Employee turnover and absenteeism in a workforce as a factor of recruitment

Submitted in partial fulfilment of the requirements for
the degree of

BACHELORS OF INDUSTRIAL ENGINEERING
in the

FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

UNIVERSITY OF
PRETORIA

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10/11/2011

This Project's aim is to determine the value of a recruitment system with regards to absenteeism and employee turnover. The approach taken is to define the cost relations and implications of absenteeism and employee turnover and determine the expected impact that a product like Shadowmatch will have on these costs. The project delivers a process and models that can be used to determine the cost of absenteeism and employee turnover. The techniques applied in this project are Markov chains, data analysis, learning curve and resource planning.

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DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING

FRONT PAGE FOR FINAL PROJECT DOCUMENT (BPJ 421) - 2011

Information with regards to the mini-dissertation	
Title (e.g. A Contingency framework for the after-sales inventory at Nissans Part Distribution Centre)	Employee turnover and absenteeism in a workforce as a factor of recruitment
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Date (month/day/year e.g. 10/05/2010)	10/11/2011
Keywords (Provide keywords from your project (for searching purposes).	Absenteeism, Employee turnover, Human resource planning, Workforce optimization
Abstract (Provide an abstract of the mini-dissertation. An abstract is a short summary of the contents covered in the item.)	This Project's aim is to determine the value of a recruitment system with regards to absenteeism and employee turnover. The approach taken is to define the cost relations and implications of absenteeism and employee turnover and determine the expected impact that a product like Shadowmatch will have on these costs. The project delivers a process and models that can be used to determine the cost of absenteeism and employee turnover. The techniques applied in this project are Markov chains, data analysis, learning curve and resource planning.
Category (Enter the category in which the project was done. E.g. Operations Research, Simulation, Logistics…)	Operations research, Resource planning, data analysis

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I. Executive summary

The objective of this project is to determine the effect that recruitment has on absenteeism and employee turnover and to quantify that effect into a monetary value to indicate the importance and value of a good recruitment system. The approach taken to reach this objective is as follows:

1. Analyse data to indicate the correlation between recruitment and absenteeism and staff turnover
2. Model the system's reaction to the change in the recruitment strategy by using Markov chains
3. Calculate the different costs related to absenteeism and employee turnover
4. Deliver a planning model to maintain a lower level of absenteeism and turnover

The models developed in this project are intended for use on large departments with similar job descriptions. These models should be used as tools to optimise a department's workforce by indicating the cost incurred due to absenteeism and staff turnover and the cost that can be saved by implementing a good recruitment system. Knowing the losses due to absenteeism and staff turnover can also serve as a decision making tool to assist in making investment decisions. This project has revealed that making a small change can have a large influence on an organisation.

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II. List of abbreviations

List of Abbreviations		
number	**description**	**Symbol**
1	Annual employee turnover	TO
2	Absenteeism	AB
3	Employee replacement cycle time	CT
4	Training time	TT
5	Cost of employment	EC
6	Annual revenue of department	R
7	Cost of department	AV
8	Department size	D
9	Average salary in department	S
10	Average authorised leave	L
11	Annual work days	WD
12	Standard time	ST
13	Optimal work force	OW
14	Required work force	RWF
15	Production days lost due to learning curve	LC
16	Predicted turnover of Shadowmatch appointed staff	NT
17	Same period resignation	SPR

III. List of tables

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Chapter 1

1. Introduction

For the purpose of this report absenteeism is seen as, a position not being filled by a worker, this excludes leave. Absenteeism is caused by employee turnover and poor job satisfaction there are many reasons for this, such as management, work environment, work relate stress and factors dependent on the individual. Regardless of these factors there exist individuals that perform well under these circumstances. This is the ideology that Shadowmatch uses, to preferably find persons such as top performers instead of changing the entire system. No system is perfect, thus changing the system might have its advantages for some but still have its disadvantage for others. This project's aim is to determine the measurable effect that a recruitment system such as Shadowmatch will have on staff turnover and absenteeism, and develop a model that can be used to determine savings and steps that should be taken to achieve it.

1.1 Background

Shadowmatch is a system used in the placement of people, with the idea of benchmarking top performers and correlating the key attributes to those of the applicants considered for a position. This approach will lead to hiring a person that will perform on the same level as the top performers due to the compatibility that the applicant show with the job description and work environment, due to the correlation between the applicant and the benchmark defined by top performers. Shadowmatch is interested in the value of this process with regards to absenteeism which is a cost driver in every industry.

1.2 The problem

Absenteeism comprises different effects on a company's revenue and its performance. These affects include:

1. Over employment
2. Underutilisation of staff
3. Loss of productivity
4. Increased risk in terms of penalties, poor service and loss of customers

The problem that needs to be addressed is to calculate the actual effect of absenteeism on a company and to identify what percentage of absenteeism is related to the workers compatibility with his/her environment. Absenteeism can be a major problem for organizations. As pressures increase on the budgets and competitiveness of companies, more attention is being given to reduce workplace absenteeism and its cost (JOSIAS, 2005).

1.3 The approach

The approach that will be taken for the project can be broken down into 3 steps

1. Research: will include analysing data in order to find correlations between absenteeism and KPI's, also included in this step is to differentiate between common illness and work/ stress induces illnesses. The research will be conducted on a control population in the call centre environment which has a high employee turnover in order to illustrate an environment with a high level of absenteeism.
2. Modelling: will focus on the simulation of such a process and the calculations to determine the quantitative effects of absenteeism on a company. The second part of this step is to model the change in a company of which good recruitment equity will induce over a period of time.
3. Conclusion: the last step is to incorporate the above mentioned and finding the value of a recruitment system that increases job satisfaction without changing the environment.

Project Aim

The primary aim of this project is to determine the value that Shadowmatch can add to a company by reducing absenteeism caused by employee turnover and poor job satisfaction. This objective will be reached by developing a model that calculates this value as well as deliver a program that the company should follow in order to gain the value of such a recruitment system.

Project Scope

This project is not industry specific and is aimed at finding the general effect instead of reducing its applicability by focussing on a single industry and its unique factors. The value will thus be based on the main cost drives related to absenteeism, such as loss of productivity, cost of over employment and turnover costs. The techniques used to develop the process of calculating the cost will deliver the most accurate results when applied to departments larger than 30 employees with a similar job description.

Chapter 2

2. Literature review

The literature review will be done in segments with regard to the different aspect of the project. These segments will include; validating the effect of recruitment on employee turnover and absenteeism, identifying the cost implications of absenteeism, identifying the cost implications of employee turnover and identifying workforce models.

2.1 Validating the effect of recruitment on employee turnover and absenteeism

It is clear that the source through which an employee was recruited is strongly related to subsequent job performance, absenteeism and work attitudes (Breaugh, 1981). As Mercer (1988) states, the most direct, cost-effective way to reduce turnover is probably to use valid, reliable employee selection tests that pinpoint which applicants fit the model of long term, effective employee. This indicates that both absenteeism and employee turnover can be reduced by using an effective recruitment strategy, that ensures that the employee is compatible with the job he/she is placed in. According to Bonn (1992) companies should pay more attention to recruitment to acquire human resources that have a high probability of being and staying successful in an organisation. Any company that is experiencing a high degree of turnover is incurring unnecessary financial costs as well as decreases in service quality and the quality of work life (Hinkin, 2000). The research previously done on the correlation between absenteeism, employee turnover and recruitment methods as well as on the financial effects of these factors indicates that investment in recruitment is one of the most efficient ways to reduce the costs of absenteeism and turnover.

2.2 Cost Implications of Absenteeism and employee turnover

Events related to the worker that might affect productivity may be him/her quitting the job or him/her being absent from work. The costs (penalties) that are accrued when a worker leaves the job are the cost of training/retraining /hiring a worker to fill the position and the cost of production loss, if any. These same cost components may apply if the worker is absent (B.D. Steward, 1994). Employees in the United States took an average of 6.2 sick days per annum and an average of 7.8 days in the United Kingdom (Aamodt, 1996). It is estimated that about 4-5% of the South African workforce are absent on any given day, and in certain companies this figure is as high as 18%. This figure is a direct loss for a company and it's been revealed that South African companies are losing millions of Rands a year due to absenteeism (Josias, 2005). There are many costs related to absenteeism and employee turnover. These costs include:

- Loss of productivity
- Over employment costs
- Recruitment costs
- Training costs

These costs are interrelated; training has an impact on productivity due to the learning curve and is most commonly overcome by over employment. Over employment reduces individual productivity and asset utilisation. The method used for recruitment impacts productivity due to organisational aptitude. Due to the complex relationships of these cost drivers data will be used to indicate the affect that recruitment has on these cost drivers.

2.3 Available models, tools and techniques

To provide the right number of the right personnel at the right time at the minimum cost is the goal of any workforce planning system (Wang, 2005). According to research done by Wang for the Australian military to indicate systems that is available to optimise a workforce, four systems were mentioned and explained.Tthese systems are:

Markov Chains models

This system has its limitations because it is non-optimising. Markov chains do add value to future planning such as create policies and forecast workforce distribution. Markov chains can be used instead of simulation modelling in order to reach the same output. This is a more flexible method to use. Markov chains are also used to calculate the effect that change has on a system. A disadvantage is that research should be done to find the probabilities of events happening.

Simulations models

A simulation by nature is system specific and is used to study the behaviour of complex systems and the systems reaction to change. The drawback of using simulations for the purpose of this project is that it would be time consuming to design and analyse the output of the simulation if it would be used in different departments and sectors.

Optimisation models

Optimisation models are used to find the optimal workforce policies in hiring and redeployment at the lowest cost. Optimisation models also aid in decision making indicating the decision that should be made in order to reach the desired objective. The models are documented to be used in the industry:

- Linear programming
- Integer programming
- Goal programming
- Dynamic programming

System dynamics models

This is a process that considers personnel as the product in a workforce supply chain and applying techniques used for modelling and analysing supply-chain management. System dynamics is mainly for strategic analysis in the sense that is concerns itself with the overall behaviour of the system under the influence of policies rather than fine details. This model can be implemented after the correct causes of flow and decisions have been identified.

Stochastic Network Models

Lu and Radonvanovic (2006) developed a model based on stochastic loss networks to characterise the dynamics and uncertainty in general workforce. They formulated profit maximisation problems with serviceability constraints. This model combines a variety of mathematical models used in a process. The models used include differential equations, the Erlang formula, queuing theory, Markov chains and non-linear optimisation models. This model captures the basic dynamics of the workforce evolution and provides optimal decisions for cost minimisation while meeting service requirement (Y. Lu, 2006). This model delivers accurate results as well as decision indicators. The limitations of this model will be the research and analysing of any workforce before the model can be implemented. An extensive amount of data is required for this model including the probability distributions of all actions and events in a workforce system. To gather this data can be a time consuming process and not all organisations have the means to capture this form of data.

Flexibility models

In order to overcome absenteeism and employee turnover in a workforce Steward (1994) developed a model that maximises the flexibility of the workforce to ensure that an unfilled positions has the minimum effect on the productivity of a department. The objective of this research was to develop mathematical models which can be used to help manager to decide optimal tactical plans (B.D. Steward, 1994). This research uses linear programming to reach the objectives as well as a trade-off analysis due to the interrelated components.

2.4 Selection of appropriate methods tools and techniques

The methods and techniques selected for this project is a combination of some of the above mentioned available models and techniques. The models that will assist in reaching the deliverables of this project should be able to deliver an optimal policy for recruitment that can be compared to a company's current policy to indicate the improvement, savings and advantages of implementing these policies.

A system dynamics model approach will be used to view the recruitment process as a supply chain. This model was selected in order to define the process and create a holistic view of such a process. This approach will indicate the influences on a recruitment process and the

flow within such a process. The aim of using this approach is to enhance the understanding of a recruitment system in order to improve the modelling of such a system.

Markov chains will be used to find the changes in the system after the implementation of a recruitment system. The changes that are of value for this project are the mean first passage times and the steady state probabilities. When steady state probabilities have been found a work-force planning mode will be used to further analyse the effect that the recruitment system will have on the system. The outcome of these models will be used to calculate the savings made by reducing absenteeism and employee turnover and a human resource planning model will be developed to keep the system in a steady state.

2.5 Supplementary methods, tools and techniques

Techniques that will be used to assist the model with data analysis will be control charts. This will assist in gathering more credible data and eliminate special causes of variation. The data analysis stage will deliver the influence of a recruitment system on employee turnover and absenteeism. This output will be used as input data for the simulation model. The data analysis stage will also indicate the impact that absenteeism and employee turnover has on the KPI's of a department. This information will be used in the validation stage of the project. Techniques found in research done by Steward and related text books (Niebel's methods, standards, and design) will be used to calculate the cost incurred due to absenteeism and employee turnover. These results will be used in conjunction with the Markov chains output to calculate the value added by implementing a good recruitment system.

Chapter 3

3. Data

The data gathered for this project will be used to determine the following

1. The correlation between absenteeism and department output
2. The average employee turnover of employees appointed by Shadowmatch
3. The absenteeism of employees appointed by Shadowmatch

The following data has been collected for this

1. A four month comparison on a day to day base, comparing the service level of a call centre with the days' absenteeism
2. The termination control sheet of a company in the financial sector indicating key information such as time of employment and recruitment method used to appoint the personnel.
3. The employee registry of a company in the agriculture industry spanning back to 2007. This company started to use Shadowmatch as a recruitment tool in 2008

3.1 Data analysis

The correlation of unfilled positions and department output are determined by finding the loss in service levels as well as the loss in human resources. The loss of human resources should be seen to have a percentage influence on the service levels/ output. According to the data gathered over a four month period 29.9% of the loss in service levels is related to unfilled positions in the department. The use of this percentage will be applied to unfilled positions and not absenteeism alone because the data that is was gathered from is based on the daily headcount.

The next data that is required is to determine what the probability is that a person will resign within a set period of time if the person is recruited by Shadowmatch. The period of time that will be used is a year because other data that will be added to the model is based on one year periods. The data in table 1 indicates the information that could be extracted and transformed from the termination control sheet. The table shows that on average 9.4% of employees that are recruited by Shadowmatch will resign within a year.

Year	Appointed	SPR	%
2008	246	20	0.081301
2009	261	28	0.10728
2010	253	24	0.094862
		Average	0.094481

Table 1

The analysis of the data from the agriculture industry revealed that 12.66% of Shadowmatch employees resigned in the same period as being appointed in. The differences between this percentage and 9.4% received from another industry indicate that the industry and environment does still have an effect on the employee turnover. Correlating these percentages with the original employee turnover revealed that between 66.4% and 75% of current employee turnover can be reduced by appointing the correct personnel. Recruitment is not the only factor that influence employee turnover thus it would not be able to reduce employee turnover to that of best practice.

The following table indicates the bench marks with regards to different industries. These figures indicate the employee turnover rates of the class leading organisations in these industries. The survey was conducted by Compensation Resources, Inc. in 2005,

Industry	**Average turnover**
Executive	8.80%
Professional	12.70%
Technical	12.70%
Sales	13.20%
Production	17.50%
Average	14.30%

Table 2

It is assumed that if a Shadowmatch employee does not resign in the same period of appointment that they will follow the above mentioned probabilities. This assumption is based on the research done by Mercer (1988) reviewing information of exit interviews, indicating that a large percentage of resignations in the first year of employment are related to recruitment.

Analysing a call centre environment concluded that well employed employees are 45% less likely to be absent. This can be explained by their compatibility to the environment and the requirements that the employees have. According to Josias (2005) there is a large statistical correlation between absenteeism and job satisfaction and intrinsic attributes.

Data conclusion	**%**	**notes**
Affect of absenteeism on Production	30	30% x AB%
Affect of Shadowmatch on absenteeism	45	improvement on current absenteeism
Affect of Shadowmatch on turnover	34	improvement on current turnover

Table 3

3.2 Data requirements for model

Input Data			
#	**description**		**Symbol**
1	Annual employee turnover	decimal	TO
2	Absenteeism	Decimal	AB
3	Employee replacement cycle time	days	CT
4	Training time	Days	TT
5	Cost of employment	Rands	EC
6	Annual revenue of department	Rands	R
7	Cost of department	Rands	AV
8	Department size		D
9	Average annual salary in department	Rands	S
10	Average authorised leave	Days	L
11	Daily demand on task/product/service	Output	DD
12	Standard time	min	ST
13	Working hours/ day	hours	WH
14	Annual work days	Days	WD
15	Selected bench mark turnover (table #)	Decimal	BMT
16	Average first cycle time of employee	min	Y1
17	Average 10th cycle time of employee	min	Y10

Table 4

Chapter 4

4. Development of conceptual solution

This project will follow a process to reach the objective of calculating the value of recruitment with regards to absenteeism and employee turnover. This process will ensure that no unnecessary cost is added in the final calculation. This process can explain as follows.

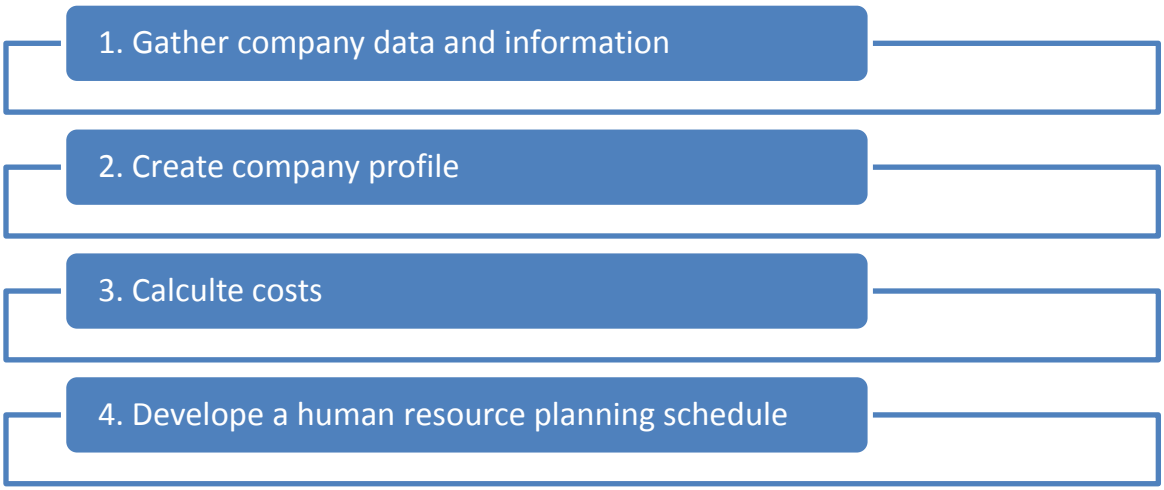

Figure 1

4.1 Gather company data and information

The profile of the company and the policies that it has in place is important to get accurate results. The data and information that it required is related to their current recruitment process and their current data with regards to turnover and absenteeism.

Data required:

1. Annual employee turnover (the number of employee leaving the department in a year/department size) TO
2. Absenteeism (number of days employees didn't attend work/number of working days* department size) AB
3. Employee replacement cycle time (the time since the employee has left till his position is fill with new trained employee) CT
4. Training time TT
5. Cost of employment (recruitment cost+ training cost+ any additional cost e.g. severance package) EC
6. Annual revenue of department R

7. Cost of department (this attributes relates to running cost of department such as; maintenance, building rent, equipment depreciation) AV
8. Department size D
9. Average salary in department S
10. Average authorised leave L
11. Annual work days WD

4.2 Create department profile

Find optimal workforce

By conducting motion studies, time studies or applying data analysis depending on the data available and the task that is being performed. The following should be gathered:

1. Demand of product/service/task
2. Average task execution time (standard time) ST
3. Require human resource (1*2)
4. Require workforce (3 / working hours per day or shift) RWF

This will be used as a benchmark to reduce over employment which is commonly used to overcome high staff turnover and absenteeism. Over employment is cost driver with regards to underutilisation of staff and assets. This section of the model is important to find the average unfilled positions and transform it into a cost of the department. The optimal workforce is calculated as follows:

OW = RWF × (1 + L/WD+AB)

Markov Chains

Two Markov chains models will be used the first will be to study the transition process and the changes a curing in the system when nee employees are appointed using Shadowmatch. The second model will be used to calculate the costs of the system in a steady state by using workforce planning models.

S_1= a position will be filled by newly appointed employee

S_2= a position will be filled by one the current employees

S_3=a position will be filled by a correctly recruited employee

$$P = \begin{bmatrix} NT & 0 & 1-NT \\ TO & FTO & P \\ BMT & 0 & 1-BMT \end{bmatrix}$$

$$[\pi_1\ \pi_2\ \pi_3] = [\pi_1\ \pi_2\ \pi_3]\begin{bmatrix} NT & 0 & 1-NT \\ TO & FTO & P \\ BMT & 0 & 1-BMT \end{bmatrix}$$

$$\pi_1 = NT\pi_1 + TO\pi_2 + \mathrm{BMT}\pi_3$$

$$\pi_2 = FTO\pi_2$$

This forces π_2 to be equal to zero

$$\pi_3 = (1-NT)\pi_1 + P\pi_2 + +(1-BMT)\pi_3$$

Replace the last equation by $\pi_1 + \pi_2 + +\pi_3 = 1$

Thus the following equations should be solved

$$(1-NT)\pi_1 = \mathrm{BMT}\pi_3$$

$$\pi_1 + \pi_3 = 1$$

NT = TO* 0.34

BMT: should be selected from table 2 according to industry

Solving these equations will deliver value for π_1 and π_3 thse two figures will indicate the trunover rate at a steady state and the probability of correct placement in the department, respectively. π_2 will be equal to zero indicating that the current workforce will be dissipated into new staff or productive staff.

The following formula calculates the amount of employees in each set for the specified time period.

$$[S_{1,T+1}\ \ S_{2,T+1}\ \ S_{3,T+1}] = [S_{1,T}\ \ S_{2,T}\ \ S_{3,T}]P_{i\,j}$$

$S_{I,T}$: The amount of employees in set i in period T

The transition stages are also important to calculate the change that has taken place in each period and find the estimate time that it takes the system to reach steady state. The transition process should be calculated to gather the accurate data for further calculations

Calculate the learning curve

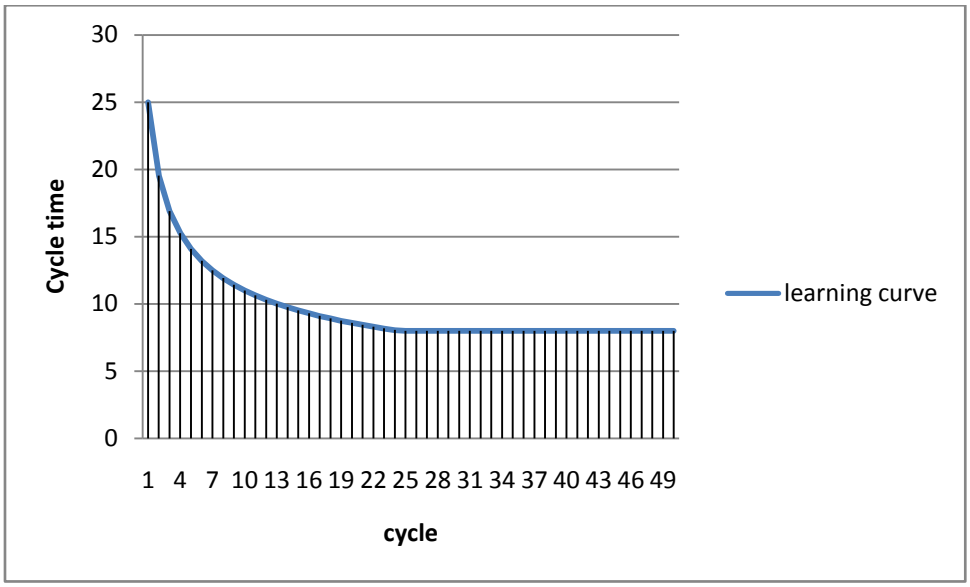

Figure 2.

The table above illustrates an example of a Wright learning curve

The learning curve model that will be used is the Wright model, developed by Wright (1936) for the aircraft industry (Freivalds, 2009).

$$Y = Kx^n$$

$$n = \frac{\ln LR}{\ln 2}$$

Also n can be found directly from the slope

$$n = \frac{\Delta y}{\Delta x} = \frac{\ln y_1 - \ln y_2}{\ln x_1 - \ln x_2}$$

To calculate the cycles needed to reach the standard cycle time replace y with the standard time, and calculate x.

Total time to reach the standard time should be calculated by using the following formula. Where x_2 is the cycles needed to reach the standard time. This formula is deducted from differentiating the area under the learning curve.

$$TT = k[(x_2 + 0.5)^{n+1} - (x_1 - 0.5)^{n+1}]/(n+1)$$

TT/ [(working hours per day)*60] =days that will be taken to reach standard time

Average cycle time while learning = TT/x_2

LC = (1/cycle time while learning)/ (1/standard time)* days needed to reach standard time

LC: consequent days lost due to learning curve

The tables below show standardised learning rates and reduces the need for unnecessary calculations if the department job description is not or industry is not contained in these tables it is recommended that the above mentioned formulas should be used.

Type of work	LR %	Industry	LR %
Assembly	85	Aerospace	85
Prototype assembly	65	Complex machines	80
Clerical ops	80	construction	70-90
Inspection	86	electronics	90-95
Machining	90	machine shop	90
welding	87	shipbuilding	82

Table 5

Learning curve percentage	Slope n
70	-0.514
75	-0.415
80	-0.322
85	-0.243
90	-0.152
95	-0.074

Table 6

Calculate unfilled positions (U)

This calculation is to determine the average unfilled positions during a year. As mentioned before, the U.S.A has an average absenteeism of 6.2 days/annum and the U.K. 7.8 days /annum. This study was conducted by only counting the absenteeism that was authorised with a sick note. This information on South Africa is hard to come by and is usually sampled from a single company or industry. 7 days/ per annum will be used as the benchmark for sick leave and will be worked into the model. This allows for absenteeism of 2.8%. This will be used to limit the effect of Shadowmatch in order to keep it rational. The influence that Shadowmatch will have on absenteeism in a department will not be allowed to reduce their absenteeism to less that 2.8%.

U =(OWF- CWF) (AB×D×WD+ CT×TO×D)/WD + LC.TO.D

This formula will deliver the average amount of unfilled position per day. This formula takes the current absenteeism, the positions being unfilled due to employee turnover and the percentage loss due to the learning curve newly appointed employees.

4.3 Cost calculations

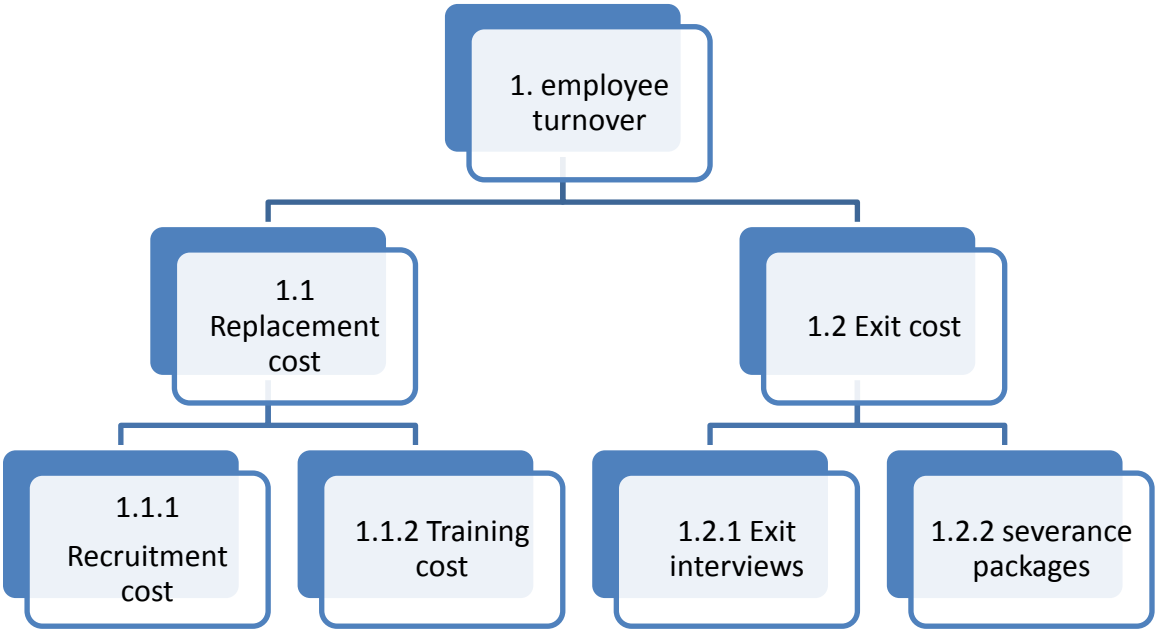

Figure 3

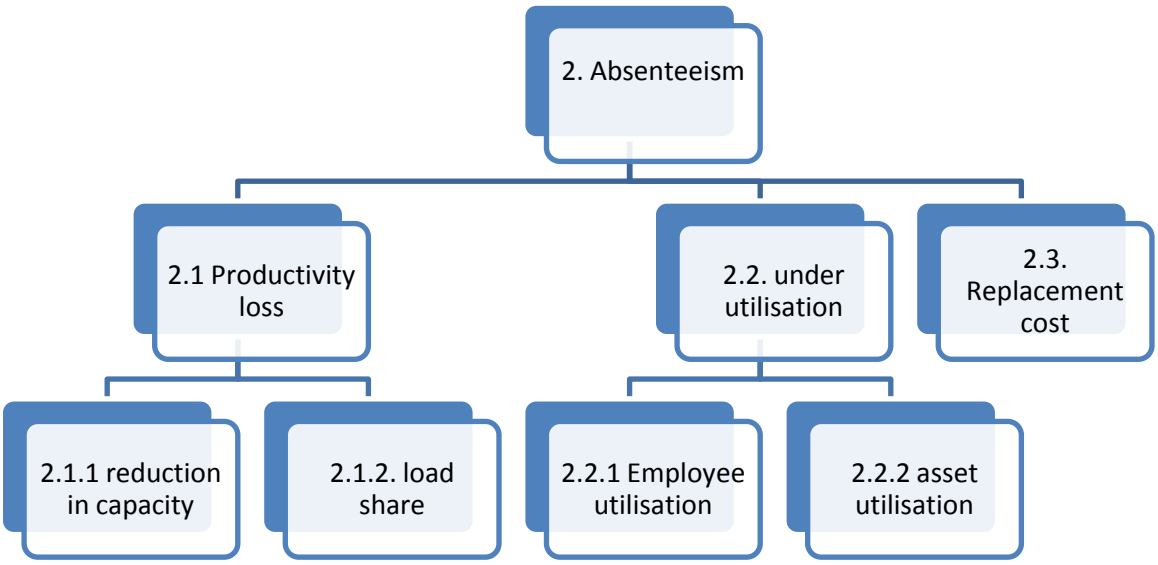

Figure 4

Calculate cost of unfilled positions

The cost related to a position not being filled is the loss of production. As stated earlier this model was developed for large departments (>30) with similar job descriptions. According to the data analysis done in the previous section it was indicated that that unfilled positions are accountable for a 30% of productivity loss. As an example in a department of a 100 employees if there is 10 unfilled positions the output will be reduced by 3%.

UC = productivity loss* revenue

Calculate cost of turnover

This calculation can be done directly from the input data, using the total cost that is incurred by a company to replace an employee.

TC = (replacement cost + leaving cost)*TO

Calculated asset utilisation

Cost lost due to underutilisation=% unproductive (average annual salary+ department value)

Model application

The process developed in this project was designed to be applied to different department in different industries. This section of the project describes the approach, methods and techniques that should be used to reach the predefine deliverables. The development of an automated application that will execute this process will increase the projects applicability and usability. A application will be developed in a spreadsheet form for simplicity and to show the calculations. Developing it in a spreadsheet form will leave the possibility open to use the same calculations and relationships to develop an application in other application software. The spreadsheet form and formulas will be used to solve an example and will be show in the appendix.

Development of a human resource planning model

The models and calculations are based on the assumption that when an employee resigns that the position will be filled directly with a Shadowmatch selected employee. To achieve this, a planning model should be create based on the company profile to determine the human resource planning that should be done this will be done based on the expected number of resignations in a period, the recruitment time and training time of a new employee. This model will be based on the same principles of MRP (material resource planning) since process is based on system dynamics. The correlation can be seen in table 7.

	Inventory Model	Recruitment Model
1	Holding Cost	Salary
2	Unit Cost	Training Cost
3	Ordering Cost	Recruitment Cost
4	Unit Demand	Human Resource Demand
5	Shortage Penalties	Productivity Loss

Table 7

Chapter 5

5. Problem solving and results

In this section an example will be solved based on the data received from a call centre. The problem will be solved using the spreadsheet application developed for this purpose the output will be the expected savings, the steady state of the system after the implementation of Shadowmatch and human resource planning that should be followed to achieve these savings.

Input Data				
#	Description		Symbol	Value
1	Annual employee turnover		TO	0.5
2	Absenteeism		AB	0.09
3	Employee replacement cycle time	days	CT	5
4	Training time		TT	40
5	Cost of employment	Rands	EC	20000
6	Annual revenue of department		R	100000
7	Cost of department		AV	1000000
8	Department size		D	100
9	Average annual salary in department	rands	S	130000
10	Average authorised leave		L	22
11	Daily demand on task/product/service		DD	6000
12	Standard time	min	ST	8
13	Working hours/ day		WH	8
14	Annual work days		WD	250
15	Selected bench mark turnover (table #)		BMT	0.1277
16	Average first cycle time of employee	min	Y1	15
17	Average 10th cycle time of employee	min	Y10	11

Table 8

After entering these figures the spreadsheet model return the following information

p5		1
0.130613	0	0.869387
0.132209	0.000977	0.866814
0.130613	0	0.869387

Table 9

The table above indicates the steady state of the system P_{ij} . This shows that in the steady state the employee turnover will be reduced to 13%, improving 36% from the original turnover. P5 refers to the period.

	$S_{1,T}$	$S_{2,T}$	$S_{3,T}$
T=1	**50**	**25**	**25**
T=2	**23.1925**	**6.25**	**70.5575**
T=3	15.61407	1.5625	82.82343
T=4	13.69991	0.390625	85.90946
T=5	13.22094	0.097656	86.68141

Figure 5

The figure above indicates the number of employees in the Different states. These numbers will be used to calculate the cost factors associated with them.

Learning curve calculations					
				in minutes	
n =	-0.35655				
cycle needed to reach standard time =			7.897626		
total time =	127.91	25	3.932339	0.640179	0.643453
	127.91				
Average cycle time =		16.196			
time to reach standard time (days) =			0.266479		
learning cost LC =	0.131627102			unproductive days	

Figure 6

The learning curve is calculated to find the loss of productivity.

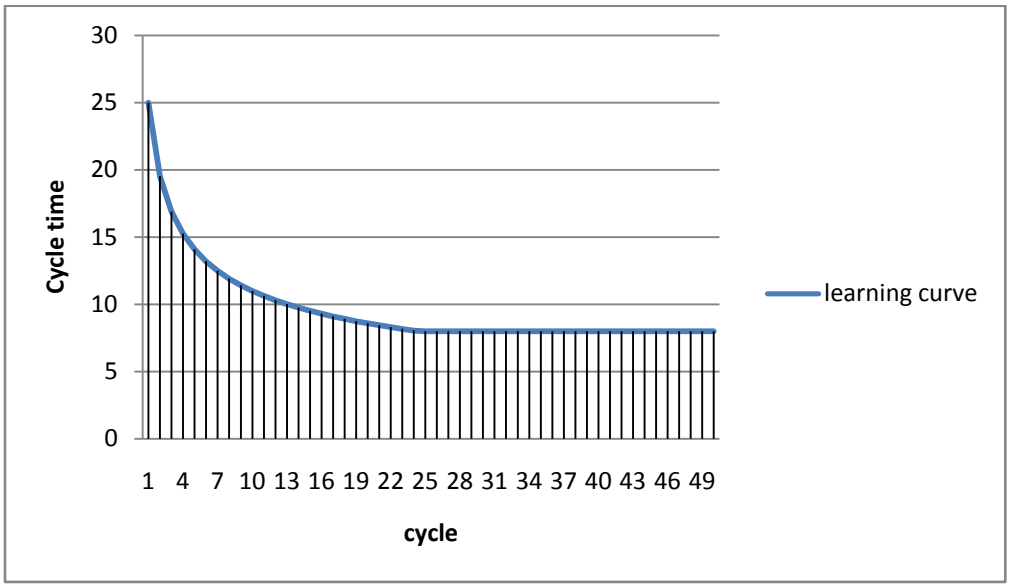

Figure 7

	Period 0	Period 1	Period 2	Period 3	Period 4	Period 5
employee hired	50	23.1925	15.61407	13.69991	13.22094	13.10118
REE	25	6.25	1.5625	0.390625	0.097656	0.024414
employees part of OWF	25	70.5575	82.82343	85.90946	86.68141	86.8744
Expected absenteeism		0.056645	0.053041	0.052138	0.051912	0.051856
Unfilled positions	16.58136	9.181086	7.671614	7.2911	7.195902	7.172101
Cost of unfilled position	4974.407	2754.326	2301.484	2187.33	2158.771	2151.63
Cost of employee turnover	1000000	463850	312281.4	273998.2	264418.8	262023.7
utilisation cost lost	187369.3	103746.3	86689.23	82389.43	81313.69	81044.74
Total cost	1192344	570350.6	401272.1	358575	347891.2	345220.1
Savings		621993.1	791071.6	833768.7	844452.5	847123.7

Table 10

The final table is the main deliverables of the model with the last row indicating the period savings that will be gain with the perfect implementation of Shadowmatch. The second deliverable of the model is the indications of the demand on human resources shown in the second row using this information with the knowledge of recruitment and training time the cycle time for replacing and employee that resigns can be minimised, reducing the average unfilled positions and overall cost.

Chapter 6

6. Validation

The validation of this project is broken down into three sections the first being validating the influence that recruitment has on absenteeism and employee turnover done in the literature review. The second being validating the change brought about by implementing Shadowmatch, this was cover in the data analysis section, and the third is validating the model, which will be cover in this section. The techniques used in the model are all industry used and accepted techniques, thus no validation is required for the execution of the model. The model validation is thus to ensure that all the factors are taken into account for the model to be reliable. The estimate changes given by the model can be described by using the RoNA (return on net assets) model to indicate what influence the changes will have on the financial performance of a company.

$$\text{RoNA} = \frac{\text{Net Income}}{\text{Fixed Assets} + \text{Net Working Capital}}$$

All the costs calculated in the model will have an influence on the net income of a company except for the underutilisation which serves as an indication of unnecessary expenses and depreciation of assets that does not translate into revenue. The other costs calculated are savings and additional production which can be added to the net income. This will increase the net income and will show a improved financial performance of the company.

7. Recommendations and conclusion

The model developed in this report was developed to assist a recruitment company with calculating the value of their product by indicating the influence of absenteeism and employee turnover on the overall cost of a department. The process developed in the project to calculate the influence of absenteeism and employee turnover can be applied in various different ways. The same process can be used to calculate the value of other changes made in the system. Other applications for the process developed are

- Value of reducing learning rate
- Trade-off studies between over employment and overall cost
- Decision making for human resource management polices

In the completion of this project the various implications with regard to absenteeism and employee turnover was highlighted. Absenteeism and employee turnover has many causes and undesirable effects. The cost associated with addressing all the causes outweighs the costs associated with rather finding an employee that is suitable for the environment. Good recruitment will not solve all the problems in a company but having a workforce with similar habits and attributes in a department will make the identification of other causes easier. Having a workforce with similar habits and attributes will empower management to take an continuous improvement approach. This project showed an example of a real life department and indicated the saving that a department will have based on the expected response that the system will have to implementation of Shadowmatch. These savings do not take everything into account such as customers lost and penalties incurred and still deliver savings that except for utilisation costs lost can be transferred directly to profit gained. These are unnecessary expenses that most companies do not take into account. The tools and techniques to minimise these expenses are available. Upgrading the recruitment system in used is a small investment which delivers big gain as seen in the example done in this report.

8. References (bibliography)

Aamodt, M. (1996). *Applied industrail/Organiosational Psychology.* Wisconsin: Cole publishing Company.

B.D. Steward, D. W. (1994). mathematical models for developing a flexible workforce. *Int J. Production Economics* , 243-254.

Bonn, M. (1992). Reducing turnover in the hospitality industry:an overview of recruitment,selection and retention. *hospatality management* , 47-63.

Breaugh, J. A. (1981). Relationship between Recruiting Sources and Employee Performance, Absenteeism, and Work Attitude. *The Academy of management Journal , 24* (1), 142-147.

Freivalds, A. (2009). *Niebel's methods,standards, and work design.* New York: Mcgraw-hill.

Hinkin, T. R. (2000, June 1). The Cost of Turnover. *CORNELL HOTEL AND RESTAURANT ADMINISTRATION QUARTERLY* , ble. 15-21.

JOSIAS, B. A. (2005). *THE RELATIONSHIP BETWEEN JOB SATISFACTION AND ABSENTEEISM IN A SELECTED FIELD SERVICES SECTION WITHIN AN ELECTRICITY UTILITY IN THE WESTERN CAPE.* Cape Town: FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES.

Mercer, M. W. (1988). turnover:reducing the costs. *personnel* , 36-40.

Wang, J. (2005). *A review of operations research application in workforce planning and potential modeling of military training.* Edinburgh: DSTO Systems Sciences laboratory.

Y. Lu, A. (2006). Workforce management and optimisation using stochastic network models. *Service Operations and Logistics, and Informatics* , 1142-1145.

Compensation Resources, Inc.. (2005). Voluntary employee turnover survey. Available: http://surveys.compensationresources.com/index.php?cPath=4. Last accessed 4 Sept 2011.

8. Appendices

8.1 Tables

Year	Appointed	SPR	%
2008	246	20	0.081301
2009	261	28	0.10728
2010	253	24	0.094862
		Average	0.094481

Table 1

Industry	Average turnover
Executive	8.80%
Professional	12.70%
Technical	12.70%
Sales	13.20%
Production	17.50%
Average	14.30%

Table 2

data conclusion	%	notes
Affect of absenteeism on Production	30%	30% x AB%
Affect of Shadowmatch on absenteeism	45%	improvement on current absenteeism
Affect of Shadowmatch on turnover	34%	improvement on current turnover

Table 3

Input Data			
#	description		Symbol
1	Annual employee turnover	decimal	TO
2	Absenteeism	Decimal	AB
3	Employee replacement cycle time	days	CT
4	Training time	Days	TT
5	Cost of employment	Rands	EC
6	Annual revenue of department	Rands	R
7	Cost of department	Rands	AV
8	Department size		D
9	Average annual salary in department	Rands	S
10	Average authorised leave	Days	L
11	Daily demand on task/product/service	Output	DD
12	Standard time	min	ST
13	Working hours/ day	Hours	WH
14	Annual work days	Days	WD
15	Selected bench mark turnover (table #)	Decimal	BMT
16	Average first cycle time of employee	min	Y1
17	Average 10th cycle time of employee	min	Y10

Table 4

Type of work	LR %	Industry	LR %
Assembly	85	Aerospace	85
Prototype assembly	65	Complex machines	80
Clerical ops	80	construction	70-90
Inspection	86	electronics	90-95
Machining	90	machine shop	90
welding	87	shipbuilding	82

Table 5

Learning curve percentage	Slope n
70	-0.514
75	-0.415
80	-0.322
85	-0.243
90	-0.152
95	-0.074

Table 6

	Inventory Model	Recruitment Model
1	Holding Cost	Salary
2	Unit Cost	Training Cost
3	Ordering Cost	Recruitment Cost
4	Unit Demand	Human Resource Demand
5	Shortage Penalties	Productivity Loss

Table 7

Input Data			
#	**description**	**Symbol**	**Value**
1	Annual employee turnover	TO	0.5
2	Absenteeism	AB	0.09
3	Employee replacement cycle time days	CT	5
4	Training time	TT	40
5	Cost of employment Rands	EC	20000
6	Annual revenue of department	R	100000
7	Cost of department	AV	1000000
8	Department size	D	100
9	Average annual salary in department rands	S	130000
10	Average authorised leave	L	22
11	Daily demand on task/product/service	DD	6000
12	Standard time min	ST	8
13	Working hours/ day	WH	8
14	Annual work days	WD	250
15	Selected bench mark turnover (table #)	BMT	0.1277
16	Average first cycle time of employee min	Y1	15
17	Average 10th cycle time of employee min	Y10	11

Table 8

p5		1
0.130613	0	0.869387
0.132209	0.000977	0.866814
0.130613	0	0.869387

Table 9

	Period 0	Period 1	Period 2	Period 3	Period 4	Period 5
employee hired	50	23.1925	15.61407	13.69991	13.22094	13.10118
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Unfilled positions	16.58136	9.181086	7.671614	7.2911	7.195902	7.172101
Cost of unfilled position	4974.407	2754.326	2301.484	2187.33	2158.771	2151.63
Cost of employee turnover	1000000	463850	312281.4	273998.2	264418.8	262023.7
utilisation cost lost	187369.3	103746.3	86689.23	82389.43	81313.69	81044.74
Total cost	1192344	570350.6	401272.1	358575	347891.2	345220.1
Savings		621993.1	791071.6	833768.7	844452.5	847123.7

Table 10

8.2 Figures

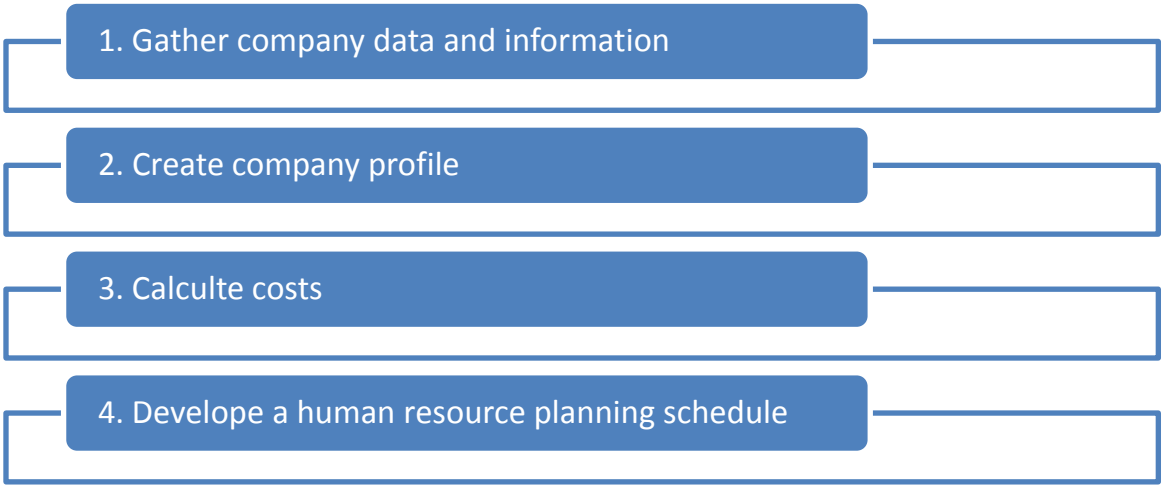

Figure 1

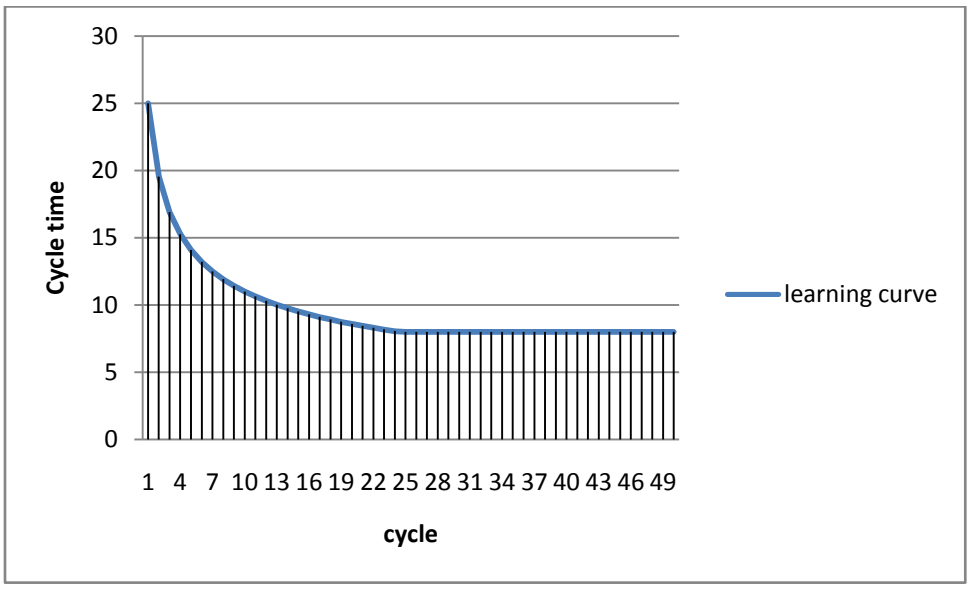

Figure 2

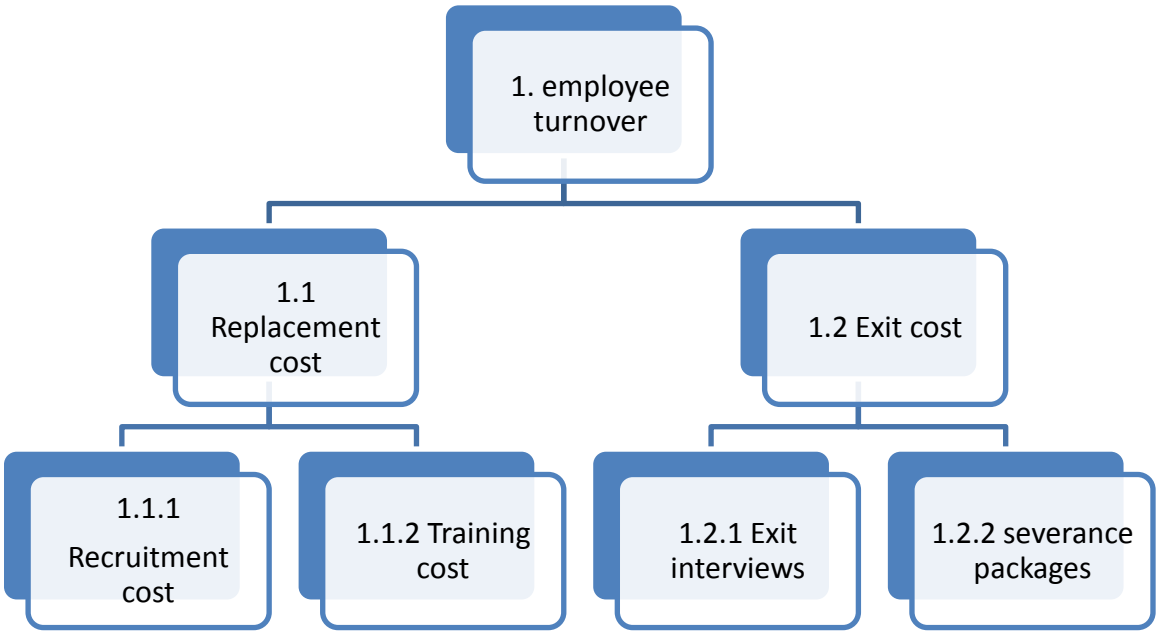

Figure 3

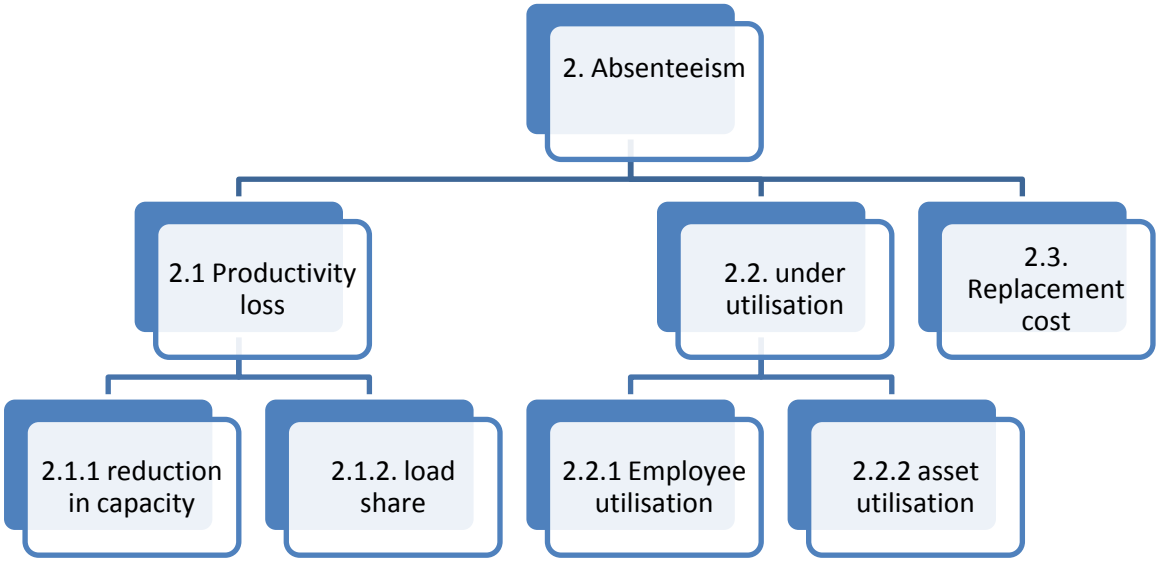

Figure 4

	$S_{1,T}$	$S_{2,T}$	$S_{3,T}$
T=1	**50**	**25**	**25**
T=2	**23.1925**	**6.25**	**70.5575**
T=3	15.61407	1.5625	82.82343
T=4	13.69991	0.390625	85.90946
T=5	13.22094	0.097656	86.68141

Figure 5

	Learning curve calculations				
				in minutes	
n =	-0.35655				
cycle needed to reach standard time =			7.897626		
total time =	127.91	25	3.932339	0.640179	0.643453
	127.91				
Average cycle time =		16.196			
time to reach standard time (days) =			0.266479		
learning cost LC =	0.131627102			unproductive days	

Figure 6

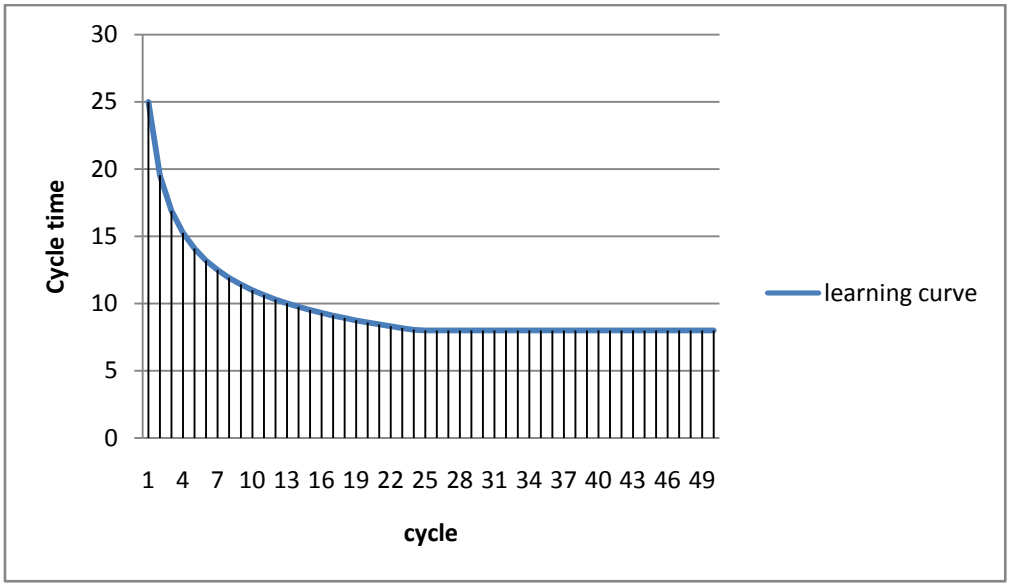
30
25
20
15
10
5
0
Cycle time
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49
cycle
learning curve

Figure 7

8.3 Spreadsheet tools

	A	B	C	D	E	F	G	H	I	J
4		**Input Data**								
5		**#**	**description**						**Symbol**	**Value**
6		1	Annual employee turnover				decimal		TO	0.5
7		2	Absenteeism				Decimal		AB	0.09
8		3	Employee replacement cycle time				days		CT	5
9		4	Training time				Days		TT	40
10		5	Cost of employment				Rands		EC	20000
11		6	Annual revenue of department				Rands		R	100000
12		7	Cost of department				Rands		AV	1000000
13		8	Department size						D	100
14		9	Average annual salary in department				Rands		S	130000
15		10	Average authorised leave				Days		L	22
16		11	Daily demand on task/product/service				Output		DD	6000
17		12	Standard time				min		ST	8
18		13	Working hours/ day				Hours		WH	8
19		14	Annual work days				Days		WD	250
20		15	Selected bench mark turnover (table #)				Decimal		BMT	0.1277
21		16	Average first cycle time of employee				min		Y1	25
22		17	Average 10th cycle time of employee				min		Y10	11

Image 1

Image 1 is to indicate which data cells represent which data values

Markov Chain

=N38	0	=1-N38	=M34	=N34	=O34	=$M$34*P34+$N$34*P35+$O$34*P36	=$M$34*Q34+$N$34*Q35+$O$34*Q36	=$M$34*R34+$N$34*R35+$O$34*R36
=N39	=N41	=N42	=M35	=N35	=O35	=$M$35*P34+$N$35*P35+$O$35*P36	=$M$35*Q34+$N$35*Q35+$O$35*Q36	=$M$35*R34+$N$35*R35+$O$35*R36
=N40	0	=1-N40	=M36	=N36	=O36	=$M$36*P34+$N$36*P35+$O$36*P36	=$M$36*Q34+$N$36*Q35+$O$36*Q36	=$M$36*R34+$N$36*R35+$O$36*R36
Error						=S34-P34	=T34-Q34	=U34-R34
NT	=0.3*N39					=S35-P35	=T35-Q35	=U35-R35
TOBMT	=J6					=S36-P36	=T36-Q36	=U36-R36
	=J20					=IF(ABS(S37)<0.01,1,0)	=IF(ABS(T37)<0.01,1,0)	=IF(ABS(U37)<0.01,1,0)
FTO	=(1-N$39)*0.5					=IF(ABS(S38)<0.01,1,0)	=IF(ABS(T38)<0.01,1,0)	=IF(ABS(U38)<0.01,1,0)
P	=(1-N$39)*0.5					=IF(ABS(S39)<0.01,1,0)	=IF(ABS(T39)<0.01,1,0)	=IF(ABS(U39)<0.01,1,0)
		Steady state indicater				=SUM(S40:U42)		

Learning curve

		Learning curve calculations				
					in minutes	
n =	=(LN(J21)-LN(J22))/(LN(1)-LN(10))					
cycle needed to reach standard time =				=10^((-J17/J21)/J30)		
total time =		=O51*(P51-Q51)/R51	=J21	=(P50+0.5)^(M49+1)	=(0.5)^(M49+1)	=(M49+1)
		=(J21*((P50+0.5)^(M49+1)-(0.5)^(M49+1)))/(M49+1)				
Average cycle time =			=N52/P50			
time to reach standard time (days) =				=N51/(J18*60)		
learning cost LC =		=(J17/O53)*P54			unproductive days	

$S_{1,T}$ $S_{2,T}$ $S_{3,T}$

T=1	**=O28*M35**	**=O28*N35**	**=O28*O35**	=M34	=N34	=O34
				=M35	=N35	=O35
				=M36	=N36	=O36
T=2	**=$M76*P76+$N76*P77+$O76*P78**	**=$M76*Q76+$N76*Q77+$O76*Q78**	**=$M76*R76+$N76*R77+$O76*R78**	=P76	=Q76	=R76

	Period 0	Period 1
employee hired	=M76	=$M79
REE	=N76	=$N79
employees part of OWF	=O76	=$O79
Expected absenteeism		=(AVERAGE((C37+$M34*C36)*$J7,(C38+$O34*C36)*$J7*0.45)*$J19/$J13)/100
Unfilled positions	=(J7*J13*J19+J8*J6*J13)/J19 +J28*J6*J13	=(C39*$J13*$J19+$J8*(C36/$J13)*$J13)/$J19 +$J28*(C36/$J13)*$J13
Cost of unfilled position	=(B40/$J13)*0.3*$J11	=(C40/$J13)*0.3*$J11
Cost of employee turnover	=($J10)*B36	=($J10)*C36
utilisation cost lost	=(B40/$J13)*($J14+$J12)	=(C40/$J13)*($J14+$J12)
Total cost	=SUM(B41:B43)	=SUM(C41:C43)
Savings		=$B44-C44