

DECISION SUPPORT SYSTEM FOR MANAGING AGING STAFF

Bradl, Peter

University of Applied Sciences Wuerzburg-Schweinfurt

Abstract

Lifespan in industrialised countries increases constantly while birth rate declines. This development affects corporations and managers. Within this paper we describe the development of a Decision Support System that shows the effects of aging staff within a corporation and helps to find measures how to deal this situation. After an introduction towards the research methodology used we introduce some models of the simulation environment. Typical questions that make a DSS useful are formulated afterwards. The outlook describes next steps as well as the final goal of the project partners.

Keywords: *Decision Support System, System Dynamics, Simulation, Aging Society,*

1 INTRODUCTION

Lifespan in industrialised countries increased by 40 years since 1860. About 25 years ago circa 75 percent of men in the age of 55 to 64 were working. Nowadays this group declined to 40 percent. [Mull00] Although, productivity increases a soaring number of companies will depend on employing people who are older than 50 years of age. (see Bräuninger 2005) Nowadays many retired people do sports and show increasing activity. Hence it is not necessary to kick them out of work – while losing their expertise.

Due to principal of seniority wages rise with the age. So employers have to verify accurately, whether the person that receives a high salary is as productive as expected. Nowadays the assumption holds that younger employees are cheaper (which is easy to verify) and at the same time are more productive than their elder colleagues (which has not been verified yet). Benefits which are not balanced by productivity, however, increase the cost of employment and result in a lower employment rate. (Bräuninger 2005)

The problem is that productivity can not be measured easily. This is because experience can hardly be quantified in today's planning systems. Hence, if there is a lack in data – how can the decision based on that be valid? Another argument states that absence from work is greater for elder people, however, is this statement correct?

The challenge becomes even greater when keeping in mind that issues in management and particularly in strategic management are dominated by feedback loops. This is that a decision which is made today will affect more sides than usually intended. So if management decides to employ just people younger than for instance 50 years it risks the loss of knowledge and experience which might lead to a worse outcome compared to the estimated loss caused by absenteeism. An exemplarily feedback loop can be seen in figure 1.

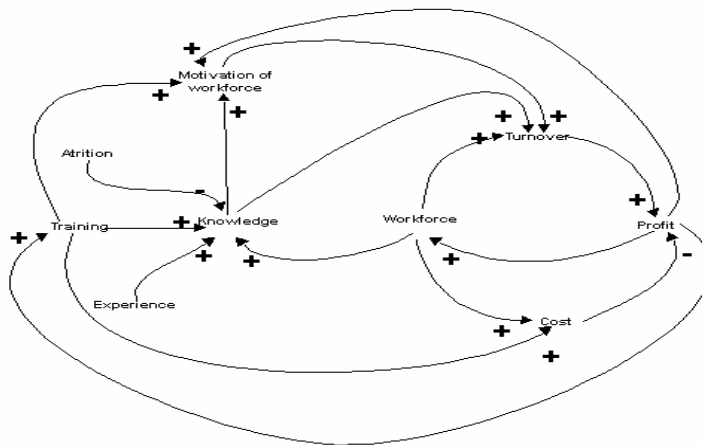


Figure 1. Exemplary feedback loop for personnel affecting profit.

Aim of the current research is to determine the “real” effect of elder people onto a corporation’s success by providing a simulation environment. In order to reach this goal various questions have to be answered in advance such as:

1. How can productivity be described and measured correctly?
2. How can the contribution of elder people be grasped?

In the following we are going to describe the research methodology and present parts of the models that have been designed so far.

2 RESEARCH METHODOLOGY

The causal loop diagram shown in figure 1 is a very useful for communicating dependencies and gaining acceptance for serious issues but it is not helpful to run simulations. The next step will describe a methodology which methodology is appropriate to transfer CLD into a form that can be base for a decision support system

In management literature several approaches to planning were introduced during the last decade (e.g. *Total Quality Management*, *Business Process Reengineering* or the *Balanced Scorecard* (see Maani et al. 2000 pp. 4-5)). They mostly addressed a certain field or operational area. Besides the Balanced Scorecard there were only few individual techniques linking management aspects (Macharzina 1999 p. 166). Organizational theory itself hardly allows the usage of figures, however, figures carry and represent the type of information managers are used to. Since planning strategies change over time, (Macharzina 1999 p. 158), they require a method that takes this into account as well – System Dynamics (SD).

2.1 System Dynamics

We will use System Dynamics since it is a methodology for analysing systemic problems (Clark 1988). In addition to the approach of plain ‘systems thinking’ SD explicitly allows the

usage of figures that in turn enables to run simulations. As a result of the usually high number of feedbacks and delays it is almost impossible to describe the behaviour of those models at their transition stage with mathematical equations and even if it would be possible to derive equations it is very unlikely that they can be solved from a manager who seeks support for her decision. Here simulation runs are the appropriate way to solve problems (see Clark 1988).

2.1.1 Modelling as Part of Problem Solving

System thinking is the “starting point” for mental models and has to be followed by some steps to finally derive Stock Flow Diagrams (SFD) representing SD model for simulations.

As intermediate stage towards SFDs so-called Causal Loop Diagrams (CLD) which allow identifying interactions and relationships between actions and e.g. their effect onto different departments, are commonly used. Richardson describes some serious problems that might occur when transforming CLDs into SFDs (Richardson 1986). But still there is a benefit when using CLDs, since they may function as a type of communication tool. A main problem in decision-making processes (even on the corporate level) is participants having different understandings and terminologies. (E.g. sales may be interpreted as sales quantity or turnover. The use of CLDs by applying modelling techniques as described e.g. in (Gomez et al. 1999) or (Maani et al. 2000) within a group enforces the members to use terms in their understanding within the design process team.¹

2.1.2 Utilisability and Simulation

An important fact for the use of SD-based Decision Support System (DSS) is that the underlying models can be used anywhere and without detailed knowledge in the field of computer science (as it is desirable for most IT in management). Many SD software packages run on standard PC or Apple computers, equipment that is available in almost every office – even on management level. Additionally, graphical user interfaces may be designed to support the manager or to provide help when entering figures e.g. when checking for consistency. Actually the underlying analytical model is usually hidden for the user and only sliders to change inputs and charts will be seen.

2.1.3 Validation

Models have to be validated before simulation runs can be done. This is done in two steps. First the structure will be validated before behavioural validation tests are undertaken. (Barlas 2000) Due to the wide-spread use of ERP-software in companies, data of almost every transaction may be stored in a database or data warehouse respectively. These figures are extremely helpful for validation and usage in models build DSS. Modern SD-software packages allow directly transferring data from the data warehouse into the modelling environment, simulating and may even write the results back into the data warehouse. Hence, validation of models in corporate planning might be much easier compared to topics like environmental issues.

¹ Details how to derive SFDs can be found in Maani et al. 2000; Sterman 2000

2.1.4 Simulation Runs and Scenario Analysis

A ‚correct’ model (SFD or CLD) *represents* reality and allows ‘playing’ within a safe environment (Mertens 1982). Assuming that the models are valid (structure and parameters) simulation runs that show results of decisions made today on the future development of the firm will be started. Simulation in SD can focus on quantitative as well as qualitative issues and will help to understand the underlying structure and backs the development of strategies for decision makers. Scenario analysis can be added to answer questions of the manner “what-if” or “how-to-achieve”.²

2.2 Data collection and analysis

In addition to data from ERP-systems we need information about macroeconomic issues. Especially aspects like absenteeism or job hopping cannot be covered without data from public institutions. In our research we cooperate with the German Demographic Network as well as the research institute of the German Federal Employment Agency. These data will be backed by results gained from interviews of managers.

3 PROTOTYPE

We started with Causal Loop Diagrams which were designed together with CEOs and Top managers of enterprises to describe dependencies and show correlations. In a next step we transferred the CLD into Stock Flow Diagrams which we use as the base for quantitative simulation.

3.1 Stock Flow Diagrams

3.1.1 Basic Structure

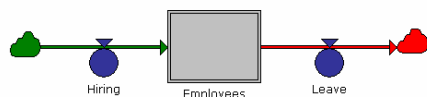


Figure 2. Basic structure for an SFD representing the aspect of employment

As shown in figure 2 employees as a stock here is just influenced by an inflow (Hiring) and an outflow (Leaving). This basic structure can be extended by so called aging chains, where each cohort is represented by an individual stock with its inflow connected to the outflow of the preceding stock.

² Details covering issues like scenarios can be found in Gausemeier et. al 1996

3.1.2 Exemplarily SFDs

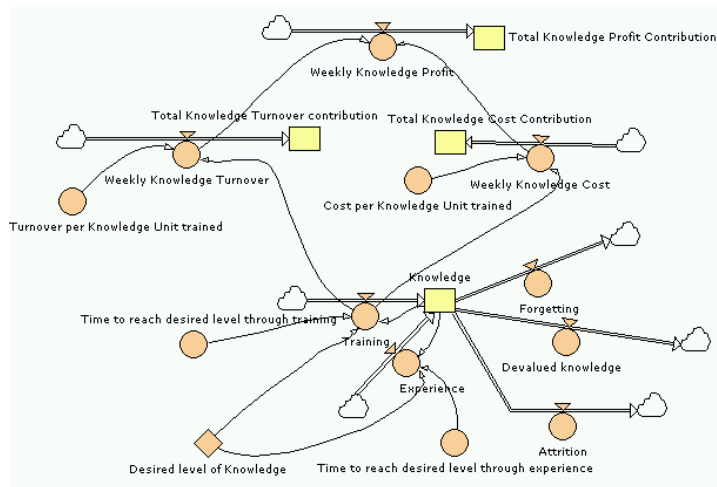


Figure 3. Sub model to describe relation between knowledge and profit.

Figure 3 and figure 4 show sub models that are used within the Decision Support System. They allow a linkage between knowledge and profit as well as a connection to the costs which are dominated by wage or day rate. Additional stock flow diagrams can be found in (Bradl 2004)

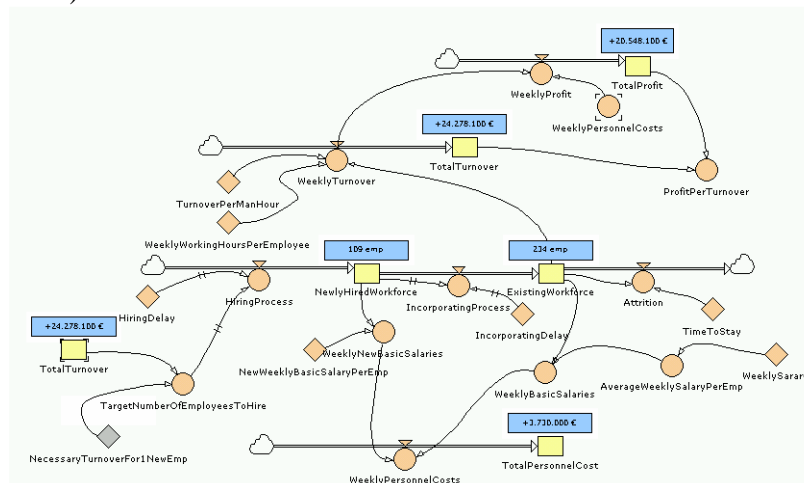


Figure 4. Sub model for profit.

3.2 Control Panel

The founder of SD, Jay W. Forrester, writes: „[System Dynamics] is an approach that should help to solve important problems on top management level” (Forrester 1961). An increasing number of books published within the last decade show various applications of SD (e.g. Ford 1999; Maani and Cavan 2000; Sterman 2000). Direct comparison to an approach using the Balanced Scorecard, which was and is strongly promoted by the inventor and many consulting firms) shows that SD is harder to understand intuitively. Hence, in order to make SD useful for managers it is necessary to provide means that keep a Decision Support System

based in SD manageable. This can be reached by “hiding” the SFD and providing a control panel. An example can be seen in figure 5. Supplementary control panels can be found in (Bradl 2004).

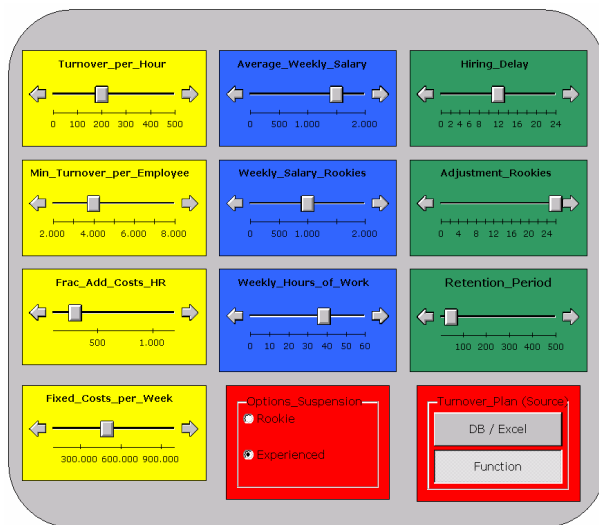


Figure 5. Control panel for a Decision Support System

4 OUTLOOK

4.1 Next Steps

The design of the prototype is an ongoing process. So we will continue with:

- Finalization of existing and development of additional (sub) models
- Validation (structure and behaviour) of the new models and the whole structure of the DSS
- Express and simulate scenarios to derive measures to tackle problems

Since the models are expected to represent a system that exists in reality the models have to be revised on a continuing base.

Possible questions for individual simulation runs may focus on some of the following aspects:

- How is profit in a firm affected by different levels of salary and may it be compensated by corresponding affecting retention periods?
- How can the contribution of elder people to a company’s success be grasped?
- What is a “good” strategy to employ elder people with positive revenues?

4.2 Final Goal of the Partners within the Project

The goal of the current research project is to detect the value added by different age cohorts to tackle general problems like how does the aging society impact the individual company and what measures can be taken to ease this impact? And, if at all possible, how can this development be useful to generate more customers and/or better services?

The researchers within the project team address these aspects and continue the development of this specific Decision Support System that allows managers to simulate the “contribution” of elder employees to the company’s success. Additionally, it is expected to help deriving strategies and employment models for experienced workers to assure secondary effects like know how transfer onto rookies as well as providing the base to keep knowledge within a firm.

If it can be shown that companies can make profit due to elder employees this might lead to a decrease in the quote of early retirement. A preferable side effect would be that the retirement systems would have fewer expenses while facing additional contributions leading to lower rate of contribution.

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