Supporting Workforce Planning

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PREFACE

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GLOSSARY OF TERMS

Within this study several of case specific terms have been used. Below are the most central terms:

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
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<tbody>
<tr>
<td>Attrition</td>
<td>People leaving an organization.</td>
</tr>
<tr>
<td>Managed Attrition</td>
<td>Attrition with the organization as initiator</td>
</tr>
<tr>
<td>Unmanaged Attrition</td>
<td>Attrition with the employee as initiator</td>
</tr>
<tr>
<td>Banding</td>
<td>A grading system for employee quality.</td>
</tr>
<tr>
<td>Pyramid</td>
<td>The demographics of the organization’s workforce. (not necessarily pyramid shape)</td>
</tr>
<tr>
<td>Workforce Planning Suite</td>
<td>The combination of: the workforce planning tool, the manual, the implementation into the organization and the analyses done in this thesis.</td>
</tr>
<tr>
<td>Workforce Planning Tool</td>
<td>The total of developed and used applications.</td>
</tr>
<tr>
<td>Workforce Planning model</td>
<td>The simulation model around which the tool is built.</td>
</tr>
<tr>
<td>Decision Support Studio</td>
<td>An (virtual) environment in which suites are deployed.</td>
</tr>
<tr>
<td>Decision Support Suite</td>
<td>decision support suite is thus a chosen set of services and recipes to support a decision making process</td>
</tr>
</tbody>
</table>
MANAGEMENT SUMMARY

The goal of this project is to develop a workforce planning tool. A workforce planning tool is a decision support system (Keen and Sol, 2008) that enables Accenture to make better informed and faster decisions about its future workforce.

The workforce planning tool has been developed with a design science approach. This approach is an iterative process where advancing insights dictate the direction of the project (Hevner et al., 2004). This process is especially suited for projects where the end result cannot be clearly defined beforehand because the iterative nature of this approach allows working towards a good solution.

Chapter 2 concludes that in order to be able to effectively optimize the organization’s performance, workforce planning can help gaining an understanding with the internal and external dynamics of the workforce of an organization. With these insights a workforce that is better equipped to achieve the business goals can be created.

In section 1.5 it is argued that a decision support system should support its users with making better decision not replace them. Not everyone is an expert when it comes to using IT systems. Therefore, according to section 4.5, a decision support tool needs a good looking and clear interface to improve the tool’s usage.

A simulation model forms the basis of the workforce planning tool. Discrete event simulation has been picked as the most appropriate method of inquiry for the workforce planning tool Chapter 3 concluded it was best suited to meet the demands that the problem situation put forward.

The workforce planning tool is tailored to Accenture’s organization. In chapter 4 several analyses have been done to reveal the structure of Accenture’s organization and its goals. Successful adoption of the workforce planning tool by the organization requires an adoption strategy. In order to determine the best strategy insight is needed into the strategic behaviors of the people influenced by the workforce planning tool.

In section 3.1 it is argued that Input data and output data that is used for communicating the tool’s results is very important for the tool’s success. Managing this data is thus an important aspect of the design.
The Figure below shows what elements the workforce planning tool should have. This Chapter will further specify how these three elements are designed and implemented.

THREE IMPORTANT ELEMENTS FOR THE ACCENTURE WORKFORCE PLANNING TOOL

The figure below shows a part of the final results of this project. At this screen it is possible to select what experimental scenario the user wants to run. In order to change the scenario’s parameters navigation to other screens is required.

MANAGING THE SCENARIO’S

The model within the tool has been validated in several different ways. A face validation where the models basic functionality was checked has taken place. For this purpose a special testing mode has been developed. The input of the parameters has been checked. Accenture’s experts evaluated the model’s results for correctness. Added to that a historical data analysis has been done to see if the tool was able to recreate what happened in the past. These tests have all improved the reliability of the tool’s results in their own way.

Finally this study has produces several recommendations:

1. Include skills of employees in the tool.
2. Do some research on how the employee demand is calculated.
3. Structure knowledge resources. What skills are present in the current day organization?
4. Improve portability of the workforce planning tool.
1 DECISION SUPPORT FOR WORKFORCE PLANNING

1.1 PROBLEM EXPLORATION

Workforce planning is hot. “The reasons are simple: with the current economy driving revenues down dramatically, many senior executives are examining how to plan ahead in order to increase their firms’ capabilities, reduce costs, and survive the economic chaos likely to continue for some time” (Sullivan, 2009).

It has become increasingly important in the past years because hiring quality staff has become increasingly difficult. Sullivan and Sims say that: “The competition for skilled labor has become more pronounced.” (Sullivan and Sims, 2007) In the study of Robert Half International and Careerbuilder.com, more than half (52 percent) of hiring managers who are having trouble recruiting cited a shortage of qualified professionals.” (Half, 2009) Ravindran states: “The problem is a shortage of skilled workers, and it exists throughout the world in a wide variety of industries, information technology, engineering, and even the fast-food industry” (Ravindran, 2009). This shortage of qualified personnel requires organizations to think about workforce planning.

According to Becker and Huselid strategy is about building a sustainable competitive advantage that in turn creates an above average financial performance (Becker and Huselid, 2006). To execute a strategy successfully the quality of the organizations personnel is very important; especially in organizations that operate with highly educated personnel. Personnel represents a big part of an organizations strategic value (Becker and Huselid, 2006). Besides the quality, also the amount of personal can have a big impact on the financial performance of an organization. If there is too much personnel and too little work, valuable financial means could be wasted. If on the other hand there is too much work and too little personnel, reaching the organizations goals could become troublesome.

The shortage of personnel is not the only problem a workforce planner needs to deal with. There are three identifiable challenges that explain the extra difficulty experienced by human resource managers when hiring new staff, these are increasing flexibility, workforce aging and the current economic recession.

The first challenge is an increasing flexibility of the workforce (Bijwaard and Veenman, 2007, Velde et al., 2005, Remery et al., 2002). Flexibility has a positive and a negative effect for an organization. More flexibility means that an organization can adapt its workforce easier to market situations, but when an experienced worker leaves the company valuable knowledge is lost.
When the workforce in the labor market in which the organization operates ages, it has an impact on the workforce inside that organization as well. Because old workers have different experience and labor cost than young workers, companies will have to adapt their strategy to this other situation. (Clark and Ghent, 2009, Harbaugh and West, 1993, Popkin et al., 2008, Rohlen, 1979, Sherman, 2008, Yashiro, 1997, Van Dalen et al., 2009).

Adding to the difficulty are Economic recessions. This challenge is not a new challenge but the challenges they posed in the past will be more difficult to handle in the future because the other challenges create a much tighter labor market with less room to maneuver (Haapakorpi, 1995, Peck, 2002, Rohlen, 1979).

These challenges are not only prevalent in the western world, but also in various other parts of the world (Yashiro, 1997, Popkin et al., 2008, Velde et al., 2005). Therefore a broad analysis of the problem is possible. Insights gained from oversees may benefit the understanding of the problem.

This study will mainly focus what Mintzberg describes as a professional bureaucracy (Mintzberg, 1983). Other types of organizations also feel the impact of these challenges. However, workforce planning for professional bureaucracies is more challenging because these organizations require more highly skilled personnel who are always in short supply.

To help organizations meet the challenges within the changing labor markets a strategic workforce planning suite will be developed. This suite will contain tools which can be employed to evaluate policies. Insight into how proposed policies work out provides allows the organization to adapt to new situations.

1.2 INTRODUCING ACCENTURE NETHERLANDS

Accenture is a globally operating organization that occupies itself in management consulting, technology services and outsourcing. Accenture works together with its customers in order to realize their ambitions and achieve tangible results. Due to intricate knowledge of the market, a worldwide network and experience in consulting, technology and outsourcing Accenture is able to apply the right people, the right skills and the right technology. 181,000 Accenture employees of which 2600 in the Netherlands help Accenture’s customers become high performance organizations. The worldwide revenue from the fiscal year that ended in August 2009 was 23.39 Billion USD (Accenture, 2009a, Accenture, 2009b).
1.3 **Accenture’s Objectives**

This project has been initiated by Accenture. The reason for doing this was that they wanted a better understanding on how to deal with uncertainty regarding the availability of new personnel and for understanding the impact of policy decisions on the organizations current and future workforce. The most important knowledge gaps for an organization regarding availability of workers are:

- **Current Workforce**: Are there enough new employees for hire?

- **Future Workforce**: How should an organization anticipate on a future shortage or abundance in the hiring market?

The most important knowledge gaps for an organization regarding Policy Impacts are:

- **Hiring**: Will an organization get a surplus or deficit of workers in the future if X people get hired now?

- **Promotion and Transfer**: What is the impact of the current promotion and transfer policy on the number of workers in each level?

- **Attrition**: Will an organization get a surplus or deficit of workers in the future if X people leave the company now?

To bridge these knowledge gaps Accenture wants to create a tool able to assist them in analyzing the impact of policy decisions and shortages in new employee availability on their workforce. To achieve this, the project will feature an IT based tool enabling Accenture's HR specialists to make better informed and faster decisions about workforce planning issues.

- **Better Informed**: Steering on workforce demand and an automated search through the solution space should be possible.

- **Faster**: The new system should be able to examine at least 5 scenarios within one hour.

1.4 **Simulation for Ill Structured Problems**

A problem can be well structured or ill structured (Goel, 1992). According to Goel an ill structured problem can be distinguished from a well structured problem based on five characteristics (Goel, 1991). Per characteristic we will evaluate if the problem described in the previous paragraphs is a well structured or ill structured problem.

- **Stopping Rules and Evaluation Functions**: This characteristic leans toward ill structured. It is not clear when a tool for workforce planning would be finished. There are always features that can be improved or added.
• **Memory Retrieval & Inferences:** This characteristic leans toward ill structured. The constraints on a design problem are non-logical.

• **Direction of Transformation Function:** This characteristic leans toward ill structured. A design problem has fluctuating constraints and goals. This is why a project can shift in the direction it is headed.

• **Solution Decomposition:** This characteristic is undecided. At this stage it is impossible to say how many modules and interconnections there are within this project.

• **Development of Solution:** This characteristic leans toward ill structured. To reach a solution to this problem an incremental approach will be necessary.

Four characteristics indicate that the problem described in paragraph 1.1 is ill structured and one characteristic is undecided. From now on workforce planning will be regarded as an ill structured problem.

According to Mitroff the problem solving process consists of four stages as shown in figure 1.1. The arrows emphasize the different activities. The four stages are the: **Perceived Problem, Conceptual Model Empirical Model and the Solution.** The activities are: **Conceptualization, Specification, Solution finding, Implementation, Consistency Check and Correspondence Check.**

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1-1 A SYSTEMS VIEW OF PROBLEM SOLVING (MITROFF ET AL., 1974)
The activities that make up a specific problem solving process can be supported with a structured set on instruments, called an inquiry system (Sol, 1982). Sol advocates simulation as the preferred inquiry system for solving ill structured problems.

The beginning of the paragraph established that the problem described in paragraph 1.1 is an ill structured problem, thus simulation will be used as method of inquiry for this thesis. Simulation is defined as the process of designing a model of a real system and conducting experiments with this model for the purposes of either understanding the behavior of the systems or of evaluating various strategies for its operation (Shannon, 1975).

1.5 DECISION SUPPORT FOR WORKFORCE PLANNING

According to Keen and Sol (Keen and Sol, 2008) a good decision making process has both an analytic element and a social element. The Analytical element consists of: information gathering, modeling, reporting and evaluation all of which benefit from formal methods and tools. The social element consisting of: leadership, collaboration, consensus-building communication and mobilization. Developing an analytical tool will not be sufficient for this project. The social element also needs to be covered. Keen and Sol argue that a studio should be developed to support the analytical element as well as the social element (Keen and Sol, 2008).

A computer based tool that helps people make decisions is called a decision support system. A decision support system is defined by Sol as: “interactive computer-based systems which help decision-makers utilize databases and models to solve ill-structured problems” (Sol, 1987). A simulation based decision support tool will cover the analytical element.
The effectiveness of a decision support system can be expressed by the three Us: *usefulness, usability and usage* described by Jacobs (Jacobs, 2005) as:

- **Usefulness**: The usefulness of decision support tools expresses the value they add to a decision making process. It thus relates to the analytic models embedded in the decision support system.

- **Usability**: Usability expresses the mesh between people, process and technologies. Usability depends mainly on the interface between users and the decision support technology. Usability expresses among others, the responsiveness, flexibility, adaptability and ease of interaction and collaboration with the system.

- **Usage**: Usage expresses the flexibility adaptively and suitability of a DSS for organizational, technical or social context. The main question concerning usage is: How is the system embedded in the decision process.

When with respect to a decision support system all the three Us are regarded of equal importance, the concept of a decision support suite emerges. A decision support suite is a well-chosen set of services and recipes for interconnectivity to support a decision making process. A studio is a (Virtual) environment in which suites are deployed.

Developing an environment for solving workforce planning related issues is out of the scope of this project. This project will feature a decision support suite that enables better and faster decision making regarding workforce planning. Though developing a new environment for this tool is out of scope, getting the tool used is a goal for this project.

A decision support system (DSS) is there to aid the decision maker not replace him. The purpose of a traditional DSS is to improve the quality of the user’s decision making. A DSS is problem oriented (Carter et al., 1992).
1.5.1 Research Questions
The question the leading up to the development of a decision support suite is main question:

What should a decision support suite look like? Considering that it is aimed at gaining an understanding of how a workforce will develop, given the uncertainty regarding the availability of new personnel and the impact of policy decisions.

The workforce planning process is very complex. A more in depth review of literature is needed to get a greater degree of understanding of the processes at work regarding workforce planning before a decision support system can be developed sub question 1:

Why is workforce planning important to an organization?

There are many forms a decision support system can adopt. There are several modeling techniques common in the field of workforce planning for example linear programming or discrete event simulation. Which technique is appropriate for this project is unclear at this stage sub question 2:

What technique is most fitting as a basis for a decision support suite for Accenture, aimed at supporting workforce planning?

After the appropriate type of tool has been determined the tool itself needs to be developed. This results in the following design statement:

Develop a tool to support workforce planning in an organization!

A good technical implementation of the tool is no guarantee for good results. A well developed analytical element that delivers valuable results is no guarantee for a successful decision support system. A lot of its success depends on how the tool is used by the organization or even if the tool is used at all. The adoption of the tool by Accenture will not happen out of itself. Sub question 3:

How can the adoption of the tool into the organizational processes be improved?

1.6 Research Approach
A research approach is the strategy the researcher will employ to come to credible research results. The strategy will consist of a sequence of steps which are used to support the two phases of a research project: theory building and theory(Gaulliers, 1992). The research approach will ultimately result in several instruments aimed at answering the research questions.

1.6.1 The Design Science Approach
The design science approach is a research approach which combines both natural science activities and design science activities. Both design science and natural science activities
are needed to ensure that IT research is both relevant and effective (March and Smith, 1995).

The aim of this study is to produce a decision support suite founded on workforce planning theory. To achieve this goal both design activities and research activities need to be employed. Hevner et al. developed some guidelines for a good design science approach. Their guidelines will be used to increase the quality of this study (Hevner et al., 2004).

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Application</th>
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<tbody>
<tr>
<td>Guideline 1: Design as an Artifact</td>
<td>A decision support suite which is able to capture the behavior of a workforce within different situations and with different policies.</td>
</tr>
<tr>
<td>Guideline 2: Problem Relevance</td>
<td>Workforce planning is relevant of an organization wants to meet the challenges posted by a dynamic labor market.</td>
</tr>
<tr>
<td>Guideline 3: Design Evaluation</td>
<td>The suite will be evaluated on how well it meets the set of requirements developed in conjunction with Accenture, but also how well the suite’s results comply with historical data.</td>
</tr>
<tr>
<td>Guideline 4: Research Contributions</td>
<td>This project will feature a workforce planning decision support suite that enables Accenture to make better informed and faster decisions about their workforce planning.</td>
</tr>
<tr>
<td>Guideline 5: Research Rigor</td>
<td>The design will be based on strategic human resource literature, literature about previous workforce planning issues and their solutions and a case study in which the organization for which the artifact is designed will be evaluated.</td>
</tr>
<tr>
<td>Guideline 6: Design as a Search Process</td>
<td>This project will feature an iterative design process, starting with a literature survey then continuing into a design and development path. However neither of these steps have a strict chronological order. It might very well be that unforeseen problems arise during the design phase that requires further research. See paragraph 1.6.2.</td>
</tr>
<tr>
<td>Guideline 7: Communication of Research</td>
<td>Communication of this project is twofold. On one side there will be written documents for an interested audience to read, on the other hand the suite’s users will be involved in the design process.</td>
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1.6.2 STAGES IN DESIGN SCIENCE

The preliminary process of this project has three stages as can be seen in figure 1-2.

![Diagram showing the stages: Case Study → Systems Analysis → Tool Design]

Each of these stages has their own goals. The case study will reveal all ins and outs about Accenture, providing input for the systems analysis. The systems analysis structures the data, from both literature and the case study, resulting in a set of requirements. The tool design stage will transform the requirements into the end product, a working tool. The nature of the design science method is the cause of the non linear approach to these stages. Iterative steps will be undertaken to improve quality in previously taken steps.

Case Study

According to Dul and Hak the definition of a case study is: “A case study is a study in which (a) one case (single case study) or a small number of cases (comparative case study) in their real life context are selected, and (b) scores obtained from these cases are analyzed in a qualitative manner” (Dul and Hak, 2008) Page 4.

The aim of this case study is uncovering how Workforce Planning is done by Accenture at this moment. Especially relevant are identifying uncertainties that influence decisions about the workforce planning but also identifying the decisions themselves. The most suitable case study variant for this goal is the practice oriented case study. Dul and Hak indicate that the main result of this method is “a specification of the main practitioner’s knowledge need” (Dul and Hak, 2008) page 55. This information is invaluable for the tool under design because it exactly specifies what knowledge gaps need to be filled.
Literature study

According to Cooper (Cooper, 1988) a literature study according to uses primary or original scholarship, and does not report primary scholarship itself. A literature review aims to summarize, clarify describe and/or integrate the content of primary reports. The review of relevant literature is nearly always a standard chapter of a thesis or dissertation. The review forms an important chapter in a thesis where its purpose is to provide the background to and justification for the research undertaken (Bruce, 1992)

Systems Thinking

Viewing workforce planning as a system enables the uses of various techniques analyzing the business processes. For this project a soft systems approach seems fit. Peter Checkland describes a soft tradition as: “The soft tradition assumes the world is problematical, always more complex than our accounts of it, but that the process of inquiry into the world itself can be engineered as a learning system.”(Checkland, 1981)

This soft tradition seems appropriate for workforce planning. Workforce planning is a subject that is hard to demarcate and almost impossible to fully delineate, using the soft tradition instead of the hard tradition enables making a useful systems analysis without having to provide an exhausting system description.

1.7 RESEARCH METHODS

The research methods that will be employed to answer the research questions of paragraph 1.5.1 are respectively:

**Method 1:** A Literature study will be used to determine what Strategic workforce planning exactly is and why it is relevant to an organization. A literature study will also be used to examine previous cases in which workforce planning tools were developed.

**Method 2:** A Case study will be used to examine Accenture. This case study will provide the information needed for the systems analysis.

**Method 3:** The design process will be based on a systems approach. The analytical tools of the systems approach are used as input for the development of the set of requirements. Furthermore the requirements will be coupled with the 3u’s as described by Keen and Sol (Keen and Sol, 2008)

**Method 4:** An adoption strategy will be based on literature.
1.8 DELIVERABLES

The deliverables for this study will be:

- **Deliverable 1**: A thesis describing the project and the analyses done.
- **Deliverable 2**: A decision support suite for Accenture’s workforce planning
- **Deliverable 3**: An accompanying user manual.
- **Deliverable 4**: (The start of) an implementation process into the organization.
- **Deliverable 5**: A scientific article about the workforce planning suite.

1.9 THESIS OUTLINE

Chapter 1 gives a general introduction to the problem and states research questions, explains the use of decision support with simulation and describes deliverables. Chapter 2 explains why workforce planning is relevant for organizations by analyzing internal organizational issues and external issues in the labor market. Chapter 3 analyzes various tooling techniques and explains the best technique for this project. Chapter 4 gives an analysis of Accenture’s business processes and other internal issues. It will eventually result in the requirements of the workforce planning tool. Chapter 5 gives an overview of the design choices for the workforce planning tool. Chapter 6 is about validation verification and testing of the workforce planning tool. Chapter 7 contains the conclusions and recommendations.
2 WORKFORCE PLANNING IN ORGANIZATIONS

Before being able to understand why workforce planning is important to an organization it is needed to know what workforce planning is. The first section of this chapter will give a definition for workforce planning. The second section will address workforce planning within an organizational context. The last section will discuss some external trends taking place in the labor market that affect workforce planning.

2.1 WORKFORCE PLANNING DEFINITION

When making a decision about workforce planning it is important to have a clear picture about the exact nature of workforce planning. Workforce planning has an ambiguous nature; even within an organization multiple definitions might be used. As an example the definition of workforce planning within a governmental organization will be given.

“Workforce planning is a systematic, proactive process, which aligns strategic planning, human capital, and budgeting to meet organizational goals and objectives through:

• Forecasting mission critical talent needs;
• Analyzing current workforce and talent supply; and
• Developing, implementing, and evaluating strategies to close gaps.”

This is the definition of the State of Georgia human resource services (State_Personnel_Administration, 2009).

Within the Georgia merit system, an organization closely linked to the state personnel administration, the following definition is used:

“Workforce planning is a systematic process for identifying the workforce characteristics and competencies required to meet the agency’s strategic goals and for developing the strategies to meet these goals.” (Brooks, 2002).

The Department of Interior and the Department of human and health services in the US government use the following definition:

“Workforce Planning (WFP) ensures that the right people with the right skills are in the right place at the right time.” (Office_of_Personnel_Policy, 2001, Office_of_Human_resources, 1999).

This definition is not clear enough. What is the right time for instance? Accenture had a project about workforce planning at Harley Davidson in which they used the following definition: “Workforce Planning is the process of analyzing and forecasting the talent that the organization needs to execute its business strategy while also creating plans to address any current and future gaps.” (Accenture, 2009c).
While this is a clear definition it lacks a scientific foundation. Its source was an internal document with no references to any scientific literature. Another definition developed by one of the leading scientists in the field of workforce planning will be used:

“Workforce planning is an integrated and forward looking process that is designed to predict (what, when, how much) will likely happen in talent management and then to provide action plans that will cause managers to act in the prescribed way. As a result of the planning process, managers will be able to avoid or mitigate people problems, take advantage of talent opportunities and to improve the “talent pipeline,” so that your organization will have the needed “people capabilities” required to meet your business goals and to build a competitive advantage over other firms.” (Sullivan, 2009)

What is interesting about this definition that it defines workforce planning as a forward looking process. Any tool aimed at supporting workforce planning will thus have to include prescriptive elements for which simulation is very well suited.

2.2 WORKFORCE PLANNING IN AN ORGANIZATION

This thesis will only review workforce planning done in organizations defined by Mintzberg as a professional bureaucracy (Mintzberg, 1983). Professional bureaucracies use standardization of skills and coordination between employees as main organizational mechanisms. The focus will be on professional bureaucracies because Accenture Amsterdam can be classified as a professional bureaucracy. Globally Accenture resembles a divisional structure more closely but the main focus for this project is the Amsterdam office only. For this type of organizations workforce planning is most challenging. They need highly skilled employees who are always in short supply.

On top of that professional bureaucracies are often semi-large to large organizations. The size of an organization increases the complexity of workforce planning. A large organization will have to use multiple levels of hierarchy in its structure. A single manager just does not have the span of control to keep track of hundreds of professionals. Having multiple levels creates challenges of its own, such as finding a good management and compensation scheme given the different levels (Bolton and Dewitrapoint, 2005).

There is an optimal size for a firm depending on its productivity and the amount of levels of hierarchy in the organization (Bolton and Dewitrapoint, 2005). It is in the organizations best interest of reaching a certain organizational profile (pyramid) that is optimal, because this will create the best cost to productivity ratio. Reaching this optimum might prove difficult. The dynamic environment constantly shifts the optimal form of the organization as well as the ability of the organization to reach this optimal form. A tighter labor market will make it more difficult for an organization to hire enough talent. This in turn will make it harder for an organization to reach its optimal form. Economic up and down terms have an effect on the organization’s productivity. In
order to reach a good organizational structure more insight in the in the uncertainties, about how to reach the best organizational profile, is needed.

2.3 Dynamic Properties of the Labor Market
A literature review has revealed three different labor market dynamics relevant for workforce planning: an increasing flexibility of employees, workforce aging and a shifting supply and demand of employees.

2.3.1 Workforce Flexibility
Some scientists think the current labor market is still very inflexible (Velde et al., 2005). But the number of flexible workers is increasing (Remery et al., 2002). In some countries there is a trend towards more protection and more similar working conditions for flexible workers opposed to fixed labor contract workers (Remery et al., 2002). When flexible workers’ contracts get more in line with fixed labor contracts, the flexible workers will be more expensive. This means that flexible workers will become less attractive for organizations.

Some scientists are of the opinion that current labor markets are already flexible “Contemporary labor markets are characterized by such a high degree of flexibility that a new type of labor market is emerging. This market features a large number of transitions during the working career.” (Bijwaard and Veenman, 2007). More flexible labor can mean that vital knowledge is lost due to a high turnover rate. On the other hand more flexible workers means that an organization can adapt easier and faster to changes in the environment.

2.3.2 Aging Workforce
The workforce in many countries and different continents is aging (Yashiro, 1997, Harbaugh and West, 1993). Workers of different ages do not have the same skills and productivity. This difference has implication for an organization. Managers must decide on the best age structure of their workforce and adopt compensation and employment policies to achieve these objectives (Clark and Ghent, 2009). When they have decided on an ideal age structure for the organization an undesirable age distribution can be addressed by employment policies such as mandatory retirement, early retirement incentive programs, or changes in recruiting and retention policies.”(Clark and Ghent, 2009)

A scarcity in qualified workers may force organizations to retain or hire older workers (Popkin et al., 2008). So instead of fitting the workforce around the work it is also possible to fit the work around the workforce. Having people of different ages impose different requirements on training and job design. Popkin et al state: “Training and tailored job and tool design may enhance the ability of a workforce to perform their jobs
safely and effectively, if what is known about human physiology, cognitive functioning, and other parameters over the lifespan is taken into account.” (Popkin et al., 2008).

2.3.3 Supply and demand of Employees
The economy goes up and down in waves (Peck, 2002) and this has certain implications for managing a workforce. In an economic upturn labor is scarce this means that labor will have high costs due to the strong bargaining position of workers (Remery et al., 2002). In a recession labor is more abundant. This allows corporations to be stricter on the qualifications of the people they hire (Haapakorpi, 1995). There is a high probability that during a recession less work needs to be done by an organization, and that costs need to be cut.

A recession can also provide an organization with a strategic opportunity. During a recession an organization can start hiring people so when the economic upturn arrives it has a high quality workforce and is ready to compete. Because organizations have a strong bargaining position in a recession costs could be saved. Employing this strategy is not without risk. Timing is very important. If personnel will be hired too soon the organization makes unnecessary costs and if the organization will start hiring too late all the high quality personnel might already have been hired by other companies.

2.3.4 Implication of the labor market dynamics
An older workforce has different characteristics than a young workforce. A different age distribution also means employees have different levels of experience. More flexibility means a higher throughput of employees in an organization. This could result in higher hiring and attrition costs, but also in an easier acquisition of new talent. It can result in higher costs because every Employee that leaves takes specific knowledge with him. Every new employee has to get acquainted with the organization. This means the employee does not produce at full capacity while learning how to operate within the organization. Furthermore there are economical effects. They influence the supply of new employees and the demand for them, requiring organizations to plan ahead so they prevent themselves from being under or over staffed. Summing up, these dynamics create uncertainty on several different terrains:

- Uncertainty regarding availability of new personnel
- Uncertainty regarding maintaining quality of personnel
- Uncertainty regarding employees moving away from the organization

These uncertainties conjure important questions about how to deal with these uncertainties. These questions indicate a lack of knowledge, these are called knowledge gaps. The knowledge gaps related to these uncertainties are respectively:

- Can an organization still get the personnel it needs?
- What does maintaining quality mean for the costs of hiring and attrition?
- What does employee throughput mean for the retention of knowledge/skills within an organization’s staff?
2.4 **BRIDGING THE KNOWLEDGE GAPS**

These knowledge gaps are never stable but evolve over time. This makes determining the impact of policies even harder because policy decisions may have a changing impact as the environment changes over time. Figure 1-1 shows the workforce planning process. It shows that opportunities to adapt the labor force come from the labor market and that there is a feedback loop in the decision making process. This loop means choices now will be influenced by choices made in the past.

![Diagram of workforce planning process](image)

2.1 THE KNOWLEDGE GAPS HAVE AN IMPACT OVER TIME

Uncertainty about the development of the (future) workforce is not only caused by the (future) developments of the labor market, but also the effect of an organization’s current and past human resource policies. For instance: What happens to the population at the higher tiers in five years, if an organization hires a lot of low level employees today? This is just one example of many possible questions a human resource manager could have.

These uncertainties prevent an organization from reaching a specific organizational profile as described in paragraph 2.2. This makes workforce planning important because according to the definition of paragraph 2.1 it aims at predicting and then mitigating these gaps.
3 TOOLING FOR A WORKFORCE PLANNING DECISION SUPPORT SUITE

A decision support system (DSS) is there to aid decision makers not replace them. The purpose of a traditional DSS is to improve the quality of its user’s decision making. A DSS is problem oriented. (Carter et al., 1992)

In section one it was argued that Accenture currently has an ill structured problem regarding workforce planning. It was also argued that a decision support system with simulation as method of inquiry is the best method to support decision makers in solving an ill structured problem.

According to Zeigler’s source system (Zeigler et al., 2000) based on Klir’s Levels of system knowledge (Klir, 1985) the data provided by Accenture’s database systems is classified as a lower level of data than the final simulation model that will make use of this data. They argue that knowledge at a higher level about a system can help gaining a deeper understanding of that system. Thus by moving from a lower to a higher level knowledge is created. The knowledge created by the simulation should help Accenture gaining a deeper understanding about its workforce planning.

There are many different modeling approaches, each with their own strengths and weaknesses. So in order to make this transition in levels easy and the knowledge created valuable, it would make sense to evaluate what modeling approach is most fitting considering the problem situation.

Simulation has many shapes and sizes. This chapter will explore what simulation formalism is most appropriate for Accenture’s workforce planning problem. Two other research techniques, commonly used in the field of workforce planning, will be evaluated for comparison.
3.1 CRITERIA

To reflect the suitability of a specific modeling approach the most important characteristics of the problem and current situation in Accenture’s organization are translated into several criteria that any modeling approach should meet.

3.1.1 CRITERION A: MATCHING THE INFORMATION AVAILABLE

Accenture uses database software to store all data about its employees that is relevant to the organization. The data stored in these databases can be of value to the workforce planning tool, able to provide an accurate initial situation for the simulation model. Not every modeling approach is equally flexible regarding the input data fed into the model. A modeling approach suitable for this situation should be capable of handling the data provided by Accenture’s databases.

Some important characteristics of the input data are:

- Datasets range from small to large (10 to 2000 employees).
- Data is generally concise.
- Data is not always accurate.

3.1.2 CRITERION B: LEVEL OF COMMUNICATION

Accenture uses employees as an atomic unit in their databases. To enable easy use of the tool and in turn communication of the tool’s results to the management, the employee should also be used in the model as an atomic unit. It is important for a modeling approach that it is able to produce results that use individual employees as central unit. This also includes for example the percentage of total employees that occupy the management level.

Using small workforces should be an option. Individual heterogeneity (differences between individuals) affects tool dynamics (Rahmandad and Sterman, 2008). The behavior of the whole workforce becomes dependent on the behavior of individuals if the workforce is small. Capturing the individual heterogeneity will be needed to create appropriate tool dynamics. An individual based approach is best suited for this.

Another advantage of keeping the data at the level of employees is that there is no need to convert the input data to a new format. This conversion process is an extra step that may produce errors, resulting in corruptions in the dataset.
3.1.3 **CRITERION C: PRESENTATION AND VISUALIZATION OF THE PROCESSES.**
Communication of the tool’s results is important. Not only do the results of the tool need to be valid the outcomes need to be esthetically appealing. An esthetically appealing interface increases management’s willingness to actually use the tool’s results (Umakant, 2007).

Producing nice looking graphs reflecting the tool’s outcomes is the first step towards this goal. Giving insight into the dynamics that create these graphs is an extra bonus that could lead to a better understanding of the system under analysis. For a consulting organization like Accenture, visually appealing reports are very important. It is the first step towards gaining trust in the quality of the generated results.

3.1.4 **CRITERION D: SUITABILITY FOR OPTIMIZATION.**
Ideally the tool gives the best possible solution given certain environmental conditions. When a tool is always able to provide the best policy solutions given a set environment, making policy would be a lot easier. Such an optimal solution, or even a set of good solutions, is easy to interpret by the tool’s users and is easily communicated to their managers. Providing optimization functionality will greatly improve the value of the tool.

The speed of analysis is an important factor with optimization especially when there are many possible alternatives. When a user of the tool has to manually input every alternative before any kind of optimum can be reach the tool looses value.

3.1.5 **CRITERION E: EXPANDABLE, ADDING EXTRA FEATURES IN THE FUTURE.**
Each project has a limited scope. This means that not every feature that is deemed valuable can be included in the first version of this tool. There may be features that are valuable that do not end up in the final implementation of the tool. Keeping an option to add those features to the tool in a follow-up project is therefore important.

Adding features to the tool is not only important for implementing old ideas that missed the first version. New insights obtained form using the tool might mandate a wholly different implementation of the tool.

3.1.6 **CRITERION F: SUITABILITY FOR TIME DYNAMIC PROCESSES**
The knowledge gaps identified in section 2.5 indicate that time is an important factor within this problem, especially regarding the effects of the current day decisions on the workforce of tomorrow. Being able to include these time dynamics into the analysis process provides a solid anchor for the validity of the tool’s outcomes.
3.2 COMPARATIVE ANALYSIS

In this paragraph several different approaches used for analyzing a workforce planning problem are reviewed. This overview is not a complete spectrum of all available methods but rather a review of some of the most commonly used methods for solving workforce planning problems. The methods will be valued a 5 point scale, table 3 holds a legend.

TABLE 3 APPROPRIATENESS OF THE TECHNIQUES

<table>
<thead>
<tr>
<th>Inappropriate</th>
<th>Neutral</th>
<th>Appropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>+ -</td>
<td>+</td>
</tr>
</tbody>
</table>

3.2.1 BENCHMARKING

Benchmarking is a measuring tool. It is a method used for comparison. Fagerström, Lowry and Getachew use the benchmarking technique to compare the performance of a newly developed system for allocating personnel in hospitals, to the performance of previously used methods. (Fagerström, 2009, Lowry and Getachew, 2009). They concluded that benchmarking has both strengths and weaknesses. The strong points they discovered are:

- Benchmarking is likely to yield cost benefits
- It is a good method for comparing cases
- Benchmarking will yield a detailed operationalization of the problem analyzed

Benchmarking also has some negative points these are:

- Multiple cases required
- Large base of historic data required
- If not every relevant aspect of a problem is covered the benchmarking may become unfair\(^1\)

Criterion A: There are not enough cases available for a benchmarking study. It might be argued that a comparison between different workforces within the organization can be done using benchmarking. It is arguable if this will provide any reliable results. Every business entity in Accenture has its own purpose and tasks resulting in different characteristics its workforces. You cannot compare very different workforces because in

\[^1\] If company x sells a product at a certain price and company y sells the same product at a higher price company x will be rated as the best buy option. But if the benchmarking failed to include the quality of service provided and company y is better at this point than company x, the best buy option might be different from what the benchmarking recommends.
Concordance to the last negative point 3 the risk of missing one of the relevant characteristics among some very heterogeneous workforces becomes too great. Result: -

Criterion B: It is possible to conduct a benchmarking study with an employee as atomic unit as shown by the study of Fagerström, Lowry and Getachew. Result: +

Criterion C: Benchmarking is an analytical/mathematical technique. This means that it can produce some nice looking graphs out of a spreadsheet model. This is something that management of a professional organization is accustomed to but nothing out of the ordinary. Result: + -

Criterion D: Benchmarking is a comparative method aimed at finding the best option amongst compared to a standard case. With the result of the study it is possible to identify the best solution among all the cases under scrutiny. Although this process does yield a best solution it is a very limited way of optimizing because the optimum is strongly related to the set of selected cases. Result: + -

Criterion E: Making adaptations or reusing a benchmarking study has two sides. Adding cases to an already designed Benchmarking study will most likely pose little problems. Adapting the variables used to compare cases with, mandate reevaluation of the benchmark resulting in a whole new study. Result: + -

Criterion F: Benchmarking is a method taking snapshots as a specific time. Time based dynamics can be analyzed by taking subsequent snapshots; however there will always be gaps between these snapshots. So even though it is possible this is still a sub optimal method from this point of view. Result: -

3.2.2 LINEAR PROGRAMMING TOOL

Billionnet formulated the problem of scheduling a workforce with different levels of worker qualifications as an integer program that minimizes labor costs (Billionnet, 1999). Wirojanagud used integer programming to tool a system with non homogeneous employees (Wirojanagud et al., 2007). Lavieri and Puterman developed a linear programming that determines the optimal number of nurses to train, promote to management and recruit over a 20 year planning horizon to achieve specified workforce levels (Lavieri and Puterman, 2009).

Criterion A: Linear programming is very well capable of handling both small and large datasets without any major difficulties. The problem with linear programming is that it is only fit for analyzing processes with linear equations. The labor market dynamics described in section 2.4 indicate workforce planning is subject to many non linear processes. Result: -
Criterion B: As Wirojanagud et al have shown that taking individual employees is a possibility. They even used individual characteristics of the employees in their study. However instead of using actual individuals the numbers are aggregated to population levels Result + -

Criterion C: Linear programming is an analytical/mathematical technique. This means that it can produce some nice looking graphs out of a spreadsheet model. This is something that management of a professional organization is accustomed to but nothing out of the ordinary. Result: + -

Criterion D: Linear programming is a commonly used research method in this field. A linear programming study is usually performed for an optimization question and thus very suited for these kinds of questions. Result: +

Criterion E: You can only optimize one objective function at the time. This means that if it is desirable that multiple objectives get weighed a precise weight factor has to be specified for all the objectives. In a multi actor situation with conflicting interests this is not trivial. When a new variable will be added the relative weight of the factors will shift mandating a reevaluation of the whole model. Result: -

Criterion F: Linear programming works with the assumption of linear equations. Therefore time and state dependent problems are hard to describe with this technique. Just like Benchmarking this can be circumvented by taking snapshots at different time intervals, but this is again a sub-optimal solution. Result: -

3.2.3 DIFFERENTIAL EQUATION BASED SIMULATION

Accenture has done a system dynamics study internally. System dynamics is suited for discovering patterns on a high level. The system dynamics based workforce planning tool of Accenture is capable of giving insight in the development of the workforce within Accenture given a chosen development strategy (growth based or revenue based).

Criterion A: Differential equation modeling is capable of accommodating a large and varied range of input data. The data available at Accenture should pose no trouble when using this technique Result: +

Criterion B: A study done for the united states air force also used the differential equation method (Carter et al., 1992). One of the things they encountered that it was quite hard to track properties of individuals in the tool, relevant for the organization. Take for instance skill management. A skill is attached to a specific worker. When that worker leaves 1 unit of that skill leaves the organization. Because there is no such thing as a single worker in a continuous tool it is impossible to attach that skill to a worker. So you will have to make a creative solution to cover skill management. Result -
Criterion C: When using this technique an elaborate dashboard can be created providing something extra. Exactly how much of an improvement this will be depends on how much time can be spent on its design. Result +

Criterion D: Optimizing a simulation model is possible but it is a very complicated subject. It is not a simple matter of balancing out equations. The time and state dynamics make the simulation model’s current state dependent on its previous state as well as on several dynamic external factors, when the external factors shift the optimum configuration of the simulation model changes with it. Optimizing in such a situation mandates a method that moves the model to an optimum configuration by adjusting its input variables constantly (Blum and Roli, 2003). Result + -

Criterion E: Expanding a differential equation model is quite hard. All the model’s elements are heavily intertwined and their behavior is dependent on the behavior of other elements nearby. Changing one part of the model might mean the whole model starts to behave differently. Result -

Criterion F: According to Nance: "Time and state descriptions form the core of a simulation tool representation." (Nance, 1981). Simulation is able to capture the complexity coming out of status changes over time. Simulation is therefore a good technique to handle dynamic processes. Result +

3.2.4 DISCRETE EVENT
There are several previous studies in the field of workforce planning that use a discrete event modeling technique (Huang et al., 2009, Geerlings et al., 2000).

A workforce planning tool based on a discrete event approach is usually very detailed. When the level of detail gets overwhelming this may have an effect on the speed of the tool. This is one of the dangers of a discrete event approach.

Criterion A: Discrete event modeling is capable of accommodating a large and varied range of input data. The data available at Accenture should pose no trouble when using this technique Result: +

Criterion B: Discrete event modeling is very well capable of communicating at the level of individuals. The individuals are represented in the model on a one by one basis. This means that all relevant attributes such an individual might have can be modeled. Result: +

Criterion C: When using this technique an elaborate dashboard can be created providing something extra. Exactly how much of an improvement this will be depends on its design. Result +

Criterion D: Optimizing a simulation model is possible but it is a very complicated subject. It is not a simple matter of balancing out equations. The time and state dynamics
make the simulation model’s current state dependent on its previous state as well as on several dynamic external factors, when the external factors shift the optimum configuration of the simulation model changes with it. Optimizing in such a situation mandates a method that moves the model to an optimum configuration by adjusting its input variables constantly (Blum and Roli, 2003). Result + -

Criterion E: The difficulty of making an expansion to a discrete event model depends on the implementation chosen by the model’s developers. When a modular approach is chosen expanding or changing modules might be an option. Changing large parts of the models logic however does mandate a new validation. Result + -

Criterion F: According to Nance: ”Time and state descriptions form the core of a simulation tool representation.” (Nance, 1981). Simulation is able to capture the complexity coming out of status changes over time. Simulation is therefore a good technique to handle dynamic processes. +
3.3 CONCLUSION

The results of the analysis conducted in paragraph 3.3 are summed up in table 4.

### TABLE 4: COMPARISON OF TECHNIQUES.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Techniques</th>
<th>Criterion A: The information available</th>
<th>Criterion B: Level of communication</th>
<th>Criterion C: Visualization</th>
<th>Criterion D: Optimization</th>
<th>Criterion E: Expandability</th>
<th>Criterion F: Time Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discrete event simulation</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Differential equation</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Linear programming</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Benchmarking</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

All the criteria that are given in paragraph 3.1 are important to the issue of workforce planning. If a technique scores a double minus on any of the point it will make the technique very impractical to use.

Linear programming and benchmarking scored a lot of minus on the criteria, this will disqualify them for being an appropriate technique since they lack a good amount of plusses on their other criteria to make up for the minuses.

According to the above analysis the technique best suited for making a decision support system for Accenture’s workforce planning is the discrete event technique. It sets itself apart from the differential equation technique because it is possible to create a model with this technique that communicates at the same level (individual employees) as the organization. It is possible to use individual employees as atomic units within a Differential equation model but it is very hard to track their individual characteristics. These characteristics are important for many business processes for example promotions.
4 WORKFORCE PLANNING DECISION SUPPORT FOR ACCENTURE

When designing a workforce planning decision support tool, a great deal of information about the organization for which the tool is designed is needed. This chapter will describe several different analyses that explore several aspects of the organization Accenture. These analyses provide a basis for the design of the workforce planning tool.

4.1 UNCERTAINTIES ABOUT WORKFORCE PLANNING IN ACCENTURE

Accenture has had a large workforce for many years. Therefore they have been employing workforce planning even if not in a structured manner. To get a clearer picture of the workforce planning activities Accenture employed, a case study was done. Another valuable insight that was aimed at for this case study was to identify uncertainties and cross reference them with the uncertainties found in literature.

The case study consists of two parts. The first part is a set of meetings with experts from Accenture. Both a HR specialist and a senior executive gave valuable input for this study. The second part consisted of the expansion of a preliminary simulation tool. This was intended as ‘learning by doing’ approach. The insight gained by expanding this preliminary tool was used as input to ask the interviewees targeted questions to alleviate any knowledge gaps found while studying this preliminary tool.

Flyvbjerg argues that a single case in a case study can already provide valuable insight into a problem situation (Flyvbjerg, 2006). For this problem the single case has provided valuable insight as well. The information gathered is summarized in an influence diagram.
4-1 WORKFORCE PLANNING WITHIN ACCENTURE
The case study has revealed there are five important uncertainties:

- Uncertainty regarding availability of work
- Uncertainty regarding incoming transfers
- Uncertainty regarding unmanaged attrition
- Uncertainty regarding the value of an employee expressed in revenue
- Uncertainty regarding the performance of the employee

The case study has revealed four choices that directly influence Accenture’s workforce:

- Hire
- Promote
- Managed Attrition
- Transfer
4.2 **ACCENTURE’S GOALS**

The goals of Accenture will be examined with respect to two different viewpoints. The first is the viewpoint of workforce planning; the second is the viewpoint of the tool.

4.2.1 **WORKFORCE PLANNING STRATEGY**

The first relevant viewpoint is the viewpoint of Strategic workforce planning. It examines the goals of Accenture regarding the use of workforce planning in general in the organization and if this supports Accenture’s business strategy.

To execute a successful strategy both the strategy design and implementation need to be done well. The implementation falls out of the scope of this project because it does not
add to the goal of this project; developing a decision support system for workforce planning. The goal of this project is not a tool able to determine how well strategy is performed.

The strategy design falls partly in the scope of this project. Making strategic decisions is the responsibility of Accenture. But giving insight in the effects of these decisions on workforce planning is something the tool should support. To do information on the demand for employees (Accenture’s Responsibility) but also number of employees per level (tools responsibility) is needed.

Another important part of workforce planning strategy is skill management. The added level of complexity this brings is however unmanageable for this project and therefore it will be considered out of the scope of this project. Adding employee skill management to the tool is something that can be considered for future projects.
4.2.2 THE DECISION SUPPORT TOOL

4.4 ACCENTURE’S GOALS FOR A DECISION SUPPORT TOOL
The second viewpoint is the tool. The most important question here is what Accenture’s needs are regarding a workforce planning decision support tool. The needs are split into two different types of needs. The first type considers the users and using the tool. The other type considers the information needs of Accenture regarding the tool.

Considering the users and using the tool there are three important needs identified for Accenture:

- Positive user attitude
- A clear user interface
- Minimal setup time

A positive user attitude is important for the adoption of the tool. If the people who should be using the tool are not happy about its design resistance will occur. To alleviate this problem the users will be involved in the tools design.

A clear user interface adds to the comfort of the people using the tool but a clear interface also prevents mistakes and therefore a better analysis. Furthermore the design of the interface is closely related to user acceptance as well as the setup time of the tool.

The setup time of the tool needs to be short. If it is a long and tedious job the tool will not be used often if at all. Having a short setup time does not only require an efficient user interface but it also puts restrictions on the amount input information that can be asked from the users.

Considering the insights the tool should give the following needs are identified:

- Good policy advice
- Policy impacts
  - Hiring
  - Attrition
  - Promotion
- Impact of Employee Availability
- Financial consequences

Given that a good policy advice is needed it means that the tool will have to be able to support determining what a good solution is and what not. To do this the tool will have to be able to examine a number of scenario’s after which the results can be evaluated and the best solution(s) can be selected. For the convenience of the user the tool should be able to evaluate these different scenarios in a short time and with a small setup time.
The impacts of the policies are at the core of the functionality of the tool. The tool should give insight in how different parameters of these policies impact the workforce.

The impact of employee availability is important for workforce planning strategy since it puts a restriction on how much a company can grow or even if it can recruit enough to match its own attrition.

Personnel costs are important especially for a consultancy company like Accenture where the personnel represent the production capacity of the company.

Insight into employee flexibility will not be considered in this study. There is no unambiguous way to measure flexibility. Therefore it is hard to operationalize and it is doubtful if it is possible to determine impacts of flexibility.

Aging effects are a long term effects. The maximum runtime is 5 years because Accenture does not have reliable input data for the tool available beyond 5 years. This is not long enough to study aging effects.

Accenture’s needs and the consequences for the tool design summarized:

1. Insight into the dynamics of the workforce pyramid development → so workforce demographics pyramid as output
2. Insight into the effects of current workforce related policies → so policy attributes as parameters
3. Insight into the effects of different demand scenarios → so employee demand as input
4. Insight into the effects of different supply scenarios → so availability of new employees as input variable
5. Insight into the financial consequences → If you know how the workforce will develop and you know what you have to pay someone costs are calculated #workers * pay.
6. Optimization. Searching for the best solution given a set of conditions → so solver functionality
4.3 **SYSTEM ANALYSIS**

The system analysis is supported by the system diagram technique (figure 4-5). It is used to provide clear system boundaries and to gain insight in the input, output and controls of the system. This system diagram is tooled after the workforce planning system within Accenture.

4.5 **WORKFORCE PLANNING WITHIN ACCENTURE**

There is a difference between current employees already contracted by Accenture and new Employees. The current pool of employees is considered an input for the workforce planning system in Accenture and the availability of new employees is considered a control. The main reason for making this distinction is that the current pool of employees is a known fact whereas new employees are an uncertainty until they are actually hired. Therefore the availability of new employees is chosen to be tooled as a constraint.

Worker productivity is considered an external variable for this project. Workforce planning is under study here and not other parts of Human Resources. Therefore it influences the workforce planning tool but falls outside of the main system.
The effects of Labor laws are outside the scope of this project. This project is considering strategic workforce planning. Considering the labor laws are universally in effect no strategic advantage or disadvantage can be gained here.

Every output and many systems variables have a close relationship with the number of workers variable. This number forms the core of the analysis and will be at a central position within the tool.

4.4 The Strategic Environment

Accenture and its employees have conflicting interests on the terrain of workforce planning. Though Accenture has multiple employees labor contracts are one on one deals. Accenture wants to get a high quality workforce as cheap as possible. Employees want to be rewarded well for their efforts. On the other hand they will both profit from engaging in a labor agreement. The employee will have an opportunity to earn a reward and the organization will have access to the employee’s skills. The problem both the employee and the organization have: what choice should they make in order that his partial influence over the outcome benefits them most? According to Luce and Raiffa this situation can be characterized as a 2-party game (Luce, 1957). The options they both have are to engage into a labor agreement or not.

Because the employees want to maximize their benefits, the organizations bargaining power lies with how it rewards its employees. The employees bargaining power lies with his or her skills. Especially when they have rare and valuable skills the employee will be able to bargain for good rewards.

The workforce planning tool will influence this bargaining game. The employees will act strategically on the outcomes of the tool. So in a sense the tool will become part of the game. This section will first describe the game, and then it will discuss what the impact of the tool on the game is and finally what the consequences of the strategic behavior of the employees are on the use of the tool.

4.4.1 A Bargaining Game

According to Peters a bargaining game may arise in a case of conflict between several parties, such that unanimity is required in order to solve the conflict (Peters, 1986). An organization and an employee need to reach an agreement before a labor contract is signed. The current situation can be described as a 2-party bargaining game.

Game theory makes use of utility functions, a method that quantifies the preference of a player for a specific option (Von Neumann and Morgenstern, 1944). So in order to reconstruct this game we will first have to determine what drives the players.
Employees are assumed to want to maximize their reward. The reward is more than the employee’s salary, it represents the total value an employee experiences by taking the job. This could include but not limited to: salary, Job satisfaction, having a nice manager, etc.

Employees can maximize their reward by either starting (or continuing) to work for Accenture or by looking for a job at another organization. When the reward they can earn somewhere else is higher than what they can earn at Accenture ($ER > R$) employees will leave the organization.

Accenture will gain a benefit when hiring an employee. This benefit consists of access to that employees skills and access to his labor. For Accenture it is only interesting to keep the employee if their benefit is higher or at least equal to the reward that they will have to pay the employee ($X > R$).

This results in the following game matrix.

- $R$: is a Reward earned at Accenture.
- $RE$: is a reward earned outside Accenture.
- $X$: is the value Accenture gets from hiring the employee.
- $(a,b) a = 1$: Accenture hires, $a = 0$ Accenture does not hire
- $(a,b) b = 1$: the employee stays at Accenture, $b = 0$ the employee leaves

<table>
<thead>
<tr>
<th></th>
<th>$R &lt; ER$</th>
<th>$R &gt; ER$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X &gt; R$</td>
<td>(1,0)</td>
<td>(1,1)</td>
</tr>
<tr>
<td>$X&lt; R$</td>
<td>(0,0)</td>
<td>(0,1)</td>
</tr>
</tbody>
</table>

The only situation where the game will lead to a consensus is at the option: $X > R > ER$. When determining if this situation applies you will need a way to measure and compare these values. Measuring these values is not a trivial matter however.

4.4.2 Workforce Planning Tool’s Influence on the Game
To understand the strategic impact of the workforce planning tool within this game a little more depth in the field of actors is required. We will consider the decision maker Accenture as two parties: The Management who makes the final decisions regarding human resource policies and the HR department that are the actual users of the workforce planning tool. An important note to be made about the employee group is that these also include both the management and the people from the HR department.
The HR department who are also the users of the tool will see the biggest difference when the tool will be introduced into the business processes of Accenture. They will have to adapt their current business processes in order to incorporate the tool into their tasks. It is therefore very important to make sure the users are familiar with the tool and an appropriate adoption strategy is chosen. This strategy will be elaborated further in section 4.4.4.

The management is less affected by the tool but will still be able to see its influence, they will be able to see the results of the analyses the HR department has done with the help of the tool. For a successful adoption of the tool into Accenture’s business processes it is important that the management trusts the results of the tool. The management at Accenture is open minded but reserved about the tool. The best way to gain their trust is to deliver reliable analyses.

The employees with exception of the former two groups will be affected by the policies imposed by the management. Even though the results of the tool might have a direct link with the policies, it might even be that some employees might not even know of the tool’s existence. The employees will receive most of their information about how the tool works and affects them via informal communications with either the management or the HR department. This informal communication provides the input data for possible strategic behavior form the employees.

4.4.3 IMPLICATIONS FOR THE TOOL

The workforce planning tool is a supporting tool so it only indirectly influences workforce planning policies, hence the final decision is made by the management and not the tool. The bargaining game of section 4.4.1 shows employees will try to maximize their benefits. This means they are most likely to react to policy changes, this means to the decisions of the managers which are indirectly influence by the analyses of the workforce planning tool.

Average employees have used formal policy changes as their most important information source. Informal communication can provide them with some extra input for possible strategic behavior. This informal information is likely not clear enough to paint a full picture without any information gaps. This will make it hard for these employees to optimize their strategy.

Employees that are part of the management or of the HR department have a different information position. Besides having access to the tool and its results they can also better oversee the implications of the tool’s analyses for workforce planning policies. This will give them an advantage over other employees and Accenture as employer. This information position shall most likely results in strategic behavior. This strategic behavior
has been present within Accenture even before they started using the workforce planning tool so it is arguable that there is even any change at all in the strategic behavior of the employees by introducing the workforce planning tool.

When the tool is used as it is intended in its design, as a support for workforce planning decisions the incentive structure of the employees will not change. There is thus a good possibility that the tool will not affect the strategic behavior of the employees in this way, other than the change in strategic behavior that is cause by different policies.

The tool provides a clear means of communicating analyses. When communicating these analyses to management it is expected this will improve the quality of workforce planning policies. When this communication also reaches the rest of the organization it will change their information position, thus most likely changing their strategic behavior.

4.4.4 Adoption Strategy
A decision support system is only successful when it is actually used by its intended users. For this to come about, the tool needs to be tailored to its users needs. These needs are best described by the users themselves.

To increase end user commitment to the project, the end users of the tool have been involved in the tool’s design. They have given valuable input for understanding the business logic the tool is aimed at supporting but also by validating the tool’s output data.

This approach is described by Barjis as the CPI modeling approach. CPI Stands for: collaboration, participation and interaction (Barjis, 2009). Following this approach has resulted in a more detailed description and a better understanding of the business processes that are supported by the tool.

One of the common pitfalls designers encounter is tunnel vision. When a modeler finishes a part of their simulation model they will use a test method, evaluating the correctness of the model. Even after testing this part of the model will not be 100% correct but the modeler will think it is.

An end user familiar with the modeled business processes is in these cases, often able to spot errors in the model’s design choices. With a traditional approach the users of such a tool are rarely involved in its design, thus leaving the opportunity for these improvements untapped.

Involving users into the tool’s design process may also cause problems. Usually the tool’s users have another frame of mind than its developers. This discordance in insights might be the root of conflict. Weedman describes a case where a difference in design cultures is the base for such a conflict (Weedman, 2008).
4.5 DEFINING REQUIREMENTS

Together with the HR experts from Accenture and based on the information displayed in the previous chapters a set of requirements has been made. The high level requirements are divided into three categories: usage, usability and usefulness as introduces in section 1.5. Figure 4-6 shows the high level requirements. In appendix A the set of lower level requirements can be seen.

4.6 THE HIGH LEVEL REQUIREMENTS

4.5.1 LOOKING AHEAD

The aim of this study is creating a decision support system for strategic workforce planning (for a definition see chapter 2.1). According to Becker and Huselid strategy is about building a sustainable competitive advantage that in turn creates an above average financial performance (Becker and Huselid, 2006). Sustainable means this competitive advantage should be valid for a longer amount of time. The accuracy of scientific predictions decreases as function of time. The longer ahead the more unreliable the prediction (Agresti et al., 1990). The maximum time this study will look ahead is 5 years. This has been set with the help of an Accenture HR specialist.
4.6 **PORTABILITY OF THE TOOL BETWEEN ORGANIZATIONS**

Creating a tool that is applicable to every organization out there is nearly impossible, even if the targeted organizations are limited to professional bureaucracies. Nevertheless this tool has been designed to provide the maximum amount of portability from one organization to another. This means the tool is flexible on many points regarding organizational structure. It is for instance capable of handling between one and an infinite number of hierarchical levels. The most prominent exception to this rule is with regard to the banding system. When the workforce planning tool is to be used in an organization that uses another system than the banding system to measure the quality of its employees additional development will be required.

Another problem might occur is that even though the activities that are executed in an organization are the same, every organization does hiring for instance, the way they do it might be different. This means that the internal logic and assumptions used to execute the hiring process in the model might not be the same.

Portability to other organizations without doing extra development, is expected to be limited. If the portability of the tool should be increased some extra research should be done on how other organizations grade their employees and how that compares to the banding system. Another point of attention would be how portable the logic of the current tool actually is.
5 Designing a Workforce Planning Support Tool

This chapter is about the specification of the workforce planning tool. The analyses done in chapters two till four are important inputs for the design.

In section 1.5 it is argued that a decision support system should support its users with making better decisions not replace them. Not everyone is an expert when it comes to using IT systems. Therefore a decision support tool needs a good looking and clear interface to improve the tool’s usage (section 4.5).

Not only are features that improve the usage of the tool a major factor in its success. The tool will have to produce valuable information. As stated in 1.4 and further underlined in chapter 3 discrete event simulation will be the technique of choice for achieving valuable information.

In section 3.1 it is argued that input data and output data that is used for communicating the tool’s results is very important for the tool’s success. Managing this data is thus an important aspect of the design.

Figure 5-1 shows what elements the workforce planning tool should have. This chapter will further specify how these three elements are designed and implemented.

![Figure 5-1: Three important elements for the Accenture workforce planning tool](image)
5.1 **THE 3-TIER ARCHITECTURE**

The workforce planning tool was not designed as a web based tool. Some of the advantages of a 3-tier architecture, such as easier load balancing across servers, do not apply. Using a 3-tier architecture is still useful however. A 3-tier architecture enables easier modifications or replacements to any tier without affecting the other tiers (Ramirez, 2000). Since the workforce planning tool is expected to be expanded and improved after this project is done, this is a very useful feature. Using 3-tier architecture is closely in line with traditional decision support systems’ architecture (Sprague and Carlson, 1982):

- Tool Base (application Layer)
- Database (data Layer)
- Human Interface (presentation layer)

The Workforce planning tool’s architectural design is based on the 3-tier architecture. A schematic of the design can be seen in figure 5-2.

5-2 THE TOOL’S ARCHITECTURE USING A PICTURE FROM (Patriot Brothers Consulting, 2007)
The workforce planning tool consists of three applications. The most important application is the simulation tool. The other two applications are services to the simulation tool making the tool easier to use.

The solver program manages the simulation tools input. It determines the number of experiments and replications that should run. Furthermore it sets the appropriate tool treatment for each replication. The solver has been developed because there was a desire to be able to run with a search mode.

Currently the search mode is available for four variables: the hiring rate, the managed attrition rate, the unmanaged attrition rate and the promotion rate. For each level in a workforce the user can put in a range and a step size for each of these variables. For every possible combination the solver creates an experiment.

A simulation tool lies at the core of this tool. This part of the tool is what essentially creates all the results and requires all the input. All the other parts of the tool are to support the tool by enabling easy communication with its users.

The statistics writer is responsible for writing the tools results to Excel. It only writes raw data. For an esthetically appealing presentation it has to be formatted for in excel itself. For this purpose the output dashboard has been developed.

User friendliness is important for end user satisfaction (Doll and Torkzadeh, 1988). It is therefore an important factor for a successful tool since the tool’s usage is highly dependent on it.

Configuring the workforce planning tool can be a tedious job. It has a lot of parameters those need to be set accurately for every run. If it is needed to set all parameters for every run that is executed the tools users might be frustrated and the tool will not be used anymore. Let’s say you want to run scenario A and B with the only difference between them that scenario B has a different hiring rate, it would be very inconvenient if you have to put in all other parameters again along with the different hiring rate. In short we need a way to store and retrieve input data.

A database is very well suited for this. For the workforce planning tool Access has been chosen as the database tool to use. Access is relatively user friendly compared to other database programs and maybe even more importantly it is widely available in organizations as it a part of the Microsoft office package.

Excel is the logical software package to use as output interface. Within professional organizations Excel is widely used as a tool for managing data. This means a lot of
people have some level of proficiency with Excel. This makes the workforce planning tool easily usable even by people who are not computer experts.

The simulation tool in the workforce planning tool reads various settings from an Access database. Configuring a tool through direct input into the database’s tables might be confusing for some users. To improve user friendliness of the workforce planning tool a graphical user interface has been developed.

### 5.2 An Object Oriented Design for the Workforce Planning Tool

Because the workforce planning tool is developed with DSOL which is based on Java, an object oriented language, the primary design will use an object oriented tooling technique. The class diagram is used to show the class structure of the tool, to avoid turning the diagram into a wall of text the classes only have their most important attributes and methods defined. Only the core functionality is depicted in this diagram. For instance the GUI (graphical user interface) consists of multiple classes but adding these would lead to a more crowded picture without providing more clarity thus they are condensed into one class. The same is done for the HR manager. The structure for the HR manager will be further explained in the next paragraph.

#### 5-3 Class Diagram of the Workforce Planning Tool

The workforce planning tool has been divided into three parts: the tool input, the tool services and the tool logic.
5.2.1 **Tool Input**
The tool input consists of several classes responsible for communicating with the configuration database. These classes retrieve the appropriate simulation parameters based on what scenario is run. The Hiring policy, transfer policy, attrition policy and promotion policy together form a policy set. As concluded in paragraph 4.1 Accenture has to make policy choices about: hiring, promotion, managed attrition and transfer. These are the instruments Accenture has to influence the development of their workforce and as such they are used as parameters for the tool.

An interesting exception here is the unmanaged attrition. Unmanaged attrition is attrition where the employee takes the initiative to leave the company. Unmanaged attrition is not a parameter Accenture can directly influence\(^2\). Despite not being directly influenced by Accenture it is still an important parameter that needs to be set by the workforce planning tool user. The fact that this decision lays with the employee makes it more an environmental variable from the view of the tool but despite this fact it is still a parameter that needs to be set in order to obtain accurate results.

The hiring pool and work demand are environmental variables. The hiring pool contains the maximum number of people hirable per year per level. The labor market is not an endless pool of labor. The hiring pool is intended to reflect this limit.

Work demand is regarded as an environmental variable as well. The work is the internal demand for labor within an organization. This may seem strange at first because an organization actively determines how much labor it needs. However this need is guided by how many work the organization has to do. Because this amount of work is largely determined by outside factors (government orders, economy) it is viewed as environmental variable.

The workforce class is the only class both part of the tool input and the tool logic. The workforce reads its initial state (the employees in it) from the database.

5.2.2 **Tool Logic**
Besides reading its initial state the workforce class is responsible for keeping track of the population of employees at each level and gather statistics about this population.

The policy set class keeps track of all the policy sets and assigns the right policy set to each workforce.

\(^2\) Indirectly they can influence this by for instance increasing happiness of their employees which will make them less likely to leave.
The Banding class has information about that banding system in it. For instance how much bands there are and what percentage of the total workforce gets assigned to a band. Since this system does not change within Accenture most of its parameters have been hard coded.

The calendar is responsible for time progression in the tool. Each month it sends out a message that is a signal for the HRManager and the employees to execute logic.

The employee is one of the individual classes in the tool. Each instance of the employee class represents real employee. The class keeps track of all the relevant attributes of an employee. Furthermore it is responsible for managed attrition. Each month the employee will make a test that determines if the employee will leave the organization or if he will stay.

The HR manager is the other individual in the tool. It represents the organization’s decision maker and as such it executes all the hires, promotions, transfers and managed attrition.

5.2.3 TOOL SERVICES
The tool quickstart is a class that prepares execution of the tool. This is needed to make sure the tool runs properly in on a java virtual machine.

The solver and the statistics writer are described in paragraph 5.2.

The tool configuration GUI is used as a user friendly way of communicating with the configuration database. It is responsible for retrieving and writing all the parameters needed by the workforce planning tool.
5.3 A SIMULATION TOOL AS CORE OF THE TOOL

This paragraph will explain design choices about the simulation tool at the heart of the workforce planning tool.

5.3.1 DEVS

Posse and Bolduc describe several advantages of the DEVS approach. Some improve the overall quality of the model others provide a specific benefit for the issue of workforce planning (Posse and Bolduc, 2003).

- DEVS gives a general framework for modeling and simulation of complex systems, resulting into a consistency throughout the simulation model.

- DEVS integrates naturally the notion of time. As argued in section 3.1.6 time management is a very important aspect of workforce planning.

- DEVS offers a formal context (separated from the model). Providing a modular structure. This will enable more easy adaptations or additions to the model in the future. The importance of this is argued in section 3.1.5.

For this project the Discrete Event System Specification (DEVS) formalism will be used (Zeigler et al., 2000). In this section the definition of DEVS models (Zeigler et al., 2000) will be briefly recalled. This recollection is inspired on the article of Posse and Bolduc (Posse and Bolduc, 2003). A DEVS model is either atomic or coupled. An atomic model describes a simple system. A coupled model is the composition of several sub models which can be atomic or coupled. Sub models have ports, which are connected by channels. Ports have a type: they are either input or output ports. Ports and channels allow a model to receive and send signals from and to other models respectively. A channel must go from an output port of some model to an input port of a different model, from an input port in a coupled model to an input port of one of its sub models, or from an output port of a sub model to an output port of its parent model. An atomic model has, in addition to ports, a set of states, one of which is the initial state, and two types of transitions between states: internal and external. Associated with each state are a time-advance and an output.

A DEVS (Zeigler, 2003) is a structure:

\[ M = (X, S, Y, \delta_{int}, \delta_{ext}, \delta_{out}, \lambda, TA) \]

Where

- \( X \) is the set of input values
- \( S \) is a set of states,
- \( Y \) is the set of output values
- \( \delta_{int}: S \rightarrow S \) is the internal transition function
δ_{ext}: Q \cdot X^b \rightarrow S

is the external transition function, where

Q = \{(s,e) | s \in S, 0 \leq e \leq TA(s)\}

is the total state set

e is the time elapsed since last transition

X^b denotes the collection of bags over X (sets in which some elements may occur more than once).

δ_{con}: Q \cdot X^b \rightarrow S

is the confluent transition function,

λ: S \rightarrow Y^b is the output function

ta: S \rightarrow R^+_0 is the time advance function

An Atomic model follows the DEVS Structure and implements each of its elements. A coupled model does follow this structure but does not implement all of its components. The components a coupled model implements are:

- the set of components
- the set of input ports through which external events are received – ports are important for routing as specified by the coupling specification (below)
- the set of output ports through which external events are sent

The coupling specification consisting of:

- the external input coupling which connects the input ports of the coupled to model to one or more of the input ports of the components – this directs inputs received by the coupled model to designated component models,
- the external output coupling which connects output ports of components to output ports of the coupled model – thus when an output is generated by a component it may be sent to a designated output port of the coupled model and thus be transmitted externally,
- the internal coupling which connects output ports of components to input ports of other components when an input is generated by a component it may be sent to the input ports of designated components (in addition to being sent to an output port of the coupled model).

As explained in paragraph 3.1.2 an individual based approach is chosen for the workforce planning tool. There are only two types of decision makers present, the Employee and the HRManager. The HRManager represents the interest of its organization and the employee represents a real life employee. These two decision makers have their own individual in the tool. The employee has one type of behavior defined, unmanaged attrition.
Unmanaged attrition is the decision of an employee to leave the organization. The employee makes this decision each month; executing this behavior at the right time is important.

The behavioral structure of the HR manager is more complex. The HR manager represents all the decisions an organization as a whole can make regarding workforce planning. This means that this individual in the tool can be several individuals in a real organization. For convenience this behavior has been grouped into one individual.

The HR manager has five different types of behavior defined. Not every type of behavior is executed each month. Table 3 sums up all the HRManagers behavior and when this behavior should be executed.

**TABLE 5 HRMANAGER BEHAVIOR AND TIMING OF THE BEHAVIOR**

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Execute in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managed Attrition</td>
<td>Each month</td>
</tr>
<tr>
<td>Assign Bandings</td>
<td>Determine eligible: January</td>
</tr>
<tr>
<td></td>
<td>Assign Banding: May</td>
</tr>
<tr>
<td>Promotion</td>
<td>September and in some cases March and September</td>
</tr>
<tr>
<td>Transfer</td>
<td>Each month</td>
</tr>
<tr>
<td>Hiring</td>
<td>Each Month</td>
</tr>
</tbody>
</table>

The time at which this behavior is executed is in line with Accenture’s HR business process in real life.

5.3.2 **THE TOOL’S STRUCTURE**

Because not every part of the logic is executed each month, it is vital for the model to keep track of what the current month is; enabling a decision about what logic shall be executed. To make sure the right logic is executed the tool makes use of the DSOL DEVS library. The option of message passing has been chosen as an appropriate way to activate components. The order in which components execute their logic is important,
because for instance you do not want to promote someone who will be fired the same month. This is very unlikely to happen in a real life situation and should be avoided in the tool. By making use of the DSOL DEVS library the order of execution can be precisely controlled. Component B will only start executing its logic if it gets a message from component A that it is allowed to.

5-4 STRUCTURAL DIAGRAM OF THE WORKFORCE PLANNING TOOL’S SIMULATION MODEL

Figure 5-4 shows the tool structure and the message paths between the different parts of the tool. Each arrow is a message line from one part of the tool to another part. There are in total 3 ways messages can be passed through the tool. What way a message will take depends on the month the message is passed in.

The tool has the option to run without transfer. If transfer is turned off all the messages sent to transfer will instead be sent to hiring.

All different parts have different phases they go through before all their logic is executed. All the parts are idle for one month. Each month the calendar will send out a message that will activate the rest of the tool. Picture 5-5 shows a state diagram of the calendar.
5-5 THE CALENDAR

As can be seen in figure 5-6, the managed attrition receives the message the calendar has sent through the HRManager’s port. After receiving the message it goes from its idle state to its determine state. When the leaving employees have been selected their departure is scheduled. Once the scheduling is done the managed attrition sends out a message it is ready and it will notify the employees their attrition is scheduled. Other state machine diagrams that are used for the workforce planning tool used can be found in appendix B.

5-6 THE MANAGED ATTRITION
5.3.3 A Flow Based Representation of the Individual’s Behavior in their Respective States

The model has an extra level of complexity. The logic presented in the previous parts of section 5.3 focuses on what logic should be executed and when should this be done. This section focuses on the logic itself and describes the steps that should be undertaken to execute a specific task. A flow approach has been chosen to represent these business processes because this technique can accurately present in what order all the steps in the business logic are executed.

When the model enters a state a set of steps need to be executed to simulate the appropriate behavior of the active individual in the model. The UML technique activity diagram (Fowler and Scott, 2000) has been used to make a specification of the appropriate steps. This technique has been chosen because it accurately resembles the tasks of real individuals in the organization.

5.7 Attrition Logic

Picture 5-7 shows the attrition logic. The figure shows one general process at the top and three sub processes beneath that. What sub process will be executed depends on the type of attrition selected by the user.
Mal and band will use attrition on everyone above a certain months at level. The amount of months at level depends on banding and level. The higher level and banding the more time it takes before employees are asked to leave.

Surplus will remove every employee that is above the desired pyramid. Lowest bandings go first. The desired pyramid is the target amount of employees per level, set by the organization.

Percentage will calculate attrition on a percentage of the current workforce. This rate is set by the user.

5-8 HIRING LOGIC

Figure 5-8 shows the hiring logic. Like attrition it is divided into a general process at the top and two sub processes. A distinction between gap and percentage type hiring is made.

Gap type hires new employees based on the difference between the current pyramid and the desired pyramid. It is unlikely an organization is always able to hire anything they want so the gap type hiring is capped by a maximum amount of hires per month. This maximum has to be set by the user. It should represent a realistic maximum. This maximum depends on the trends within the job market so it is not possible to make this maximum a hard coded setting.

Percentage type hires employees based on a hiring rate as a percentage of the current workforce.
5-9 PROMOTION LOGIC

Figure 5-9 shows the specification of the promotion logic. Promotion logic also has its general process specified at the top, and two sub processes specified beneath that.

Gap type promotes based on the difference between the desired and actual pyramid on the level that the tool is promoting to.

Percentage type promotes a percentage of the level the tool is promoting from.
5.10 TRANSFER LOGIC

Figure 5-10 shows the transfer logic. This figure is different from the other Activity diagrams, in a sense that it does not show a general process and sub process. The transfer process is executed on a requesting HRManager and a HRManager receiving and evaluating the request.

If the requesting HRManager determines he has a shortage of employees on a specific level, he makes a request to all other HRManagers. When they receive such a request they will evaluate if they have a surplus of employees on that level. If so they will send a list of employees that could be transferred. The requesting HRManager receives the list and makes a selection of the employees he wants to have.

5.4 THE DSOL SIMULATION SUITE

The DSOL simulation suite is a java based library designed as a toolbox for creating simulation tools (Jacobs, 2005). The DSOL simulation suite was used for this project because of several reasons:

The DSOL simulation suite has a General Public License. This means that no royalties have to be paid to any third organization. This is a big advantage because such specialized software is usually very expensive.

Because DSOL is based on java and is developed in an object oriented programming environment, it is a very flexible simulation suite. DSOL’s flexibility is often only bound by the programmer’s creativity and skill with Java.

The new version of DSOL contains a library that supports building a simulation model with the DEVS approach. Having a library that gives a specification of how: atomic
models, coupled models, ports and connections should be implemented provides a platform for a consistent modeling approach and in the end will save a lot of time.

Java is a widely used language. Because of this, there is a lot of support for interaction with other software. For this project an Access database was used as a means to store the tools configuration. Excel was used as output interface. Java has excellent support for interoperability with Excel and Access. For interoperability with Access Java uses a JDBC-ODBC bridge (Sun_Microsystems, 1996-1999) and for Excel it uses apache POI (Oliver et al., 2009).

The most prominent disadvantage of the DSOL simulation suite is the steep learning curve for new users. Using DSOL requires java programming knowledge and some specific knowledge about the library itself. For an experienced Java programmer learning DSOL is not hard, for newcomers to Java, it may prove more difficult.

5.4.1 DEVS APPLIED

The function of this paragraph is to show how the DEVS concept was interpreted by the developers and implemented into the JAVA code of the workforce planning tool. The paragraph does not show all the code of the tool just some interesting extractions from the coupled model HRManager and the atomic model managed attrition.

The HRManager shows how an ‘inputport’ and an ‘inputport coupling’ of a coupled model are implemented. The managed attrition shows how all the parts of a DEVS model, introduced in section 5.3.1, are implemented.

**HRManager:**

Set of components: Managed Attrition, Assign Bandings, Promotion, Transfer and Hiring.

The HRManager has no output ports specified but it does have an input port:

```java
public InputPort<Message> startPort = new InputPort<Message>(this);
```

Its input port is coupled with the input port of the unmanaged attrition atomic model. It will pass any message sent to the HRManager on to the managed attrition model.

```java
this.addExternalInputCoupling(startPort, managedAttrition.startPort);
```

**Managed Attrition:**

There is an input port for receiving messages and a port to activate the testing mode of managed attrition.

```java
X: /** The test port. */
```
There are three states. The idle state is the waiting state. In the decide phase the employees that will need to leave will be picked. In the schedule phase the employees that have been picked will be scheduled to leave.

S: /** The IDLE phase */
private Phase IDLE = new Phase("Wait until one month has passed");
/** The DECIDE phase */
private Phase DECIDE = new Phase("Pick the people that will be leaving");
/** The SCHEDULE phase */
private Phase SCHEDULE = new Phase("Schedule when people are leaving");

The output port sends a message when Managed attrition is done executing its activities.

Y: /** The ready port. */
public OutputPort<Message> signalReadyPort = new OutputPort<Message>(this);

When the managed attrition is in the decide phase the internal transition moves it to the schedule state otherwise to the idle state.

δ<sub>int</sub>: protected void deltaInternal()
{
    if (phase == DECIDE)
    {
        phase = SCHEDULE;
    } else
    {
        phase = IDLE;
    }
}

When a message is received the decide phase will be activated. This counts for both testing and normal mode.

δ<sub>ext</sub>: protected void deltaExternal(final double elapsedtime, final Object value)
{
    Message signal = (Message) value;
    if (signal.getTheMessage().equals("Start") && phase == IDLE)
    {
        phase = DECIDE;
    } else if (signal.getTheMessage().equals("Unmanaged Attrition Done") && phase == IDLE)
When in the decide state the code for picking employees is executed for each level of employees and each workforce. After this statistics are updated. When the state is schedule the picked employees will be scheduled to leave.

\[
\lambda:\ \text{protected void lambda()}
\]

\[
\begin{array}{l}
\text{if (phase == IDLE)}
\{
\}
\text{else if (phase == DECIDE)}
\{
\text{this.attrition = manager.resolveManagedAttrition();}
\text{SortedMap<Integer, Vector<Employee>> pyramid = this.manager.getWorkforce().getPyramid();}
\text{for (Integer level : pyramid.keySet())}
\{
\text{int amountAttrition = 0;}
\text{for (Employee employee : attrition)}
\{
\text{if (employee.getLevel() == level)}
\{
\text{amountAttrition++;}
\}
\}
\text{this.managedMap.put(level, amountAttrition);}
\}
\text{this.updateAttritionPersistents();}
\}\
\text{else if (phase == SCHEDULE)}
\{
\text{manager.scheduleAttrition(this.attrition);}
\text{signalReadyPort.send(new Message(GlobalTimeControl.getCurrentMonthName().toString(), this));}
\}
\end{array}
\]

Time control is done outside by the calendar. Each month the managed attrition receives a calendar. The schedule and decide states will be resolved instantly.

\[
\text{TA: protected double timeAdvance()}
\]

\[
\begin{array}{l}
\text{if (phase == DECIDE)}
\end{array}
\]
{ 
    return 0;
} else if (phase == SCHEDULE)
{
    return 0;
} else
{
    return Double.POSITIVE_INFINITY;
}
}
5.5 **THE DATABASE**

The database has been designed with the help of an Entity Relationship Diagram (ERD) and as much in line with Normal form rules (Kent, 1982) as is feasible.

5.5.1 **THE DATA TOOL**

The complexity of the data tool for the Access database lies with tying together workforces, what hierarchical levels they have and consequently what policy set corresponds with this. A policy set consists of all the parameters needed to configure a policy. A policy is an aggregate term for all the instruments an organization has to influence its workforce. An exception to this rule is the unmanaged attrition rate which is an instrument of the employees. In the current data tool a policy set is linked to a specific level in a workforce. It is argued that it is no use to reuse these parameters for other workforces and levels because each has its own unique setup. A data tool set up in a way that it would promote reuse would in fact promote improper configuration of the tool. It is so unlikely that a specific level in workforce A requires the exact same set of parameters as in workforce B that this option has not been developed. During the design of the database an entity relationship diagram was used to help create a good structure for the database. The Entity relationship diagram can be seen in figure 5-11.
5.5.2 DATABASE NORMALIZATION
Performance issues when reading from the database are virtually nonexistent so optimizing response time is not necessary. Considering this the database tool used is in fourth normal form (Kent, 1982). The fifth normal form was inconvenient for this kind of application since it required splitting up many of the tables into smaller tables. The database is read from java and each table needs its own piece of code for its information to be retrieved from the database into java. Splitting the tables into smaller tables to reach fifth normal form would considerably complicate the coding on the java part of the tool.
5.6 **THE WORKFORCE PLANNING GUI**

![Scenario Table](image)

**5-12 THE SCENARIO TABLE FROM THE ACCESS DATABASE**

Filling a database table (Figure 5-12) might be trivial for people accustomed to databases but for someone lacking proper knowledge problems might occur. The Scenario_ID is the primary key for this table. This means that no double entries may be used in this field. When doing this Access will give a proper error message so filling this out will not pose too much problems. The values of the workforce set variable however, are read from another table. When another workforce set should be added, it will have to be done in the workforce set table. This will cause confusion with people who have no experience with designing databases.

To increase user friendliness of the workforce planning tool a GUI (graphical user interface) has been. Figure 5-13 shows the alternative way to pick scenarios. Creating new scenarios can be done at the press of button intuitively named “create scenario”. Figure C-0-1 in the appendix C shows the screen that will emerge after pressing this button. Figure C-0-2 to figure C-0-6 show the other screens that are part of this interface.
5-13 MANAGE THE SCENARIOS

The GUI will make the tool is better presentable as well. People prefer to see some familiarly looking windows style screens, opposed to a multitude of tables that they have to navigate themselves in order to put in the right settings.

It is still possible to configure the tool with direct input into the database, if the user manages to put in all the setting in the right format. This option might be convenient if the need arises to merge the two databases. In this case copy pasting tables would be an option.
5.7 Workforce Planning Business Process

The case study revealed that in the current situation Accenture uses a lot of ad-hoc decision making. Even though designing business processes was not mandated for this project, the complete absence of a business process required a small amount of process design to be done.

Using the tool means a more formalized process is in order. Figure 5-13 shows the process that is designed for this tool.

To satisfy the optimization requirement a search mode is needed. With this mode a range of parameters can be entered into the tool. The tool will search over these ranges and will identify a set of good solutions. This mode will support identifying what a good solution is. The search tool can be used by filling out one or more of the ranges in the GUI. This option screen is shown in figure C-0-6. When the learning mode is desired filling out only the run length will suffice.

In order to satisfy the insight requirements a learning mode is needed. This mode gives a detailed insight in all the events taking place in the tool. This mode will support answering the question why something a good or bad solution is.
5.8 TESTING MODE

In order to support ongoing testing of the tool, a testing mode has been developed. This testing mode supports module testing (Balci, 1998). In this mode it is possible to run only parts of the simulation tool so its behavior can be evaluated without interfering interactions with other parts of the tool logic. Figure 5-15 shows the testing mode’s interface, which contains a simple drop down menu used to select the part that should be tested.

5-15 THE TESTMODE
6 VALIDATION, VERIFICATION AND TESTING OF THE WORKFORCE PLANNING TOOL

For this research the design science method as described by Hevner (Hevner et al., 2004) has been used. This method uses a linear design process. Improvements are made with an iterative process. This has some repercussions for validation, verification and testing for the workforce planning tool. These activities have not been put into a separate design stage but rather they are executed during development of the tool.

6.1 FACE VALIDATION AND VERIFICATION

According to Balci face validation can be described as: “The project team members, potential users of the tool, people knowledgeable about the system under study, based on their estimates and intuition, subjectively compare tool and system behaviors under identical input conditions and judge whether the tool and its results are reasonable. (p356) ”(Balci, 1998)

The face validation of the workforce planning tool has been done in two steps. The first step was a module test in which the testing mode was used extensively. The second step was a face validation of the whole tool.

As an example of how the first step was done we will test the managed attrition. In figure 6-1 the input parameters of one of many tests can be seen, figure 6-2 shows the output corresponding with the input of 6-1.

<table>
<thead>
<tr>
<th>Policy_Set_ID</th>
<th>Unmanaged Attrition Rate</th>
<th>Managed Attrition rate</th>
<th>Attrition type</th>
<th>Attrition delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCIM Analyst</td>
<td>15.0%</td>
<td>44.0%</td>
<td>Percentage</td>
<td>1</td>
</tr>
<tr>
<td>MCIM Consultant</td>
<td>17.3%</td>
<td>2.3%</td>
<td>Percentage</td>
<td>2</td>
</tr>
<tr>
<td>MCIM Manager</td>
<td>16.7%</td>
<td>3.9%</td>
<td>Percentage</td>
<td>3</td>
</tr>
<tr>
<td>MCIM Senior Executive</td>
<td>2.5%</td>
<td>1.5%</td>
<td>Percentage</td>
<td>5</td>
</tr>
<tr>
<td>MCIM Senior Manager</td>
<td>10.0%</td>
<td>4.5%</td>
<td>Percentage</td>
<td>4</td>
</tr>
</tbody>
</table>

6-1 ATTRITION TESTING DATABASE SETTINGS
6-2 ATTRITION TESTING GRAPHS

As seen in the graphs the number of analysts plummets a lot faster than that of the other levels that only marginally decrease. This is attributed to the much higher percentage of attrition analysts have in this test. Further is seen that even though the decline is slow in most levels it is a decline only which does make sense since only managed attrition is active in this example.

The second step of the face validation is a lot less conclusive than the first step. The input data somewhat reflects the real parameters used by the HR department within Accenture, but is for all intents and purposes mock up data. Because of the many complex interactions between the modules it is hard to correlate the tools behavior to its input. The test is still valuable however. It shows that the tools general behavior makes sense.

6-3 HIRING, PROMOTION AND THE CURRENT PYRAMID

For instance promotion is only done once a year. In the promotion graph(figure 6-3) there are big shifts at this time of year. Consequently in the current pyramid graph (Employees per level) at exactly the same time the same big shifts occur.
6.2 INTERFACE ANALYSIS

According to Balci Interface Analysis can be described as: “The interface analysis category consists of several techniques that are especially useful for verification and validation of interactive and distributed simulations. (p360)” (Balci, 1998). In this case interface validation has been used to check the interface between the simulation part of the workforce planning tool and the database part. It is important to check if the tool gets all the correct input parameters from the database.

For this purpose, logger software has been developed. These loggers write the simulation tools settings to a text file. If the parameters in the text file have the same value as in the database, the simulation tool reads the data correctly. Figure 6-4 schematically depicts this process.
6-5 PARAMETER TESTING

In total three loggers have been made. One logger is made to check the policy parameters, one is made to check the demand and supply pool and the last is made to check the employees who are read from the database to initialize the workforces. Appendix E holds an example output of each type of logger.

6.3 EXPERT VALIDATION

Experts in the field of HR Management have contributed to the tool by validating the tool logic. During the development of the tool several meetings were held where the outcomes of the tool were discussed together with the logic that created the output. The meeting reports of these meetings are in Appendix F. With the help of these experts a lot of realistic processes have been put into the tool. Note that not every remark in these reports has made it into the tool, especially the remarks from the September meeting. Developing insights determined some remarks were no longer valid or needed to be adapted.

An important part of the expert validation has been the checking of all the assumptions that are used in the tool. For instance, sometimes the input data available to the tool is not complete. When appropriate banding information is lacking the banding of that person is defaulted to three. While this is by no means an ideal solution it has been agreed by the developers and the experts that this is the best solution available. It is at least better than deleting the employee from the records because in the end for the tool banding information is less important than actual numbers of employees. A list of the assumptions is in appendix F.
6.4 **HISTORICAL DATA VALIDATION**

Historical data can be used to determine if the simulation tool behaves as the system does (Sargent, 2008). The workforce planning tool was created to give insights in the future developments of Accenture’s workforce. It is argued that if it can recreate past developments of the workforce the tool will be able to give valuable insights into future developments.

In these tests actual data from Accenture was fed into the tool. The tool was then configured so that it matched all the parameters that were used in the actual business setting in November 2008. A screenshot of the workforce was loaded into the workforce planning tool so that the tool had the same workforce pyramid as was present in the organization in November 2008. The results of the run were compared with the data about Accenture exactly one year later in November 2009.

![Graph showing the workforce in November 2008](image)

### 6.1 THE WORKFORCE IN NOVEMBER 2008

Figure 6-1 shows the starting point of the simulation. For this test the whole consulting workforce was used. This workforce is a large part of the total amount of personnel within Accenture. The year 2008 was part of the economic recession that also impacted Accenture. As a consequence of the economic recession Accenture’s workforce in November 2009 shrank compared to the workforce in 2008. Since the workforce planning tool has the recession parameters as input it should also show a shrinking workforce.
6-2 ATTRITION AND EMPLOYEES PER LEVEL

Figure 6-2 shows the attrition, both managed, unmanaged and total attrition. It also shows the number of employees per level. When comparing the attrition with the hiring, it is clear that the hiring is much lower than the attrition, something conform to a shrinking scenario. The employee per level graph clearly shows this shrinking scenario. Something that stands out is that hiring among analysts is least affected by the economic recession. This is most likely due to Accenture’s strive to reach a pyramid shaped organization so consultant hiring was slowed, analyst hiring was also slowed but not by the same amount.

6-3 HIRING
Figure 6-4 shows the promotions done by the workforce planning tool. This promotion moment is the promotion round of September 2009. It may seem odd that number 11 is associated with September. This is caused by the fact that the simulation is started in November 2008 and this date is at 0 in the graph.

Another important note that has to be made is that during initial runs the amount of promoted from the analyst level to consultant level was too low. After lowering the eligibility for promotion form 24 months to 12 month it showed the data shown in figure 6-4. It is hard to say at this point if this anomaly is caused by errors in the model or if there is a lenient interpretation of the 24 months eligibility boundary within the business. Some further evaluation with the business is needed to find an answer to this problem.
Figure 6-6 shows the set of most important input parameters for the model. For this validation the percentage option in the attrition hiring and Promotion policy was chosen. The percentage option is most suited for gaining insight into the behavior of a workforce given those specific parameters.

Figure 6-7 shows the final results of the validation run. When comparing the historical value to the left to the simulated value to the right it is clear that the differences between the simulated and historical data are not very big. None of the differences is larger than 5% of the historical value.

The weakness of this test lies in the fact that it only represents a single run. Unfortunately there was no additional data available for other tests. From the results of this test it is possible to conclude that for November 2008 till November 2009 the workforce planning tool provides a reliable result. Although this result speaks for the reliability of the workforce planning tool it does not bear enough weight to conclude that the workforce planning tool provides reliable results in general.

### 6.5 REQUIREMENTS EVALUATION

In section 4.5 several high level requirements have been set for this project. These requirements have been addressed throughout the thesis. This section will provide a summary of how these requirements have been met.

1. The tool needs an aesthetically pleasing interface
What is aesthetic is in the eye of the beholder to some extend. In this case Accenture is that beholder. Accenture has a distinct house-style developed by experts in that field. The graphical user interface has drawn inspiration from the style guidelines used by Accenture to format their presentations and tools. The result of this can be seen in paragraph 5.6 and Appendix C.

2. The tool’s output should be in Excel

This requirement has been met. The tool writes raw data into Excel. Each experiment has to be individually loaded into the dashboard to turn the raw data into usable graphs.

3. The output of the tool should be clear and easily comparable between runs

This requirement has been partially met. All the experiments produce the same graphs in that sense they are easily comparable. But like stated at the previous requirement each experiment has to be individually loaded into excel thus the dashboard is capable of handling one experiment at a time. So when comparing between experiments it is needed to store the graphs by hand. There is an opportunity here to improve comparability between runs.

4. Setting up the model should not take longer than a few minutes

To achieve reliable result for a simulation run sufficient input data is required. It is not always possible to reduce the setup time to just a few minutes because some of the required data is quite extensive. This requirement has only been partially met. As explained in section 5.5 the workforce planning tool makes use of a database to store its input parameters. When the parameters of the workforces that the user is interested in are already in the database it is possible to set up an experiment in a few minutes. When they are not put in yet setting up an experiment will take a bit longer.

5. It should be obvious to a user the tool is a simulation and not a spreadsheet model

This requirement is met by showing several graphs and a workforce demographic pyramid during runtime. The tool’s user can see how the workforce develops during simulation time. The dynamics are what set simulation apart from any spreadsheet model.

6. The tool should support analyzing the impact of a predefined set of policy options

This requirement corresponds with the basic functionality of the workforce planning tool. The tool allows its users to redefine several policy option for each level within each workforce that the user might be interested in Appendix C figure 2 shows a screenshot of this functionality in the graphical user interface.

7. The tool needs a convenient way to explore multiple policy options
This requirement is met with the options present in the run setup panel as can be seen in the Appendix C figure 6. The functionality shown here allows the users to search over a range of policy options circumventing the need to restart the tool several times with different parameters.

8. **The tool should be able to simulate all Accenture’s workforces**

Besides meeting this requirement the tool is also able to simulate any potential new workforces. Doing so will require some reconfiguration of the database, i.e. the new workforces will need to be added. All Accenture’s current workforces are already part of the database.

9. **The most up to date state of the workforce should be loaded from Access into the model**

For this purpose a special parsing functionality has been developed for the workforce planning tool. This parsing functionality is able to read a new dataset from an excel 2007 file. This file should have a few specific column headings. For convenience these headings correspond with the headings used in Accenture’s personnel database. An example of the Graphical user interface belonging to this functionality can be seen in Appendix C figure 3.
7 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The goal of Accenture was to develop a decision support tool for their workforce planning. In order to achieve this goal several questions had to be answered.

Sub question 1:
Why is workforce planning important to an organization?

Section 2 has shown that both internal and external factors influence workforce planning. Section 2.2 argues that the performance of an organization is influenced by the organizational demographic. In order to maximize the organization's performance a specific organizational profile is needed which is in turn influenced by the productivity of the organization. The internal and external dynamic make this optimization process very hard because these dynamics constantly change the best solution.

“Workforce planning is an integrated and forward looking process that is designed to predict (what, when, how much) will likely happen in talent management and then to provide action plans that will cause managers to act in the prescribed way. As a result of the planning process, managers will be able to avoid or mitigate people problems, take advantage of talent opportunities and to improve the “talent pipeline,” so that your organization will have the needed “people capabilities” required to meet your business goals and to build a competitive advantage over other firms.” (Sullivan, 2009) So in order to be able to effectively optimize the organization’s performance, workforce planning is needed to deal with the internal and external dynamics.

Sub question 2:
What technique is most fitting as a basis for a decision support suite for Accenture, aimed at supporting workforce planning?

Section 3 is dedicated to this question. Several criteria that are prescribed by the problem and organization’s criteria are given. The best technique is chosen based on how well it is able to fit these criteria.

According to the analysis in section 3 the technique best suited for making a decision support system for Accenture’s workforce planning is the discrete event technique. It sets itself apart from the differential equation technique because it is possible to create a model with this technique that communicates at the same level (individual employees) as the organization. It is possible to use individual employees as atomic units within a Differential equation model but it is very hard to track their individual characteristics. These characteristics are important for many business processes for example promotions.
The two other techniques that were scrutinized had difficulties meeting the criteria that the input data put upon them thus they have been discarded.

Sub question 3:
How can the adoption of the tool into the organizational processes be improved?

A decision support system is only successful when it is used by its intended users. For this to come about the tool needs to be tailored to its users needs. The users themselves will know best what they need.

For this project the end users of the tool have been involved in its design. They have given valuable input for understanding the business logic the tool is aimed at supporting but also by validating the tool’s output data.

For a precise specification of the tools usage a user manual has been developed. This manual helps the users understanding the tool and allowing them to use it without further instructions.

Main Question:
What should a decision support suite look like? Considering that it is aimed at gaining an understanding of how a workforce will develop, given the uncertainty regarding the availability of new personnel and the impact of policy decisions.

A workforce planning tool has been designed for Accenture Amsterdam. It helps gaining a deeper understanding by making the implications of policy decisions transparent. The tool itself does not provide any answers. It is in essence a tool and not a solution to a problem, its users should connect the dots regarding their problems and draw their own conclusions.

One of the drawbacks of creating a tool opposed to delivering a done solution is that it requires its users to know what they are doing. Just like not everyone who uses a hammer is able to build a house, not every user of the workforce planning tool will be able to make accurate prediction on the future workforce. The effect of this drawback has been mitigated by the manual and by several training sessions but it is still a very real danger.

The tool itself is the most complete answer to the main question of this thesis. Within the tool all the results of the analyses and all the design choices come back to for a finished product together.
7.2 DISCUSSION OF THE DESIGN SCIENCE METHOD AND PROJECT DEVELOPMENT

The design science method is an ill structured method of developing software. No fixed phases you go through, always the possibility to get back on previous work done. This means that advancing insights gained during the project are easily incorporated. The method is therefore suited for an ill structured problem. It does provide several design guidelines. The project will be evaluated according these guidelines.

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guideline 1: Design as an Artifact</td>
<td>The artifact designed is one of the most important deliverables of this project. A decision support suite which is able to capture the behavior of a workforce within different situations and with different policies has been developed.</td>
</tr>
<tr>
<td>Guideline 2: Problem Relevance</td>
<td>Chapter 2 discusses workforce planning and its relevance to an organization.</td>
</tr>
<tr>
<td>Guideline 3: Design Evaluation</td>
<td>Evaluating a design is hard. It is possible to check for logical outcomes but in the end it is impossible to give a guarantee the tool will work every time within any context. Instead you will have to aim for acceptable results within its context.</td>
</tr>
<tr>
<td>Guideline 4: Research Contributions</td>
<td>This project will feature a workforce planning decision support suite that enables Accenture to make better informed and faster decisions about their workforce planning. The most striking example possible to give is that Accenture seems very keen to get to work with the workforce planning tool. They think they can gain a great benefit from implementing the tool into the organization. This eagerness to implement is the strongest indication possible of the tool’s success.</td>
</tr>
<tr>
<td>Guideline 5: Research Rigor</td>
<td>A lot of formal design methods and diagrams have been used. All of these methods provide the project with research rigor. Designing software is sometimes more an art than an exact science. Putting the outcomes of all the used methods together creating one artifact that actually does what is designed for, requires you to take of your analyst hat and put on your engineering hat otherwise it is impossible to create a working artifact.</td>
</tr>
<tr>
<td>Guideline 6: Design as a Search Process</td>
<td>The search process is visualized in figure 7-1. Phase one shows how the project was envisioned at the start of the project. The input and output interface in Excel. The model is the only application. During the case study of Accenture a need for optimization arose along with a need to include transfers in the model. In phase 2 an application responsible for setting up an experimental frame was added to the tool. During the</td>
</tr>
</tbody>
</table>
second midterm meeting with the committee the idea of using an Access database as input interface was formed. This allowed for spanning multiple workforces into the workforce planning tool. As a result phase 3 could now be implemented. A team of Accenture employees in India have developed a workforce planning model that uses a sophisticated method to calculate supply and demand. Adding this functionality to the workforce planning tool would provide the simulation with more reliable input. In the end the project did not go further than phase 3.

Guideline 7: Communication of Research

Communication has been a very important aspect of this project. Both for gathering important data required for building a valid simulation model as well as for improving adoption of the tool. These things went hand in hand by letting Accenture’s employees contribute to the design a sense of ownership was created that improved adoption as well as provided valuable information for the mode,
7.1 PROJECT PHASES

The drawback of the method is that it offers little support. It is very easy to get lost in a complicated subject. The reason why design science method was a suitable method for this project is, because of the environment in which this project took place was suitable for it. In my opinion, if you want to be able to successfully design with the design science method a lot of feedback is required. You will need to be able to have a knowledgeable
discussion on the design. The value of discussion was recognized as early as the beginning times of western science. According to Socrates life was not even worth living without it (Ron, 1995). Yet again discussion has proven its worth in this project.

7.3 RECOMMENDATIONS

When this project is over, not all possibilities for the workforce planning tool have been exhausted. This paragraph contains several recommendations for further research and possible expansions of the workforce planning tool.

Recommendation: Do some research on how the employee demand is calculated.

During this project the need to determine the demand of employees arose because this information is used as input into the workforce planning tool. Currently determining the demand of workers within Accenture involves an educated guess by Accenture’s HR experts. This information is actually very important for Accenture’s workforce planning policy since it is used to establish recruiting targets. It is possible to add a level of professionalization with establishing this demand. It would be advisable to do some research on what the best method for establishing this demand is.

Recommendation: Include skills of employees in the tool.

Knowing how your workforce will develop in terms of amounts of people per level is already a great asset. The tool could even be made more useful if the skill of employees were added to it. This is an extra level of intensification that can be added to the tool. It will allow the tool to support competency management. This will bring a whole new dimension to getting the right people on the right time in the right place.

Recommendation: Structure knowledge resources. What skills are present in the current day organization?

Adding skills of employees to the workforce planning tool is no trivial matter however. When a serious attempt is made at this the first step will be making an inventory of the organizations knowledge resources. Only when a clear set of skills has been operationalized can the skills of employees be added to the workforce planning tool. Executing this research will be hard because of privacy and confidentiality issues.

Recommendation: improve portability of the workforce planning tool.

In its current state the workforce planning is only directly usable by Accenture. The biggest barrier that prevents use in other organization is that the workforce planning tool is heavily intertwined with the banding system as used by Accenture. A lot of Accenture’s business logic is dependent on the banding of an employee. When the
workforce planning tool is to be implemented in organizations other than Accenture either a more general approach to the policies and banding system has to be developed, or the tool has to be adapted to the specific organization it should be used in.
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<td>The run setup</td>
<td>109</td>
</tr>
<tr>
<td>E-0-1</td>
<td>the hiring and the demand pool</td>
<td>110</td>
</tr>
</tbody>
</table>
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**APPENDIX A: FUNCTIONAL REQUIREMENTS WORKFORCE PLANNING TOOL**

<table>
<thead>
<tr>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each workforce should have another set of assumptions: (for instance the ATS workforce promotion eligibility depends on banding and MAL and for consultancy only on MAL)</td>
</tr>
<tr>
<td>The excel input contains a choice for workforce which the tool should run (this can be a service line or csg, but also a combination, for instance MCIM or the Netherlands)</td>
</tr>
<tr>
<td>Contains a choice for growth strategy (revenue or headcount based)</td>
</tr>
<tr>
<td>Contains a choice for start date</td>
</tr>
<tr>
<td>Contains a choice for run length</td>
</tr>
<tr>
<td>It should be possible to centrally set policies regarding hiring promotion and attrition per level.</td>
</tr>
<tr>
<td>Promotion policy setting should contain: promotion type (gap/percentage), allowed, promotion interval (march &amp; September /September)</td>
</tr>
<tr>
<td>Hiring policy settings should contain: Policy type (gap/percentage) allowed</td>
</tr>
<tr>
<td>Attrition policy settings should contain: policy type (age and band limit / surplus relative to target/percentage)</td>
</tr>
<tr>
<td>There are input sheets available for every workforce.</td>
</tr>
<tr>
<td>The workforce input sheet should contain the revenue for the starting year per type of work (consulting/technology/outsourcing)</td>
</tr>
<tr>
<td>The workforce input sheet should contain the division of revenue per type of work</td>
</tr>
<tr>
<td>The workforce input sheet should contain the growth of revenue per year per type of work</td>
</tr>
<tr>
<td>The workforce input sheet should contain the division of types of work per year</td>
</tr>
<tr>
<td>The workforce input sheet should contain the current headcount per level per month at level</td>
</tr>
<tr>
<td>The workforce input sheet should contain the current headcount per month at level</td>
</tr>
<tr>
<td>The workforce input sheet should contain the current headcount per gender</td>
</tr>
<tr>
<td>The workforce input sheet should contain the target headcount</td>
</tr>
<tr>
<td>The workforce input sheet should contain the productivity per level</td>
</tr>
<tr>
<td>The workforce input sheet should contain the billing rate + growth per level</td>
</tr>
<tr>
<td>The workforce input sheet should contain the banding per level</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>The workforce input sheet should contain the promotion eligibility per level</td>
</tr>
<tr>
<td>The workforce input sheet should contain the hiring rate delay and limit per level</td>
</tr>
<tr>
<td>The workforce input sheet should contain the attrition rate (managed and unmanaged) and delay per level</td>
</tr>
<tr>
<td>The workforce input sheet should contain the attrition age limits per level</td>
</tr>
<tr>
<td>The workforce input sheet should contain the pyramid growth per level</td>
</tr>
<tr>
<td>The demand pyramid must have the option to be entered with filling out its absolute values</td>
</tr>
<tr>
<td>The demand pyramid must have the option to be entered with filling out its percentages.</td>
</tr>
<tr>
<td>Each workforce has its own promotion policy logic. This should be possible to set within the excel configuration file.</td>
</tr>
<tr>
<td>The input for the tool consists of 1 list of employees. (so only one workforce will be simulated at any time)</td>
</tr>
<tr>
<td>The user interface should be easily usable(only relevant parts need to be visible)</td>
</tr>
<tr>
<td>The user interface should be esthetically appealing</td>
</tr>
<tr>
<td>The user interface should have data input verification</td>
</tr>
<tr>
<td>The demand pyramid should be changeable per year</td>
</tr>
<tr>
<td>Either the input of all the variables should be defined per year/run (not only per run) or the tool should have a pause option at which the input can be changed.</td>
</tr>
<tr>
<td>Assumptions should be made visible.</td>
</tr>
<tr>
<td>Assumptions can be set in the excel configuration</td>
</tr>
<tr>
<td>The tool should provide useful results(effectiveness)</td>
</tr>
<tr>
<td>Special promotion cases should be possible e.g. promote a band 1 with 22 mal (not eligible) instead of a band 3 with 24 mal (eligible).</td>
</tr>
<tr>
<td>A minimum of 10 levels should be configurable in the tool;</td>
</tr>
<tr>
<td>No limit on available level within the tool</td>
</tr>
</tbody>
</table>
Employees can enter the tool at each level through hiring

Employees can make progression through the tool by promotion

Employees can enter the tool at each level through transfers

An employee can leave the tool at each level through managed attrition

An employee can leave the tool at each level through unmanaged attrition

An employee can leave the tool at each level through transfers

The tool is to calculate the costs of attrition/hiring

The tool is to calculate the costs of off shoring

The tool is to calculate the costs of transfer

The maximum run time is 5 year

Until further notice the promotion logic is based on a random draw (not banding dependent) after checking for eligibility

Unmanaged attrition should preferably be defined per level/banding/year and not only per level/year

Transfer policy should be implemented as a flux, in % / level

Bandings will be assigned randomly!

Enterprise is not bounded by march/September promotions this situation must be supported

The tool should be able to generate those results fast (efficiency)

The output of the tool should be esthetically pleasing and informative

The output should contain the headcount per level

The output should contain headcount per level per time

The output should contain the hiring per year per level

The output should contain the promotion per year per level
| The output should contain managed attrition per year |
| The output should contain unmanaged attrition per level per year |
| The output of the tools should be easy to compare; Either within 1 workbook or between different ones |
| This project is not intended to give advice on the most efficient business processes |
| The workforce planning suite should contain a process description for the usage of the workforce planning tool within an organization |
| The tool should be accompanied with a user manual. |
| The nature of the tool (it’s a simulation not an excel tool) should be clear to the user. |
| The added value of the simulation should be clear to the user |
APPENDIX B: STATE DIAGRAMS

Calendar

```
(t = 0 month)

Idle

Signal 1 month Passed

Send Message

(t = 0 month)

Done

Signal 1 Month Passed
```

B-0-1 CALENDAR

HR Manager: Managed Attrition

```
(t = 0 month)

Determine which people leave

(t = 0 month)

People Leaving

Schedule Leaves

(t = 0 month)

Signal ready

Signal employee Attrition Scheduled

Done
```

B-0-2 MANANGED ATTRITION
HR Manager: Promotion

B-0-3 PROMOTION

HR Manager: Transfer

B-0-4 TRANSFER
Employee:
Unmanaged Attrition

State

$\text{State } x$

$t = 0$

Time in the state

B-0-5 UNMANAGED ATTRITION
APPENDIX C: GRAPHICAL USER INTERFACE

C-0-1 CREATE A NEW SCENARIO
C-0-2 CREATE A NEW WORKFORCE SET
C-0-3 MANAGE THE POLICY SETS

C-0-4 PARSE A FILE
C-0-5 LOAD AN EXCEL WORKBOOK TO PARSE
C-0-6 THE RUN SETUP
APPENDIX D: THE DATABASE LOGS

Consulting

Demand Pool

Level: Analyst -- (1=99)
Level: Consultant -- (1=99)
Level: Manager -- (1=99)
Level: Senior Manager -- (1=99)
Level: Senior Executive -- (1=99)

Hiring Pool

Year: 1 -- (1=99, 2=99, 3=99, 4=99, 5=90)

E-0-1 THE HIRING AND THE DEMAND POOL

<table>
<thead>
<tr>
<th>Hiring</th>
<th>Level: Analyst</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attrition: Delay: 1</td>
<td>Managed rate: 7.8, Unmanaged rate: 9.4</td>
</tr>
<tr>
<td>Promotion: Policy type: PERCENTAGE</td>
<td>Promotion percentage: 20.0, Eligible NML: 24</td>
</tr>
<tr>
<td>March: false</td>
<td>Allowed: true</td>
</tr>
</tbody>
</table>

Consulting Level: Consultant

<table>
<thead>
<tr>
<th>Hiring</th>
<th>Level: Senior Executive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attrition: Delay: 2</td>
<td>Managed rate: 10.0, Unmanaged rate: 10.0</td>
</tr>
<tr>
<td>Promotion: Policy type: PERCENTAGE</td>
<td>Promotion percentage: 10.0, Eligible NML: 5</td>
</tr>
<tr>
<td>March: true</td>
<td>Allowed: true</td>
</tr>
</tbody>
</table>

E-0-2 THE POLICY PARAMETERS

Consulting

<table>
<thead>
<tr>
<th>ID</th>
<th>Workforce</th>
<th>Level: Senior Executive</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID: 10050683</td>
<td>workforce: Consulting</td>
<td>m1: 122, band: THREE</td>
</tr>
<tr>
<td>ID: 10039031</td>
<td>workforce: Consulting</td>
<td>m1: 110, band: THREE</td>
</tr>
<tr>
<td>ID: 10031466</td>
<td>workforce: Consulting</td>
<td>m1: 110, band: THREE</td>
</tr>
<tr>
<td>ID: 10057004</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 1004432</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 10035067</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 10020296</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 10022735</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 10001616</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 10069379</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 10050277</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 10091363</td>
<td>workforce: Consulting</td>
<td>m1: 98, band: THREE</td>
</tr>
<tr>
<td>ID: 10055969</td>
<td>workforce: Consulting</td>
<td>m1: 94, band: THREE</td>
</tr>
</tbody>
</table>

E-0-3 THE WORKFORCE
APPENDIX E ASSUMPTIONS AND MEETING REPORTS

Tool initialization:

1. Assumption: all employees with no banding specified enter as banding 3.

Hiring:

2. Assumption: 60% of all hired employees are males.
3. Assumption: a percentage of available people will be hired.
4. Assumption: all newly hired employees enter as banding 3.

Managed Attrition:

5. Assumption: number of employees removed as a percentage (policy) from the total number of employees.
6. Assumption always the lowest banding will be removed first.
7. Each month has 1/14 of the total yearly attrition October and April have 2/14

Promotion:

8. Assumption: Highest bandings are first promoted.
9. Assumption: It is percentage of eligible employees.

Unmanaged Attrition:

10. Assumption: randomly pick an employee for unmanaged attrition.
Supporting Strategic Workforce Planning

Aggregated Meeting report of meetings on 4-9-2009, 7-9-2009, 8-9-2009

Tool should have a running mode: Learning mode, Analysis mode.

The tool should be able to be run with a revenue target and a workforce target.

The maximum time span is 5 year.

It should be possible to run for only 1 year.

Main input: These should be implementable with both a percentage and a number.

- Wanted Division of people over the levels
- Attrition
- Requirement
- Transfer
- Promotion

A percentage is not always the right way to input this information especially with small numbers. E.g. 5% of 2 is nothing. Therefore for small numbers an alert should be present that numerical values should be used as input.

A policy change can be instantaneous.

Managed attrition consists of: not extending contracts, termination of permanent contracts and retirement. In the Accenture case retirement is not a commonly used option considering the age of the workforce.

The user interface should be clear.

To tool the (non) availability of new personnel a delay will be implemented. The delay has a minimum of 1 month (Hiring process takes that long.) And it should be able to be set in the interface.

Types of workforce: There is an overview in the excel document in the input folder made by casper.

Banding is the same cross workforce.
Input Interface: Example

<table>
<thead>
<tr>
<th></th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Growth</td>
<td>Growth</td>
<td>Growth</td>
</tr>
<tr>
<td>Consultant</td>
<td>Decline</td>
<td>Growth</td>
<td>Decline</td>
</tr>
<tr>
<td>Manager</td>
<td>Erratic</td>
<td>Growth</td>
<td>Stable</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

More examples in excel.

Promotion logic in enterprise is different. Explained in detail in the PowerPoint presentation Casper sent.

Eligibility can be tooled the precise promotion logic will be determined at a later date when there is more insight in what happens at Accenture but also on how does the tool react. **For now check for eligibility randomly pick.**

Enterprise is not bounded by March/September promotions.

Exceptional situation: ATS is part of SI&T but not of consulting while SI&T part is of consulting.

Question from HR Management: What is the goal/benefit of strategic workforce planning?
Meeting Report 6-Nov-09

Scope of the project:

Considering there is only 1 month left for this project, we agreed that we should be aiming for the architecture drawn up in phase 2. Phase 3 and 4 are definitely interesting but not feasible for this project.

---

**Demand input interface:**

Add a percentage based input possibility.

**Financial tool:**
For now Accenture is only interested in costs, revenue is out of scope. Costs that are in scope are: attrition costs, hiring costs and salary.

Average attrition costs per level:

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Consultant</th>
<th>Manager</th>
<th>S. Manager</th>
<th>S. Executive</th>
</tr>
</thead>
<tbody>
<tr>
<td>7000</td>
<td>16000</td>
<td>25000</td>
<td>30000</td>
<td>40000</td>
</tr>
</tbody>
</table>

**Historical data:**

There is some data available from 2006. From 2008 on there is full availability of historical data.

**Assumptions:**

HR manager:

- It should base its decisions not only on the current situation but also on expected shortages and surpluses.

Hiring:

- All employees enter as banding 3
- 40% of the new hires are female
- A percentage of the current headcount will be hired

Promotion:

- Mode 1: 80% Highest bandings are promoted first 20% randomly distributed among banding 3 and 3+
- Mode 2: 100% Highest banding goes first
- Mode 3: ATS special case

Managed Attrition:

- Number of employees removed is based on current headcount and the attrition percentage.
- The lowest bandings go first
- Each month has 1/14 of the total yearly attrition October and April have 2/14

Unmanaged Attrition:
• Attrition takes place whole year round with peaks (twice as much) in October and April.
• Each month has 1/14 of the total yearly attrition October and April have 2/14

Banding:

• Curb bandings randomness. Banding can change max 2 steps. So banding 3 can become anything. Banding 1 can become 1, 2 and 3.
APPENDIX F: OUTPUT DASHBOARD

F-0-1 THE EXCEL OUTPUT DASHBOARD