for a self correcting (negative) link. (Sterman, 2000)

An example of a positive feedback loops, modeled with a stock and flow structure, are illustrated in following figure.

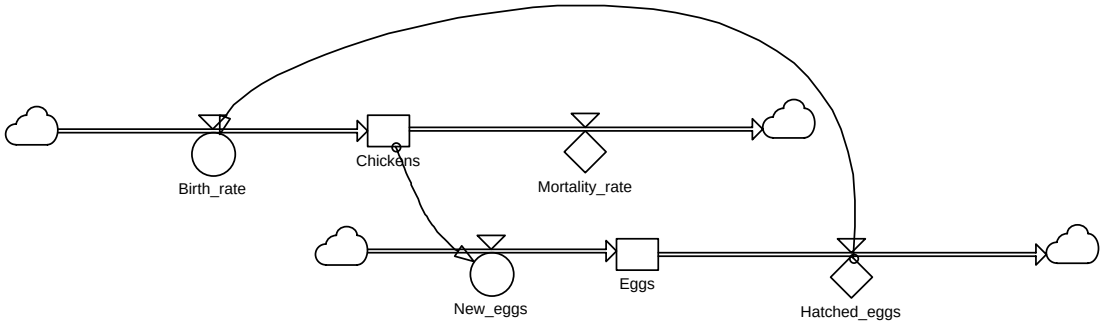


Figure 6: Stock and flow structure of positive feedback loop.

Stock and flow structures are, as causal loop diagrams, a good way of capturing mental models. It's also a good way of communicating results from a completed modeling effort. The biggest advantage with stock and flow structure compared to causal loop diagrams is its ability to capture the accumulation and flows in a system. The notion of stock and flow structure consists of five elements. These elements are:

- Stocks which accumulate the flow (illustrated with a rectangular box).
- Inflows which add up the stock (illustrated with an arrow into a stock).
- Outflows which subtract the stock (illustrated with an arrow out from a stock).
- Valves which controls the flow (illustrated with circles or diamonds)
- Clouds which represents a source outside the boundary of the model.(Sterman, 2000)

Sterman (2002) has developed a task in order to test the understanding of stock and flow structure. Below you find the task.

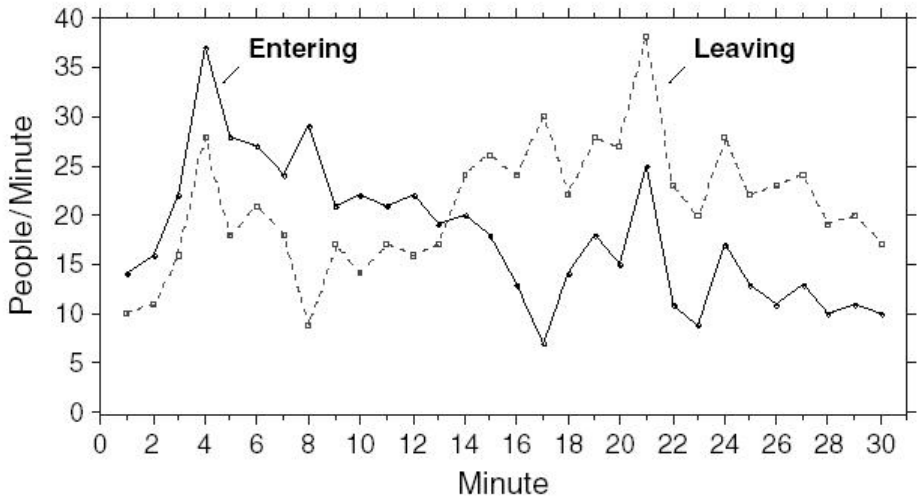


Figure 7: The department store task. Sterman (2002)

The questions to this task are the following.

1. During which minute did the most people enter the store?
2. During which minute did the most people leave the store?
3. During which minute were the most people in the store?
4. During which minute were the fewest people in the store?

Correct answers:

1. Minute 4
2. Minute 21
3. Minute 13
4. Minute 30

Even though two ways of illustrating the reality in a model are presented (causal loop diagram and stock and flow structure) there still remains knowledge that is difficult to capture. This knowledge is stored in the mental models of persons and is usually tacit. (Ford and Sterman, 1998) Ford and Sterman also propose a special method for making tacit knowledge explicit (Ford and Sterman, 1998). Stenmark (2001) proposes instead use of Information Technology in order to leverage tacit knowledge without making it explicit and thereby making the holder of the information redundant.

Time delays

Except for the feedback loops its also stated that time delays are crucial in purpose of determining the dynamic of a system. Delays between actions and consequences are everywhere in human systems according to Senge (1990). An example of a delay is the time until your invested money in a building project is actually turned into a building. Sterman (2000) believes time delays are particular troublesome and common. He also argues that delays are slowing the ability to accumulate experience, testing hypothesis and improving these.

According to Senge (1990) delays can result in "overshoot". An overshoot is described as follows. When you aim for a goal but don't recognize when you've already achieved the desired state. Unrecognized delays can also result in instability or breakdown. A good example is a shower with a ten second lag instead of two seconds when you adjust the temperature. You want to increase the heat so you adjust the shower tap. Nothing happens because it's a ten second delay before your adjustment is changing the heat. You don't

perceive the heat wanted therefore you try to increase the heat again by adjusting the shower tap even more. Now ten seconds has left and the heat is much more than you wanted. One lesson from this example is that the more aggressive behavior in a negative feedback loop with a delay, the longer time it will take before you reach the desired temperature. The behavior is counteractive and produces instability and oscillation instead of moving quickly towards the goal of pleasant temperature of the water. (Senge 1990)

Sterman (2000) defines a delay as a process whose output lags behind its input in some fashion. He also separates two different delays. These are material delays and information delays. A material delay captures the physical flow of material in a delay process. An information delay on the other hand captures gradual adjustments of perception or beliefs. An example of an information delay is the perception time to observe the flow of potential customers shifting to actual buying customers.

Nonlinearities

Nonlinearities become important to discuss because effects are rarely proportional to their cause. One example of nonlinearity is pressure from your boss. In the beginning this pressure increases your working capacity but this development is not proportional and will change as you perceive the goals more and more unachievable. Many effects reach some sort of saturation point where the development of the effect is less than before. In order to illustrate these nonlinearities table functions are used. To draw table functions, which illustrate the reality well, one can use a special method to elicit the right curve. This method contains elements as normalization, finding reference points, considering extreme points and testing its sensitivity among others. (Sterman, 2000)

The modeling process

In this section a description of the modeling process will be presented. The modeling process consists of five different steps which create a loop of iterative working with the possibility to jump between all steps.(figure 7)

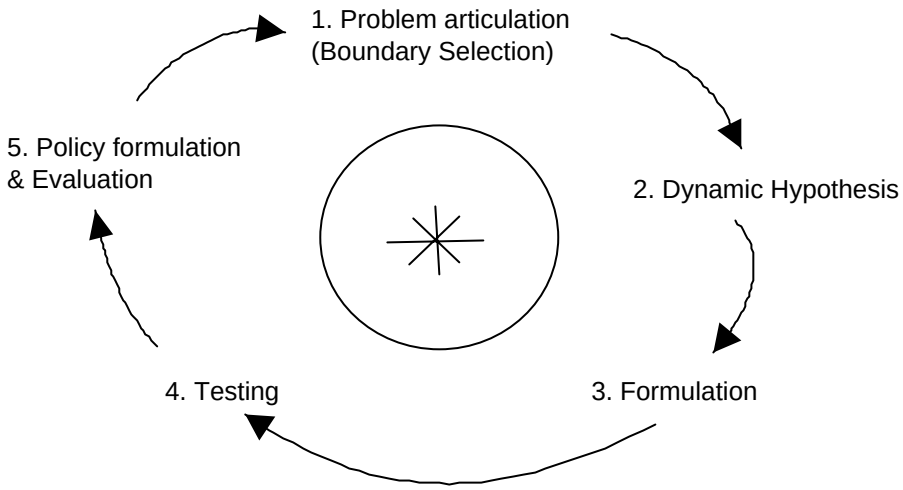


Figure 8: The iterative modeling process. Source: Modified from Sterman (2000)

Problem articulation is the first step where the problem shall be stated and motivated. It's also important to define key variables and the time horizon that is relevant. The problem articulation shall also include historical behavior of the key concepts and variables. Sterman gives a warning of modeling systems instead of specific problems.(Sterman, 2000)

The second step is called formulation of a dynamic hypothesis. This dynamic hypothesis is used to explain the problematic behavior. From this problematic behavior a first mapping shall be made. This mapping can be completed with for example causal loop diagram. (Sterman, 2000)

After these two first steps a simulation model shall be formulated. This simulation model specifies the structure and decision rules. In this model estimation of parameters, behavioral relationships and initial conditions are made. Tests are also made in order to control the consistency and boundaries. (Sterman, 2000)

The fourth step of the modeling process consists of a testing phase where tests are made to compare the model behavior with the reference mode. Tests are also made in order to study the models behavior when stressed by extreme conditions. Many more tests exist in order to build confidence in the model. See section 3.2.3 about managing resources for more information. (Sterman, 2000)

The fifth and last step in this iterative work deals with policy design and evaluation. Policy design and evaluation is not only about changing parameter values but it's also about changing the structure of the model. Structural changes might deal with changing dominant feedback loops and shortening long delays. (Sterman, 2000)

3.2.3 Resource dynamics

In the book Competitive Strategy Dynamics, Kim Warren (2002) connects the area of SD with strategic issues. Warren describes one way of approaching strategic work with a resource based approach of SD. A resource based approach implies a focus on the organizations strategic resources. Examples of strategic resources are sales force, production capacity, customers, service reputation, sales force morale etc. In these examples both tangible and intangible resources are mentioned. The intangible resource might not be as obvious as the tangible but they still affect the performance of the organization.

Following quote is cited from an article contrasting the Resource Advantage view with Industrial Organisation Economics.

> *The basic idea is that it is resources that are difficult to imitate and substitute that are the basis for superior performance. (O'Keefe, Mavondo, Schroder, 1999 p. 3)*

Schroder et al. (1999) also state the following quote:

> *What is important is the firm's ability to develop core competencies that are so embedded in the organization that they are causally ambiguous, inimitable, not tradeable, not easily substitutable and important to specific customer segments. This is the key secret to sustainable competitive advantage, and brings in dimensions such as the learning organisation, a market orientation, and firm culture and climate. (Schroder et al., 1999 p. 7)*

Prahalad and Hamel (1990) identify core competencies from three different tests. The first test states that a core competence has to provide potential access to a wide variety of markets. If a competence provides the end product with significant contribution it's also a core competence according to the second test. Finally a core competence must be difficult for competitors to imitate. Prahalad and Hamel mean that when several individual competencies and production skills are connected into a complex system it is difficult to imitate the core competence.

One of the core issues of an organizations performance is to understand its time-path and control its future movements. In order to do so one needs to understand the change of resource levels through time and how that change can be controlled. Since it's necessary to understand change in resource levels it's consequently fundamental to define the concept of strategic resources. (Warren, 2002)

> *"…a resource is anything to which the firm has access that might be useful to it in some way." (Warren, 2002 p. 16)*

According to Warren (2002) the dependency might seem obvious how resources and performance interact over time. However, this is not the case. In order to clarify these issues the following questions are often raised:

- How durable is the resource? For a resource to be a sustainable advantage it's necessary that it doesn't decays or become obsolete quickly. Although the resource maintains its value the context might be evolving due to new technologies or raising customer expectations.
- How mobile or tradable is the resource? If a resource is very mobile the sustainable advantage is little. If resources can be bought or sold they're particularly mobile.
- How replicable is the resource? If a competitor can easily copy the resource it's definitely not a sustainable advantage.
- Can the resource be substituted? If an organization cannot buy or copy a resource they might try to substitute the resource needed. Then the resource isn't of course a sustainable advantage.
- Are the resources complementary? If a resource isn't complementary with other resources in the organization it's not a sustainable advantage since it's of little value. (Warren, 2002)

Above mentioned questions are often the foundations of explanations about strategic resources. The questions are used to explain whether access to a particular resource represent a barrier to entry a market. This way of using the questions implies two fundamental weaknesses:

- The characteristics listed are seldom black and white. A resource is seldom neither absolutely durable nor non-mobile. Often the resource characteristics described apply in some degree.
- The ability to maintain, remove, copy or substitute resources is a dynamic issue. Except for tradable resources no resource can be switched on and off. The ability to maintain, remove, copy or substitute resources is a dynamic issue. It's important to study the pace in which resources build and decay. In order to study this, means for measuring and representing rates of change in resource levels are needed. (Warren, 2002)

Managing resources

In order to illustrate changes in the resource level a stock and flow structure is used. Two important rules are introduced with this structure. The first rule states that all inflows and outflows are measured in the same unit per time period. The second rule states that a stock can only change by inflows and outflows. (Warren, 2002)

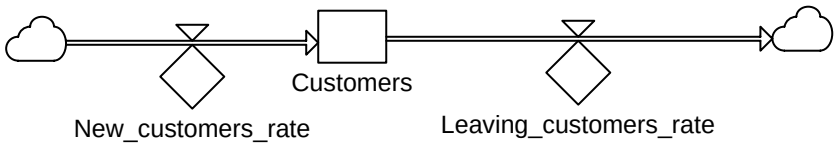


Figure 9: Customer stock

At this point the concept of resource is defined and a way of illustrating them is decided. In order to manage the resources we also need to measure them. When detailed information for a measurement is not available estimates have to be done. These shall preferably be made by people with experience and good judgment. (Warren, 2002)

Some resources, or changes in resources, we are trying to measure might entail skepticism. This skepticism usually touches the models sensitivity of input (Sterman, 2000). An example of that kind of change in resources is the increase of new customers in an organization when a ten percent decrease in price is carried through. These uncertainties are not easy to deal with but managers do make judgments on this kind of information. Our goal is to make the managers' assumptions explicit in order to understand the organization. Another most important aspect of the measurement is the time scale chosen. If the time scale is to short the result of the measurements might be fluctuating too much to be easily understandable. On the other hand the time scale shall not be too long since that would make important fluctuations vanish. The time scale must be decided according to the organizations need for information and its studied issue. It's also important to separate inflow and outflows. If, for example, customer volume changes it's very important to unfold the flows named winning and losing customers. This should be done because they might have different driving forces. (Warren, 2002)

Breierova and Coudhari (1996) propose the use of sensitivity analysis in order to test the sensitivity in the structure of a SD model and in the value of parameters chosen. Test of parameter sensitivity is usually done simply by changing the value of the parameters in order to study the behavior of the dynamics in the model. Parameter sensitivity tests are useful both in model building and model evaluation. Breierova and Coudhari (1996) states the problem of values forced to be estimated instead of measured precisely. If a model is insensitive to some parameter values its good enough to estimate these.

In purpose of building confidence into a model different tests are made. These tests are boundary adequacy, structure assessment, extreme conditions, sensitivity analysis etc. When finding errors, understanding of the complex system studied will increase and consequently improve the model and the decisions made upon it. Since all models are limited and simplified representations of the real word it's impossible to validate a model in the sense of confirming its objective truth. It's very important to critically assess the boundaries of the

model, the time horizon and the level of aggregation in relation to what purpose the model has. (Sterman, 2000)

According to Sterman (2002) the result of a model is more sensitive to the boundaries of the model, level of aggregation and representation of decision making than to parameter values.

Competition on resources

There are three different types of rivalry of immediate interest when it comes to resources. These are:

- Develop potential resources as for example winning lots of first time users.
- Switch resources away from competitors and prevent the opposite from happening.
- Win attention among customers regarding shared resources with competitors. (Warren, 2002)

Below the first type of rivalry will be explained since it's relevant for this thesis. According to Warren (2002) many finite resources can only grow by depleting another stock of potential resources. Examples of this behavior are the gasoline that can only be produced by depleting oil and buyers that depletes the stock of potential buyers. It's important to notice that an initiating rapid growth of the resource will slow down when the resource is depleted. Imagine a customer growth situation. In the beginning customers will flow into your company rapidly but as the potential customers approaches a volume of zero the growth will fade away. At this moment other important strategic decisions shall be made in purpose of hold on to the won customers. While customers flow into our organization the depleted resource implies fewer customers to win for our competitors. (Warren, 2002)

The driving forces which affect the customers in their decision to use our products are of course very many. Warren (2002) tries to generalize these. His generic forces affecting a customer to choose our organization and not a competitor are these:

- Marketing efforts
- Relative value of product
- Word of mouth effect
- Take up costs

Marketing efforts are of course the advertising done to improve the sales of the product. A special note shall be made to the relative value of the product. Warren emphasizes that customers take up a product because the benefits are larger than the price. The word of mouth effect is created when people start buying a product. The buyers affect the people they meet and they affect more people on their part. The take up costs are additional costs derived from choosing our product.

In addition to above mentioned forces one can find exogenous factors affecting the resources. Common ways of categorizing these factors are according to a PEST-analysis. PEST is an acronym for Political, Economical, Social and Technological changes. Political changes are for example new regulations by governments and economical changes might be increased GDP in development countries. Social changes are for example increased training among students in new technologies and technological changes deal with new features in machines to a lower cost.

Capturing tangible resources

When combining the structure of tangible resources a comprehensive structure is obtained. This structure can be used to capture the dominant drivers of performance over time. The task of management teams is to diagnose the existing structure and then designing or redesigning the structure in order to increase the performance of the organization. (Warren, 2002)

Warren (2002) also proposes a seven step process for capturing the strategic architecture. The first step is identifying the time-path of performance. Warren stresses the importance of picking an indicator which is relevant for the organization. It's also important to avoid ratios and instead focus on absolute measures. Finally he emphasizes the choice of an appropriate time horizon relevant for the organization.

The second step deals with identification of resources at the heart of the organization. This means in general terms that it's important to clarify which resources are most important to the organization. (Warren, 2002) Since this thesis's problem area defines the research problem as the resource customers this step will not be further unfolded.

The third step aims at quantifying the resources. It's not just enough to identify the inflows and outflows of the resources. It's also important to define the arithmetic controlling the flows. Two important notions are the matching of time scales between different stocks and keeping the stocks and flows consistent and accurate. (Warren, 2002)

The purpose of the fourth step is to map out the dependence of the flows and levels of resources. This is primarily done in purpose of finding out whether a resource is affecting other resources in growing or constraining. Typical dependencies are between price and functionality which affects the potential sales. (Warren, 2002)

The fifth step combines the first four steps. In the fifth step one is supposed to combine the stock and flows and all the dependencies into one whole structure. Three remainders are given in this step.

- Check all the flows so that they are properly represented.
- Make sure all the links between resources are captured.
- Add connections to the chosen performance measurement. (Warren, 2002)

The sixth steps purpose is to quantify more of the structure than in the third step. While assessing time charts and the dependence of each resource discussions usually occur. How to handle these discussions are described in managing resources. The final and seventh step introduces decision making in order to increase performance of the organization. The process of improving the organizations resources is unfolded in next section. (Warren, 2002)

Capturing intangible resources

When measuring soft factors obstacles usually occur. Soft factors like reputation among customer or staff morale do affect the organization even if it's hard to measure. A logic way of dealing with soft factors or intangible resources is proposed by Warren (2002). Driving performance in an organization without reflecting about the level of strategic resources is not possible. Furthermore the strategic resources can only be built or sustained with tangible resources. Therefore,

> *"the influence of intangible resources must be felt through some impact on the organizations ability to capture and hold on to those same tangible factors." (Warren, 2002 p. 118)*

Even the intangible factors need to be unfolded in order to gain increased understanding. They can be indirect resources, reflecting peoples' feelings or expectations, or characteristics or attributes associated with tangible resources. Four characteristics have a special impact on the dynamic systems they appear in. The first characteristic states that intangible resources take time to accumulate. This can be due to physical constraints and lags in perception. Second the intangible resources can be destroyed quickly. One example of this is organizations using environmental resources with a bad judgment. The third constraint deals with factors not noticed until they suddenly drop. For instance an airline hasn't got any sustainable advantage because they have acceptable safety standards. But if an accident occurs the resource immediately becomes visible in the performance of the airline. The fourth characteristic stresses the impact intangible resources have on the tangible resources. (Warren, 2002)

Intangible resources need to be measured and not only with vague statements as "Our customers are delighted with our customer service". The customer satisfaction needs to be measured with perhaps a scale from 0-1 where 0 is a total absence of satisfaction and 1 is fully satisfied. It shall be reminded that a persistent high customer service finally turns into a normal behavior expected by the customer. The same situation might occur if context changes. (Warren, 2002) In order to have a strategic architecture that is reflecting the organization one must integrate the intangible resources. It is a balance between having a too detailed image and having important intangible resources mapped. (Warren, 2002)

When identifying the intangible resources it's a good starting point to question the list of tangible resources. Are there some indirect resources not included? The question asked then shall be if some indirect resource drives any flows of the tangible resources. When the identification is done its important to map the structure, time-path information and connections (feedback) explaining the behavior of the indirect resources. Identification and measurement of the resource attributes are the following step. Only relevant attributes which make a difference shall be identified and measured. After this identification the attributes shall also be mapped (like the indirect resources) in a structure with time-path information and connections. (Warren, 2002)

Finally Ackere, Warren and Larsen (1997) state that leaving soft factors out of the model because difficulties in measurement is not a sufficient reason. The model often behaves more inaccurate without soft factors compared to soft factors that are not exact. This behavior occurs due to the soft factors importance in understanding the given problem.

3.3 Understanding System Dynamics

This section contrasts one methodology and one method which are named SD and Soft Systems Methodology (SSM). This contrast facilitates deeper understanding for the choice of SD in this particular study.

3.3.1 Introduction

The underlying assumption of both SD and SSM is a belief of observing systems as a whole and not breaking the reality apart. Checkland expresses this belief:

> *It is not nature which divides itself up into physics, biology, psychology, sociology etc,. it is we who impose these divisions on nature; and they become so ingrained in our thinking that we find it hard to see the unity underlies the divisions. (Checkland, 1993 p. 60)*

3.3.2 Soft Systems Methodology

When studying systems from a hard perspective, for example a weapon system, a definition of weapon system will always be completed. If the weapon system was studied by a researcher using soft system methodology the outcome could be disarmament and/or political negotiation. The main difference between hard and soft systems thinking is the soft systems capability of solving general problems in human activity systems. (Checkland, 1993)

The methodology Checkland has developed for soft system thinking will be briefly described below. The main purpose of this methodology is to solve perceived problems or situations. (Checkland, 1993)

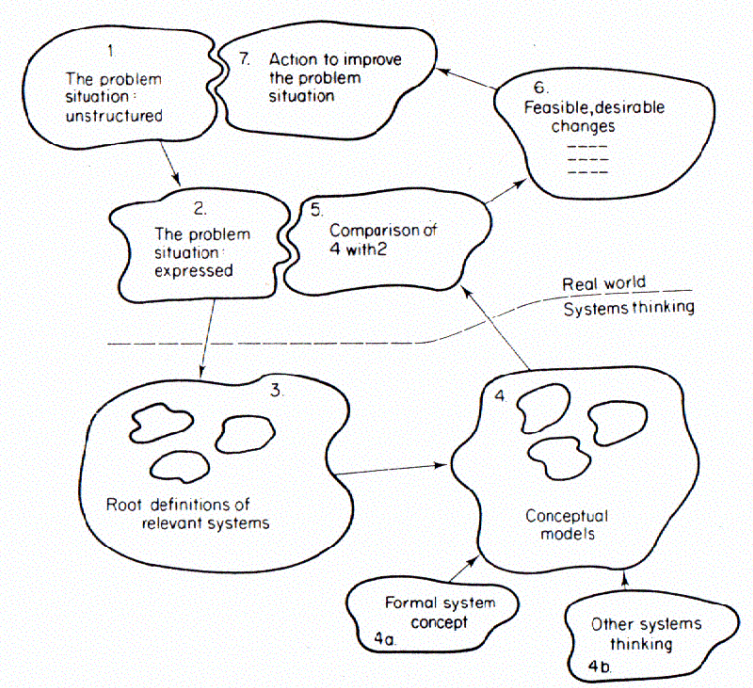


Figure 10: The SSM methodology Source: Checkland (1993)

As seen in figure 10 SSM consists of seven different steps. Step one and two aim at describing the problem as thoroughly as possible. This shall be done without imposing a special structure on the problem. A difference between hard and soft thinking in these stages is that with SSM the researcher tries to find as many different perspectives on the problem as possible while a hard system researcher focuses on the well defined system. (Checkland, 1993)

In step three of SSM the researcher shall define names of the relevant systems in relationship to the problem. These definitions are called root definitions and decide the position chosen regarding the problem situation. In step four conceptual models are built in order to unfold the activities systems needed to be undertaken. The goal of these activities needed to be undertaken is the root definitions made in step three. The conceptual models are built with

regular verbs. In the figure two additional steps exists. These are four a and four b. Four a gives input to the building of conceptual models with formal models of existing human activities system in purpose of avoiding major flaws. Four b gives the researcher an opportunity to transfer his model into other modeling tools as for example SD. (Checkland, 1993)

When using the conceptual models, created in step four, in reality the researcher also starts working with step five in SSM. This step is a comparison stage between step four and two. It is consequently a comparison between the description of the real word problem and the conceptual model. The purpose of step five is to generate a debate where parties concerned produce suggestions for change. These suggestions for change lead the researcher into the sixth step. The sixth step entails to study whether the suggestions are cultural feasible and systematic desirable. Checkland raises a warning flag for the possibility of finding changes matching both of these criteria. The last and seventh step deals with the implementation of changes. According to Checkland the researcher might find three different types of changes. These are changes in structure, procedures and attitudes. Structural changes are long term changes as for example organizational changes. Changes in dynamic entities are called procedural changes while attitude changes are dealing with intangible characteristics of human beings. The two first mentioned changes are relatively easy to implement while the latter one is more complicated. (Checkland, 1993)

3.3.3 Contrasting System Dynamics with Soft System Methodology

SSM is a methodology while SD is a method. An extensive discussion can be found in Checkland (1993) why SSM is a methodology and not a method. In this study SSM and SD will be compared even if the categorization of them differs.

As stated earlier in this thesis the goal of SD is to increase learning about complex systems. The purpose of SSM is however to solve problems, also stated in this thesis. The differences between these goals are not so different since SD solves problems by increasing the knowledge of the problem owner. The connection between SD and SSM is also intimate since both ways of working is founded in Systems Thinking. SSM even suggests SD as a complementary way of creating conceptual models.

The overarching goal of working with UNOSAT is to study the effects on the *strategic understanding* when modeling and simulating the *complex customer system*. This implies more knowledge about the complex system where the problem exists. Parts of the characteristics for SSM are found in the way of how SD has been used in this thesis. Examples of characteristics are the incorporation of intangible and soft factors and conceptual models. Still there are some considerable differences between this study's work with SD and the methodology SSM. This thesis has not a focus on implementation which is an essential part of SSM. Two major necessary parts of this thesis are the resource dynamics perspective and interactive learning environments. These are strongly connected to SD and are not part of the SSM methodology.

3.4 Applying System Dynamics

With only a complete SD model no improvements will be made. The model has to be used in order to increase the organizational performance. This chapter will deal with the use of a SD model.

3.4.1 Introduction

SD is a method using computer simulation tools to carry through the goal of increased learning in complex systems (Sterman, 2000). Since SD is a method with large impact of information technology it's interesting to position SD within informatics.

According to Dahlbom (1999, p. 16) informatics is,

> *A discipline tracking (leading) the development of information technology, with the ambition to put that technology to good use, acting both on the technology and on the organization of its use.*

Consequently it's interesting to ask the question about putting SD to good use acting both on the technology and the organization.

Sterman (1991) claims that all of us will be model consumers in some way. Unfortunately many people regard models as black boxes they don't understand. A lot of results from models have to be judged according to their relevance and validity. In order to create this judgment it's important to understand the model and leave the impression of a model as a black box. Sterman also claims that computer models are often misused intentionally and unintentionally as a consequence of the black box thinking. Sterman suggests spreading a basic understanding of models in order to tear down the black box thinking. Harris (2000) states the importance of increased and faster learning with SD compared to real experiments. Experimenting with a computer model is also less risky than with real people, equipment and processes.

In this thesis are scenarios used in simulation and presentation parts of the modeling process. Scenarios represent plausible outcomes and are created as one reference, one negative and one positive scenario.

3.4.2 Improving an organization

When having a complete structure of resources and dynamics one can use the following method (consisting of five different tasks) in order to improve the performance. The first task to complete is minimizing any leakage of resources. This task is applicable on all core resources but is common among people resources. Customers are one example of resource which might be won but then the resource is leaking due to poor product quality or service. These leakages, or outflows from stocks, have more impact than just the loss of a customer. The leakage comprises also a loss of the efforts in winning the lost customer. (Warren, 2002) Warren also states that it might be beneficial to change certain behaviors in order to halt leakages. Examples of this preferable behavior is reduced sales efforts focusing on existing customers, halting the hiring rate of staff for developing existing staff and reducing the amount of new products in favor of extending the commercial life of existing products. When studying the outflows of resources (in purpose of mapping leakages) one should ask at least four control questions. These are:

> *"Has this leakage previously been lower than it is at present? Are there parts of the business where loss rates are particularly low? Do rivals, or other benchmark firms, manage to sustain lower loss rate? How low a rate of loss might be feasible, at best?" (Warren, 2002 p. 107)*

When the leakages are identified it is necessary to find the reason to why they are leaking. When the outflow involves people it is possible to make exit interviews. These interviews can provide the reason to why, for example, customers or staff is leaving the organization. Resource losses due to insufficiency in other resources are especially interesting since they take longer time to resolve. (Warren, 2002)

The second task in this method is identifying whether the necessary drivers of resource inflows are working effectively. Warren (2002) states the importance of not creating a list of unreachable efforts needed to be completed. Instead this work should be done by redirecting efforts in purpose of saving time and money. An example of a driver is marketing budget which drives the win rate of potential customers. Even when the drivers have enough resources the inflows might be constrained due to lack of clarity among the staff. Therefore it is most important to instruct the staff whether they should focus on for example retaining old customers or winning new customers.

The third task involves eliminating balancing mechanisms that might constrain progress. An example of this balancing mechanism is production that might not keep up with the acquisition of new customers. (Warren, 2002) Warren suggests that one should reflect over a very positive development in a resource and then formulate all things that might go wrong. This will reveal the balancing feedback loops holding back progress.

The fourth step is identifying and validating any reinforcing loops that should be driving growth actually doing this. This occurs first in the fourth step because Warren believes there is no use of finding new customers until the organization is capable of handling these. This step is common to be carried through too early in the process. A common failure in this task occurs when information about this kind of feedback mechanisms not are distributed to the people who need it. This failure occurs between regions in organizations as well as between departments and managers. (Warren, 2002) According to Warren organizations should not look for new reinforcing feedback loops until they have made sure their existing ones are working properly. In this fourth step Warren states a warning of negative reinforcing feedback. If they exist the organization should make sure balancing loops exist to work against this unwanted behavior.

The fifth and last step uses stepwise solutions in order to eliminate unwanted behavior. Sometimes it is not possible to wait for an effect to develop over time. In these cases one can use stepwise solutions. These stepwise solutions are possible to categorize as solutions stabilizing one single resource and solutions bringing the whole organization to a new level. Examples of stepwise solutions are outsourcing and rationalizing staff. Stepwise solutions adding up a resource involve some certain actions. It is important to build up complementary resources before action is taken in order to handle the peak of inflow created by the stepwise solution. For example it is important to build up an appropriate service level before adding a step of new customers. It is also important to be prepared for a loss among the old resources if a step is implemented. For example when hiring many new people some old staff might quit. The conclusive reasoning about stepwise solutions is that one should consider the secondary effect carefully and think through the scale and time of the effects.

Warren (2002) joins the opinion of quantification as an essential thing to do while creating SD models. Coyle (2000) argues instead in favor of qualitative models where the quantification isn't necessary. Coyle explains his point of view like this:

> *The justification for the inevitable uncertainties has always been that system dynamics concerns itself with behavior modes, dominance of modes and dominance transfer, not with precise numerical values. In many cases, none of this is unreasonable, but the question abides of whether there is a point at which it might cease to be reasonable. (Coyle, 1998 p.356)*

Coyle (2000) believes the quantification should be omitted rather than producing a model of no value. He describes a classical SD model capturing the dynamics of the Maya Culture's fall. This model is an example of a model which should have not been quantified. One example of a huge assumption is the estimation of three generations (75 years) in order to complete a monument construction in the Maya Culture.

Qualitative SD modeling includes only an influence diagram and not simulations. It is also named "soft Operational Research" (Coyle 1998). Coyle refers to Checkland and Scholes (1990) and Coyle and Alexander (1997) when he states that the qualitative approach has proven to be effectively combined with SSM.

3.4.3 Interactive learning environments

One way of using SD models is by making a simulation model. The history of simulation models is positive since the last fifteen years. Before fifteen years ago simulation models were used in purpose of predicting the future state of a system. Now simulation models are used also as tools of making managers understand problem and opportunities of a firm, both in the past and in the future. (Ackere, Warren & Larsen, 1997)

In order to clarify the concepts of simulation models and games a definition is provided by Lane.

> *A game is deemed to be a collection of information and relationships in rules, algebra and logic made visible to an observer, and presenting data to and requiring information from an observer/participant. A simulation, on the other hand, is simply a collection of information and relationships in rules, algebra and logic made visible to an observer. (Lane, 1995 p. 605)*

Lane (1995) states that simulations or games are effective learning devices. There are three important factors making learning effective. The first is dissemination of content and the second is opportunities for experimenting with the content. The third factor deals with the fact that feedback is necessary in order to learn.

The focus when creating games from a SD model is foremost on transferring the learning to people who are not very close of the modeling process. Games based on simulation models create commitment and understanding in organizations. These games are often described as "management flight simulator". SD based games have the possibility to create mutual understanding among managers in a company. Managers in a company can for example discuss a strategy they will implement and try it in the game. If they are not aware of the interdependence between, for example marketing and production, they will learn it when the company fails to perform. (Ackere, Warren & Larsen, 1997)

Spector and Davidsen (1998) make a critical assumption that simulation is not necessarily equal to a learning environment. For an efficient learning to take place Spector and Davidsen

propose frequent and constructive feedback from a tutor. They also state the importance of explicit goals and mechanisms to achieve the goals made explicit.

A general observation made by Spector and Davidsen (1998) is the following characteristics of domains where interactive learning environments based on SD models are implemented.
- In complex and dynamic domains.
- Learning well enough in purpose of identifying key relationships and their behavior.
- The learners are most often students or managers who can't manage complex system well enough.

A proposed way of working with the creation of interactive learning environments is given by Spector and Davidsen (1998). The first thing to complete is an analysis of the subject domain. In this analysis a needs assessment, participant background check and an identification of key concepts, principles, procedures and relationships should be emphasized. Computer based tutors, not based on SD, together with measures for learning effectiveness both pre- and post-simulation are part of the working process. It is also recommended that learning mechanisms gradually fade as the learner increases its knowledge base. Spector and Davidsen stress the importance of human to human communication in order to make the learning effective. An interesting finding from Spector and Davidsen in successful system based learning environments was the dependence of instructors providing preparations and basic information to the learners. The effects of learning seemed also highly dependent of discussions and exercises after simulation. The last finding was the absence of measures of learning effectiveness.

Interactive learning environments are not without critics. There are some common pitfalls making the interactive learning environment become obsolete. The first pitfall described is the importance of clear objectives with the learning process. The second pitfall stresses that material and experiences must be capable of introducing the participant to learning and knowledge. It is also very important to not neglect other teaching methods even if interactive learning environments appear to have good effect. A fourth pitfall deals with technology driven games and simulations. The technology must interplay with the purpose of the learning because there needs to be a balance between activities and the purpose. The briefing before a game starts is very important in order to make participants understand the game. Finally there is also a warning about the resources necessary for these kind of games, both in development and implementation. (Lane, 1995)

Vennix (1999) believes it is too simplistic to believe a management flight simulator can provide the knowledge for the people involved in the SD process. Therefore he proposes the use of group model building. Group model building is suitable in situations where opinions differ greatly in a group. Issues which constraints learning are cognitive limitations, differences in perceptions and ineffective communication patterns. These constraints can be encountered with the group modeling process. Vennix emphasizes two certain issues to be addressed in order to resolve problematic situations with several opinions. The first issue states that it is not useful or even impossible to complete a whole model building cycle. Sometimes is, for example, no quantification possible or useful to carry through (Coyle, 1998). Vennix (1999) concludes that it is probably better to be aware of quantification than disregarding it completely.

3.5 Summary

SD differs from Systems Thinking because it uses computer simulations and tests different policies. SD is applied on complex human systems in order to increase the understanding of them. These complex human systems are characterized by feedback processes, time delays and nonlinearities. In order to build a computer based model with SD a method is followed. It contains five different steps and is called the modeling process.

Throughout this thesis a resource perspective has been used. For example are the customers always considered as resources which increase and decrease over time. In order to manage the resources one must know which resources an organization consists of. Resources exist as tangible and intangible. Capturing the intangible resources is done by studying the connections to the tangible resources and by matching certain characteristics.

When improving an organization one can use a framework of five different steps containing tasks as how to stop resources from leaking, how to increase the inflow to a resource etc. In order to see these changes one must measure the resources. When measuring the resources an issue about estimations will arise. When no data about a resource exist one can estimate these values or not doing the quantification at all.

In order to use the SD model as efficient as possible one can construct an interactive learning environment on top of the model. This environment will facilitate learning by providing immediate feedback and making impossible real world experiments possible. Interactive learning environments have some drawbacks and should therefore be supported by for example a teacher on the system.

4. Empirical data

In this chapter the empirical data of this study is presented. This chapter contains the project process, the modeling process and the interviews. The effects of the method SD is documented in interview responses and in descriptions of the modeling process. This first section named project processes aims at describing the practical details of the project.

4.1 Project process

This section describes how the project has been carried through. The project process and project proposal is described together with a description of the organization where the project has been completed. The time schedule, goals, workshops and presentations are also described in this chapter. Finally in this section issues of this project are mentioned.

4.1.1 Project proposal

As many other organizations is UNOSAT characterized by uncertainty and heavy workload. The decision to dedicate a part of UNOSAT's resources on this study was not obvious. When the decision was made for this study to be initialized the decision makers at UNOSAT and clients of this study knew nothing about the method SD. We defined together the broad boundaries of the project proposal. These were the beginning of a time consuming and relatively long period containing several different proposals. The proposals were supposed to fulfill following demands in prioritized order:

1. The proposal must create some useful result for UNOSAT.
2. The proposal must be feasible to accomplish within the academic demands placed by IT-university.
3. The proposal must be applicable within the field of SD.

The problem area where the project proposal finally circulated was the fact that UNOSAT does not have any paying customers. UNOSAT is a very young organization and are still funded by donors. This funding will vanish during 2005 and UNOSAT is supposed to be self-sustainable. This transformation is very difficult and therefore has the articulated problem in the modeling process been:
How can the managers of UNOSAT learn more about their complex customer system?

The goal setting in this study has been intense and necessary to maneuver this thesis work. The initial goals when commencing the study were the following:

- Create new insights and generate new knowledge with the persons at UNOSAT.
- Create a model which UNOSAT can use in order to communicate its customers system.
- Create a tool UNOSAT can use for simulating different scenarios.

4.1.2 Time schedule

The time boundaries of this thesis were stated to last the first six months of 2004. Potential long-term effects identified shall occur within a time frame of approximately three years in order to be relevant (Alain Retiere, 20 November). This project was initialized in December 2003 when a project proposal was developed. During the first part of 2004 a model was constructed, used and evaluated. The total time of the thesis ended up with six months as planned. The time schedule of the modeling process was two months. After different delays the total time ended up with almost three months.

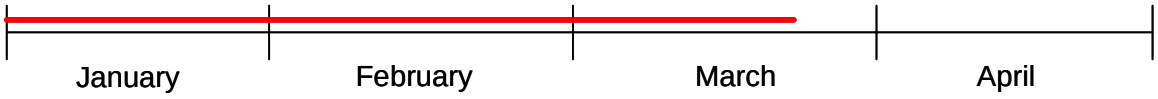


Figure 11: Timetable of modeling process

The time schedule of the modeling phase endured for all January and February. During this time approximately one workshop (one hour) per week was carried through in order to build the model.

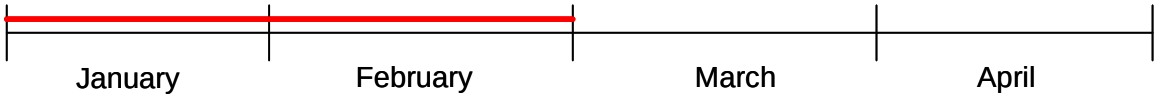


Figure 12: Timetable for modeling phase

The time table of the simulation phase has been approximately three weeks in March.
This follows the initial planning made in the beginning of the modeling process. The goal of this simulation phase has been to identify interesting behavior in the model and identify estimations needed to be studied in detail.

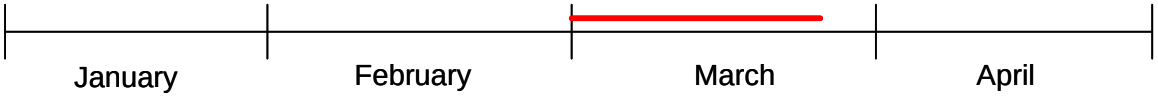


Figure 13: Timetable of simulation phase

4.1.3 Workshops

The practical modeling and discussions were made during workshops for approximately one hour. Occasionally workshops have been both longer and shorter. The workshops have had a maximum of three people present at the same time including myself. The main reasons to this are because of time constraints and difficulties of finding meeting times. Workshops have usually taken place in meeting rooms but occasionally in restaurants. The participants of the workshops have been the following people:

- Olivier Senegas (project manager)
- Alain Retiere (project coordinator)
- Ian McClellan (assistant of project coordinator)

The amount of participation has varied among these participants. Mr. Senegas has participated in 75 percent of the workshops while Mr. Retiere has participated in 25 percent of the workshops. Mr. McClellan has participated in less than 15 percent of the workshops.

The participation in workshops has been different between the people involved. Mr. Senegas was from the first day at UNOSAT appointed as my contact person and the one I was reporting to. This is why he became the one participating in a majority of the workshops. Mr. Retiere has a particularly heavy workload with lots of traveling; workshops with him were therefore naturally hard to schedule. The reason to why Mr. McClellan didn't participate more is because of time constraints in the modeling process. Meeting several people during different occasions was too time consuming.

Some workshops have been very useful while some meetings have not had any effect. An example of a very useful workshop was when one person proposed practically all my planning for the next week without knowing about it. His suggestion was well aligned with the modeling process. An example of a not so useful workshop was when one person questioned the use of the questions asked and indicated that he did not understand the purpose of the quantification.

4.1.4 Reflections on software used for modeling

The software Powersim has been used in this study for computer simulations. Powersim is manufactured by a company (Powersim) from Norway which develops software for computer modeling. The version used in this study has been Powersim 2.51. This version is not the latest update from Powersim.

Powersim has both advantages and disadvantages. Since Powersim is the first and only software I have used, for modeling with SD, it is hard to identify advantages of the software. One feature worth mentioning is the zooming functions in Powersim which are very effective. The disadvantages of Powersim are unfortunately numerous:

- Snapshots disappear when you use the function of cut and paste in the model. This cut and paste function has been used quite often in my work since I have mirrored several parts of the model.
- The undo function is one of the most important functions while working with creative software like programming, image processing and modeling. In Powersim it's only possible to regret one step and that is deficient.
- Frequently I needed to use the search function when the model has expanded. Unfortunately Powersim is only capable of searching for the entities in the model and not in the equations. This can be solved by copying the whole equation list into a word processor and use its search function.
- Causal loop diagrams should be easy to sketch without consuming a lot if time. This is not the case in Powersim unfortunately. Powersim is adapted for creating stock and flow structure and not causal loop diagrams. It is feasible to sketch these but it will acquire some time.
- Integration with communication software like web browsers and e-mail clients would be desirable. For instance the need of e-mailing the model occurs frequently but is not solvable from the software.
- Often more than one person study and comments the model. This creates a need for effective comment handling which doesn't exist.

4.1.5 Presentations

The presentations of the modeling result have been completed in two different ways. One special presentation was made for Mr. Senegas since he has been this studies main client during the modeling process. Another presentation has been produced for Mr. Bjorgo who has not been part of the modeling process. The differences in these presentations have mainly affected the level of explanations. While presenting to Mr. Senegas less explanations have been necessary as he has had better background knowledge.

4.1.6 Project issues

From the first meeting with UNOSAT it was clearly stated that they were under heavy time pressure and therefore could delays arise when meetings were needed. Time with the people at UNOSAT was consequently a bottleneck for the modeling process. This expected problem

did occur and the consequence was one interview not carried through. The goals of the project were fulfilled even if they did not follow the time schedule.

Other expected problems were communication with my supervisors. Both of the supervisors were located in Sweden and that limited us to communication through e-mail, instant messaging and telephone. The roles of my supervisors were discussed before this study was initialized. Martin Börjesson had the mission of guiding me through the whole thesis while Maria Poutilova was supposed to guide me through building the model. The communication problem did occur with Maria Poutilova.

4.2 Interviews

This section contains summations from the interviews carried through. Totally two interviews were carried through. The first interview contains quotations translated to English. The interview questions can be found in appendix 1 and 2.

4.2.1 Interview 1

The general opinion about SD is positive from the respondent. There are though presumptions in the model which are difficult to grasp. The respondent believes the model is quite logical constructed but has some limitations regarding level of details. There are is a good balance between simplifying the real world and still being representative.

Useful knowledge from the presentation and discussion has dealt with how the different elements in the model are connected with each other. The respondent expressed himself about what he learned with the following two quotations. “The presentation is logical built up but of course with limitations about details.” “In a more concrete way I have learned how the different elements are connected.” The interconnectivity between the flows has also been useful knowledge for the respondent. The respondent believes it’s useful to understand “how one outflow affects another inflow.”

The general understanding of the context has improved and knowledge about the balance between driving forces are improved according to the respondent. The result of the presentation and discussion will not lead to any changes in decision making for the respondent the forthcoming year. “That is due to a good reflection of reality in the model.” There are although some decisions coming up which importance have been stressed by the model. Examples of these decisions are the question of price setting and the ability of scaling UNOSAT staff.

The advantages of using SD are the visibility of the most important driving forces and its ability in tracing changes throughout the model. Other advantages of SD were expressed like the following quotations. “One can see the effects of actions depending on the input given.” “It contributes with a higher awareness level within UNOSAT since everybody has their own perspective. It puts the ideas on paper.” One can state that the model helps providing a mutual perspective. It is beneficial to make this one perspective explicit in order to facilitate discussions.

Disadvantages of using SD incorporate the simplifications in the model and the difficulties in quantifying parameters. The respondent said that the model is “a simplification of the reality and it is very risky to quantify the driving forces.” Another limitation in the model is events occurring irregularly but affecting the flows strongly. “It is risky in the model to omit

exogenous accidental occurrences which might have a positive or a negative affect. But we have to start out from a normal mode since we can't anticipate these occurrences." Examples of these irregularities are for example unforeseen statements by the UN Secretary General (e.g. related to rules and regulations).

The respondent stresses also the importance of the word of mouth effect. The respondent said: "Some assumptions about negative word of mouth effect are missing". According to the respondent is it also too optimistic estimations of the amount dissatisfied purchases before a customer become a former customer.

The respondent concludes that when he saw the whole model printed in one paper it was difficult to understand. But after presentation and explanations it is relatively easy to understand. He also emphasizes the importance of knowing UNOSAT to understand the model and the analysis. When talking about what kind of new discussion topics this model might create the response was none. "It will be more like confirmation and strengthening." In UNOSAT they have already talked about, for example, how to achieve a scalable organization and how to deal with the price. "We have only touched these issues regulation and pressure, dissatisfied customer and constraints." Some of the subjects would have been discussed nevertheless without the model.

The conclusive interview answers deal with the respondents view on the time invested in this presentation and discussion. The respondent believes it was well spent time and concludes that this kind of study with quantification and connections are rare but needed within the UN-system.

4.2.2 Interview 2

The general opinion about SD is positive from the respondent. The respondent gave this concluding quotation, "it's a very interesting tool". The tools provided a clearer view of the organization according to the respondent. He expressed this feeling of clarification as "putting the main components of the organization on paper". A big problem during the modeling process was complexity in the organization. The respondent expressed himself according to following quote, "one of the biggest problems was the fact that it is not so easy to model a UN-organization."

The opinion about the modeling phase is generally positive with some limitations. The respondent thought it was interesting to see the different state of minds for customers modeled as stocks. It was "…the occasion to check the different steps between potential customer and loyal customer. Identifying the different stocks and the main factors were very interesting." The limitations are connected to the quantification of the model. The respondent believes that it will "maybe be easier for us to use the same model but with other estimations later this year."

The simulation phase has been more interesting for the respondent than the modeling phase. "The simulation phase gives a clear vision of what could be the result of our different actions". When describing what the respondent had learned he expressed himself like the following quotation. "UNOSAT is a new project with new technology and methodology. Our first goal is to develop our platform but we must anticipate all our actions towards customer. We must start now. We have to anticipate our actions now before the platform is developed." This is not new for the respondent but it has been more emphasized because of the work with

SD. He expressed himself in the following terms, "in my mind I have learned this in the sense that it is clearer than before."

When answering the question if some decision have been or will be affected in the future due to this project the respondent answered no. One reason to this is because "many of the actions have already been launched". The respondent expressed him self as the following quotation: "The model will not change radically our vision of the business development but I am sure it will help us focus on the main factors. What we can see from the simulations is that the result arrives a few or many months later."

The biggest advantages of using SD are the clear vision of the models development over time. The respondents impression of the model is reflecting the ideas two years ago when UNOSAT was initialized. He also believes the model is a confirmation of how the managers in UNOSAT imagine the organization. The respondent also says it is a "clear vision of our business and the development during the next months."

The biggest disadvantage of using SD has been the difficulties in estimating parameters.
A summation of the quotes regarding this issue is collected here: "It has been very difficult to do some clear estimation for the main factors. The estimations have been one of the main problems. It is not possible for us to make clear estimations. It is not possible to use the quantification of the model. The model should be used for global tendencies."

The last question in this interview dealt with the time spent on SD compared to its benefits. The respondent said: "It was not at all waste of time." He stated that the benefits of the model were more worth than the time spent on it.

The respondent had an interesting suggestion before the interview finished. He thought it would be useful to develop an interactive learning environment with a specific target group and purpose. The purpose was increased learning about specific parts of the model for a specific target group. This interactive learning environment would be something to use during meetings and seminars. The respondent believes it could be a good communication tool and a good utilization of the model. "It would be easier to explain for organizations that it would be better for them to work with us."

4.3 The modeling process

This section reports about the two and a half months when the modeling process took place. An additional categorization has been made in order to clarify the modeling process suggested by Sterman (2000). Basically the five steps of the modeling process have been divided into two phases. The first phase embraces step one to three. This phase is named modeling phase. The second phase embraces step four and five and is called simulation phase. The descriptions of these two phases are found last in this section.

4.3.2 Modeling phase

This section describes the first phase of the modeling process. In this phase we have built the model. An overview of the model is attached in appendix 3

The goals of the modeling phase were a complete SD model covering the complex system of customers in UNOSAT. Except for this model the goal was to make reflections possible and asking questions possibly generating new knowledge. The goal with a complete model is not

only to build a foundation for the simulation but also to make mental models of the decision makers explicit. The model can then function as a base for discussions.

Problem articulation

The articulated problem in the modeling process has been expressed as too small amount of paying customers. The managers of UNOSAT were rather open for suggestions regarding which problems to investigate. The articulated problem is a consequence of other problems like not attracting customers or too little value in the product to sell. The problematic behavior in UNOSAT has been explained by, among others, poor knowledge of the customers and unfamiliarity to invest in new technology in order to save money.

Formulation of dynamic hypothesis

The dynamic hypothesis is expressed as, **How can the managers of UNOSAT learn more about their complex customer system?** The formulation of a dynamic hypothesis has mainly been conducted through discussions with UNOSAT. During these discussions causal loop diagrams have been developed. These diagrams were abandoned in favor of the use of stock and flow structure.

Formulation of simulation model

The first workshops to build the simulation model consisted of general discussions and contemporaneous sketches. These were transformed into computer models. From workshop three we have had the computer model as a base for our discussions. Some workshops were also prepared with direct questions where direct answer were noted but not directly implemented into the model. From workshop four we started to use a printed model in order to have an overview of the model. During this step a quantification of the model was done. An interesting remark during the construction of the model was the lack of need to emphasize the importance of exogenous and endogenous variables.

Results of the modeling phase

One of the goals of the modeling phase was to complete a SD model over UNOSAT's customer system. Whether reflections have been made or if any new knowledge has been generated can be found in section 4.2 where the interviews are reported. In that section it is also reported whether the model has been a reason for discussion within the company.

4.3.3 Simulation phase

The modeling process is continued in the first two sections (testing and policy design and evaluation). After that some conclusions of the model analysis is presented. Three scenarios have been created from the simulations and are presented in appendix 4. Besides scenario and modeling process a suggestion is made for an interactive learning environment.

Testing

The essential information deriving from the tests of the model is an increased quality and confidence in the model and its results. The clients at UNOSAT were not well acquainted with testing procedures of a SD model and their confidence in the model did not change after tests were finished.

Policy design and evaluation

During the policy design and evaluation a lot of parameters have been changed. Except for changing parameter values some table functions have been changed in order to study the behavior of the model. Even flows have been disconnected and added in order to study changes in behavior. In order to make the different parameter values and structural changes more explicit three scenarios are created. The scenarios can be found in appendix 4.

Model analysis

The main conclusions from the model analysis can be described with the following paragraphs:

- Keeping the driving force regulation and pressure under control.
- The exponential increase of customers will reflect the whole model.
- Price, specialized products and new market segment rate are key parameters in driving and constraining customer flows.

A larger summary of the main conclusions in the model analysis can be found in appendix 5. The whole model analysis is not available in this thesis.

Suggestion for an interactive learning environment

From the model constructed in this study it is possible to build an interactive learning environment where the managers of UNOSAT can easily access and change the different parameters. An example of how this environment could be designed is found in 6. This interactive learning environment was although not constructed due to lack of relevance in relationship with the value it could deliver.

Results compared to initial goals

The simulation phase has fulfilled the goals of finding interesting behaviors and identifying parameters needed to be studied in detail. These results have been communicated to UNOSAT and the result of this communication can be found in the next section where interviews are documented. A tool for simulating scenarios also exists in the shape of the model.

5. Analysis

This chapter will analyze empirical data from the theoretical framework. The analysis is divided into three sections which are named initial understanding, effects of SD on the strategic understanding and the modeling process. After these three sections a summary of the key effects is documented.

5.1 Initial understanding

In this section the initial *strategic understanding* in UNOSAT is analyzed from existing theoretical framework.

The perspective on customers in UNOSAT was strongly influenced by their marketing strategy (see section 1.4.3). The marketing strategy was divided into three different parts where the first part represented mass marketing of UNOSAT towards a big mass of organizations and customers (Pine, Peppers and Rogers, 1995). The second part consisted of increasing the awareness level of the customers. This was planned as mass market activities too while the third and last part had influences of creating a learning relationship with the customer. The mass marketing efforts in part one and two contained cross national segments which UNOSAT targeted (Wedel & Kamakura, 2002). These cross national segments were the nine different groups of customers described in section 1.4.3. UNOSAT's third part of their marketing strategy contained a web portal. This web portal is an attempt in creating a learning relationship with their customers (Pine, Peppers and Rogers, 1995). UNOSAT created also a database where they intended to store relevant information about the customers. This database is a tool facilitating learning relationships with customers. UNOSAT creates both standardized and customized products where the customized products are the foundation for building a learning relationship.

UNOSAT is not utilizing the possibilities of Internet as an enabling technology of learning relationships. In addition to learning about customer needs and preferences when they already have placed an order, UNOSAT can use the possibilities of Internet in order to establish a learning relationship in the training and awareness phase. This presumes using, amongst others, educational tools on Internet. Pine, Peppers and Rogers (1995) suggest an implementation of four different strategies in order to create a learning relationship with customers. In the case of UNOSAT is an information strategy very important since they have collected data but are not using this fully. The organizational strategy which contains a customer manager and a capability manager is an organizational structure which almost exists today at UNOSAT. In addition to these managers a design tool which is suggested as part of the production/delivery strategy necessary in UNOSAT to efficiently use already collected data. Finally UNOSAT will face the issue of choosing profitable customers who they want to start a learning relationship with. Since UNOSAT is a not for profit organization an explicit assessment strategy about this issue is needed. Except for this three-part approach to the customers UNOSAT completed a SWOT analysis. Making a SWOT analysis is probably better than nothing for UNOSAT but it is an old strategic approach with a number of alternatives (Ghemawat, 2002). Warren (2002) considers a SWOT analysis to be obsolete and useless.

One of UNOSAT's most important communication channels is their web portal. UNOSAT intend to establish contact and perform transactions with customers through this web portal.

From this description can UNOSAT be regarded as an organization relying on e-business (Kalakota, 2001). Strategies for young e-business companies are here applied on UNOSAT which is a non for profit organization. In order to have a sustainable e-business strategy an entrepreneur must have a systemic view of critical success factors argues Bianchi and Bivona (2002). These critical success factors are dynamically connected and changes through accumulation and depletion. A dynamic view of critical success factors doesn't exist at UNOSAT. In their market strategy is the web portal emphasized as a very important tool but no study is made of its interconnections or its importance for different phases of a customer order (awareness, order making etc.)

The e-business strategy called "get big fast" (GBF) applies on UNOSAT with modifications (Oliva, Sterman and Giese, 2003). When considering this strategy the organization regards positive feedback loops as competitive advantages. In organizations where GBF is fully applicable companies grow in order to obstruct competitors with aggressive marketing. This is not the case with UNOSAT. However is the balance, which must exist in an organization with a GBF strategy, between attracting customers and expanding existing infrastructure highly important in UNOSAT. Since service quality is an important driver of attractiveness UNOSAT should consider to overstaff in order to avoid creating a negative reputation. (Oliva, Sterman and Gieses, 2003)

UNOSAT didn't use any explicit strategic approach which could be derived from dynamic thinking. Lyneis (1999), Richmond (1997) and Morecroft (1984) argue in favor of SD as a facilitator or support to a strategy development process. The strategy developed in UNOSAT is consequently not supported by SD.

5.2 Effects of SD on the strategic understanding

In this section the *strategic understanding* of the customer system in UNOSAT after the process of using SD is analyzed.

The overarching strategy approach at UNOSAT has been influenced by dynamic thinking even if no revolutionary changes have been made in existing strategies. The existing perspective is still founded in for example a SWOT analysis. Several quotations indicate an understanding of change over time and interconnectivity which might support UNOSAT in their work with strategies in the future (Lyneis, 1999).

Both respondents grasped the concept of understanding change over time according to the following quotations: "One can see the affects of actions depending on the input given." We must start now. We have to anticipate our actions now before the platform is developed." "What we can see from the simulations is that the result arrives a few or many months later." This is one of the most important knowledge to learn with SD according to Sterman (2000). It also indicates an increased *strategic understanding* of customer dynamics and change over time according to Lyneis (1999), Sterman (2000) and Warren (2002). One respondent stated also that a specific piece of knowledge which has been emphasized during the process was the fact that UNOSAT must anticipate their actions since they occur some time after initiated. With this insight it is likely for UNOSAT to experience fewer actions which result in unexpected side effects (Sterman, 2000). No direct connection between change over time and mass marketing was expressed by the respondents. The actions which both respondents talk about are likely to contain mass marketing activities. This implies that UNOSAT's perspective on mass marketing now contains a dynamic view.

The largest disadvantage (of SD) experienced by the respondents is the concept of quantifying the model. According to the respondents was it difficult and risky to quantify the model. A summarizing quote is the following, "the estimations have been one of the main problems". The theoretical framework provides different perspectives. Warren (2002) argues in favor of quantification while Coyle (2000) opposes the quantification when it is not needed or possible. Sterman (2000) claims however that one should focus on the behavior and not the values. The values should be used as a start engine to study the behavior. The difficulties in UNOSAT can be explained by no time path of UNOSAT (Warren, 2002). Ackere, Warren and Larsen (1997) make a statement where they emphasize the importance of soft factors and argue for measuring badly is better than not measure at all. Lyneis (1999) argues also for building a detailed quantified model in order for SD to support strategy development.

Respondent one learned more about the interconnectivity between flows and driving forces during this project. He said amongst others that it was interesting to understand "how one outflow affects another inflow." This understanding is an indication of an increased understanding for complex systems (Sterman, 2000). It is also an indication of better understanding for the critical success factors in e-business organizations and their dynamics (Bianchi & Bivona, 2002).

The ability to provide the customer structure in a well defined and organized way has been appreciated by both respondents. One quotation proving this is the following: "It contributes with a higher awareness level within UNOSAT since everybody has their own perspective. It puts the ideas on paper." This clarification is something usually achieved with conceptual models like SD or SSM. (Sterman, 2000 & Checkland, 1993) The mapping of customers, in the study, was made with cross national segments as recommended by (Wedel & Kamakura, 2002). An equivalent mapping was made when UNOSAT segmented its customers in nine different target groups. This mapping is though old and not conceptualized.

The same correspondence, between the respondents, is not found in the question regarding interactive learning environment. According to one respondent is there a need for an interactive learning environment. He said: "It would be easier to explain for organizations that it would be better for them to work with us." The respondent believes it would be a good communication tool. This statement contradicts my reflections where I stated that UNOSAT should not develop an interactive learning environment. Instead could UNOSAT put their resources in other teaching methods according to Lanes (1995) description of common pitfalls. The response from the respondent is on the other hand aligned with arguments of Ackere, Warren and Larsen (1997). The biggest advantage of performing experiments in an interactive learning environment based on UNOSAT's *complex customer system* is the immediate feedback (Warren, 2002). An example of an interactive learning environment can be found in appendix 6.

The second respondent had no clear opinion regarding an interactive learning environment. This might be explained by too little time for reflection. An interesting remark is the fact that none of the two respondents mentioned the possibility of making experiments not possible in the real world as Harris (2000) describes it. The reason to this could be because no extraordinary experiments have been accomplished. The characteristics (of domains where interactive learning environments are implemented) observed by Spector and Davidsen (1998) matches the characteristic of UNOSAT because the managers don't manage the system well

enough. The reason to this match might be due to a short history of UNOSAT or because it's always possible to manage an organization better. In case of developing an interactive learning environment at UNOSAT the method for developing these environments formulated by Spector and Davidsen could be used.

The fact that attraction of customers must be followed by an expanding infrastructure is essential in order to succeed with a GBF strategy (Oliva, Sterman and Gieses (2003). In the case of UNOSAT is it extremely important to communicate this insight to stakeholders and managers. Since interactive learning environments has the purpose of communicating results to people not so close to the modeling process this would be suitable for UNOSAT when educating people about this balance. (Sterman, 2000).

5.3 The modeling process

Consequently in this thesis the concept of modeling process has been used. The modeling process has had impact on this thesis and its result. Therefore is it important to analyze the empirical data generated by this process. The modeling process has been categorized in two different phases (modeling phase and simulation phase). This categorization was made in purpose of increasing the understanding for the clients of the process.

The modeling phase

The articulated problem in this modeling process has been explained as having too few paying customers. The motivation of the problem in UNOSAT can be described as not having an explicit problem; more a feeling of the problem area. This problem articulation follows partly the recommended guidelines by Sterman (2000). The discrepancy between Sterman's' recommended way of handling problem articulation and the reality was the explicitness and broadness of the articulated problem. Due to UNOSAT feeling of problem area the articulation became broader than recommended.

The dynamic hypothesis which the modeling process was based on was formulated as: **How can managers of UNOSAT learn more about their complex customer system?** This dynamic hypothesis explains the earlier mentioned articulated problem. During the modeling process the issue of considering variables to be endogenous or exogenous didn't occur. (Sterman, 2000)

The creation of a simulation model was characterized by discussions and sketches transformed into computer models. As stated earlier the quantification of the model was very difficult. A stock and flow structure was used early in the process instead of causal loop diagrams. With the stock and flow structure it was easier to apply resource based thinking throughout the modeling and the stocks became more visible. The stock and flow structure have certain advantages compared to causal loop diagrams (Sterman, 2000). When communicating the model to UNOSAT the stock and flow structure has been used. When communicating with stakeholders outside the operational business of UNOSAT causal loop diagrams should be used as a complement. Tests of the model confirm Sterman's (2000) argument models being more sensitive for changes in structure than in parameters.

The simulation phase

Since this is a model of estimations a true reference mode doesn't exist and has not been able to be tested. A limitation of this study is the amount of explicit testing in the model. Due to time constraints the complete explicit testing had to be postponed. Frequently during

interaction with UNOSAT the model has been implicitly tested. Especially model boundaries have been issues of discussion. The consequence of not completing all tests has not lowered the confidence in the model as Sterman (2000) is warning about. The consequence is rather a higher probability of faults which might occur.

The re-design of the model according to new decision policies which has been made is limited to the creation of scenarios (see appendix 4) and not changing structure as Sterman (2000) recommends. This is a limitation since these policies should be defined by the managers and then implemented in the model. The scenarios provide the foundation from where the model analysis (see appendix 5) is generated.

Presentations

Three characteristics were synthesized from the presentations. The first characteristic dealt with the mixed responses after the presentations. After one presentation spontaneous comments like the following were stated: “many interesting connections” “a sort of aha-reaction”. Other reactions during presentations have been many questions about the boundaries of the model and the quantification. After presenting for Mr. Senegas the amount of boundary question were almost zero. During the presentation with Mr. Senegas more detailed questions were received regarding the angle of the curves and different detail behavior. During the presentations pressure were put on the importance of studying the connections and behavior instead of focusing on the values.

The second characteristic involved the abstraction levels of the respondents, which to some extent varied. Some of the answers in the interviews reveal a perspective of very good understanding for the connections between elements in the model while some answers indicate an operational perspective focusing on quantification. The third and last characteristic was the several spontaneous discussions which arose around behaviors of the model. These discussions have taken some time but have been very important in order to increase the understanding.

5.4 Key effects

The overarching impression of effects on UNOSAT’s *strategic understanding* of their customers has been an increased general dynamic and “change over time” understanding. This understanding has influenced the view on activities taken (which could incorporate mass marketing) and UNOSAT’s strategic approach. The strategic approach has not been revolutionary changed but an alternative in dynamic resources has been introduced instead of SWOT analysis. A new customer mapping has been completed aligned with the dynamics and change over time. This new mapping is an alternative to existing customer segmentation in UNOSAT. However are there no results indicating an increased understanding of the risks with following the strategy GBF (see section 3.1.2)

The analysis indicated an increased understanding of changes in UNOSAT’s organization over time. This increased understanding is one important characteristic of SD and one of its strengths. Except changes over time the understanding of long terms effects was increased for one of the respondents. This understanding is also emphasized in SD and can be considered as one main result of the method. Both respondents have emphasized the difficulties in quantifying the model. A possible explanation to these difficulties is the short time path of UNOSAT. The literature argues about pros and cons about quantification and both sides have their advantages (see section 3.4.2)

One respondent expressed an increased understanding of the interconnectivity between flows and driving forces. It can however not be stated that the other respondent didn't increase his understanding. The interconnectivity is the foundation of complex systems and therefore is it highly important to understand. One respondent believed an interactive learning environment could help UNOSAT communicate this complex system to external organizations. With this tool would UNOSAT be able to explain and confirm their theories. The respondent's idea coincides with theories about interactive learning environments. The possibility of testing new experiments not feasible in reality was not mentioned by the respondent.

The problem articulation was defined to broad according to recommended way of working with SD. The problem was described as an area where UNOSAT sensed a problem. The problem should have been defined more explicit and narrower. Finally a re-design of the structure were not carried through during the simulation phase. This does not fully correspond to the correct way of working. The correct way of working would have been making a new structure with a decision policy from the manager. Instead were scenarios used for documenting changes made in the model.

6. Discussion

After presenting an analysis of the empirical result, this chapter contains selected reflections about the analysis. The chapter is divided into two main sections which are named general discussion and modeling process.

6.1 General discussion

In the analysis three factors form together the main positive result of this thesis. These three factors are:

- An increased understanding of change over time
- An increased understanding of long term effects
- An increased understanding of interconnectivity

With these areas of increased understanding I consider this thesis to have answered the first research question which was stated whether SD can support the *strategic understanding* of the *complex customer system* at UNOSAT.

This thesis could have generated even more *strategic understanding* but some constraints arose because of the following factors:

- Difficulties in articulating the problem
- Difficulties with quantification
- No re-design according to new managerial policies

The broad defined problem articulation was a consequence of the problem area where UNOSAT felt they had a problem. During the process we reworked the problem articulation many times but it was not until in the end of the project I could clearly see the areas where the focus should have been aimed. An example of these new problems is the issue of increasing the price and customers reaction vs. adaptation time to this new price. The difficulties in quantifying the model occurred due to the lack of relevant data in UNOSAT. It was consequently very hard to recreate any time path. The reason to why they hadn't much relevant data was caused by the short time they have been active (two years).

In order to fulfill a complete simulation phase I should have made a re-design of the model with new managerial policies implemented. The simulation phase could have been improved if the time table had allowed for iterative changing of the structure according to the new policies. Unfortunately and naturally omitting of this step was caused by my experience of constructing models compared to experienced researchers. While simulating I constructed three different scenarios with different parameters. The importance of the scenarios has decreased since they only consist of changes in parameters. As stated above no tests with new structures were made and this should have been done with the scenarios in order to increase their relevance.

The choice of SD must be questioned since another method could have been used and different results would have been generated. SSM is the method which SD is contrasted against in this thesis. Using SSM with the purpose of increasing *strategic understanding* of the *complex customer system* at UNOSAT would probably have generated similar results and other more useful results. An example of a useful result would be a different and probably more detailed problem description. Another interesting result which would have been generated by SSM is implementing results. The resource dynamics perspective and interactive learning environments aren't a part of SSM and this would affect the understanding in

UNOSAT. The effects would probably not be grave on this study since an interactive learning environment isn't developed anyway.

The result of this study and how it could have been improved is worth discussing. The result could have been improved if the third interview would have been completed. The implications of this interview would have been a larger empirical base and new input to the analysis. A broader perspective on the effects of SD could have been obtained if the interactive learning environment would have been created.

The method used in this study was field experiment. If this study would have been carried through with another method different result would probably have occurred. If the purpose of the study would have been to regard the researcher as part of the research object different results would have probably occurred. Potential changes in the result could have been a stronger focus on the actions taken by the researcher. For example was the decision to not change the structure while creating the scenarios very influential. With an action research method this decision should have been compared with a process where the structure actually would have been changed. Another research method which could have been used in this study is case study. If this method would have been used the effects should have been compared to other cases with similar studies. The boundaries of a potential case could be managers at UNOSAT. The comparison would then be done between managers in UNOSAT.

In the theoretical framework of this thesis some contradictive arguments exist. One area with contrary arguments is the quantification of a model. Several authors argues in favor of quantifying because they consider it better to quantify wrong than not to quantify at all. Some authors argue in the opposite way where they say quantification is not always reasonable to carry through. My opinion about quantification was positive when this study was initialized. I have however changed my mind from the experiences with UNOSAT. I believe UNOSAT could have had more use of a work without quantification

6.2 The modeling process

The modeling process consists of five steps which are all useful to progress with the SD work. The categorization I made upon these steps helped categorizing my work and made it more understandable for my clients. With modeling phase and simulation phase as established concepts between me and my clients it was easier to discuss during the process.

In the modeling phase I used different tools to build the model. One of these tools was the software Powersim. Powersim was unfortunately not good enough when I used it. It was also not suitable when I used it together with my clients. One shall though remember that the version of Powersim I used was not the latest. During the modeling phase I noticed an already high level of understanding in UNOSAT of variables which at first sight might seem to be exogenous but in fact are endogenous. This understanding exists probably because of the nature of UNOSAT to work with global issues.

My conclusions about building an interactive learning environment for UNOSAT were unfortunately negative after completing the model. The main reason was the available resources at UNOSAT for constructing this kind of software. The second reason was the limited number of potential users since UNOSAT is a small organization. I also believed, with the result from the model analysis, that there is no real value in creating software for communicating this result internally. The result can be communicated with traditional tools

without dedicating extra resources. After a suggestion from one respondent to use the interactive learning environment towards a specific group of people I changed my opinion. With this suggestion there is probably enough value in creating the software compared to the resources spent. During this thesis completion phase a decision has been made to construct an interactive learning environment outside the boundaries of the thesis.

With this discussion of the modeling process as background my overarching impression concludes to be positive. Mr. Senegas has taken part in most of the workshops and has grasped the concept of SD fast. The effects on UNOSAT from the modeling phase are not as significant as in the simulation phase. The total amounts of effects on UNOSAT have been stronger in the simulation phase since the model analysis and scenarios were completed in this phase. More results have consequently been available for absorption. It is however surprising that none of the respondents consider themselves to have gained completely new knowledge about the organization from the modeling. This can be explained by different definitions of the concept "new knowledge". It can also be due to a model not useful enough. The respondents' explanation about the model reflecting the reality very well is also plausible as reason to why no completely new knowledge about the organization were generated.

6.2.1 Presentations

Despite many what if questions from the respondents about the boundaries of the model, the level of these must be accepted even if there is a desire of expanding the model. Regarding Mr. Senegas detailed questions it was obvious that he felt comfortable with the model. During the presentation and the surrounding discussion I noticed a feeling of responsibility for the model which I did not see in the other presentation.

If the presentations would have been carried through with several participants I believe the number of interesting discussions could have been even more. During the presentations and discussions I have decided not to present the limitations of the model. These have still been subject of discussions since the respondents have asked about them.

6.2.2 Impact on the process

The modeling process has been affected by me, my supervisors and by UNOSAT themselves. In order to create transparency in this modeling process the strongest impacts are described below.

Supervisors

The importance of my supervisors was radically changed from the day I commenced the modeling process until the day I ended it. With the modeling process completed I can conclude an increase of my supervisors' importance in the modeling phase. The affect of Martin Börjesson has not been as changed compared to expectations as the affect of Maria Poutilova. Martin Börjesson has given me advices regarding how to perform the workshops and discussed the usefulness of the modeling process and the model. Maria Poutilova has focused solely on modeling technique and corrected several flaws I was not aware of. I underestimated her affect gravely when the modeling process commenced.

My impact on the modeling phase

My impact on the modeling phase has been more significant than I first imagined. During the whole phase I have been affecting my clients in different ways. This list is a selection of the most important occasions when I have been affecting the model and my clients.

- The importance of my question formulation has been stated when my clients have not understood or misunderstood the questions. I have tried to formulate my questions well in advance in order to check them from these flaws.
- Sometimes the answer to some questions has been out of range for what is possible. Then I have asked the question again and explained what I have perceived as out of range.
- I have occasionally, and unintentionally, asked the same question twice during the same workshop and received different answers. This was solved by clarifying the question and asking it again.
- The answers to my questions have also been affected by the motivation of my clients and the motivation of me. With a high motivation, a more focused and concentrated dialog has occurred.

My impact on the simulation phase

With the experience from the modeling phase, where I underestimated my impact on the process, I commenced the simulation phase with a greater insight regarding my impact on the process.

The work of the simulation phase has been extremely iterative. By testing different parameters interesting behaviors have been found. My impact on this testing was mainly my choice of tests made and behaviors presented. It was also my responsibility to complete the testing without overlooking any parameters. The impact of my supervisors has not been significant in the simulation phase. The biggest external impact on the simulation phase derives from UNOSAT because they have partly controlled which areas of the model to focus on.

During the simulation phase I made one important decision in order to be able to complete the work within the time table. I did not attempt to change the structure according to desired policies with my client. Instead we made changes in parameters and analyzed these behaviors.

UNOSAT's impact on the modeling process

With UNOSAT's impact is meant all clients involved in the modeling process. UNOSAT's impact has been strong since they have designed the model by describing how their business is operated. These descriptions have not always been consistent since the business has not been tested in different scenarios. An example of this is the expected customer attraction and the response from UNOSAT. Throughout the process has UNOSAT been informed about the modeling process and educated in the basics of SD. This education might have affected the result compared to if they wouldn't have been aware of SD. However, initializing a modeling process with SD demands a high transparency and a will to educate the clients. This is considered to be one of the strengths of SD.

7. Closing words

In the beginning of this thesis the research problem was stated as studying the effects of SD modeling and simulation on the *strategic understanding* of a *complex customer system* at UNOSAT.
From the research problem three research questions were identified:
- Can SD increase the *strategic understanding* of the *complex customer system* in UNOSAT?
- Which are the advantages of using SD at UNOSAT?
- Which are the obstacles of using SD at UNOSAT?

The research problem is answered in this thesis because using SD has increased the *strategic understanding* of UNOSAT's *complex customer system*. The *strategic understanding* has been constrained due to certain limitations.

The advantages of using SD at UNOSAT are foremost the following:
- Increased understanding of the interconnectivity of the customer system in UNOSAT.
- Increased understanding of long term effects in UNOSAT.
- Increased understanding of change over time in UNOSAT.

The disadvantages of using SD are the following:
- The model is limited due to many estimations.
- The model is simplified compared to the reality.

My overall impression of SD in order to increase the *strategic understanding* of UNOSAT's customer system is good but not convincing. Too many problems have arisen to consider this project to be a success. The dominant problem has been the quantification and its implications together with the articulation of the problem. The effects on UNOSAT are however satisfying and I still believe the managers' understanding of the customer system has increased. It is also important to be aware of other possible reasons, than concluded in this thesis, to why increased understanding was produced in UNOSAT. Increased understanding arises sometimes by explicitly encouraging new knowledge generating interaction in an organization. This thesis might consequently have been a facilitator of increased understanding merely by stating the intentions of the organization. It is also possible that the increased understanding would have occurred no matter if some study would have been performed or not.

During the literature study I surprisingly didn't find many evaluating studies of SD. Therefore will my suggestion for further research contain the issue of evaluating SD in several contexts. Putting SD to use in non for profit organizations as UN is another very interesting area of research. Other research areas would be how SD could interact with data collection methods in order to generate the values needed for quantification. The interactive learning environment which will be constructed outside this thesis boundary is interesting to study from a similar perspective as in this thesis, consequently an evaluation of the *strategic understanding*. During the study an issue about quantification of models arose. This issue is very important to study further since resources might be invested in an in-depth analysis of parameter values but not creating any use in the model.

8. References

Books

Backman, J. (1998). *Rapporter och uppsatser.* Lund: Studentlitteratur.

Bauman, Z. (1992). *Hermeneutics and social science.* Worcester: Billing & Sons Ltd

Blaxter, L., Hughes, C. & Tight M. (1996). *How to research.* Buckingham: Open University Press

Checkland, P. (1993). *Systems Thinking, Systems Practice.* West Sussex: John Wiley & Sons Ltd.

Checkland, P. & Scholes, J. (1990). *Soft Systems Methodology in Action*. Chichester: John Wiley & Sons.

Darmer, P. & Freytag, P. (1995). *Företagsekonomisk undersökningsmetodik.* Lund: Studentlitteratur.

Eriksson, L. T. & Wiedersheim-Paul, F. (1999) *Att utreda, forska och rapportera* Malmö: Liber ekonomi.

Holme, I. M. & Solvang, B. K. (1997). *Forskningsmetodik. Om kvalitativa och kvantitativa metoder.* Studentlitteratur: Lund.

Kalakota R. & Robinson M. (2001). *e-Business 2.0: A Road Map for Success,* Boston: Addison Wesley.

Mintzberg, H. (1994). The *rise and fall of the strategic process.* London: Prentice Hall.

Patel, R. & Davidsson B. (1994). *Forskningsmetodikens grunder.* Lund: Studentlitteratur.

Sacket, P. R. & Larson, J. R. (1990) Research strategies and tactics in industrial and organizational psychology. In Dunnette, M. D. & Hough, L. M. (Eds.), *Handbook of industrial and organizational psychology* (pp. 419-489). Palo Alto: Consulting psychologists press.

Schwartz, P. (1998). *The art of the long view: planning for the future in an uncertain world.* New York: Bantam Doubleday Dell Publishing Group

Senge, P.M. (1990) *The fifth discipline, the art and practice of the learning organization.* New York: Century Business

Sterman, J. D. (2000). *Business Dynamics, System Thinking and modeling for a complex world.* New York: McGraw-Hill Higher Education.

Yin, R. K. (1984). *Case study research.* Beverly Hills: SAGE Publications Inc.

Warren, K. (2002). *Competitive Strategy Dynamics.* West Sussex: John Wiley & Sons Ltd.

Articles

Ackere, A. V., Warren, K. & Larsen, E. (1997). Maintaining Service Quality under Pressure from Investors: a Systems Dynamics Model as a Hands-on Learning Tool. *European Management Journal*. Vol. 15, pp. 128-137.

Breierova, L & Choudhari, M. (1996). *An introduction to sensitivity analysis.* Massachusetts Institute of Technology.

Bianchi, C. & Bivona, E. (2002). Opportunities and pitfalls related to e-commerce strategies in small–medium firms: a system dynamics approach. *System Dynamics Review*. Vol. 18, pp. 403-429.

Coyle, G. (1998). The practice of system dynamics: milestones, lessons and ideas from 30 years experience. *System Dynamics Review.* Vol. 14, pp. 343-365.

Coyle, G. (2000). Qualitative and quantitative modelling in system dynamics: some research questions. *System Dynamics Review.* Vol. 16, pp. 225-244.

Coyle, G. &. Alexander, M. W. D. (1997). Qualitative modeling of a nation's drugs trade. *System Dynamics Review* Vol. 13, pp. 205-222.

Dahlbom, B. (1997). *The new informatics*. http://www.viktoria.se/~dahlbom Latest visited: 040326 17:16

Dahlbom, B (1996). *From System Thinking to Networking*. http://www.viktoria.se/~dahlbom Latest visited: 040326 17:48

Dewan, R., Jing B. & Seidmann A. (1999) One to One Marketing on the Internet. In *Proceeding of the 20th international conference on Information Systems* (pp. 93-102). Charlotte, NC. http://portal.acm.org/toc.cfm?id=352925&type=proceeding&coll=GUIDE&dl=ACM&CFID=21532532&CFTOKEN=75771363

Dick, B. (2002). *Action research: action and research*. http://www.scu.edu.au/schools/gcm/ar/arp/aandr.html Latest visited: 040121 13:30

Ford, D. N. & Sterman J. D. (1998). Expert knowledge elicitation to improve formal and mental models. *System Dynamics Review*. Vol. 14, pp. 309-340

Forrester, J. (1994). Learning through System Dynamics as preparation for the 21st Century. *Keynote Address for Systems Thinking and Dynamic Modeling Conference for K-12 Education.*

Ghemawat, P. (2002). Competition and Business Strategy in Historical Perspective. *Business History Review*. Spring, pp. 37-74.

Harris, B. (2000) *Applying System Dynamics to business: An expense management example.* http://facilitatedsystems.com/index.html Latest visited: 040326 17:36

Lane, D. C. (1995). On a resurgence of management simulations and games. *The journal of the operational research society.* Vol. 46, pp. 604-625.

Lyneis, J. M. (1999) System dynamics for business strategy: a phased approach. *System Dynamics Review*. Vol. 15, pp. 37-70.

Morecroft, J. (1984) Strategy support models. *Strategic management journal*. Vol 5, No. 3, pp. 215-229

Oliva, D., Sterman, D. J. & Giese, M. (2003). Limits to growth in the new economy: exploring the 'get big fast' strategy in e-commerce. *System Dynamics Review.* Vol. 19, pp. 83-117

O'Keefe, M., Mavondo F. & Schroder B. (1999). *The resource-advanatage theory of competition iplications for Australian agribusiness. h*ttp://www.agribusiness.asn.au/Review/Perspectives/indexpre99.htm Latest visited: 040326 18:13

Olofsson and Sixtensson (1997) A system dynamics approach for return on investments calculations. http://www.flajt.se/logg/krono.shtml Latest visited: 040326 18:20

Pine, J., Peppers, D. and Rogers, M. (1995). Do you want to keep your customers forever? *Harvard Business Review*. March-April.

Porter, M. (2001). Strategy and the Internet. *Harvard Business Review*. March.

Prahalad, C. K. & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*. May-June.

Richmond, B. (1997) The Strategic Forum: aligning objectives, strategy and process. *System Dynamics Review*. Vol. 13, pp. 131-148

Spector, M. J. & Davidsen, P. I. (1998). Constructing Learning Environments using System Dynamics. *Journal of Courseware Engineering*. Vol. 1, pp. 5-11

Stenmark, D. (2001). Leveraging tacit organizational knowledge. *Journal of Information Management Systems.* Vol. 17, No. 3, pp. 9-24.

Sterman, J. D. (1991). A Skeptic's Guide to Computer Models. http://sysdyn.clexchange.org/road-maps/rm-toc.html Latest visited 040326 18:30

Sterman, J. D. (2002). All models are wrong: reflections on becoming a systems scientist. *System Dynamics Review.* Vol. 18, pp. 501-531.

Vennix, J. A. (1999). Group model-building: tackling messy problems. *System Dynamics Review*. Vol. 15, pp. 379-401.

Wedel, M. & Kamakura, W. (2002) Introduction to the special issue on market segmentation. *International Journal of Research in Marketing.* Vol. 19, pp. 181-183.

Internet

http://www.unosat.org Latest visited: 040412 16:35

http://www.systemdynamics.org/ Latest visited: 040429 17:22

[1] http://www.un.org/aboutun/basicfacts/unorg.htm Latest visited: 040205 11:02

[2] http://www.unitar.org Latest visited: 040205 10:02

[3] http://www.unops.org Latest visited: 040205 10:30

Other documents

UNOSAT Business Plan. Internal document.

Statement of work for longer term earth observation market development of ENVISAT-based services. Internal document.

ANSWER TO. Statement of work for longer term earth observation market development of ENVISAT-based services. Internal document.

UNOSAT range of products and services. Internal document.

Workshops

Mr. Retiere and Ian the 5th of January
Mr. Senegas the 7th of January
Mr. Senegas the 21st of January
Mr. Senegas the 27th of January
Mr. McClellan the 27th of January
Mr. Senegas the 5th of February
Mr. Senegas the 10th of February
Mr. Retiere and Mr. Senegas the 12th of February
Mr. Senegas the 26th of February
Mr. Retiere the 29th of February
Mr. Senegas the 3rd of March
Mr. Senegas the 12th of March
Mr. Senegas the 23rd of March
Mr. Bjorgo the 25th of March (Presentation)
Mr. Bjorgo the 25th of March (Interview)
Mr. Senegas the 1st of April (Presentation)
Mr. Senegas the 4th of April (Interview)

Conversations

Mr. Retiere the 20th of November
Mr. Retiere the 17th of November

Mr. Senegas the 16th of December
Mr. Börjesson, frequently during the whole project
Ms. Poutilova, frequently during January, February and March

Appendix 1

Interview 1

What is your general opinion about System Dynamics?

What is your opinion about the presentation?

Do you believe you have learned anything useful during this presentation? If yes, what have you learned? If no, how do you think you could have increased your learning?

Will any decisions you will make in a near future (approximately 1 year) be affected by these conclusions and by the model? If, yes. Which decisions?

Which are the biggest advantages of using System Dynamics at UNOSAT?

Which are the biggest disadvantages of using System Dynamics at UNOSAT?

Have we talked about something new you haven't talked about before in UNOSAT?

Was this project useful in terms of time vs. use?

Do you have any other comments?

Appendix 2

Interview 2

What is your general opinion about System Dynamics?

What is your opinion about the modeling phase? (positive and negative critique)

What is your opinion about the simulation phase? (positive and negative critique)

Do you believe you have learned anything useful during this project due to our work with System Dynamics? If yes, what have you learned? If no, how do you think you could have increased your learning?

Have any decisions you have made/will make in a near future (approximately 1 year) been affected by this modeling process/model?

Which are the biggest advantages of using System Dynamics at UNOSAT?

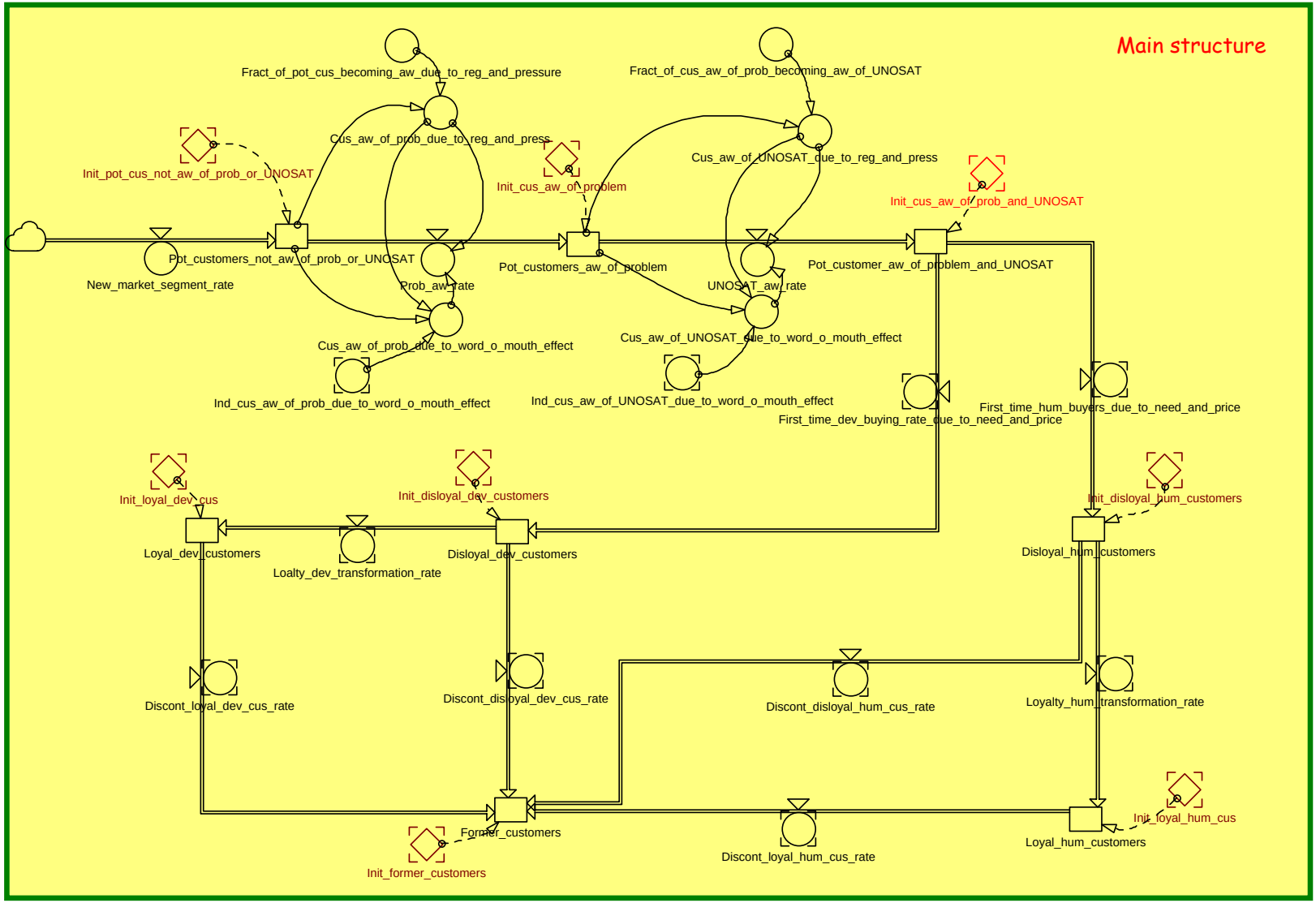
Which are the biggest disadvantages of using System Dynamics at UNOSAT?

Was the time you spent on SD worth it?

Do you have any other comments?

Appendix 3

Main structure



Appendix 4

Scenarios

In this section three different mini scenarios will be presented. The two latter scenarios are based on the reference scenario. It is not feasible to present all differences between the scenarios in this report since it involves several changes of variables. The scenarios exist though as three different computer files with all the differences on an adherent compact disc. Key parameters are presented by name and values.

First time estimation scenario

This scenario was created during the modeling phase. It is characterized by estimations that don't fit together. These overestimated estimations derive from not enough clarification while talking about parameters and an optimistic attitude. Because of the overestimated parameters this scenario has only been used to revise estimations and clarification of parameters. In this scenario are definitions of stocks also presented in order to clarify the model.

Pot_cus_not_aware_of_problem_or_UNOSAT

This stock contains the potential customers of UNOSAT. These potential customers know nothing about above mentioned problems and solutions. They work within the UN-system and could use UNOSAT as a tool in their job. A customer is a person working for an UN-organization. They are not aware of why they need satellite imagery and how satellite imagery works. The initial value of these people is **345**. This amount is increased by a new market segment rate and decreased by a problem awareness rate.

Cus_aware_of_problem_and_UNOSAT

This stock contains people that have become aware of both their problem and their solution in form of UNOSAT. It is increased by UNOSAT awareness rate and decreased by first time buying rate. These customers are ready to buy except for the parameters named need, price and delivery delay. The initial values of these people are **100**.

Disloyal_dev_customers

The disloyal development customers are customers between their second and eighth purchase of development products. They have for example accepted delivery delay, price and need. They are though more likely to become former customers than the loyal customers. The flow increasing this stock is first time buying rate while it has two decreasing flows. These are "discontinuation disloyal dev rate" and "loyalty dev transformation rate". The initial values of these people are **3**. The **disloyal humanitarian customers** are similar to the customer group described above. The initial values of these people are though **2**.

Loyal_dev_customers

The loyal development customers are people who have bought more than 8 purchases from UNOSAT. They are not as likely to become former customers as disloyal customers. The stock is increased by "Loalty_dev_transformation_rate" and decreased by "Discont_loyal_dev_cus_rate". The initial values of these people are **1**.The **loyal humanitarian customers** are similar to the customer group described above. The initial value of this group is also **1**.

Former_customers

The former customer is of course the worst kind of state a customer can be in for UNOSAT. This customer is disappointed about price or delivery delay or has stopped buying because of "natural reasons" as new work tasks. The former customer stock is increased by "Discontinuation_disloyal_dev_customers_rate", "Discontinuation_loyal_dev_customers_rate", "Discontinuation_disloyal_hum_customers_rate" and "Discontinuation_loyal_hum_customers_rate". The initial values of these people are **0**.

New_market_segment_customers_rate

Defines when the market expands and the target group of UNOSAT services enlarges. The estimation of the market expansion is set to 500 people during month 8-12 from initialization of model, 500 people during month 20-24 and 1000 people during month 31-35.

Most important values in the attraction part of the model:

These three parameters control the strength of the word of mouth effect driving the flow of customer not aware of their problem or UNOSAT to become aware of their problem but still not aware of UNOSAT.
"Effect_of_marketing_on_aw_prob_fract" = Maximum value of 150 percent
"Base_aw_of_prob_fract"= 10 percent
"Base_contact_freq" = 2 persons/person/month

These four parameters control the strength of the word of mouth effect driving the flow of "customer not aware of UNOSAT but aware of their problem" to become aware of their problem and UNOSAT.
"Effect_of_marketing_on_aw_of_UNOSAT" = Maximum value of 150 percent
"Effect_of_reports_on_aw_of_UNOSAT_fract" = Maximum value of 115 percent
"Base_aw_of_UNOSAT_fract" = 0,15 percent
"Base_contact_freq_UNOSAT" = 8 persons/person/month

These parameters control the flow of customers aware of both their problem and UNOSAT becoming disloyal humanitarian customers or disloyal development customers.
"Hum_average_normal_price" = 10000 $
"Hum_price" = maximum value of 25000 $
"Hum_fraction_need" = 15 percent
"Dev_average_normal_price" = 15000 $
"Dev_price" = 15000 $
"Dev_fraction_need" = 30 percent

Most important values in the buying part of the model:

These parameters control the amount of recurrent purchases that are made due to specific products. A specific product is created and customized for one special customer.
Fract_of_disloyal_hum_rec_customers_buying_due_to_spec_prod = Maximum value of 50 percent
Fract_of_loyal_hum_rec_customers_buying_due_to_spec_prod = Maximum value of 50 percent

These parameters control the impact delivery delay and price has on the disloyal recurrent buying customers.
"Effect_of_exp_hum_del_on_rec_disloyal_hum_cus" = Maximum value of 250 percent
"Effect_of_hum_price_on_rec_buy_disloyal_hum_cus" = Maximum value of 200 percent
"Effect_of_exp_dev_del_on_rec_buying_disloyal_cus" = Maximum value of 300 percent
"Effect_of_dev_price_on_rec_buy_disloyal_dev_cus" = Maximum value of 200 percent

These parameters control the impact delivery delay and price have on the loyal recurrent buying customers.
"Effect_of_exp_hum_del_on_rec_loyal_cus" = Maximum value of 250 percent
"Effect_of_hum_price_on_loyal_hum_rec_buying_rate" = Maximum value of 200 percent
"Effect_of_exp_dev_del_on_rec_buying_loyal_cus" = Maximum value of 350 percent
"Effect_of_dev_price_on_loyal_dev_rec_buying_rate" = Maximum value of 200 percent

These parameters control the flows from disloyal to loyal customers regarding both humanitarian and development customers.
"Fraction_becoming_dev_loyal_due_to_purchases" = Maximum value of 8 purchases
"Fract_becoming_dev_loyal_due_to_spec_prod" = Maximum value of 1,8 percent
"Fraction_becoming_hum_loyal_due_to_purchases" = Maximum value of 8 purchases
"Fract_becoming_hum_loyal_due_to_spec_prod" = Maximum value of 1,8 percent

Reference scenario

The reference scenario was created while correcting the first time estimation scenario. Estimations were made and revised due to unrealistic behavior of the model. The reference scenario is the scenario from which the two following scenarios are created (Positive and Negative). The most important input and output is presented below:

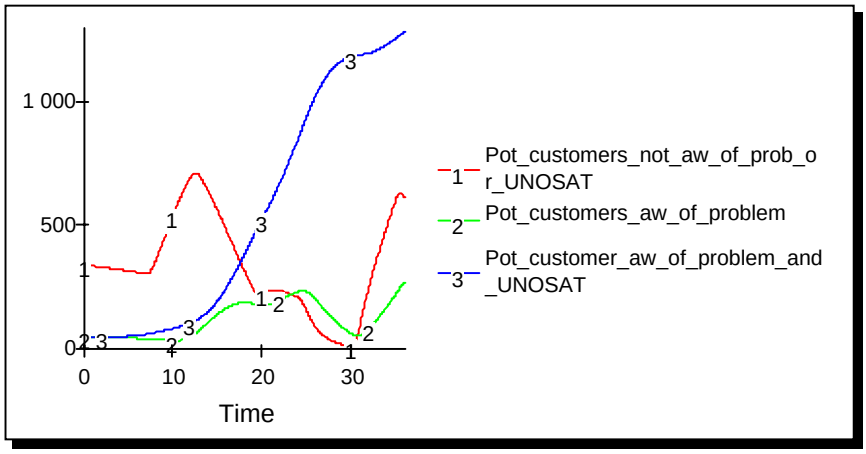


Figure 36: The three main stocks in the attraction part of the model

In this graph it's possible to interpret a safe and satisfying customer resource base for UNOSAT. Potential customer aware of problem and UNOSAT are high and there are still more potential customers not aware of problem and UNOSAT to deplete.

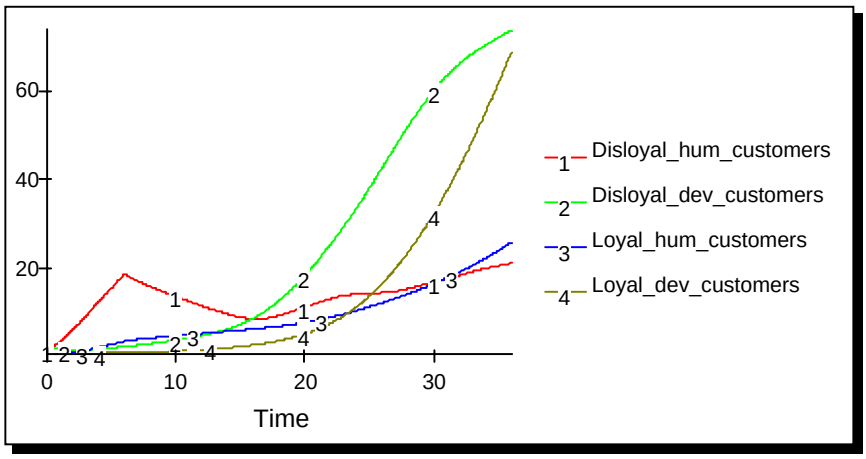


Figure 37: The four stocks in the buying part of the model

The developments of disloyal and loyal customers are expected and promising. The amount of customers being loyal has a slow start but is increasing well after 24 months.

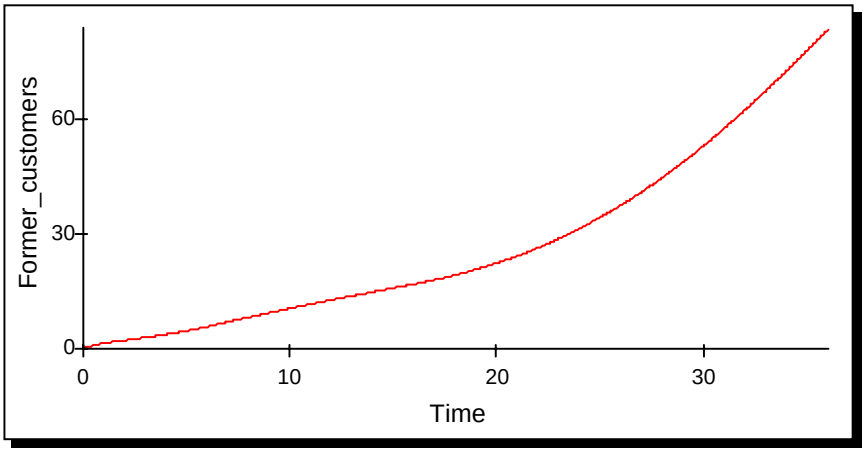


Figure 38: The stock of former customers

The stock of former customers will not remain at the same level even though it is a desired behavior. The reason to this behavior is the normal discontinuation rate which constantly increases the stock of former customers. The worrying behavior starts after 20 months where the speed of accumulating former customers increases. This behavior can be traced in the following graph.

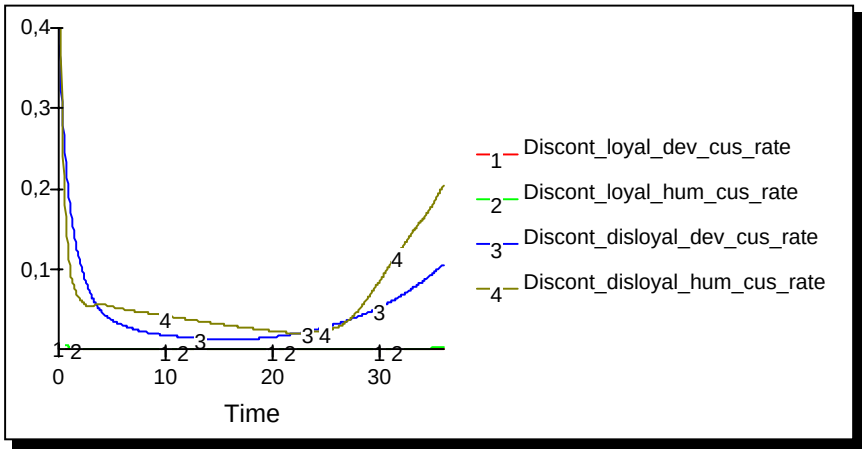


Figure 39: Discontinuation rates controlling flows into the stock former customers

In this graph one can trace the accumulation pace of former customer stock. During month 25 an increase occurs from mainly the disloyal customers. This increase take place because of earlier discussed exponential increase of customer flows in the system. If there are a large amount of disloyal customers consequently more customers will become former customers since the fractions remain. A total amount of 0,3 customers leaving UNOSAT per month might not appear as a high value but when adding the customers together the graph in figure 39 is created.

Pot_cus_not_aware_of_problem_or_UNOSAT	345
Cus_aware_of_problem_and_UNOSAT	50
Disloyal_dev_customers	3
Disloyal_hum_customers	2
Loyal_dev_customers	1
Loyal_hum_customers	1
Former_customers	0
New_market_segment_customers_rate	500 (8-12) 500 (20-24) 1000 (31-35)
Effect_of_marketing_on_aw_prob_fract	Maximum value of 140 percent
Base_aw_of_prob_fract	5 percent
Base_contact_freq	1 persons/person/month
Effect_of_marketing_on_aw_of_UNOSAT	Maximum value of 140 percent
Effect_of_reports_on_aw_of_UNOSAT_fract	Maximum value of 115 percent
Base_aw_of_UNOSAT_fract	7,5 percent
Base_contact_freq_UNOSAT	2 persons/person/month
Hum_average_normal_price	10000 $

Hum_price	Maximum value of 25000 $
Hum_fraction_need	10 percent
Dev_average_normal_price	15000 $
Dev_price	21000 $
Dev_fraction_need	20 percent
Normal_disloyal_cus_discontinuation_fract	5 percent
Normal_disloyal_cus_discontinuation_fract	5 percent
Normal_loyal_cus_transition_fract_into_former_cus	5 percent
Fract_of_disloyal_hum_rec_customers_buying_due_to_spec_prod	Maximum value of 40 percent
Fract_of_loyal_hum_rec_customers_buying_due_to_spec_prod	Maximum value of 40 percent
Effect_of_exp_hum_del_on_rec_disloyal_hum_cus	Maximum value of 250 percent
Effect_of_hum_price_on_rec_buy_disloyal_hum_cus	Maximum value of 200 percent
Effect_of_exp_dev_del_on_rec_buying_disloyal_cus	Maximum value of 300 percent
Effect_of_dev_price_on_rec_buy_disloyal_dev_cus	Maximum value of 200 percent
Effect_of_exp_hum_del_on_rec_loyal_cus	Maximum value of 250 percent
Effect_of_hum_price_on_loyal_hum_rec_buying_rate	Maximum value of 200 percent
Effect_of_exp_dev_del_on_rec_buying_loyal_cus	Maximum value of 350 percent
Effect_of_dev_price_on_loyal_dev_rec_buying_rate	Maximum value of 200 percent
Fraction_becoming_dev_loyal_due_to_purchases	Maximum value of 8 purchases
Fract_becoming_dev_loyal_due_to_spec_prod	Maximum value of 8,2 percent
Fraction_becoming_hum_loyal_due_to_purchases	Maximum value of 8 purchases
Fract_becoming_hum_loyal_due_to_spec_prod	Maximum value of 8,2 percent

Negative scenario

The importance of listed parameters is still high even though they are more negative than before. Average decreases by approximately **50** percent of all parameters have been made in order to create this scenario.

While simulating this negative scenario the results were of course lowered concerning the output. The most interesting output is presented below:

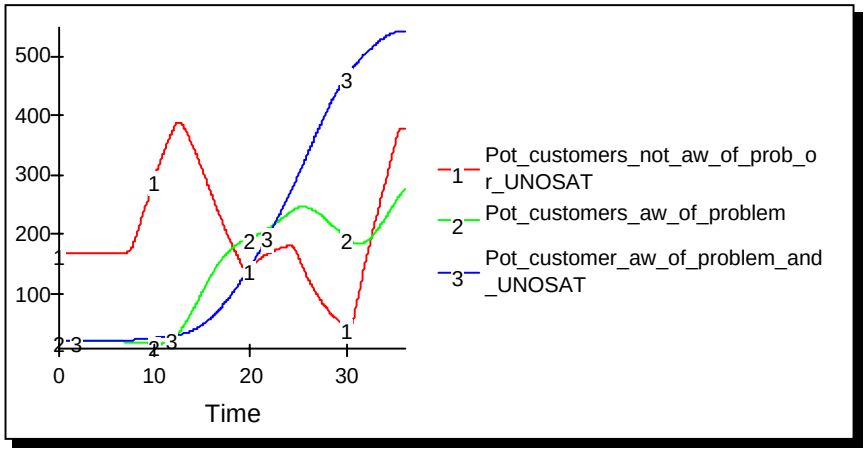


Figure 40: The three main stocks in the attraction part of the model

The biggest difference (except for the changed values) in this graph from the reference scenario is potential customers aware of problem. Since potential customer aware of problem and UNOSAT doesn't work as strongly as in the reference scenario the stock of "potential customer aware of problem" has time to refill.

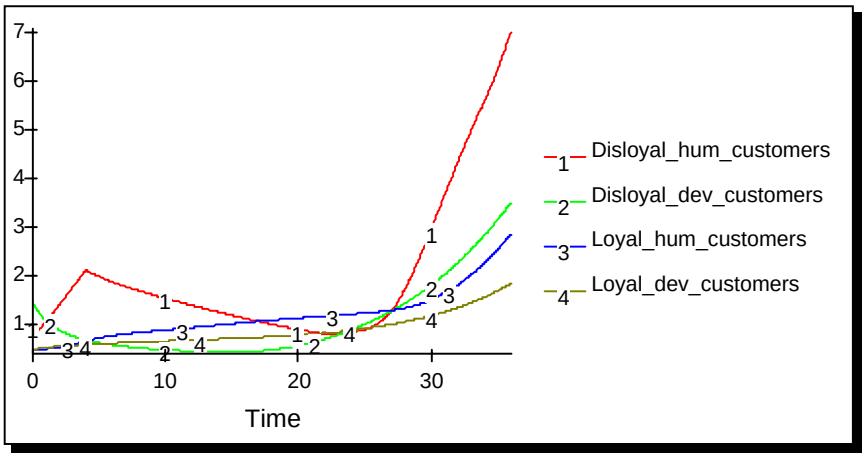


Figure 41: The four stocks in the buying part of the model

The differences in the four stocks of disloyal and loyal customers are significant between this scenario and the reference scenario. The stock with disloyal humanitarian customers is dominating in this graph while it was among the smallest in the reference scenario. The increases of disloyal development customers and loyal development customers have dampened considerably. The reason to these changes is the slow start of development customers. When all parameters have been lowered with 50 percent the reactions in the stock are much smaller (see y-scale). Disloyal humanitarian customers increases fast because of a smaller price gap than for the development customers.

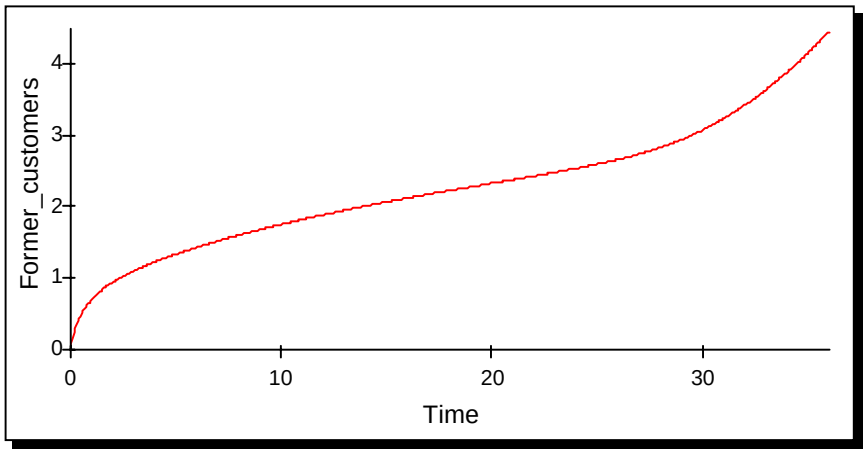


Figure 42: The stock of former customers

In this graph the worrying behavior remains but it appears a few months later than in the reference scenario (30th month). The stock is increasing its speed and that is not a desired behavior. Otherwise is of course the amount of customers leaving UNOSAT much smaller than the reference scenario since there are less people who can be dissatisfied.

Pot_cus_not_aware_of_problem_or_UNOSAT	173
Pot_customers_aw_of_problem	25
Pot_customer_aw_of_problem_and_UNOSAT	25
Disloyal_dev_customers	1,5
Disloyal_hum_customers	1
Loyal_dev_customers	0.5
Loyal_hum_customers	0.5
Former_customers	0
New_market_segment_customers_rate	250 (8-12) 250 (20-24) 500 (31-35)
Effect_of_marketing_on_aw_prob_fract	Maximum value of 120 percent
Base_aw_of_prob_fract	2,5 percent
Base_contact_freq	0,5 persons/person/month
Effect_of_marketing_on_aw_of_UNOSAT	Maximum value of 120 percent
Effect_of_reports_on_aw_of_UNOSAT_fract	Maximum value of 108 percent
Base_aw_of_UNOSAT_fract	3,7 percent
Base_contact_freq_UNOSAT	1 persons/person/month
Hum_average_normal_price	10000 $

Hum_price	Maximum value of 35000 $
Hum_fraction_need	5 percent
Dev_average_normal_price	15000 $
Dev_price	27000 $
Dev_fraction_need	10 percent
Normal_disloyal_cus_discontinuation_fract	2,5 percent
Normal_disloyal_cus_discontinuation_fract	2,5 percent
Normal_loyal_cus_transition_fract_into_former_cus	2,5 percent
Fract_of_disloyal_hum_rec_customers_buying_due_to_spec_prod	Maximum value of 25 percent
Fract_of_loyal_hum_rec_customers_buying_due_to_spec_prod	Maximum value of 25 percent
Effect_of_exp_hum_del_on_rec_disloyal_hum_cus	Maximum value of 250 percent
Effect_of_hum_price_on_rec_buy_disloyal_hum_cus	Maximum value of 200 percent
Effect_of_exp_dev_del_on_rec_buying_disloyal_cus	Maximum value of 300 percent
Effect_of_dev_price_on_rec_buy_disloyal_dev_cus	Maximum value of 200 percent
Effect_of_exp_hum_del_on_rec_loyal_cus	Maximum value of 250 percent
Effect_of_hum_price_on_loyal_hum_rec_buying_rate	Maximum value of 200 percent
Effect_of_exp_dev_del_on_rec_buying_loyal_cus	Maximum value of 350 percent
Effect_of_dev_price_on_loyal_dev_rec_buying_rate	Maximum value of 200 percent
Fraction_becoming_dev_loyal_due_to_purchases	Maximum value of 12 purchases
Fract_becoming_dev_loyal_due_to_spec_prod	Maximum value of 2 percent
Fraction_becoming_hum_loyal_due_to_purchases	Maximum value of 12 purchases
Fract_becoming_hum_loyal_due_to_spec_prod	Maximum value of 2 percent

Positive scenario

The importance of listed parameters is still high even though they are more positive than before. Average increases of approximately **30** percent of all parameters have been made in order to create this scenario.

While simulating this positive scenario the results were of course higher concerning the output. The most interesting output is presented below:

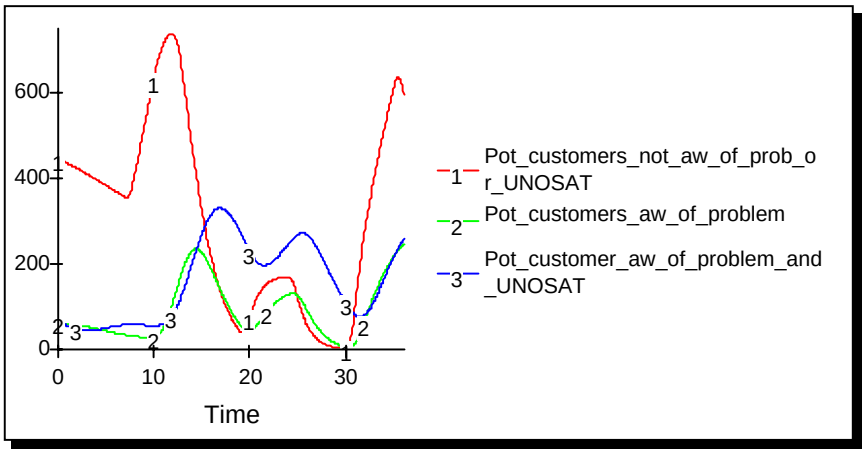


Figure 43: The three main stocks in the attraction part of the model

In this graph the change of new market segment rate is clearly visible since potential customers not aware of problem or UNOSAT are higher than in the reference scenario. The second curve indicates a high pace outflow from its stock. In the two previous stocks potential customers aware of problem and UNOSAT have had time to refill and created an increasing curve.

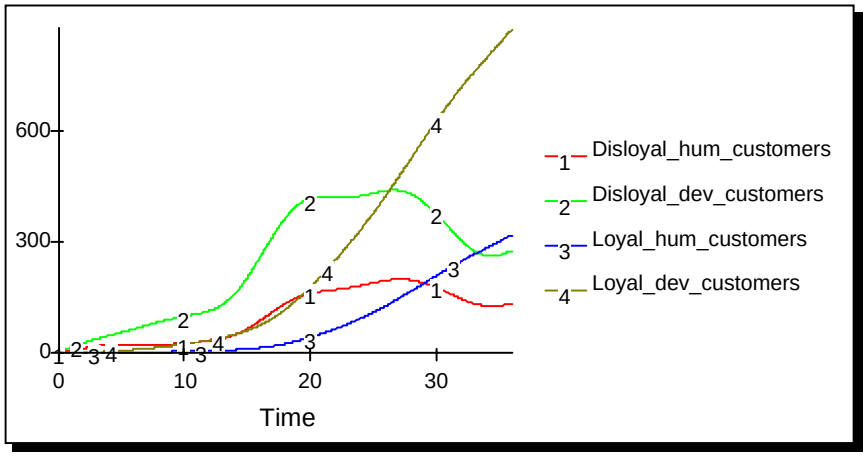


Figure 44: The four stocks in the buying part of the model

Except for a significant increase in values the most obvious difference in behavior occurs in disloyal development customers. This increase occurs due to an exponential increase of customers buying. This effect is discussed thoroughly in model analysis.

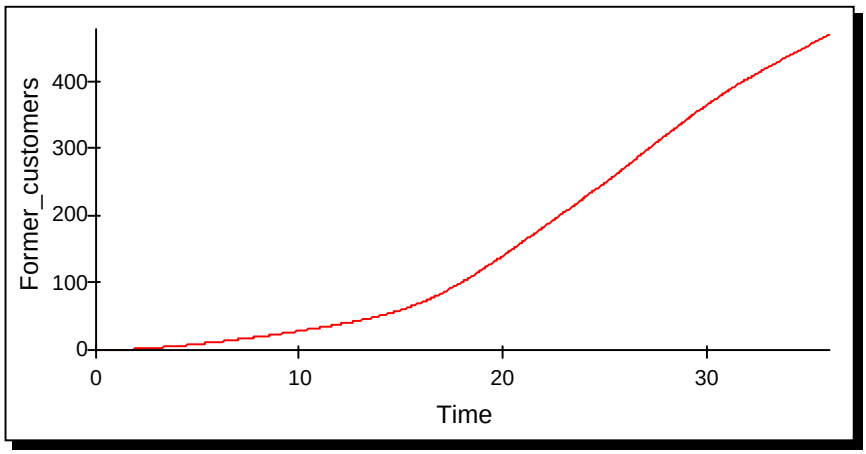


Figure 45: Former customer development

This curve has almost a similar behavior as former customers have in the reference scenario. The same worrying tendency, as stated earlier, occurs after 15 months when the curve starts to increase with a higher pace.

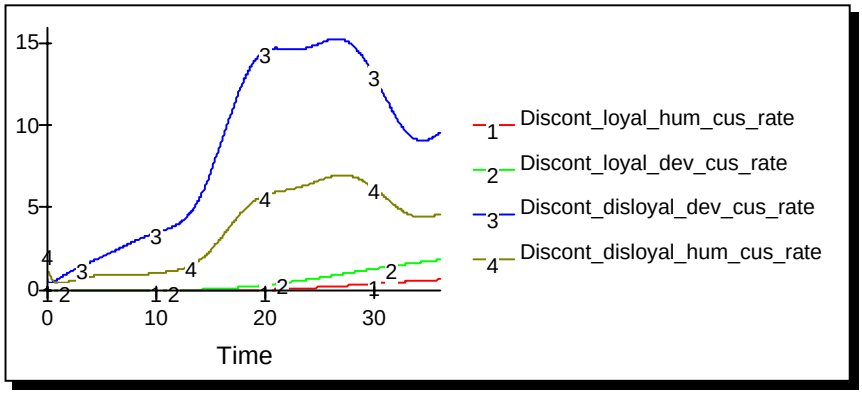


Figure 46: Discontinuation rates from all four stocks flowing into former customers

In this graph it is possible to trace the behavior of former customers. After approximately 15 months all discontinuation rates starts to increase. The reason to this behavior derives also from the exponential effect described in model analysis.

Pot_customers_not_aw_of_prob_or_UNOSAT	450
Pot_customers_aw_of_problem	65
Pot_customer_aw_of_problem_and_UNOSAT	65
Disloyal_dev_customers	3,9
Disloyal_hum_customers	2,6
Loyal_dev_customers	1,3
Loyal_hum_customers	1,3
Former_customers	0
New_market_segment_customers_rate	650 (8-12) 650 (20-

	24) 1300 (31-35)
Effect_of_marketing_on_aw_prob_fract	Maximum value of 162 percent
Base_aw_of_prob_fract	6,5 percent
Base_contact_freq	1,3 persons/person/month
Effect_of_marketing_on_aw_of_UNOSAT	Maximum value of 162 percent
Effect_of_reports_on_aw_of_UNOSAT_fract	Maximum value of 175 percent
Base_aw_of_UNOSAT_fract	9,75 percent
Base_contact_freq_UNOSAT	2,6 persons/person/month
Hum_average_normal_price	23000 $
Hum_price	Maximum value of 25000 $
Hum_fraction_need	13 percent
Dev_average_normal_price	15000 $
Dev_price	15000 $
Dev_fraction_need	26 percent
Normal_disloyal_cus_discontinuation_fract	6,5 percent
Normal_disloyal_cus_discontinuation_fract	6,5 percent
Normal_loyal_cus_transition_fract_into_former_cus	6,5 percent
Fract_of_disloyal_hum_rec_customers_buying_due_to_spec_prod	Maximum value of 65 percent
Fract_of_loyal_hum_rec_customers_buying_due_to_spec_prod	Maximum value of 65 percent
Effect_of_exp_hum_del_on_rec_disloyal_hum_cus	Maximum value of 250 percent
Effect_of_hum_price_on_rec_buy_disloyal_hum_cus	Maximum value of 200 percent
Effect_of_exp_dev_del_on_rec_buying_disloyal_cus	Maximum value of 300 percent
Effect_of_dev_price_on_rec_buy_disloyal_dev_cus	Maximum value of 200 percent
Effect_of_exp_hum_del_on_rec_loyal_cus	Maximum value of 250 percent
Effect_of_hum_price_on_loyal_hum_rec_buying_rate	Maximum value of 200 percent
Effect_of_exp_dev_del_on_rec_buying_loyal_cus	Maximum value of 350 percent
Effect_of_dev_price_on_loyal_dev_rec_buying_rate	Maximum value of 200 percent
Fraction_becoming_dev_loyal_due_to_purchases	Maximum value of 5

	purchases
Fract_becoming_dev_loyal_due_to_spec_prod	Maximum value of 11,8 percent
Fraction_becoming_hum_loyal_due_to_purchases	Maximum value of 5 purchases
Fract_becoming_hum_loyal_due_to_spec_prod	Maximum value of 11,8 percent

Appendix 5

Model analysis

This chapter contains a conclusion of the model analysis which is the result of the simulation phase. The full model analysis is presented in a separate report.

Conclusions

If "regulation and pressure" becomes a driving force with the strength as estimated UNOSAT can decrease their marketing efforts and redirect these resources. Even if "regulation and pressure" become limited compared to estimations is it important for UNOSAT to evaluate its marketing efforts. If the "regulation and pressure" is completely miscalculated and approaches zero UNOSAT must maximize its marketing efforts. This first conclusion derives from the driving force of "regulation and pressure". A characteristic of "regulation and pressure" parameters are the difficulties of measuring and estimating values. The values are though so strong that they match the driving force of "word of mouth" even when the estimations are limited. "Regulation and pressure" has consequently a very important role to play in the organization of UNOSAT.

An important topic to discuss within UNOSAT is how they can constrain the demand for satellite images if they detect an exponential increase of people becoming aware of problem and UNOSAT. When the exponential increase starts to grow there might not be time to find solutions and therefore it is important to plan for this potential outcome of the future. Both development and humanitarian orders have an increasing exponential development. This exponential effect is caused by the increase of "potential customers aware of problem and UNOSAT". It is almost not possible to change this behavior without changing the structure but it is possible to increase or decrease the pace of the curve by changing other parameters. The exponential effect of "potential customers becoming aware of problem and UNOSAT" derives from two driving forces named "word of mouth effects" added together with the driving force called "regulation and pressure". This behavior is transferred to a flow of new orders because there are no real constraints. The constraints existing are the following driving forces: price, success stories and delivery delay. According to estimations are "success stories" only affecting in the beginning of the simulation and are therefore not a strong constraint. The "delivery delay" is no constraint since UNOSAT is a network organization with scalable staff resources. What is left for constraining demand is the "price". And since UNOSAT is a non profit organization even this mean of constraining is limited.

"Price" is the only parameter which is able to effectively constraint an exponential increase of customers. "Price" is though constrained by other reasons in UNOSAT and might therefore not be possible to change as needed. Except price is "need" an important parameter when considering controlling the flow of customer. These two forces control the amplification of the different flows after potential customers have become aware of both problem and UNOSAT. "Price" is very sensitive and can change the behavior of the buying part (5 last stocks, see main structure) in the model if either a static or a dynamic price is used. The price must consistently be regarded in its relation to perceived normal price of the customer.

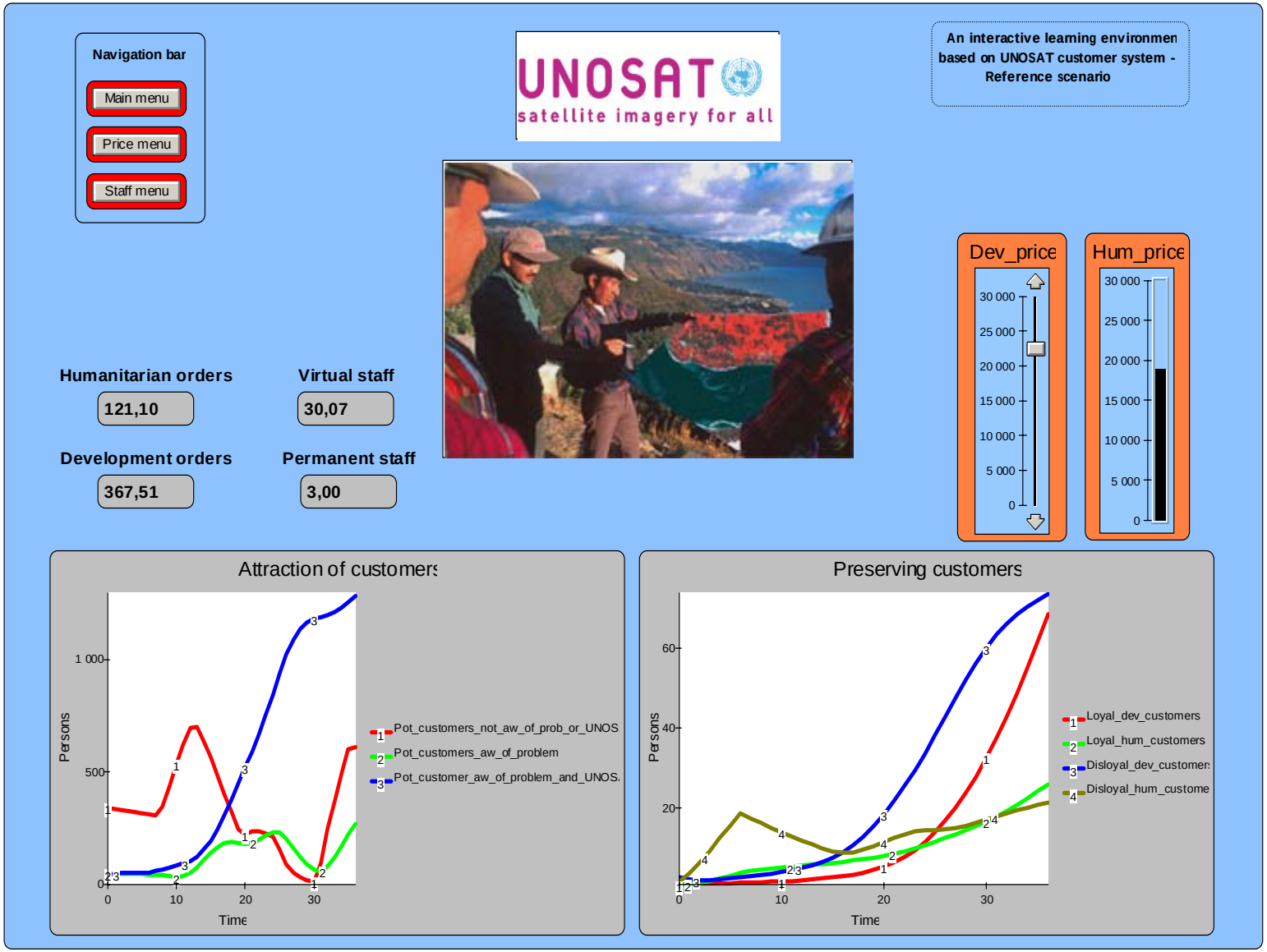
According to the behavior of the model is it important for UNOSAT to find a new market segment after approximately more than 25 months. The estimations of UNOSAT were a new market segment each year in increasing sizes. This is not necessary as long as it is possible to increase the number of new potential customer after month 25. In the planning of UNOSAT they must also calculate with the delay between entering a new market segment and establishing oneself there. UNOSAT must remember that the amounts of customers are finite and the inflow will cease to flow eventually.

The specialized products in UNOSAT have a strong impact on making customers loyal. This strong impact should be utilized by UNOSAT in order to transfer as many customers as possible to the state of mind where they can be considered to be loyal. It might even be preferable to dedicate resources for specialized products instead of trying to raise the amount of recurrent purchases the customers do.

This strategy of using customized products according to customers' specific needs and preferences is close to one-to-one marketing where the selling organization tries to establish a learning relationship with the customer. According to managers in UNOSAT are customized products appreciated customers (which is also shown in the model) and therefore should UNOSAT change marketing focus from the now dominant strategy mass marketing to one-to-one marketing. An ambition of one-to-one marketing exists in the web portal but it is not used efficiently. The web portal needs to be re-worked in order to attract customers and developed with more features which will increase the knowledge about UNOSAT's customers. Possible features to use in the web portal is mapping the customers and their visits by using User ID:s, IP-adresses and log files. When adding this information with a customers order history and other information sources new knowledge can be generated about the customer. An example would be to understand which part of the portal that is most visited by the customers. Another possible feature is to use collaborative filtering. This is basically when UNOSAT suggest to a customer what they might be interested in due to last maps they viewed. The mass marketing perspective on the other hand contains global campaigns where product alternatives are given to the customer for choosing. This marketing strategy is used in UNOSAT in order to market the organization. This might be the correct strategy in order to make customers aware of UNOSAT. My belief is that a one-to-one marketing strategy is preferable when the customers are going to buy from UNOSAT.

Finally is a discussion about dissatisfied customers documented. A change from five dissatisfied purchases to one dissatisfied purchase make the driving force of dissatisfaction become equally strong as the normal discontinuation when people leave UNOSAT due to changing job etc. This is not likely according to estimations from UNOSAT since they have estimated with approximately five dissatisfied purchases before the customer leaves. If UNOSAT are dedicated about their desire to keep their customers the "average amount of purchases" before leaving is a good parameter to study. It can indicate the development over time for customer behavior. "Average amount of purchases" is also a parameter easily accessible. This parameter must of course be complemented by, for example, studies about why the customers are leaving.

Appendix 6


Navigation bar
Main menu
Price menu
Staff menu
UNOSAT
satellite imagery for all
An interactive learning environmen based on UNOSAT customer system - Reference scenario
Humanitarian orders
121,10
Virtual staff
30,07
Development orders
367,51
Permanent staff
3,00
Dev_price
Hum_price
30 000
25 000
20 000
15 000
10 000
5 000
0
Attraction of customers
Persons
Time
Pot_customers_not_aw_of_prob_or_UNOS
Pot_customers_aw_of_problem
Pot_customer_aw_of_problem_and_UNOS.
Preserving customers
Loyal_dev_customers
Loyal_hum_customers
Disloyal_dev_customer
Disloyal_hum_custome

Appendix 7

Sensitive parameters

In this section are parameters more important than others highlighted. These parameters have a strong impact on the behavior of the model and are therefore recommended to study in depth.

Attraction parameters

The first parameter of high importance is "new market segment rate". "New market segment rate" is the parameter which controls the inflow to "potential customers not aware of problem". It defines the expansion of the UNOSAT market. In the reference scenario this parameter is estimated to 500 after one year, 500 after two years and 1000 after three years. With a strong inflow from this parameter into the system the importance of preserving customers are lowered. Without this flow UNOSAT has a grave long or medium term issue.

The next parameters of importance are the two regulation and pressure variables. These parameters make a large amount of customers become aware of both problem and UNOSAT. They are difficult to estimate and measure which give the model a serious uncertainty factor. The issue of uncertainty makes it even more important to study these variables.

Within the "two word of mouth effects" there exist four different parameters which are controlling the amplification of these effects more than others. These four parameters are "Base contact frequency", "Base contact frequency UNOSAT", "Base awareness of problem fraction" and "Base awareness of UNOSAT fraction". If UNOSAT need to amplify or reduce the two word of mouth effects they should direct their efforts to these variables.

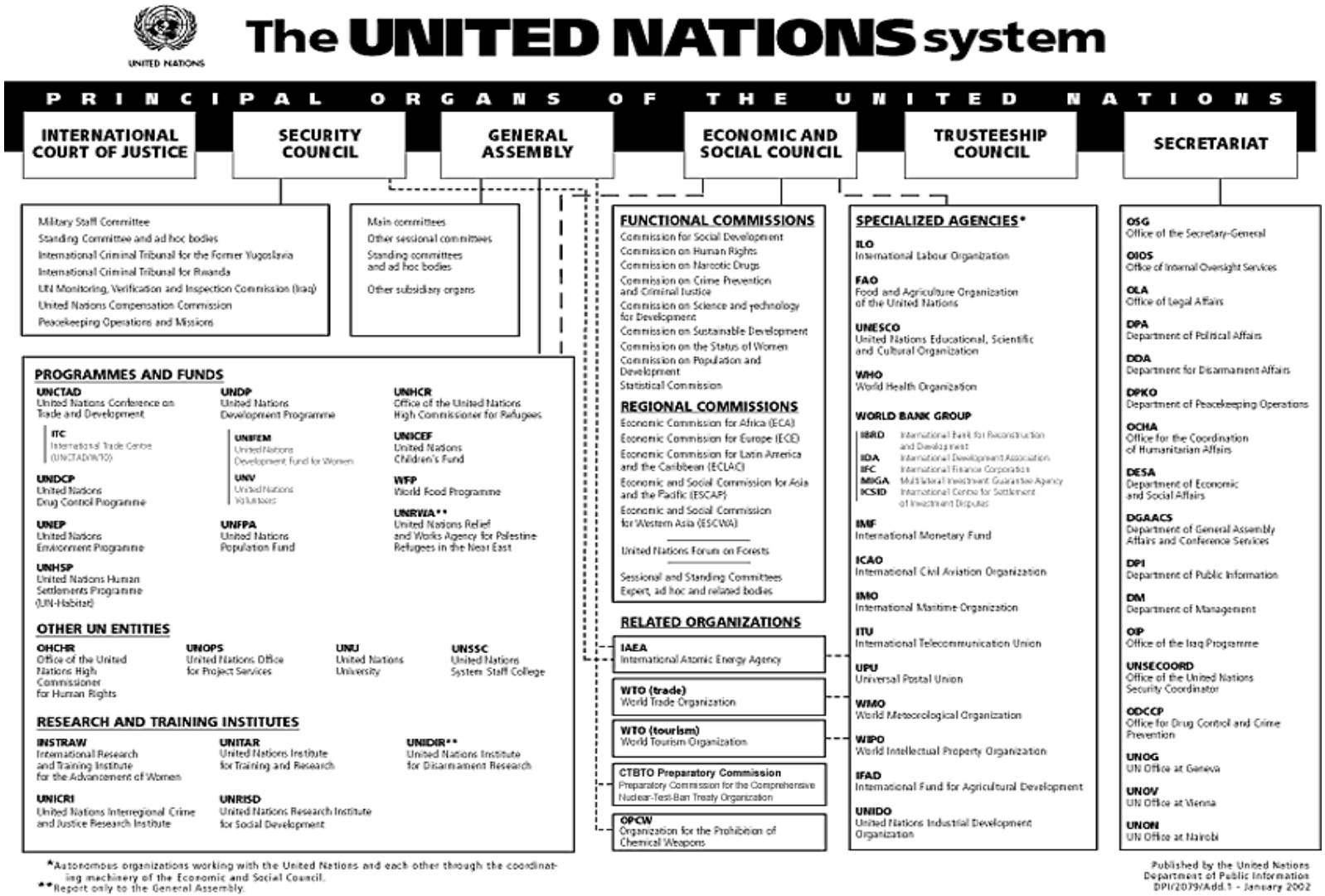
Buying parameters

In this part of the model there exist two parameters more important than all else. These parameters are need and price. The need controls the amount of customers becoming buyers and is rather easy to study thoroughly. The price parameter is more different to reveal since it is not the actual price that is interesting. It is instead the perceived normal price from the customer which is important. The importance is revealed in the example of humanitarian orders. The price gap between perceived normal price and actual price will have a delay, a habituation time, before the customer perception will match the actual price.

The parameter "normal discontinuation fraction" is also important since it's the only parameter causing "former customers" to accumulate during the first 10-25 months depending on scenario. Measuring and studying this parameter would give important knowledge on how to decrease the flow and how to reinstate the former customers into the system. Another important parameter to study is productivity, both for development and humanitarian orders.

The last group of parameters important to study is how many unsuccessful purchases a customer in average do before becoming a former customer, how many successful purchases a customer do before becoming loyal and the impact of specialized products on loyalty transformation. The reason to why this group is more interesting than other groups is the fact that these parameters control the flows in and out of the stocks with already attracted customers. If "new market segment rate" is zero UNOSAT need to focus on this group of parameters in order to keep as many customers as possible.

Appendix 8


UNITED NATIONS
The UNITED NATIONS system
PRINCIPAL ORGANS OF THE UNITED NATIONS
INTERNATIONAL COURT OF JUSTICE
SECURITY COUNCIL
GENERAL ASSEMBLY
ECONOMIC AND SOCIAL COUNCIL
TRUSTEESHIP COUNCIL
SECRETARIAT
Military Staff Committee
Standing Committee and ad hoc bodies
International Criminal Tribunal for the Former Yugoslavia
International Criminal Tribunal for Rwanda
UN Monitoring, Verification and Inspection Commission (Iraq)
United Nations Compensation Commission
Peacekeeping Operations and Missions
Main committees
Other sessional committees
Standing committees and ad hoc bodies
Other subsidiary organs
PROGRAMMES AND FUNDS
UNCTAD United Nations Conference on Trade and Development
ITC International Trade Centre (UNCTAD/WTO)
UNDCP United Nations Drug Control Programme
UNEP United Nations Environment Programme
UNHSP United Nations Human Settlements Programme (UN-Habitat)
UNDP United Nations Development Programme
UNIFEM United Nations Development Fund for Women
UNV United Nations Volunteers
UNFPA United Nations Population Fund
UNHCR Office of the United Nations High Commissioner for Refugees
UNICEF United Nations Children's Fund
WFP World Food Programme
UNRWA** United Nations Relief and Works Agency for Palestine Refugees in the Near East
OTHER UN ENTITIES
OHCHR Office of the United Nations High Commissioner for Human Rights
UNOPS United Nations Office for Project Services
UNU United Nations University
UNSSC United Nations System Staff College
RESEARCH AND TRAINING INSTITUTES
INSTRAW International Research and Training Institute for the Advancement of Women
UNICRI United Nations Interregional Crime and Justice Research Institute
UNITAR United Nations Institute for Training and Research
UNRISD United Nations Research Institute for Social Development
UNIDIR** United Nations Institute for Disarmament Research
FUNCTIONAL COMMISSIONS
Commission for Social Development
Commission on Human Rights
Commission on Narcotic Drugs
Commission on Crime Prevention and Criminal Justice
Commission on Science and Technology for Development
Commission on Sustainable Development
Commission on the Status of Women
Commission on Population and Development
Statistical Commission
REGIONAL COMMISSIONS
Economic Commission for Africa (ECA)
Economic Commission for Europe (ECE)
Economic Commission for Latin America and the Caribbean (ECLAC)
Economic and Social Commission for Asia and the Pacific (ESCAP)
Economic and Social Commission for Western Asia (ESCWA)
United Nations Forum on Forests
Sessional and Standing Committees
Expert, ad hoc and related bodies
RELATED ORGANIZATIONS
IAEA International Atomic Energy Agency
WTO (trade) World Trade Organization
WTO (tourism) World Tourism Organization
CTBTO Preparatory Commission Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization
OPCW Organization for the Prohibition of Chemical Weapons
SPECIALIZED AGENCIES*
ILO International Labour Organization
FAO Food and Agriculture Organization of the United Nations
UNESCO United Nations Educational, Scientific and Cultural Organization
WHO World Health Organization
WORLD BANK GROUP
IBRD International Bank for Reconstruction and Development
IDA International Development Association
IFC International Finance Corporation
MIGA Multilateral Investment Guarantee Agency
ICSID International Centre for Settlement of Investment Disputes
IMF International Monetary Fund
ICAO International Civil Aviation Organization
IMO International Maritime Organization
ITU International Telecommunication Union
UPU Universal Postal Union
WMO World Meteorological Organization
WIPO World Intellectual Property Organization
IFAD International Fund for Agricultural Development
UNIDO United Nations Industrial Development Organization
OSG Office of the Secretary-General
OIOS Office of Internal Oversight Services
OLA Office of Legal Affairs
DPA Department of Political Affairs
DDA Department for Disarmament Affairs
DPKO Department of Peacekeeping Operations
OCHA Office for the Coordination of Humanitarian Affairs
DESA Department of Economic and Social Affairs
DGAACS Department of General Assembly Affairs and Conference Services
DPI Department of Public Information
DM Department of Management
OIP Office of the Iraq Programme
UNSECOORD Office of the United Nations Security Coordinator
ODCCP Office for Drug Control and Crime Prevention
UNOG UN Office at Geneva
UNOV UN Office at Vienna
UNON UN Office at Nairobi
*Autonomous organizations working with the United Nations and each other through the coordinating machinery of the Economic and Social Council.
**Report only to the General Assembly.
Published by the United Nations Department of Public Information
DPI/2079/Add.1 - January 2002