Supporting Long-term Personnel Planning of a Service Provider

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Abstract

The purpose of the paper is to demonstrate, how a dynamic aging chain model can support strategic decisions in personnel planning. More specifically, we use a system dynamics model to improve the recruitment and training process in a large German service provider in the wider field of logistics. The key findings are that the aging chain of service operators within the company is affected by a variety of delays, for instance for training, promotion, and ordering of personnel, and that the structure of the planning process generates cyclic phases of personnel surplus and shortage. The discussion is based on an in-depth case study, which was conducted in the service company in 2008. Implications are that planning processes have to be fine-tuned to account for delays in the aging chain; the simulation model provides a tool to gain insights into the problem and to improve the actual human resource planning process.

Keywords: personnel planning, aging chain, simulation, delays

1. System dynamics for human resource management

The usage and utility of system dynamics for a specific human resource management issue (personnel planning) is demonstrated in this paper based on a case study from the service industry. Therefore, we use an aging chain model of personnel "flowing" through an organisation. When doing so, we draw on our experience in the field of supply chain management and transfer insights from this field to human resource management. The purpose of this paper is to show, how a dynamic model—and the process of generating it—can enhance decision making in long-term personnel planning.

For many years, system dynamics modelling has been employed for analysing human resource issues (e.g., Packer, 1964; Runcie, 1980; Andersen and Emmerichs, 1982; Abdel-Hamid and Madnick, 1991; Doman et al., 2000; Hafeez and Abdelmeguid, 2003; Liou and Lin, 2008). The reason, why a methodology frequently used in supply chain management (e.g., Towill, 1982; Morecroft, 1983; Sterman, 1989; Gupta and Gupta, 1989; Wikner et al., 1991; Towill, 1996; Fowler, 1999; Anderson et al., 2000; Akkermans and Vos, 2003;

Spengler and Schröter, 2003; Akkermans and Dellaert, 2005) can beneficially be transferred to human resource management, lies in the fact that system dynamics is capable of representing dynamic systems in general. In that sense, employees flowing through a number of organisational stages (for instance representing different hierarchical or training levels) are conceptually not much different from material flowing along the many stages of a supply line. The same abstract structures exist in personnel as in material chains: for instance, delays, accumulation in stages, iterations to earlier stages, information feedback between stages. The behaviour resulting from this structure is, again, similar in material as in personnel chains: overcrowding at certain stages, unfulfilled demand at other stages—in one word, such chains are difficult to understand and to manage (Sterman, 1989).

Nevertheless, it is crucial to note that this similarity does not imply a mechanistic view of people within organisations that can be processed like material—this is neither the intention of the system dynamics approach nor of this paper. Rather, the claim is that certain phenomena exist that arise just because there are a certain number of people at one stage in an organisational aging chain, for instance. Although all people in an organisation are individuals, as a group of people they might generate a specific problem and such problems are addressed by system dynamics projects.

The remainder of this paper is structured as follows. The next section starts with a presentation of the case company and its personnel structure. The major issues of its personnel planning process are discussed and actual and potential effects of the issues are considered. Then, the actual process of building a dynamic model of personnel planning is described and an overview of the model is provided. At the end of that section, we highlight the implications for the case company that resulted from the modelling and simulation project; subsequent changes in personnel planning policies are presented. In the third section, some general features of system dynamics as a method for human resource management are discussed. The paper closes with a short exposition of future extensions of the model and related projects.

2. Case study: System dynamics modelling of a dynamic chain of operator staff

a) Issues of long-term personnel planning in the case company

The case company is a service provider in the logistics industry.[1] In Germany, the company is the market leader in this industry and has a quasi-monopolistic status. One of the

[1] Due to confidentiality reasons, neither the name nor exact data from the case company can be revealed. All information given in this paper should be seen as illustrative only.

major services, which the firm provides, requires the availability of highly skilled operator staff. The company's performance depends to a great share on the timely and effective provision of this service. The intellectual and personal requirements for these operators are demanding; furthermore, the duration of their training is rather long. Thus, personnel selection as well as personnel development of these employees is a complicated matter, resulting in a difficult and frequently sub-optimal personnel planning process, which has a major effect on operational performance (Ahmad and Schroeder, 2003). However, due to preferable employment conditions and high job reputation, there is no principle shortage of potential employees. Therefore, the company's task is to recruit and to train operators at the right time, in order to fulfil all requests for their service.

The basic structure of the long-term personnel planning process that is set up in the company is displayed in Figure 1. It represents a control loop for the number of available staff members. This control loop incorporates two delays. These are established on the one hand by the time it takes to recruit suitable candidates for in-house training (approx. 12 months) and on the other hand by the duration of the training. The latter incorporates actually two delays: the duration of the basic training (approx. 15 months) and the on-the-job-training (OJT; approx. 24 months). Based on these numbers one can see that it takes about 51 months on average between the ordering of new staff and its delivery. A further complication in the given situation is caused by the fact that some staff members are needed for non-operational tasks such as training, projects etc. For instance, the company uses a trainer recruitment scheme that heavily relies on operational staff members. Such an approach can lead to a further aggravation of a staff shortage problem, as it requires in times of shortage with high trainee numbers also higher numbers of operational staff members that need to be available for training purposes.

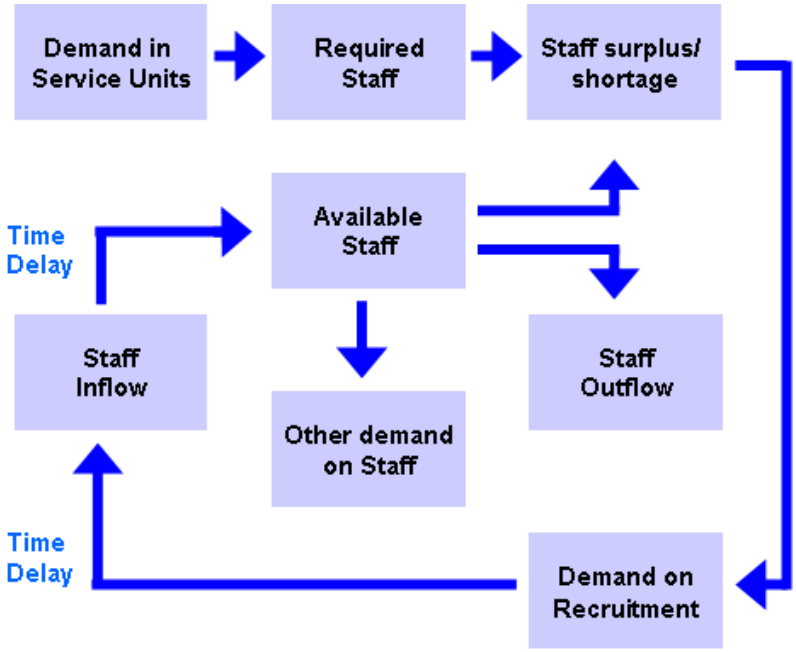

Figure 1: Schematic sketch of the long-term personnel planning task for the service provider

In the past years the case company has experienced a situation of overall demand growth for its service with short intermittent periods of growth decline or even stagnation. The performance of the case company's long-term planning scheme during this period is described by its managers as sub-optimal. The main reason for this statement is that the staff situation is perceived by transient but prolonged periods of staff shortages and situations with a surplus in staff. Both situations are highly undesirable as they potentially result in a declining service quality or in too high personnel costs and lower productivity, respectively. In summary, it appears that the seemingly trivial problem of providing just the right amount of qualified people at the right time actually is highly non-trivial.

b) Design of the system dynamics based modelling approach in the case company

As it was described in the last section, the problem of long-term capacity planning for service personnel in the case company is highly complex with respect to its dynamics. Therefore, the case company decided to complement its regular planning tools by a modelling approach based on system dynamics, which focuses on the analysis of the complex temporal behaviour of key variables of social systems. The goals that were set by the case company's management for the given study were stated as follows:

- conduct a structural analysis of the existing long-term personnel planning process for service operators,
- provide a dynamic analysis of the existing planning policies,

- construct a scenario-tool to improve the existing planning policies as well as the established risk management approach accompanying the existing processes.

To meet these requirements, a framework for the given project was defined as follows:

- Phase 1: Performance of interviews with members of the case company from all involved departments.
- Phase 2: Interactive construction of a basic system dynamics model with the client.
- Phase 3: Test and validation of the constructed model for one defined service centre of the case company.
- Phase 4: Test and validation of the model for a second service centre.
- Phase 5: Definition and evaluation of future scenarios to demonstrate the capabilities of the new planning tool.
- Phase 6: Possible rollout to all remaining service centres in Germany.

This multiphase approach highlights the fact that a system dynamics based modelling approach is much more than a back-office modelling exercise with some expert involvement. The main reason for this is the necessity to build up intensive client involvement to foster commitment and trust into such a new approach to organizational planning (Vennix et al., 1992; Vennix, 1996; Rouwette and Vennix, 2006; Snabe and Größler, 2006). This insight is confirmed by this study, too. We even got told by the client company that their intensive involvement created additional value—even if the constructed model would be discarded after project termination—due to the quality of the discussions that can be "facilitated" in the organization through the modelling performed. Therefore, in the following we report on the usefulness of both, the process and the model (Sterman, 1988; Lane, 1995). The description of a simplified version of the model also incorporates some generalized simulation results that demonstrate the usefulness of the chosen modelling approach.

c) Insights from the modelling building process

The modelling project was conducted between March and November 2008. About two months were used to carry out interviews in the client organization. The modelling process then mainly took place in the time between May and July 2008 and was completed by a longer testing and validation period that ended in September 2008. The scenario analysis was finally performed consecutively until November 2008, when the project went into review to decide about a rollout into all of the company's remaining service centres in Germany.

By interviews with different stakeholders of the personnel planning process, most of the relevant data about the existing planning paradigm could be collected. Additionally, interviews were a prerequisite for the acceptance of all further steps in the client organization as they provided knowledge about the considered organizational processes and builds up trust between the project team and the client organization. Important insights that were gathered about personnel planning through the interviews were:

- different parts of the organization focus on different parts of the overall planning process so that no one department is focusing on the overall architecture of the process as a whole (“no systemic picture”);
- important characteristics of the process, as for example lead times in the planning process, were believed to be different depending on the source of the information;
- uncertainties in the process and conditions are mainly considered in a qualitative fashion;
- management follows a “best bet” approach, when deciding about the most probable outcome of the planning process, instead of using target corridors that reflect the uncertainty in the planning approach and the knowledge about the environment;
- organizational knowledge about past problems and its causes is mainly neglected for recent planning activities as it resides in the experience of regular work staff that often fills out a position for a much longer period of time than its respective management.

Through a presentation of these insights at the beginning of the modelling process itself, it was possible to build up credibility for the following process. The main reason for this is that all involved staff members and managers felt involved and were pleased to share these “organizational truths” that seemed not new to the organization, but had not been formulated in such a comprehensive manner.

The modelling process then involved several working sessions with a group of six to ten people who accompanied the modelling exercises step by step. In the context of these sessions, several additional insights were gained, for instance

- data inconsistencies exist in the planning databases used by the local service centres of the case company and the centralized planning department. These inconsistencies had never been realized as only the rigor character of the formal

modelling approach has motivated a comparison of the databases in such a detail that the respective problems could be identified,

- the overall lead time between ordering of new personnel and this personnel becoming operational was found to be much longer than believed. This insight also meant that the implemented planning horizon was actually not long enough, which also brought up questions about the adequacy of the existing forecast methods for this time horizon.

In general all participants reported in the course of the sessions that the systemic representation of the planning process that was created during the modelling sessions provided an integrative picture of the process that had not been accessible to the organization before. Additionally, it was remarked by the participants that the quality of the discussion in the sessions was very high and led to an interdepartmental dialogue, which was not in place before the project had started.

Next to these more qualitative insights also some quantitative aspects of the planning process were found to be of high interest by the session group members. An example is the dynamic consequence of the existence of temporal variations in the lead times of the recruitment process. As it has been stated above, the overall lead time of this process can be split up into three times, namely the recruitment lead time (12 months), the duration of the basic training (15 months) and the on the job training (24 months). If one now assumes that these lead times are only average times that display some variance, a situation arises that is displayed in Figure 2.

Here the flow of 100 trainees through the overall recruitment process is displayed, with the number of ordered staff being shown in blue, the number of trainees being recruited being displayed in yellow, the number of trainees in basis training being depicted in grey, the number of trainees in OJT shown in turquoise and the amount of trainees having completed the recruitment process (and, thus, being operational) displayed in black. What one can observe in Figure 2 is that—although the average lead time is 51 months—of course not all ordered operators are fully productive after this time. While some might finish their training earlier, there are also some employees that take longer to become operational. Although this insight is rather intuitive when one considers the meaning of the term “average lead-time”, the planning process did not take this fact into account before this simple simulation outcome was presented.

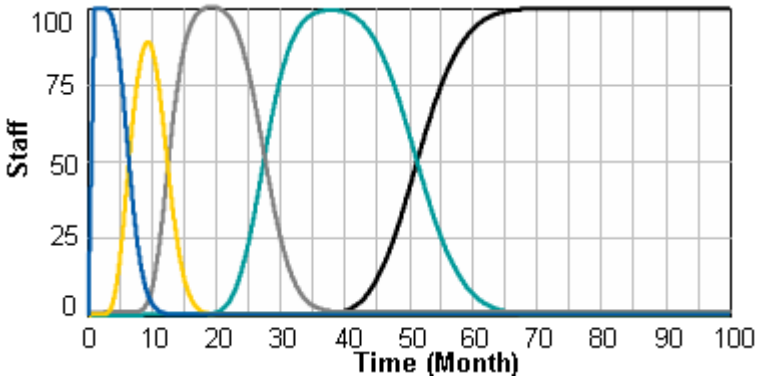

Figure 2: Flow of staff through the different stages of the recruitment process of operational personnel

Other quantitative insights gained in the modelling process comprise the influence of limited capacity in the local centre for on the job training, effects of different policies for distributing trainees to the centres, and the occurrence of cyclic behaviour in personnel capacity. Most of these issues were analyzed using the system dynamics model that is discussed in the next section.

d) A simplified dynamic simulation model of the personnel planning process

A simplified diagram of the system dynamics model that was developed in collaboration with the case company is depicted in Figure 3. The displayed model was build using the Vensim software package. The figure shows a regular system dynamics stock/flow diagram (Lane, 2000), which is based on the conceptual understanding of issues as symbolized in Figure 1 above. The central chain represents the flow of trainees from basic training to on-the-job-training to becoming operational personnel. Between these stocks (or stages in which personnel can be—marked as rectangles in the diagram) exist flows that represent the fact that trainees get promoted through this chain (marked with double arrows) and, ultimately, become fully operational. These flows are controlled by information feedback loops (marked as single arrows) that symbolize the decision making process in personnel planning. The flow of operational staff towards the bottom of the diagram (and back) represents the fact that operators frequently have to fulfil non-operational tasks, like training, and are not productive during these times. The actual model that is used for running simulations has a mathematical equation linked to each variable in the diagram that characterizes its behaviour over time in relation to the development of other variables in the model. Of course, the simulation results presented in this paper depend on this parameterization and must, therefore, be considered as explicatory, not precise.

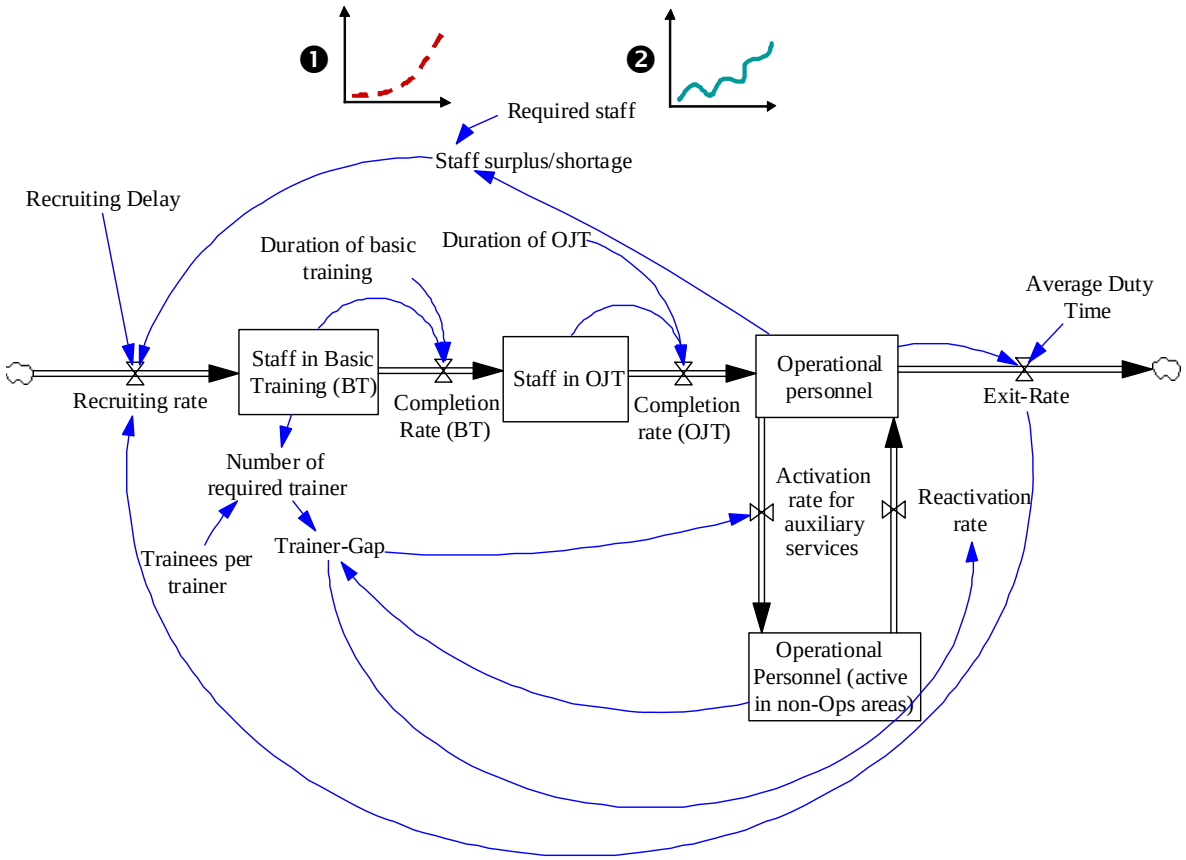

Figure 3: Simplified system dynamics model of personnel chain in case company

The two small line graphs at the top of the figure characterize two simulation runs that are used in this article as an example for the results that one can gain from a scenario analyses based on a system dynamics model. They show the externally determined future development of demand, in this case of required operator staff. In Scenario 1, a continuously growing demand for operators is assumed. Scenario 2 also assumes growing demand for operators; however, in the second scenario the assumed demand cycles around the expected growth trajectory. The simulation results for these two scenarios are shown in Figure 4. For reasons of confidentiality, actual numbers are exemplary only and do not correspond to the number of staff in the case company.

While in both cases the number of operators increases in accordance with the demand for new staff, one counter intuitive result can be observed. In both scenarios, i.e. also when there are no cycles in demand, personnel does not grow continuously but fluctuates around the growth trajectory. Thus, for instance operator capacity (depicted on the right hand side of Figure 4) might be characterized by phases of shortages and over-supply, even when the external input into the system does not show such cycles: a phenomenon that can be observed

in the case company. These cycles are generated by the delays in the system in connection with inadequate ordering policies for new operator personnel.

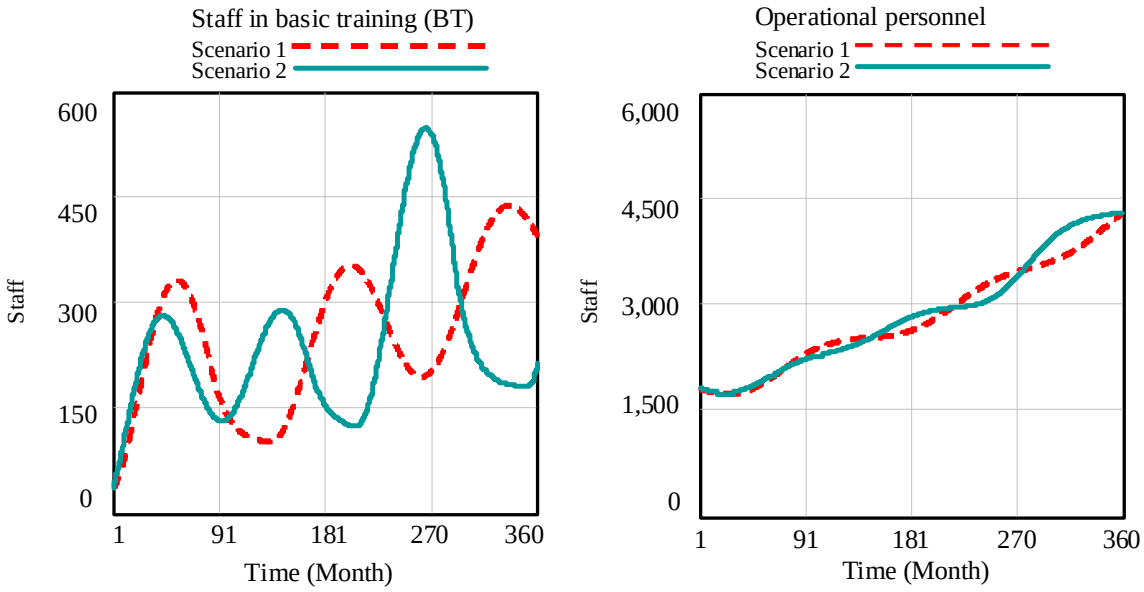

Figure 4: Simulation output for two exemplary scenarios (note the different scales on y-axes)

The cycles can be found in all stages of the personnel chain. For instance, the number of operators in basic training fluctuates with a very high amplitude with ups three times as high as downs (depicted on the left hand side of Figure 4). This, of course, has profound consequences for the planning of training capacity, for instance, trainers, rooms, and technical equipment. Additionally, it has to be noted that the cycles in the two scenarios do not correspond; therefore, a further analysis of the causes and consequences of cyclical behaviour in the industry is necessary (for an example from another industry see Liehr et al., 2001).

e) Implications of Modelling and Simulation for Personnel Planning

When asked about the benefit of the described project, the representatives of the case company reported to the project team the following value propositions, which actually cover more aspects than originally were anticipated at the beginning of the project:

- with the implemented tool a more detailed planning paradigm could be implemented (group level instead of centre level) in the framework of the long-term planning process;
- due to the possibility to speed up the planning process significantly, it now appears suitable to repeat the personnel planning cycle several times a year instead of only going through the process once a year;

- the risk management approach that accompanies the long-term planning process can now be complemented by some quantitative scenarios that are provided almost in real-time;
- the established systemic perspective on the planning process problem that intensified the communication between all stakeholders is credited with having kicked off a new organizational dialogue targeted at the personnel planning process;
- some representatives from the case company expect that the new scenario tool can along with other purposes also act as a learning platform for the case company as it integrates the experience and perspective of several departments.

Finally, in the framework of some discussions at the end of the project possible future applications of the tool were mentioned by the project team members of the case company. Of those especially the following were assumed to possess high potential:

- use of the scenario tool in the frame of strategic negotiations (e.g., management workshops, discussions with workers unions),
- use of the scenario tool for training purposes (e.g., “management flight simulators”), and
- use of the scenario tool as part of a consultancy service offered to other companies in the industry (e.g., strategic partners).

In summary, analysing the personnel planning process of the case company based on a system dynamics modelling process showed the potential for significant changes in the organization and strategic leverage for the competitiveness of the enterprise. Thus, the presented system dynamics based approach can provide a key capability in the field of strategic human resource management, which will be the focus of the next section.

3. System dynamics and strategic human resource management

Personnel planning models based on system dynamics aim at improving the performance of companies and, thus, are part of what has been called “strategic human resource management” (see, for instance, Schuler and Jackson, 2007; Salaman et al., 2005). Because system dynamics models consist of representations of real-world objects and relationships between objects, assumptions about the structure of systems are made transparent. Therefore, following a request by Roehling et al. (2005), with system dynamics projects we open up the black-box and formulate theories how personnel planning can support the performance of the

company—enabling a formalized approach to strategic human resource management (Fleetwood and Hesketh, 2008; Harney and Dundon, 2006; Boxall, 2003; Lam and Schaubroek, 1998). As with applications in supply chain management, system dynamics models provide testable hypotheses about personnel planning processes that might be used to improve the management of human resources.

In a similar way, by conducting system dynamics studies in personnel planning, we address Dipoye's (2007) "outrageous statement #3": we advance understanding and applications. Understanding of human resource issues is improved by using system dynamics models because they are open for inspection. Thus, one inherent feature of system dynamics models is that they can be easily scrutinized, advancing a rigorous approach to science. At the same time, system dynamics projects aim at improving real problem settings by providing a way to test alternative human resource management policies. In other words, system dynamics has the improvement of conditions as a major goal.

Ferris et al. (2007) request to take non-linear relationships into account when conducting research in the field of human resources. System dynamics models do not rely on the linearity of phenomena and researchers are not forced to assume linear relationships. By its very nature, system dynamics comprises non-linear behaviour patterns which are mainly caused by feedback loops or non-linear linkages between variables. Instead, functional relations can be formulated either in arbitrary mathematical form or can be graphically approximated, giving the chance to deviate from assumptions about linearity.

Recently, there has been a slowly growing interest in the supply chain literature about human resource issues (e.g., Carter et al., 2000; Large and Gimenez, 2006; Othman and Ghani, 2008). Because system dynamics is an accepted method in supply chain management but can beneficially be used in human resource management as well, it also offers a bridge between the two disciplines. Since many issues from both fields are structurally similar, they can be tackled with system dynamics. Based on this view of system dynamics as one common method for both fields, it could help identifying research questions that are interesting and relevant for supply chain and human resource management.

4. Outlook

Although system dynamics had its first and many subsequent applications in the area of supply chain management, it is also a valuable method to be used for human resource management issues. We have supported this claim with the help of a case study that addresses

the personnel planning process of a service provider. For the case company both, the model as well as the modelling process proved useful in order to mitigate their problems.

Future research will concentrate on transferring the insights gained in the modelling project with the case company to other industries and companies. For example, we have observed (and started to investigate) a similar process within the personnel chain of a big transportation provider.

Furthermore, we want to generalize our findings on how delays in the personnel planning process combined with delays in the personnel aging chain lead to systematic problems with human resource capacity. Here it might also be of great interest to combine such an analysis with the question of how other departments interact with the HR department and what the implications of these kinds of interactions are. Such a combined perspective might foster the idea of an integrated strategic resource management including personnel. Reducing the complexity of the models even more might be a way to analyse this subject.

Finally, personnel planning models should contribute towards the understanding of a more general research issue: the explanation and management of cyclical behaviour in industries.

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