Developing a Performance Measurement System for the South African Tooling Industry

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Abstract

The Tooling Industry in South Africa has been identified as a great expansion opportunity by the Government, addressing problems such as economic decline and unemployment. A benchmark study has been done by a German University to compare the European and South African Tooling Industries. The purpose of this project is to develop a system of performance measurements that could assist the South African tooling industry in moving forward. The scope of the project is limited to small, struggling tooling companies with less than 15 employees, which represent 80% of the industry. This system will not only create visibility in terms of performance, but it will provide a base for goal-setting and continuous improvement as well. Some of the capabilities of this performance measurement system is the ability for each company to choose specific measurements and to change it over time as the company changes. It provides a single-view dashboard that prioritizes improvements for the managers. It also tracks performance over time and indicates when there is a decline in a measure’s performance. This project is done for the NTIP (National Tooling Initiative Program) alongside Fourier Approach, a consulting Industrial Engineering firm. Chapter 1 of this report includes the introduction to the project: the background, problem statement, project aim and scope. Chapter 2 is the literature study containing a summary of the Benchmark study done by Germany and an in-depth study of performance measurement to provide a base for making decisions about the development of the system. Chapter 3 defines the method that is used to solve the problem. Chapter 4 contains the main deliverable of this project, the Performance Measurement System. Chapter 5 is the practical application of the system developed in chapter 4 in a Performance Tracker in Excel. Chapter 6 concludes this project and includes recommendations for future study.
Chapter 1

Introduction

1.1 Background

The National Tooling Initiative Program (NTIP) is a program that is aimed at the recovery and growth of the tooling industry in South Africa. It is a joint venture of the Industry and Government to support economic growth and job creation. There are two major components of this initiative: Skills development and enterprise development. This project is done for the enterprise development side of the NTIP, alongside Fourier Approach.

The term "tooling industry" refers to the collection of Tool, Die and Mould (TDM) Manufacturing companies in a country. TDM Manufacturers vary from very small one-man shops to medium sized tool shops, to large factories. The South African manufacturing industry uses about R6B of tools, dies and moulds per year. It has declined so much in the last 20 years that it moved from a position of 80% local supply, to less than 20% local supply currently. This negative trend in the industry needs to be reversed. The NTIP is confident that improving/expanding the tooling industry in South Africa will not only create job opportunities, but it will improve the country’s economy. If South Africa could satisfy the market for TDM Manufacturing locally, the NTIP estimates that the industry would be able to fund sustainable job creation to the value of R2B per year. The NTIP estimated this improvement to be equal to 13 000 steady jobs.

A benchmark study was performed by a German Tooling Academy, [WBA (2011)], to compare local tooling industry practices in South Africa with international recognized practices. Several challenges and opportunities were identified, ranging from costing, planning, productivity, factory layout and production systems, control, logistics to macro supply chain consolidation and specialization. The NTIP has joined forces with Fourier to assist with solving these problems.

1.2 Problem Statement

1. There is a big gap between the South African tooling industry and international competitors in terms of price and quality, causing South African manufacturers to prefer the international suppliers.
2. There is a declining trend in the South African tooling industry, because the need is not seen for continuous improvement.

3. There is a lack of financial and operational transparency in the South African tooling companies.

4. Due date reliability is a very big problem in the South African Tooling industry.

1.3 Project Aim

The aim of this project is to develop a performance measurement system for the South African tooling industry to assist in motivating continuous improvement, track performance trends, create an improved degree of financial and operational visibility.

1.4 Project Scope

The target market for this performance measurement system is 80% of the tooling companies, those with less than 15 employees and limited or no knowledge of performance maturity in the company. This project will determine the performance measurements that needs to be taken, and provide a system that will collect them with a dashboard to display the most important performance measurements. The model is developed using Microsoft Excel, because most of the tooling companies who will use it have limited access to computer software. Implementation is out of the scope of this project.

1.5 Deliverables

1. The main deliverable of this project is the Performance Measurement System that is developed specifically for the small South African Tooling companies as stated in the Project Scope above.

2. The second deliverable is an Excel model that will assist a company in choosing performance measurements, and provide data sheets for collecting the measurements. The system will do the necessary calculations on the data and provide a summary of the performance of the company on a dashboard. The system will also provide means for establishing goals.
Chapter 2

Literature Study

2.1 Benchmarking

In order to understand the benchmark study that was performed by the German University, WBA (2011), a clear understanding of benchmarking (what it is and how it is done) and best practices are required.

Benchmarking is a means of comparing operations of one company with the performance of others (Susan, 2001, p.44). Benchmarking is often not a once-off action, but a continuous process of measuring products, services and practices and comparing it against the leading competitors in the same industry. From the research it is clear that the ultimate goal of benchmarking is to determine the gap in performance, to identify the processes that can eliminate the gap, and to improve them to be better than the competitors’ by using known best practices or developing innovative ‘even better’ practices. Competitive benchmarking is when a firm’s performance is measured against that of the ‘best-in-class companies’, (Shetty, 1993, p.39). Benchmarking can be done on processes, products, services and strategies, (Drew, 1997, p.326), and partners may be internal or external.

The five basic steps of benchmarking, from (Shetty, 1993, p.40):

1. Identification of the function to be benchmarked
2. Selection of the superior performers
3. Collection and analysis of data
4. Establishing performance goals
5. Implementing plans and monitoring results

2.1.1 Benchmark of the South African Tooling Industry

WBA is a German Toolmaking Academy (Aachener Werkzeugbau Akademie) who is a trusted partner of application-oriented research, as well as for current issues in the industry. In 2011
WBA did a benchmark study to compare leading German tooling companies with South African tooling companies. The study was done over 6 months in 35 companies from 6 provinces, of which 22 agreed to make their data available. This is considered a representative sample, two thirds of the total sample space. Each company was benchmarked separately by using the same measurements. Then the results were compiled into an overall view of the South African tooling industry, called a Sector Wide Benchmark.

Some of the problems encountered by WBA while preparing for the benchmark study, was that the need for change is not seen. The willingness of companies to invest time in strategic positioning is very limited. Business practices were found to be hardly ever questioned in South Africa. By doing benchmarking and determining the gaps in the industry, WBA has provided a base for strategic reorientation of the South African tooling industry.

WBA determined 9 categories of performance measurements, with 5 - 18 measurements in each category. These measurements are too many to include a detailed discussion of the findings of each measure in this project, and therefore the problem areas will be used as a basis for choosing the most important measures. The major problems that were identified in each of the 9 categories are:

1. **Finances**
   The TDM (Tool, Die and Mould) Manufacturing industry is not very profitable in South Africa, mainly because “being busy is confused with making profit.” A lack of education in the importance of financial figures causes a lack of financial transparency. SA tool shops are reluctant to upgrading their machinery to keep up with the technology, because they don’t understand the value that they could gain from investments. This causes other companies in the industry to move ahead while those with older technology stay behind and keep thinking what they are doing is good enough.

2. **Products**
   In the presentation of the benchmarking study, [WBA (2011)](#), the following comment is made about the products: “Most South African tool makers target a price driven shrinking market with high competition and seek revenues in part production competing with their customers.” South Africa focuses on Part Production, but that all the other areas of related service is much lower when compared to the German industry. This might be because the market is much smaller in SA and that it is more beneficial to work this way, but is is risky due to lack of knowledge and local competition.

3. **Customers**
   On time delivery is a very big problem for South African Tooling companies, and it is managed less than 50% of the time. Heavy delays of at least one week happen almost every third delivery due to lack of planning. Customers often complain about low quality.

4. **Machines**
   Tool shops in SA are less flexible and outdated technologies are still used often. The operating time of machines are often not tracked, limiting operational transparency.
5. **Suppliers**
SA tool shops are very dependent on their suppliers and suppliers are not managed very well. This is mainly because of bargaining power on the suppliers’ side. Supplier management and make/buy decisions can improve lead times drastically.

6. **Employees**
WBA made an observation that employees in SA tool shops are relatively old, compared to the average age of German tool shop artisans. This indicates that the necessary generation transition is not undertaken in many tool shops. This might become a problem in the future, which is why the NTIP deployed the skills development initiative as part of the bigger project to improve the local industry. A low level of education is also a major problem, and there is a very high percentage of employees without any formal education. Artisans in charge of tool shops without basic management education are also problematic, as they do not understand the value of e.g. financial systems or performance measures.

7. **Organization**
Many tool makers work like tradesmen, instead of splitting component manufacturing and assembly. This causes decreased productivity. It is considered norm in SA to work single shifts, and extra shifts are only used for increased capacity, but not for reduced lead time. Accidents happen more often in SA, due to uneducated employees. SA lead times are very long, and imported tools arrive quicker than tools made by local suppliers. Work flow is frequently interrupted by rush orders, and not even 50% of the companies do production planning. This causes daily rescheduling, which wastes unnecessary time. Very often, work pieces are not clearly marked and looking for parts in the tool shop wastes a lot of time.

8. **Process**
Quotations are estimated over the thumb, and a support system for this is required to avoid under quoting. Process stability is a problem, and many try out cycles are often required before production can begin. Workstations are often not designed ergonomically.

9. **Strategy**
Decision making need to move from being a day-to-day activity to being long term in order to define a strategy and to build a development plan.

### 2.2 Performance Measurement

Performance Measurement is something that can be used in many different applications and contexts in the world. The specific definition thereof depends on the application, but it is always a term that is used to describe the act of quantifying some kind of action and then documenting it. This section aims to understand all the aspects of performance measures in the manufacturing environment. Resources that were considered include articles from journals, as well as websites from professional consulting companies who specialize in performance measurement.
2.2.1 The Development of Performance Measurement

Managers need information to make decisions, and the quality of the decision is directly related to the quality of the information it is based on. Decision making information is derived from performance measurement data. Through the years, many attempts have been made to provide guidelines for collecting decision making information and performance measurements. According to a historian, Chandler (1962), the origins of performance measurements can be traced back to the 19th century when the manufacturing industry started to expand.

- Up to the 1980’s the performance measurement systems in manufacturing companies were based on traditional cost accounting systems, Ghalayini et al. (1997). Financial measures such as profit, return on investment, sales per employee and productivity were used to monitor, control and improve operations. These traditional cost accounting systems, however, focused more on monitoring and controlling systems than on supporting improvement and optimization in manufacturing companies. Financial measures also did not address the dynamics of changing systems, according to Ghalayini et al. (1997).

- During the 1980’s, customer requirements changed as a result of global competition, Cross and Lynch (1988). To stay competitive, manufacturing companies needed to keep up to date with quality standards, variety, cost trends, dependability and shorter lead times. This lead to the development of systems such as TQM and JIT, which required other measurements than the existing financial measurements of the time.

- In the 1990’s, many integrated performance measurement systems were created to provide an overall view of a company’s performance and to include all levels of workers in the vision of a company, Kaplan and Norton (1992). Relevant measurements were required to indicate the performance of operators and machines on manufacturing level, as well as for supervisors and managers.

- Today, performance measurements give managers important information about processes, services and products. It can indicate the level of customer satisfaction and the actions that are necessary when something goes wrong, Washington (2009). Although it is not a solution to any problem in itself, performance measurements monitor performance and provide a base for identifying areas of improvement. In the development of an integrated measurement system for the European manufacturing industry, Browne et al. (1997) emphasized the importance of performance measurement by saying that it is a prerequisite for improvement. An international management consulting firm with over 30 years of experience, R. Micheal Donovan and Co. Management Consultants, specializes in providing manufacturers with business performance improvement services. On their website, Performance Measurement Metrics for Success (n.d.), they also emphasize the importance of choosing the right performance measurements by saying “Currently, the right performance metrics for gauging everyone’s performance and level of improvement are essential to supply chain management’s success.” In a study at Harvard University about the necessity of performance measurement, Behn (2003) proved that performance measurement supports managers in eight specific managerial activities: evaluating, controlling, budgeting, motivating, promoting, celebrating, learning and improving. When
choosing measurements, [Behn (2003)] says that it is important to consider which of the management activities it will benefit. If a measurement does not benefit any of the above managerial activities, it has no purpose. If measurements are chosen carefully, though, it can lead to much faster improvement and more effective decision making by managers.

2.2.2 Common Problems with Performance Measurements

Traditional measurement systems have been well established since the 19th century, but when globalization started they needed more information from their measurements in order to make improved systems. In 1997, a University from Ireland and from Norway collaborated to develop a generic set of performance measures to be used in the European manufacturing industry, [Browne et al. (1997)](#). This resulted from the need to compare companies to see which has the better practice. In order to do this national European benchmark, they needed to compare apples with apples. Some companies, however, were reluctant to making changes and this forced them to motivate the reason for not using only traditional cost accounting systems. Five main problems were identified with traditional measurement systems:

1. **Lack of relevance:** Traditional cost accounting systems do not support production control, does not measure all the elements related to the company strategy and it is misleading in pricing decisions.

2. **Distorted Costs:** Traditional methods of distributing overhead costs can significantly distort costs, because both direct and indirect costs have become much more flexible in the past two decades.

3. **Inflexibility:** This refers to the inflexibility of the measurement system itself. In traditional cost accounting systems, the reports cannot be adapted to suit every company’s specific requirements. It also does not have the capability to change as the company changes. Accounting reports are mostly a reflection of the past and are mostly used to justify a case for blaming someone for negative variances.

4. **Hinderance to progress:** It is often seen that managers do wasteful and unnecessary tasks to make the figures look good. A very common problem in manufacturing is that managers tend to focus on machine and labour efficiency. This encourages large production quantities, which leads to large amount of inventory. It makes accurate accounting data more difficult and costly to obtain.

5. **Subject to the needs of financial accounting:** Very often the cost accounting measurement systems are considered a side-product of the financial accounts. Although, to be of value, measurement systems must consider things like flexible periods, overhead absorption and inventory; things that cannot be expressed in financial terms.

The growing need for a competitive edge in the manufacturing market lead to the development of management philosophies such as Total Quality Management (TQM) and Just-in-Time (JIT)
to name just a few. Measurements were needed to assess the success of these new philosophies and consequently new measurement systems were developed. The Department of Industrial Engineering at the University of Missouri, in Columbia, identified and addressed some problems of integrated measurement systems of the time, Ghalayini et al. (1997). In an analysis of the state-of-the-art integrated measurement systems, the following shortcomings were identified:

1. There is a need for a system that is tailored to meet a company’s specific needs and can evolve as the company develops.

2. Performance measurement systems are mainly used for monitoring and controlling, rather than for improvement.

3. No mechanism is provided for specifying goals.

4. There is no allowance for any revision of the measurements, the systems are not dynamic.

5. Time is not stressed as an important measure of improving performance.

6. No system has yet provided a specific tool that facilitates the controlling, monitoring and improvement of activities on the shop floor.

R.Micheal Donovan & Co is an international Management Consulting firm in the US who provides manufacturers with business performance improvement services. With over thirty years of experience and with a good reputation, it is considered worthwhile to consider the practical problems with performance measurement that they have encountered over the years. They have noted the same problems with conventional measures as Browne et al. (1997), and in addition also named other practical problems with conventional measurements:

1. Monthly financial reviews are time consuming and rarely result in systematically changing future performance. The reason for this is that the financial review and the operations review do not connect with each other or with the strategy.

2. Financial review meetings actually encourage managers to modify their activities or reports so that they will not get into trouble. This is because many business managers really understand what drives their business’s success.

### 2.2.3 Performance Measurement Systems

Since the aim of this project is to develop a performance measurement system that is customized for the tooling industry, it is necessary to study the concepts underlying the design of such a system. Two sources were considered in this part of the research, Jonsson and Lesshammar (1999) and Neely et al. (2000):

1http://www.rmdonovan.com/performance_measurement/
Critical Dimensions of a Performance Measurement System

Jonsson and Lesshammar (1999) found that "most firms were both using wrong measures and failing to use the right measures in correct ways." This specific study aimed to identify and describe the characteristics of the most important dimensions of a performance measurement system in a manufacturing environment. The 6 critical dimensions that was established by Jonsson and Lesshammar (1999) are:

1. **Strategy**
   This dimension deals with the long-term factors that contribute to success in the manufacturing environment. It emphasizes the importance of metrics being related to the strategy of the company.

2. **Flow Orientation**
   Efficient flow of materials, with high quality and short throughput times are some of the products of effective manufacturing. Manufacturing should be measured as a process in the supply chain, and partnerships should be encouraged.

3. **Internal Efficiency**
   Mixing qualitative and financial measures is necessary for measurement of the overall internal efficiency.

4. **External Effectiveness**
   This dimension deals with the measurement of customer satisfaction. Quality and service levels are often used for measuring external effectiveness, instead of external data from customers. Customer satisfaction does not get measured as often because it is not quick or easy to collect. The measurement system should aim to rather look at the external effects of their production, and trace it to the internal causes to find a solution.

5. **Improvement Drivers**
   Performance measurement data should be collected as a base of creating action plans for improvement and development.

6. **Simple and Dynamic**
   Measurements should be simple to calculate and use. Too many or complex measurements might turn the focus on checking the past. A structured set of measures that give an overall view of the performance should be developed specifically for each company. Systems such as SMART, Cross and Lynch (1988), and The Balanced Scorecard, Kaplan and Norton (1992) are used as examples of simple and dynamic performance measurement systems.

The Performance Measurement System Design Process

Neely et al. (2000) recognized that many different performance measurement systems have been developed, but that a framework is required for designing such a system. The Balanced
Scorecard is only one of many examples of frameworks that suggest areas where performance measurement is required, but that doesn’t guide the identification of the appropriate measures. One of the main aims of the study was to establish how to develop a balanced performance measurement system. The desirable characteristics of a performance measurement system were identified by researching all the available academic theory available at the time, and building on it through practical applications. Figure 2.1 shows the conclusion made about these characteristics in the study.

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<th>Desirable characteristics of a performance measurement system design process</th>
<th>Desirable characteristics of the output of the process</th>
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<td>Performance measures should be derived from the company’s strategy.</td>
<td>Performance measures should enable/facilitate benchmarking.</td>
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<td>The purpose of each performance measure must be made explicit.</td>
<td>Ratio based performance measures are preferable to absolute numbers.</td>
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<td>Data collection and methods of calculating the level of performance must be made clear.</td>
<td>Performance criteria should be directly under the control of the evaluated organizational unit.</td>
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<tr>
<td>Everyone (customers, employees and managers) should be involved in the selection of the measures.</td>
<td>Objective performance criteria are preferable to subjective ones.</td>
</tr>
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<td>The performance measures that are selected should take account of the organization.</td>
<td>Non-financial measures should be adopted.</td>
</tr>
<tr>
<td>The process should be easily revisitable – measures should change as circumstances change.</td>
<td>Performance measures should be simple and easy to use.</td>
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<td>Performance measures should provide fast feedback.</td>
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<td>Performance measures should stimulate continuous improvement rather than just monitor.</td>
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Figure 2.1: Desirable characteristics of a performance measurement system design process, [Neely et al.] (2000)

The process framework (figure 2.2) developed in [Neely et al.] (2000), is another product of active research studies in nine different manufacturing companies in the UK. It is a practical process and was considered in the development of the solution methodology in Chapter 3 of this project.
A performance measurement approach that has become well known and is still widely used and acknowledged today, is the Balanced Scorecard. The development of the Balanced Scorecard resulted because of the realization that traditional financial measurements alone were not adequate anymore. Kaplan and Norton (1992) argued that managers needed a balanced view of financial and operational measures. The Balanced Scorecard is a set of measures that provides a quick comprehensive view of the business performance. It allows managers to look at a business from four different perspectives: Customer, Internal (core competencies), Innovation and Learning, and Financial perspective. Figure 2.3 shows a graphical representation of the Balanced Scorecard as it is widely know today.
This approach minimizes the number of measurements so that managers can know what to focus their attention on. For the balanced scorecard to work, managers are required to articulate their specific goals and translate them into specific measures, as explained in Section 2.2.3 of this document. The following statements summarize the guidelines that Kaplan and Norton (1992) used to implement and test the concept of the Balanced Scorecard initially:

- The customer perspective helps companies identify what it is that they need to do to keep their customers satisfied.
- The internal perspective then translate those customer expectations into what the company must actually do. It helps to keep the focus on critical operations that enable the satisfaction of customer needs.
- Because of the dynamic nature of the market, targets for success continually change and it is necessary to keep up with the changes by means of innovation and learning.
- The financial perspective then shows how everything is contributing the improvement of the bottom line.
2.2.4 Operational vs. Strategic Measures

Porter (1996) emphasized that there is a difference between operational effectiveness and strategy by referring to the effect of the global revolution in the early 1980s in Japanese manufacturing. At the start of the revolution, distinct strategic positions were not identified, but focus was on optimizing their operational effectiveness. The Japanese industry was so far behind the frontiers of the time, hence they were able to improve on multiple operational measures (like cost and quality) simultaneously. This phenomenon, however, only continued until the operational effectiveness was optimised. Only then they realized that they have to begin identifying and improving on core competencies in order to stay ahead in the industry. Japan, being one of the leaders in manufacturing, is an excellent example of how the South African tooling industry should go about to get closer to international standards in the market. The first step will be operational effectiveness, and only after that should a company focus on developing strategic advantage. The model that is developed in this project, provides for the performance measurement of both operational and strategic effectiveness. It is done by allowing a company to choose from a set of predefined measures. Initial measures are chosen based on the company’s current knowledge or level of effectiveness on an operational level. Once the initial improvement measures have been identified and optimized to a specified goal, other measures can be chosen to move towards a strategic operating position. The next section will aim to identify which measures are crucial to measure in a manufacturing company.

2.2.5 Performance Measures in Manufacturing

The phrase "What you measure is what you get" has been the motivation for the development of performance measurement over the years. It has been proved through years of performance measurement development that the behaviour of management and employees are greatly affected when effective measurements are taken. As manufacturing developed and the need for performance measurements were recognized, many different performance measurements were developed. This section contains an in-depth look at the different measurements that were found in the literature study. Ranging over the past 20 years, from 1992 to 2012, the research is used to make an informed decision on what performance measurements to use in the South African tooling industry. In figure 2.5 of this section, all the different measures from different researches are collected and tabulated in order to establish measures that are most frequently used. Figure 2.5 contains only the top 10 measures, which are the 10 measures that was encouraged by more than 50% of the researchers. The information is obtained from the following previous studies:

- Ghalayini et al. (1997) created a framework called IDPMS (Integrated Dynamic Performance Measurement System) for improving manufacturing performance. The framework itself is outdated and not in used anymore, but the measurements that were identified in the application of this system is very relevant for the purpose aiding the selection of appropriate measures for the tooling industry.
Gunasekaran et al. (2001) developed a framework for measuring the different components of a supply chain. As a result, a list of metrics is presented with the emphasis on suppliers, delivery performance, customer service and inventory. A tooling company is in essence part of a larger supply chain, and therefore these measures are considered very relevant for the purpose of this project.

ISTMA is the International Special Tooling and Machining Association and serves as a global platform for cooperation for tooling companies in America, Asia and Europe. Every year, they collect statistics from their members and publish a report called the Statistical Yearbook. This information is then freely available for all their members. All non-members, however, can view reports from 10 years back. The statistics are outdated and not important, but what is important is the measurements that they use, ISTMA (2002). All the ISTMA members take the same measures in order to be comparable with each other. It is important, though, to note that these measures are for annual statistics of the industries, and therefore some measurements that are tabulated might be completely irrelevant for the purpose of this project.

MESA (Manufacturing Enterprise Solutions Association) International is a global community of manufacturers, producers, industry leaders and solution providers who are focused on improving Operations Management capabilities through the effective application of technology solutions and best practices. Fraser (2006) is a research project that was conducted for MESA with the aim of establishing how operational improvements impacts financial performance. The results from this research was used to justify investments in software applications that enable operational improvement. An on-line survey was conducted, consisting of 135 manufacturing companies. Some of the observations that was made from the industry leaders was that manufacturers should not measure everything, but should focus on a few metrics that are within their control. Only once those areas improve, should they add new metrics. The metrics that was found to be used in more than 50% of the companies are included in the creation of figure 2.5.

Gomes et al. (2007) studied the performance measurements of 92 Portuguese manufacturing companies and also provided a list of measurements that was found to be most widely used in Portugal.

El Mola (2010) did a research-based study to find critical measures specifically for the manufacturing industry as a first step of designing an effective performance measurement system. A framework was proposed for the selection of the appropriate measures. The critical measures were obtained by comparing 15 different academic sources, and in conclusion a list of the most critical measures and the most common ways to measure them were made.

WBA Aachener Werkzeugbau Akademie is the German Institution that did a benchmark study on the South African Tooling industry in 2011. WBA (2011) (also see section 2.1). They are mostly renowned for their research and development in the German tooling industry. The performance measures that they used to benchmark the overall South African industry are included in the creation of figure 2.5. It is important to note that not all of WBA (2011)
these measures will be useful for every company. Collecting measurements takes time and resources and therefore it should be limited to a few key indicators that are custom for every tooling company.

### Selecting Appropriate Measures

El Mola (2010) made an observation similar to that of Neely et al. (2000) that the literature is very vague about how to actually choose measurements for a specific company. Unlike Neely et al. (2000) who developed a process for designing a performance measurement system, El Mola (2010) addressed the first step in the design of such a system which is selection of the measurements. The framework is shown in figure 2.4 and is divided into two parts: what to measure, and how to evaluate the selected measures.

![Figure 2.4: Framework for selecting measures in performance measurement, El Mola (2010)](image)

2.3 Literature Summary

The literature study supported a in depth understanding of performance measurement. How it works, how to design a performance measurement system and the known issues that should be avoided in designing new systems. All of these will be considered in the development of this project. One of the most important outputs of the literature study, is the table containing the 10 most used measurements. The sources of these measurements are explained in section 2.2.5 and the findings presented in table 2.5 below:
<table>
<thead>
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<tbody>
<tr>
<td>1 On-time delivery</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>2 Lead time (time between order and receive)</td>
<td>6</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>3 Defect levels (customer)</td>
<td>6</td>
<td>1</td>
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<td>1</td>
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<td>4 Cycle time</td>
<td>6</td>
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<td>1</td>
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<tr>
<td>5 Quality (internal number of defects)</td>
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<tr>
<td>6 Sales (growth can also be measured)</td>
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<tr>
<td>7 Material cost</td>
<td>4</td>
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<td>1</td>
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<tr>
<td>8 Labour cost</td>
<td>4</td>
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<td>1</td>
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<tr>
<td>9 Profitability</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10 Earnings before tax, interest and depreciation</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
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</tr>
</tbody>
</table>

Figure 2.5: Top 10 Manufacturing Performance Measurements
Chapter 3

Methodology

3.1 Overview

The purpose of this project is to create a performance measurement system for the small tooling companies in South Africa and to create tool to display the most important measures on a dashboard. This system must be adjustable for companies with different levels of maturity and it must motivate continuous improvement. The information and knowledge obtained from the literature study serves as a starting point of the development of this project. This chapter aims to establish the steps that must be followed in order to achieve the project aim, it considers project risks and established the requirements in terms of knowledge.

3.2 Solution Approach

The four-step high level process that will be followed in the development of this project is mapped below:

Figure 3.1: Major steps of the project development process
3.3 Project Risks

It is important to predict the problems that might occur in a study in order to prevent it from ruining the project outcomes.

- Determining measurements for the tooling industry is not very hard, because there are hundreds of things that can be measured. The problem is to find the most important measurements and to narrow them down to an amount of measurements that can be reflected on a dashboard.

- The things that indicate the performance of each company differ depending on the company maturity and/or strategy.

- It may occur that a company does not even have a clearly defined strategy.

- Some tool shop managers have very little computing knowledge and the Performance Tracker tool will be a computer-based application. It is necessary to make the system as user friendly as possible.

3.4 Industrial Engineering Applications

The Industrial Engineering knowledge applied in this project is mainly in the field of Operations Management, but various other Industrial Engineering fields of knowledge is also required:

1. For the analysis and formalisation of the requirements, the knowledge that is used is primarily obtained from the literature study and through meeting with enterprise developers at the NTIP. Systems Engineering is another field of Industrial Engineering, which also helps in looking at the bigger picture and finding a suitable solution.

2. The designing of the performance measurement system is a repetitive process of brainstorming, negotiating and re-organising several performance measurements. The framework of the system was developed by taking a innovative design route, and pairing it with the requirements of the NTIP. The finer details of the framework’s applications is the pure Operations Management, with a small amount of Accounting also included.

3. Information Systems Design is applied in the creation of the Performance Tracker. The application is Excel-based in order to accommodate users with a low level of computing skills or limited software resources. A basic knowledge of Visual Basic Applications (VBA) in Excel will be required and obtained as the project progresses.
Chapter 4

The Performance Measurement System

4.1 System Requirements

The first step in any design process is to specify the requirements. This is a very crucial part of the project development and determines if the end product will meet the user needs. These requirements are obtained through discussions with Fourier and NTIP, and also by considering the literature available on performance measurements.

The requirements are as follows:

1. The system must create visibility and motivate continuous improvement.

2. The performance measures are different for each company, depending on their maturity. The system must provide capability for a company with little knowledge to choose appropriate measures and develop their measurements to a more mature level.

3. A company with little knowledge should be guided to be able to articulate their well-being in terms of numbers.

4.2 Assumptions

The system is based on the following assumptions:

1. A company has to measure and improve on basic operations before moving to strategic competence.

2. Even though all the companies in the scope of this project are small (less than 15 employees), their operational effectiveness range from worst to best. The system must provide measurements that are suitable/adjustable for all of them.

3. There is no adequate knowledge in the companies for them to choose their own measures. They have to be guided in the decision.
4.3 System Design

4.3.1 Introductory Logic

Figure 4.1 illustrates the high-level elements that are core to the existence of a tooling company. It works as follows: Usually, a company will start with planning, then implement that planning into its processes and then see to it that the customer is satisfied (see the blue arrow). Since the tooling industry is already established and do not have the time or knowledge to start over from the inside out, they have to work with what they have and work their way to the inside (see the red arrow). This means that they first have to measure and improve their basic customer satisfaction elements. Then they can move on to more "mature", competitive customer satisfaction elements and start to improve their process. Then, when their customers are happy and they have process visibility, they can start planning to improve their processes to a more advanced level. This is the basis and motivation behind the creation of the performance measurement system designed in this project for the South African tooling industry.

![Figure 4.1: Performance Measurement Depth](image)
There are four levels of measurement maturity that a company can have. The aim of this measurement maturity classification is to enable the small, struggling companies in the scope of this project to position themselves in terms of measurement maturity and to take the most crucial measurements on that level. This will not only create visibility, but it will motivate continuous improvement in a company. It will also ensure that a low level of effort is required to get performance measurements of high value. As a company progresses from the one level to the next, it is assumed that the previous level of measurements are being measured and controlled as a part of basic operations. These levels of maturity are:

1. Qualifying:
   This is the non-negotiable measurements that have to be taken for the company to make an existence. They are mainly concerning the customer’s interests, with the exception of the profit measurement.

2. Competitive:
   These are the things that companies have to measure, control and improve in order to be competitive in the market. The measurements on this level has partly got to do with customer interests, but it is mostly about process performance.

3. Advancing:
   These are planning and forecasting techniques that can be used to gain more control over the operations in a tool shop. These measurements concern mostly activities that allows a company to plan ahead of time.

4. Strategic:
   These are the things that set a company apart from the rest. They are company-specific and can not be defined in this matrix. On this level, a company will choose an element that they would like to exceed at in the market and allow trade-offs to accomplish the best level of performance for that element.

Choosing the measurements for each Measurement Maturity level, is the next step and it is done by considering all the aspects of a company that needs to be controlled. Industrial Engineering is known to ensure effective integration between man, machine, money and material. In order to manage these four categories, they must be measured. This concept, together with the critical performance measurements discovered through the literature study (figure 2.5), supports the Measurement Maturity Matrix displayed in figure 4.2 below. Take note that the Strategic level of measurements are not specified because they are unique for each and every company, and once a company has achieved that level of measurement maturity, this system has served it’s purpose.
4.4 Defining the Measurement Maturity Matrix

4.4.1 Measurements concerning "Man"

The first question that a company has to answer is whether they have knowledge about the timeliness of customer orders. This is a yes or no question. If the answer is "no" then it means that they have no accurate knowledge of how many orders they deliver late. Being a supplier to other manufacturers who are dependent on them, this is a crucial measurement. This measurement has to be implemented and tracked over time, with goals set for improvement. This goal-setting will provide motivation for continuous improvement. Once they are comfortable with the new measurement and seek more improvement and be more competitive in the market, they can then move on to the next level of measurements. It is then required that they
get a scheduling tool and measure more competitive things and follow the same goal-setting approach once again. Measuring the lead time will enable a company to tell its customers how long they have to wait for an order. If the lead time is reliable, it will be an advantage in the market. The "Man" measurements are discussed in more details below:

**Qualifying Measurements**

- **On time customer orders**
  "On time" means that the date that the product was delivered and the date that the customer expected the product is the same. This metric gives a percentage of the number of orders that was delivered on time in a month. This is a reliability measure that is very important in keeping customers satisfied. The only inputs required to measure this is the date that the order was placed and the date that the order was delivered.

- **Successful orders**
  When the right product is delivered at the right time, in the right quantity and at the right price it is considered a successful order. The right time means "on time" (as with the first measurement) and the right price means that the the quoted price for the product is right according to the costing model. The costing model is a separate Excel model that Fourier developed and is used as an input for this model in this case. The right product/quantity simply means that the right product/quantity was delivered to the right customer. This information is obtained from customer follow-up and compared to initial order information. The measurement that is calculated from this data in the percentage successful orders per month.

**Competitive Measurements**

- **Customer Lead Time**
  Once a company knows how reliable its deliveries are in terms of timeliness, there is a need to forecast and the time that a customer has to wait for orders, the lead time. In order to calculate the lead time, the company will have to implement some planning and scheduling tools. These prerequisites for calculating the lead time are:

  - Bill of Material - a list of the raw materials and sub-components needed to manufacture an end product.
  - Defined Routing - the steps for manufacturing an item, the operations and sequence of each step, and the resources required.
  - Production Scheduling Tool - this tool manages the allocation of jobs to staff and resources in specific time frames. Once a production schedule is implemented and followed, this data can be used to accurately tell a customer when to expect an order to be finished. There are many scheduling tools available for this function, and on this level a company should invest in such a system. Alternatively, but not
preferably, scheduling could be done manually. This, however becomes a counterproductive task if there are frequent rush-orders or long waiting times in between processes for no clear reason. A scheduling tool would provide the data to see what is causing the trouble and to test it before implementing changes.

The customer lead time is classified as a competitive measure because a customer would prefer the supplier with a reliable and shorter lead time. Customers need to know how long they will wait for their order. Once the lead time has been established and stabilised, attempts can be made to reduce the lead time. This measurement can be used to establish, with a one or a few month’s data, a reliable probability distribution of each product’s lead time whilst the company is learning to use their scheduling system.

- **Supplier Lead Time**
  This measurement is almost the same as Customer Lead Time, except that now the tooling company is the customer in the supply chain and they have no control over the length and reliability of their supplier’s lead time. This is a risk element, because if the suppliers don’t deliver on time it delays the rest of the supply chain downstream. To improve this measurement, production forecasting can be done to order raw materials in time. An MRP (Material Requirement Planning) system should be implemented here to avoid stock-outs of raw materials.

- **Employee Productivity**
  Productivity is a measure of efficiency, expressed as a ratio of output to input. In this specific measurement, employee productivity is a specific type of productivity measure that uses the total employee hours per month as input and the complete finished units per month as an output. Taking the ratio of this input to output then gives an indication of the number of units produced per hour. The same can be done for the gross profit margin (net sales minus cost of sales) to establish the gross profit made per hour.

**Advanced Measurements**

- **Demand Planning Accuracy**
  The small tool shops being considered, all work on a pull system. A pull system is one where production takes place based on customer orders. The nature of the tooling industry makes it very crucial that lead time is as reliable and short as possible. Reliability is something that is no longer negotiable on this level. Lead time, however, is a measurement that will probably require improvements to the system and capital expenditure to reduce. In the tooling industry in South Africa, the customers look for the tooling supplier with the lowest costs. Costs should only be compromised if the customers are highly dependent on quick response to orders. Not all customers need the products in a short time, but they usually look for the cheapest cost. The trade-off between the cost and lead time is something that the company managers has to decide based on their customer profiles. Adjustments like this should be made in agreement with the customers.

  Risks of not having raw material in stock or delaying production because of rush orders
are something that a tooling company would like to avoid, because it causes unreliable lead times. To have enough raw materials in stock, it is necessary to forecast production. In a pull-system, forecasting of production means forecasting customer orders (in other words, demand forecasting). This is done by looking at previous customer order patterns and discussing collaboration with frequent customers so that planning can be done to provide their orders in time.

4.4.2 Measurements concerning "Machine"

Qualifying Measurements

- **Process Reliability**
The question that is asked to a company to determine if they must measure this element is whether they have any knowledge of how reliable their system is. Incidents often occur in a tool shop that causes production to stop or to slow down. As a qualifying measurement, process reliability means that a tool shop knows how often these incidents occur and for how long. These stopping or slowing incidents are classified into two types: Scheduled maintenance and unscheduled failures. Scheduled maintenance of equipment is something that should be planned ahead of time and is usually in regular intervals. The purpose of this measurement is to collect information of any type of incident that causes a piece of equipment to slow down or stop the production. This information can then be used to determine the reliability of the process. It may also help to identify problems that occur often and to create a maintenance schedule to prevent these problems. Information can also be obtained to see if a specific machine is failing constantly, or if a certain product’s machine set-up causes trouble, or if a specific employee is often involved in a machine incident. Cost of failures can also be determined by adding the repair cost and the cost of the products lost together. This can be used as motivation for routine maintenance.

Competitive Measurements

- **Throughput**
Throughput is the rate at which the system produces units that contribute to the bottom line of the company, to make money. Since the tooling companies under consideration all work on a pull system, it can be assumed that everything that is being produced has been ordered. This measurement can be compared to total system capacity to see if the company can aim to take any more orders than it currently does.

- **Cycle Time**
Cycle time is the total time it takes to produce a product from start to finish and it is unique for every product. It is a key measurement in performance evaluation and cost control. The planned cycle time is calculated from the product routing plan. The actual
cycle time is the time it took to actually make the product. The measurement that is calculated from this is the Cycle Time Conformance, the percentage of times that the planned and actual cycle times are the same. Another measurement that is calculated here is the unplanned production hours, the time that a product spent in the system longer than planned. This is the total actual cycle time minus the total planned cycle time. This can be used as a great motivation for continuous improvement when multiplied by the gross profit per hour. The figure that is calculated by this then illustrates the profit lost for every hour of production that takes longer than planned.

Advanced Measurements

- **Schedule planning accuracy**
  The accuracy of a company’s scheduling affects the internal and external reliability measures in terms of time and cost. The schedule should be accurate enough at this stage that is a valid representation of the actual production. Actual process data should then be logged into a database and be compared to the schedule in order to update the schedule in time to warn customers if an unexpected error occurred that will delay an order.

4.4.3 Measurements concerning ”Money”

Qualifying Measurements

- **Net Profit Margin**
  The net profit is the measurement that articulates the bottom line of a company. How much money it actually makes when all the expenses are deducted. The net income is the sales minus the cost of sales. The net profit margin is a measurement of the percentage of net income that is represented in the net profit. If the net profit margin is low, it can be an indication of low sales, high cost of sales or high expenses. All of these measurements are calculated on an income statement, but on a qualifying level of measurement it is only important to measure these financial aspects and to know if the company makes profit or not.

Competitive Measurements

- **Sales**
  When a company has passed the qualifying level of financial measurements and know whether they make profit or not, they can now look at the things that affect their profitability. Sales is the first thing that affects this, and if a company has cut all operating costs to the bone and can still not make any profit, they need more sales. If a company
knows that sales is their problem, they can focus on marketing their products or creating a costing strategy to help them improve their sales.

- **Cost**
  There are different types of cost affecting the net profit of a company. The two major considerations is cost of sales and operating expenses. They could also be a reason for low profit margins. It might indicate that a company has to look for cheaper suppliers, or that they have to cut on operating expenses.

### Advanced Measurements

- **Budget Planning Accuracy**
  When a company knows if it makes profit and they can see how their sales and costs affect their net profit, they need to start forecasting their finances by means of a budget. This will help them to learn to plan ahead and stay within a budget. This can then be used to plan for future investments in upgrades to improve their operations.

### 4.4.4 Measurements concerning ”Material”

#### Qualifying Measurements

- **Quality (returns/complaints)**
  The question that is asked for this measurement is if a company knows how many complaints they get from customers and why. This is the most basic quality measure that a company can have without investing any costs in quality control process. By doing customer follow-up the customer complaints can be recorded and the company can determine the amount of complaints they get per month, the percentage of customer issues that get resolved and they can also see if a specific product is repeatedly giving the same problems and stop that before it causes the company to loose customers and get a bad reputation.

#### Competitive Measurements

- **Internal Defect Rate**
  This level of measurement requires of a company to implement some kind of a quality control system. Statistical Process Control (SPC) is used to monitor a process to ensure that it operates at its full potential. This is an internal measure of quality, whereas the customer complaints is an external measure of quality. The measurement that is useful here is the amount of points on the statistical control charts that are out of the control for
each product or part divided by the total production hours. This will give the defect rate, in other words the defects per operating hour.

Advanced Measurements

- Waste
  When a SPC system has been implemented, the company can ideally now go on to apply Six Sigma techniques to the process. Six Sigma is a management strategy that seeks to improve the quality of processes and its outputs by identifying and minimizing defects and variation. Lean Six Sigma is a variation of the above, but it results in the elimination of seven kinds of waste, classified as defects, overproduction, transportation, waiting, inventory, motion and over-processing. The manufacturing industry is a very typical environment for the application of this concept and it is used by leading manufacturers worldwide today.

4.4.5 Strategic Measurements

When a company reaches the Advanced level of measurements, they have implemented quite a few of processes to help them with their production management. They have enough knowledge about their system to know where the problems are and they have an understanding of what could improve the problems. When they reach a point where they know all these things and what to improve even further to really have a strategic advantage in the market, they will have to make trade-offs between measures like cost, quality and lead time. This will be different for each and every company. The purpose of this performance measurement system was to help a company with little or no knowledge to choose critical performance measures and to motivate continuous improvement. When a company reaches the Strategic Measurement Maturity level, the performance measurement system developed in this project has served its purpose and a company will choose a specific strategy to continue their operations. They can, to support their strategy look as some of the theories that has been successfully adapted in the manufacturing industry by leading companies, like Theory of Constraints (TOC), Total Quality Management (TQM), Just In Time(JIT), Lean Manufacturing and Six Sigma. Alternatively, a company might be satisfied with staying on a competitive or advanced level of measurement as defined by the Measurement Maturity Matrix. This is likely to be the case if they are already producing up to capacity, or if they have no interest in investing any more money in improving or expanding the business.
Chapter 5

The Performance Tracking Tool

This chapter contains an explanation of the inner workings of the Performance Tracking Tool that was developed to support motivation for continuous improvement in a struggling tooling company. This tool is made in Microsoft Excel to be as user-friendly as possible to be used by a person with a low computer skill level and with only access to basic computer software. The purpose and functional requirements of this tool is:

1. To provide a mechanism for choosing the right Measurement Maturity level and corresponding performance measurements.
2. To provide a platform for collecting data.
3. To automatically calculate meaningful information about the company’s performance.
4. To automatically track this information over time.
5. To provide a mechanism for goal-setting to motivate continuous improvement.
6. To provide a dashboard that can show with a “quick view” where performance levels are declining.

5.1 Assumptions

- There is no current systematic process for performance evaluation over time in these companies.
- Each company in the scope of this project has a computer and basic working knowledge of MS Excel.
- The users of this tool do not have any other database or method of tracking performance data.
- The Performance Tracking Tool only covers the Qualifying and Competitive levels of Measurement Maturity for the purpose and scope of this project.
5.2 Interfaces of the Tool

The Performance Tracker consists of 6 major types of interfaces, explained below with screen-shots of each interface:

5.2.1 The Home screen

This is the first interface that the user will encounter, figure 5.1. Here a first time user will select ”Choose Measurements” and be directed to the mechanism that aids in selecting the right performance measurements for the company’s Measurement Maturity level. Other users can choose to go directly to the ”Input Director” where they can choose which data sheet to open, or they can go directly to the ”Dashboard”.

![Figure 5.1: The Home Screen](image)

5.2.2 Measurement Selection Mechanism

This is the second interface that a first time user will encounter. It is broken up into two steps that help to classify a company’s Measurement Maturity and assign the appropriate performance measurements:

1. The Qualifying Measurements Questionnaire
   In this first questionnaire(figure 5.2), five questions are answered by yes/no answers, and based on that the Competitive Measurements Questionnaire is populated. If an answer in any one of the categories (Man, Machine, Money or Material) is ”no”, then it means that the company does not have adequate data about that category on that level of maturity and that they are not yet measured. Then they are positioned on a Qualifying level of
maturity for that category of measurement. If a category’s answer is “yes” then they can move to a competitive level of measurement for that category.

2. The Competitive Measurements Questionnaire

This questionnaire is populated based on the answers of the Qualifying Measurements Questionnaire in step 1. Only the categories that are adequately measured on a qualifying level gets asked here. See the example in figure 5.2 and 5.3 of these two questionnaires. Appendix 7.1 contains a Measurement Maturity Matrix with all the relevant questions for each level and category.
5.2.3 The Data Input Director

This is an interface that displays the positioning of the company in terms of the Measurement Maturity Matrix. From this interface the user can select the different performance measurements and the program will automatically take them to the data sheet for the selected measurement. The year and month is also set in this interface and automatically updated everywhere else in the data sheets. An example of this interface, with the configurations as in figure 5.2 and 5.3 above, is shown in figure 5.4:

![Data Input Director](image.png)

Figure 5.4: Data Input Director

5.2.4 Data Collection Sheets

Data Sheet Functions

The data sheets have built-in functions that simplify and enhance the use of the Performance Tracker.

- Each sheet initially has its own unique headings with one line for data input. A new line is created every time a data entry is made. This creates a user-friendly interface when there are a lot of data entries involved.

- At the end of each month the data can be archived. There are separate Excel workbooks for each data sheet. When a sheet is archived, it is copied to it’s separate workbook and a new sheet is created for each month’s data.
After the data has been archived, each data sheet in the Performance Tracker can be cleared so that the user does not have to scroll down to view all the data.

There are also buttons to redirect the user between the Home screen, the Input Director and the Dashboard.

The data collection sheets are different for each of the different types of measurements, discussed in order of Measurement Maturity levels below.

**Qualifying Measurements Data Sheets**

- **On Time Customer Orders**  
  This sheet is what will be used to document customer orders as they come in, an order number will be assigned to it, the product will be selected from the drop-down list, the date of the order will be recorded. The delivery time that is planned will then be compared to the date that the product was actually delivered. From this, the percentage late orders are calculated in the "Current Stats" sheet. This sheet will be explained later in this chapter.

- **Successful Orders**  
  This measurement is a percentage that is calculated from data on the same sheet as the On Time Customer Orders. The additional data that is added to the sheet concerns if the product quote that was given to the customer is right according to their costing model. It also includes an aspect of customer follow-up, to check if the right product was delivered in the right quantities. These four areas together - time, price, product and quantity - make an order successful or not. This is something that can be changes as the user learns what is most important for their customers.

![Customer Orders Data Sheet](image)

**Figure 5.5: Customer Orders Data Sheet**

\(^1\)Please note that any data contained in the data sheets in this chapter is purely for demonstration; real process data could not be used.
• **Process Reliability**
This data sheet collects information about machine failures. The data from this sheet is used to determine the total failure time and the total failure cost at the end of each month. The other data fields are required to ensure tractability of failure causes. It may be that the same machine keeps failing unexpectedly, or that a certain part’s design is faulty, or it might even be that the same employee is not working with care and causing failures often.

![Process Reliability](image)

Figure 5.6: Customer Orders Data Sheet

• **Net Profit Margin**
This Income Statement data sheet (figure 5.7) is required to calculate the net profit and the net profit margin. This sheet can be adjusted by each company to include their specific incomes and expenses.

![Income Statement](image)

Figure 5.7: Financial Data Sheet
Quality

On the qualifying level of measurements, quality is measured by the number of customer complaints or returns. This data sheet simply collects information about the incidents where customers had complaints about a product. It might be that a certain product keeps giving problems and then it can quickly be picked up by this data sheet. It also includes a field that notes whether the customer’s complaint was resolved or not, indicating by the end of the month the number of customer complaints that a company resolved.

![Figure 5.8: Customer Complaints Data Sheet](image1)

Competitive Measurements Data Sheets

Customer Lead Time

On a competitive level of measurements, the Customer Lead Time data sheet replaces the Customer Order sheet of the qualifying measurement level. The same calculations can be made, and more. This sheet also collects the order information. See chapter 4.4.1 for the input requirements for this data sheet. Figure 5.9 shows this data sheet in two parts which are actually in one line, but is broken up in two for documentation purposes. The data from this sheet is used to calculate the customer lead time per product and it’s reliability. The throughput is also calculated from this table since a tooling company works on a pull system and hence all the orders that gets finished is considered as throughput.

![Figure 5.9: Competitive Level Customer Order Sheet](image2)
• **Supplier Lead Time**

  This sheet is similar to the customer order sheet, except that it is about orders that the company make for its raw materials. The supplier lead times and reliability is determined on this sheet.

  ![Supplier Lead Time Data Sheet](image)

  **Figure 5.10: Supplier Lead Time Data Sheet**

• **Employee Productivity** This data sheet collects the number of shifts that each employee has worked during each week of the month. It then uses the Shift Length from the Control Sheet to determine the total number of hours all the employees worked per month. This is then used together with the throughput and net profit to determine the units per hour and the profit per hour.

  ![Employee Productivity Data Sheet](image)

  **Figure 5.11: Employee Productivity Data Sheet**

• **Income Statement** On a competitive level of measurements, the same Income Statement is used as in figure 5.7, except that now the profit is not the most important measurement that a company must aim to control. Now they have to improve the things that effect profit on their income statement. They can either aim to increase sales or to reduce costs. Both these measurements become important to track over time on this level.

• **Internal Defect Rate** This measurement requires for some kind of quality control system to be implemented in a tooling company. This sheet will be adjusted to suit a company’s
quality control information, but this measurement basically aims to calculate the total number of rejects and to reduce that over time.

![Internal Defect Rate](image)

**Figure 5.12: Internal Quality Data Sheet**

### 5.2.5 The History Tracker

This is a sheet that will not be accessible to the user. It contains all the calculations of the measurements as explained for each data sheet above. There are two different sheets for this purpose: The "Current Stats" sheet and the "Stats History" sheet. The "Current Stats" sheet contain the formulas and calculate the performance measurements based on the current month’s data. At the end of each month, the user can click on the button named ”Update Stats” on the Dashboard, and then the current month’s stats is copied and the values (without the formulas) are pasted in a new line in the "Stats History” sheet. This "Stats History” is then used to construct the Dashboard.

### 5.2.6 The Dashboard

This is the most important user interface where the user or management can see what areas in the company needs attention without putting a lot of thought into it. The dashboard contains graphs of the relevant performance indicators in each level of measurement maturity and category. Below each graph, the user can set a goal value for that specific measurement. This must be a realistic, achievable goal. Just below this goal, a calculation is then done to show the distance that the company is from the goal. Then there is also an indicator: a green, yellow or red sign indicating the measurement behaviour in the past month. If a positive change happened, it changes to green; if it stayed the same, it is yellow; and if a negative change happened, it will be red. This will allow the user to see where the negative changes occurred without putting a lot of thought into it. The user can also click on that indicator to go to the sheet where the data is captured. There he will be able to see what went wrong and establish processes to avoid the problem from reoccurring. The dashboard is displayed in two parts, in figure 5.13 and 5.14. A complete overview of the entire dashboard is shown in figure 5.15.
Figure 5.13: The Qualifying Measurements Dashboard
Figure 5.14: The Competitive Measurements Dashboard
Figure 5.15: The Complete Dashboard
Chapter 6

Conclusion

More than half of the South African Tooling Industry consists of small, struggling companies. In an aim to improve the industry, the NTIP (National Tooling Initiative Program) was established. The problems with the tooling industry that has been identified by the NTIP is the big gap between South African and international companies, a declining trend in the industry because of a lack of continuous improvement, problems with performance visibility and due date reliability. These problems were all addressed by creating a performance measurement system specifically for these small South African tooling companies that requires a low level of effort for a high value of information to assist them in managing and improving their operations.

The first part of the project aim, to develop a performance measurement system, was achieved by developing a system called the Measurement Maturity Matrix, which provides performance measurements on different levels of maturity in four categories. This system also provides a mechanism for helping a company choose the right measurements, by means of a questionnaire.

The second part of the project aim, which is to assist in motivating continuous improvement, track performance trends and to create and improved degree of financial and operational visibility, was achieved by creating a practical tool for the Measurement Maturity Matrix. This is an Excel-based tool that provides an automated measurement selection mechanism, data sheets for the performance measurements and a dashboard where a ”quick view” of the performance of a company is visible.

This system can in the future be developed into a database, and include measurements for the advanced and strategic level of measurement maturity.
### 7.1 Measurement Maturity Matrix with Questionnaire

<table>
<thead>
<tr>
<th>Man</th>
<th>Qualifying</th>
<th>Competitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you know how many of your orders are on time?</td>
<td>On time customer orders</td>
<td>Do you have the ability to tell a customer exactly when they will receive their order?</td>
</tr>
<tr>
<td>Do you know how many of your orders you get right?</td>
<td>% Successful orders</td>
<td>Do you know how long your suppliers take to deliver and with what reliability level</td>
</tr>
<tr>
<td>Do you know how productive your employees are?</td>
<td></td>
<td>Do you know how productive your employees are?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Machine</th>
<th>Qualifying</th>
<th>Competitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you know how reliable your system is, e.g. how often unplanned production losses occur?</td>
<td>Process Reliability</td>
<td>Do you know how much you produce per day/week/month?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do you know what your cycle time per product is?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Money</th>
<th>Qualifying</th>
<th>Competitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you know how much profit you make?</td>
<td>Net Profit Margin (bottom line)</td>
<td>Do you know how much money you make from sales?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do you know what it costs to make a product?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Qualifying</th>
<th>Competitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you know how many complaints you get and why?</td>
<td>Quality [returns/complaints]</td>
<td>Do you have an inspection system?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do you know what your defect rate is?</td>
</tr>
</tbody>
</table>
References


Performance Measurement Metrics for Success (n.d.).
URL: http://www.rmdonovan.com/performance_measurement/


