Soili Vasikainen

PERFORMANCE MANAGEMENT OF THE UNIVERSITY EDUCATION PROCESS

UNIVERSITY OF OULU GRADUATE SCHOOL
UNIVERSITY OF OULU
FACULTY OF TECHNOLOGY
SOILI VASIKAINEN

PERFORMANCE MANAGEMENT OF THE UNIVERSITY EDUCATION PROCESS

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University of Oulu Graduate School; University of Oulu, Faculty of Technology
University of Oulu, P.O. Box 8000, FI-90014 University of Oulu, Finland

Abstract
The goal of this thesis is to investigate whether the performance management systems of the university education process can be developed by using the mechanisms and indicators of operations management.

This thesis is a result of a multiple-case study consisting of two polar cases: the Faculty of Technology and the Faculty of Humanities in the University of Oulu. Both faculties have several departments which constitute separate cases.

This study explores the elements of the performance management systems used by the Ministry of Education during the first decade of the 21st century and considers whether these performance management systems have affected the university education process. First, the existing research is examined to understand what kind of factors affect the controllability and performance management of organisations. Furthermore, an empirical study was conducted on how the control mechanisms of the Ministry of Education reflect the main variable of controllability analysis. After that, the changes in the education processes in the various departments of the two faculties were examined using a controllability analysis.

The results indicate that the financial models of the Ministry of Education reflect to some extent the main variables of controllability analysis. However, the models focus almost solely on output indicators. The Ministry of Education should consider expanding the models to include input and process variables.

During the 21st century the number of university drop-outs has increased dramatically. This indicates that the process has become more ineffective. The focus of control has shifted from control of the quality of input to the quantity of the output. The finances of the Faculty of Humanities have decreased and it has had to adapt to the financial model of the Ministry of Education by seeking financial flexibility and by changing the production process (decreasing the number of new students, giving a more restricted variety of courses, restricting the maximum amount of credits). The Faculty of Technology faces a different situation. Most notably, the Department of Electrical Engineering has faced the problem of rapid growth. This has caused problems related to the quality of material (students), insufficient capacity and the inability to produce the volumes that the Ministry of Education desired. The Department of Electrical Engineering therefore made its own decision to decrease the number of new students. The reason for this was different from that of the Faculty of Humanities. The Department of Electrical Engineering was not able to increase the production volume to a sufficient level. The Faculty of Humanities instead had a problem of overproduction. The Ministry of Education does not compensate for production that is over its targets.

Keywords: controllability, performance management, process control, public sector, university
Vasikainen, Soili, Yliopiston opetusprosessin suorituskyvyn johtaminen.
Oulun yliopiston tutkijakoulu; Oulun yliopisto, Teknillinen tiedekunta
Oulun yliopisto, PL 8000, 90014 Oulun yliopisto

Tiivistelmä
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Humanistisen tiedekunnan rahoitus on vähentynyt tutkimusjaksona ja tiedekunta on pyrkinyt sopeutumaan erilaisiin taloudellisiin liikkumavaraan ja muuttumalla opetusprosessia (pientämällä sisäänottoa, kaventamalla kurssitarjontaa ja rajoittamalla tutkinnon kokonaisopintopistemäärää). Teknillisen tiedekunnan tiedekuntaa vastaavat aloittelut on erilaiset.


Humanistisen tiedekunnan rahoitus on vähentynyt tutkimusjaksona ja tiedekunta on pyrkinyt sopeutumaan erilaisiin taloudellisiin liikkumavaraan ja muuttumalla opetusprosessia (pientämällä sisäänottoa, kaventamalla kurssitarjontaa ja rajoittamalla tutkinnon kokonaisopintopistemäärää). Teknillisen tiedekunnan tiedekuntaa vastaavat aloittelut on erilaiset.

Asiasanat: julkinen sektori, ohjattavuus, prosessin ohjaus, suorituskyvyn johtaminen, yliopisto
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I started my doctoral studies ten years ago. At that time I was working in the administration of the University of Oulu. A lot has happened during these ten years, but at last I had the opportunity to complete my thesis and my studies.

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<td>APS</td>
<td>Australian Public Service</td>
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<td>APQC</td>
<td>American Productivity and Quality Center</td>
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<td>BSC</td>
<td>Balanced Scorecard</td>
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<td>DPMS</td>
<td>Dynamic Performance Measurement System</td>
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<td>ECTS</td>
<td>European Credit Transfer System</td>
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<td>EFQM</td>
<td>European Foundation for Quality Management</td>
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<td>ENQA</td>
<td>European Association for Quality Assurance in Higher Education</td>
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<td>EP2M</td>
<td>Effective Progress and Performance Measurement</td>
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<td>EQAR</td>
<td>European Quality Assurance Register for Higher Education</td>
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<td>EQF</td>
<td>European Qualifications Framework for lifelong learning</td>
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<td>FMIP</td>
<td>Financial Management Improvement Programme</td>
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<td>GPRA</td>
<td>Government Performance and Results Act</td>
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<tr>
<td>HEI</td>
<td>Higher Education Institute</td>
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<td>ISCED</td>
<td>International Standard Classification of Education</td>
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<tr>
<td>JIT</td>
<td>Just-in-time</td>
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<td>MRP</td>
<td>Materials Requirements Planning</td>
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<td>NPM</td>
<td>New Public Sector Management</td>
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<td>NPFM</td>
<td>New Public Sector Financial Management</td>
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<td>OPT</td>
<td>Optimised Production Technology</td>
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<td>PM</td>
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<td>SITRA</td>
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1 Introduction

1.1 Background

The 1990s brought about an increased impetus in changing the landscape of the public sector of many economies. An important characteristic of such change has been the dominance of management, often described as New Public Management (NPM), in effecting the transition from old-style bureaucratises, with a producer emphasis on a more commercial style of management. The NPM has been characterised by the restructuring of public services, particularly where there is decentralisation and corporatisation and by the displacement of the old-style public administration with a new management focus in public services. This is part of the desire to place public services in the position of market or quasi-market services. Contracts, employee incentives to perform, are deployed in the name of greater efficiency in the public services; a more explicit role for the management (in a top-down, hierarchical, functional concept) of the public services; the perceived need to rationalise public services and, above all, the stress on quantification as a means of demonstrating achievements (efficiency gains, new levels of performance) and of holding responsible persons accountable. These strands of the NPM are evident in many of the reforming economies (Lapsey 1998).

Recent years have seen considerable attempts to change systems of organisational control and accountability in public sector organisations, with a range of financial management and value-for-money initiatives being launched by governments from different ends of the political spectrum (Gray et al. 1993, Humphrey et al. 1993, Humphrey & Olson 1995, Hood 1991, Hood 1995, Guthrie 1993). Such reforms have been classified under a number of labels, such as “new” public sector management or accountable management initiatives, and have seen the promotion of a wide range of accounting-based techniques, such as delegated budgets, performance indicators, efficiency scrutinisers and inspections, value-for-money audits, cost-improvement programmes, financial management information systems, cost-based planning systems, internal markets and formula based funding mechanisms (Olson et al. 1998).

As has happened in many public service organisations, the last decade has seen unprecedented pressure to reform universities. The most relevant of these reforms have been: a shift from elite to a mass higher education system; cuts in
state funding and so difficultly financing the institutions exclusively with public funds; the emergence of new approaches, such as NPM; and greater competition between universities (Shattock 1999, Amaral & Magalhães 2002, Chevaillier 2002, Salter & Tapper 2002).

Growing demands to become more competitive, efficient, effective and accountable, have led to an increased interest in introducing control mechanisms aimed at assessing organisational performance. As a result, performance management systems (PMS) have been implemented in some universities and the measurement of research and teaching performance has become increasingly common within universities. In several countries, different kinds of performance indicators have been developed, mostly by government initiatives, to monitor the quantitative aspects of performance (Cave et al. 1988, Melo et al. 2010, Bogt & Scapens 2012).

Behn (2003) questions what purpose – exactly – is a public manager attempting to achieve by measuring performance? Producing reliable and valid reports of government performance is no end in itself. In seeking to learn from performance measures, public managers frequently confront the black box enigma of social science research. The data – the performance measures – can reveal whether an organisation is performing well or poorly, but they don’t necessarily reveal why. The performance measures can describe what is coming out of the black box of a public agency, as well what is going in, but they don’t necessarily reveal what is happening inside. Once the managers have figured out what is going on inside their black box, they have to figure out how the few things they can do are connected to the internal components they want to affect (because these components are, in turn, connected to the desired outputs or outcomes) (Behn 2003).

In considering public sector performance improvement, there are two important issues which need to be addressed: what is to be measured? and how should the information arising from the measurement process be used? It is common practice in public sector performance management literature to talk about the three Es of:

1. economy;
2. efficiency; and
3. effectiveness,

based on a simple input, process and output model of organisations (Boland & Fowler 2000).
The managers of a public agency may not have complete freedom to choose their own performance measures. They may have to pay attention to measures chosen by others. Even when they must respond to measures imposed by outsiders, however, the leaders of a public agency have not lost their obligation to create a collection of performance measures that they will use to manage the agency (Behn 2003).

The Finnish central government has adopted a performance prism approach to management by results systems in ministries and government agencies. This concept is stated in the Central Government Budget Decree in section 65, 1–4 (since 2004).

According to the Central Government Budget Decree, the activity report of a government accounting office on operations included in the final accounts of the accounting office shall comprise the following:

1. A review of activity by management and especially of the most important changes that have occurred therein, and management’s assessment of performance and the trend therein during the budget year (review by management).

2. The most important information concerning the economy and productivity of activity, the performance and profitability of priced activities, the cost recovery rate of jointly financed activities and the trend therein (information on operational efficiency).

3. The most important information concerning the volume of services performed and public goods produced and the most important information concerning service capacity, the quality of services and public goods and the trend therein, and an account of the impact on the effectiveness of government policies and finances (information on output and quality management).

4. The most important information on the number of personnel, structure of personnel in various task groups, personnel expenses and the structure thereof, and labour welfare and the trend therein, as well as the trend in expertise and other intangible capital and the renewal of functions and services (information on human resources management).
Fig. 1. Performance Prism – the criteria of performance and true and fair view on performance in Finnish government agencies (Ministry of Finance 2006).

The steering of higher education in Finland has been geared towards management by results since the late 1980s, when university budgets began to include performance-based funds. Budgeting based on operational expenditure and performance agreements was adopted in 1994.

The principle underlying management by results is that the objectives set for institutional activities and the resources needed for their implementation are determined in negotiations between the Ministry of Education and each university. The financing is allocated to the universities as a block grant to be used at their discretion. The steering system, in which the Ministry mainly has a strategic role, highlights performance evaluation and incentives. Decision-making powers have been devolved to universities, and emphasis is on university management. The 1998 Universities Act has further enlarged universities autonomy in internal matters (Ministry of Education in Finland, www.minedu.fi).

Finland faces the same problems of high tax-rates and an aging population as many other European countries. This combination calls for tight cost management in the public sector because it is financed by taxpayers’ money. The government
cannot afford to waste money. Ensuring value-for-money in public spending therefore becomes more and more important.

Fig. 2. Regulated Environment for Non-marketable Goods (since there are no private universities).

The management and performance systems created for the private sector had not been copied in public sector until 1990s when public sector reform began. Before that, the focus was mostly on politics and compliance to budget. These are still important, but many new aspects have also been included in public sector management (Ewell 1999).

Organisational performance has always exerted considerable influence on the actions of companies. Consequently, the ways and means of accurately measuring this performance are perceived as being an increasingly important field of research for both organisations and academics alike. A vast array of disparate information concerning performance management (PM) has been made available through the efforts of a number of researchers in different functional silos and the field is now well recognised as being an important part of the manufacturing strategy literature. PM is also evolving at a considerable rate to combat new organisational realities; owing to the fight for industrial supremacy, the concept of performance, as it is measured and evaluated, is undergoing a transformation in modern business organisations. The external environment is becoming identified as the next frontier of PM: in the coming years, there is expected to be a significant increase in inter-organisation PM developments, such as supply-chain PM, and more particularly, extended enterprise PM. Extended enterprise involves the formation of closer co-ordination in the design, development, costing and the organisation of the respective manufacturing schedules of co-operating independent manufacturing enterprises and related suppliers. It is the consequent
result of a move away from the traditional view of manufacturing companies with clear boundaries, limited relationships with other companies and a focus on internal efficiency and effectiveness only (Folan & Browne 2004).

Johnson and Kaplan (1987) claimed that the decreased reliance on direct labour, increased capital intensity and increased contribution made by intellectual capital and other intangible resources rendered it inappropriate to rely on traditional methods of matching revenue to costs and consequent short-term measures of profit as a measure of performance. They proposed that a selection of non-financial indicators should be employed, based on an organisation’s strategy, and including measures of manufacturing, marketing and research and development. Many other writers at this time were promoting a similar theory. Howell and Sourcy (1987), for example, developed a series of non-financial measures that emphasised quality, inventory, material scrap, equipment maintenance and delivery throughout. Bromwich and Bhimani (1989) highlighted the importance of replacing measures of labour productivity, machine utilisation and standard cost variances with measures of quality, delivery time, inventory reduction and machine performance in the new manufacturing environment (Chenhall & Langfield-Smith 2007).

Controllability analysis was developed at the Helsinki University of Technology in Finland in the 1980s. In the development of the controllability analysis, the idea was to use quantitative information about the production control. The most important starting point was to identify what is controllable in a production plant and what should be controllable. Controllability is the basis for control. This was the reason behind developing a system to analyse and develop controllability of a production plant. This system was developed to analyse the production and material flow and it was called a controllability analysis. The formal structure of controllability analysis was presented in the thesis of Eloranta (1981). The controllability analysis was developed further in a research project financed by SITRA (The Finnish Innovation Fund). Controllability refers to the system’s ability to achieve the targets set for it. In other words, the better the controllability is, the better the ability to react to changes is (Haapasalo et al. 2006).

Since the NPM and the need for measurement systems related to it started in 1990s in the public sector and the public sector did not share the development history of the private sector, it is important to concentrate on the basic operations management tools and techniques when studying the operations processes in universities. The public sector cannot start by implementing the most
sophisticated systems and ideas of the private sector, because the basis for implementing them is missing.

In Finland, the university sector was reformed in 2010. Finnish universities have always been tightly controlled via legislation. In effect, many aspects of university organisation have been guaranteed by legislation. The university reform changed this situation by freeing up the system and setting the scene for the development of an “entrepreneurial culture”. The new Universities Act and a series of university mergers can be seen as attempts to improve university efficiency and effectiveness in Finland (Aarrevaara et al. 2009). In present-day Finland, higher-education is provided through a binary system of universities and polytechnics. Finnish polytechnics are relative newcomers to the higher education scene. They began as experimental institutions in 1991. Polytechnics are meant to have a close relationship with “working life” and part of their mission statement is to foster regional development. Core funding comes from the government. Under the Polytechnics Act, a license for managing a polytechnic can be granted to the government itself, to a local authority (municipality) or a joint municipality body (municipal federation), or to private organisation (a registered Finnish limited company or foundation). In 2010, local authorities ran six polytechnics; seven were run by municipal education consortia and 13 by private organisations. Therefore there are several models of governance for polytechnics, but at present universities under the Ministry of Education operate according to a single, centralized model (Aarrevaara et al. 2011).

When I was working at the University of Oulu and had questions relating to resource allocation and performance measurement, scientific research on these fields would have been very welcome. This was also the starting point for writing this thesis. Even though I have been working with management accounting, I considered that the basic problems were not in this field. Instead, I discovered a strong possibility that the knowledge from operations management could be applied to help bridge the gaps and to develop a better system for performance management.

It is no use trying to construct more sophisticated formulas in management accounting if the basic information about operational processes is weak. Therefore, more specific data on the operational processes in universities is needed for management by targets to function properly (Lehtimäki 2001).
1.2 Objectives and scope

1.2.1 Research questions

The main goals of production can be divided into goals of productivity and goals of controllability. Controllability is a system’s ability to reach the goal from its present state (Eloranta 1981). “The external environment determines the conditions for goal attainment. If the internal system is properly designed, it will be adapted to the external environment, so that its behaviour will be determined in large part by the behaviour of the latter…” (Simon 1969 in Eloranta 1981).

Public sector organisations have recently adopted, to some extent at least, performance measurement systems. In the management of universities and other public sector organisations, the focus has been on productivity. This is because the productivity of public sector organisations needs to be improved. Process perspective has not been interesting in this sense, because it requires more detailed data. This is one of the reasons why controllability analysis is the method used to collect data in this thesis. Its focus is on the operational level processes and so it provides information about the real operations.

Rekilä (2006) states that, as the Finnish universities are state-owned, they depend on the state and are tightly managed by the state. State steering appears to be stronger in the area of education than in research. Rekilä (2006) continues that the Finnish university system is increasingly fragmented due to decentralised decision-making and market-based steering. Market-based steering emphasises direct contact between departments and external actors, which lends support to activities based on self-regulation. A university can be called a hybrid organisation, which is halfway towards an entrepreneurial university. The universities try to strike a balance between state steering, market-based steering and academic tradition. They have the simultaneous roles of a bureaucracy, a firm and an academic community. Having delegated decision-making and trying to support the markets, the state has lost its chance to maintain overall control. At the same time, it is very difficult for the universities to reach unanimity in the dialog with the state (Rekilä 2006).

_The research goal of this thesis is to find out if the performance management systems of the university education process can be developed by using the mechanisms and indicators of operations management._
To reach this goal, the following research questions have been formulated:

1. How do the performance management systems used by the Ministry of Education to manage the university education process in 21st century reflect the main variables of the controllability analysis?
2. How have the performance management systems used by the Ministry of Education affected the university education process?
3. How can the performance management systems of a university education process be developed according to the controllability analysis?

1.2.2 Scope

Goal theory with measures and metrics related to goal attainment is the basis for this thesis. According to Eloranta (1981), control is the main function of operations management and controllability a necessary precondition of control. The metrics discussed in this thesis are therefore mostly related to control.

Strategic management and related perspectives are not discussed. This thesis deals primarily with adaptive and operative control layers and only the interconnections with strategic control are discussed. Operations management is of major interest here, in particular the control aspect of management systems (Eloranta 1981).

The main focus is on the performance of an education process, not on a balanced and integrated measurement system of a university. This means that, for example, research is not included in the performance measurement system. Performance is a concept that is often confused with productivity. Whereas productivity is a fairly specific concept related to the ratio between output and input, performance is a broader concept that covers both the economic and operational aspects of an industry. Performance refers to excellence, and includes profitability and productivity among other non-cost factors, such as quality, speed, delivery and flexibility (Pekuri et al. 2011).

Education is seen here as a production process. The focus is on operations management, not on education research or on a student perspective. Education process is understood to be a process which includes teaching and all the management needed for planning and control of education. General administration, such as staff recruitment and development or procurement, is not included in this process. As well as value for money, the outputs of the education
process could be defined as how well a university is able to transform new students into the suitably qualified people that are needed in working life. The ability to learn and understand the needs of working life and blend them into course development is essential. The ability to minimise utility usages for production and operations is also critical (Phusavat 2013).

1.3 Research approach

Research is an activity that we all undertake to learn more about our environment and the impact we have upon it. Research is labelled in many different ways: academic, scientific, fundamental and applied, to give just four examples. However, all of these labels do not change the most important aspect of research itself – namely that research is about discovery (Ryan et al. 1992).

Scientific research is a value neutral, objective search for the “truth”. Scientific research is regarded as “objective” research, which means that research is a process of constructing precise theories validated by well-designed tests using large and, as far as possible, unbiased samples. Replicability and critical evaluation of method and results are the hallmarks of this type of research (Ryan et al., 1992).

A theory consists of two parts: the assumptions, including the definitions of variables and the logic that relates to them, and the set of substantive hypotheses. The assumptions, definitions, and logic are used to organise, analyse, and understand the empirical phenomena of interest, while the hypotheses are the predictions generated from that analysis (Ryan et al. 1992).

The development of a theory begins with the researcher thinking of an explanation for some phenomena. Whether he spells it out formally or not, the researcher is making certain assumptions. From the assumptions, the researcher explicitly or implicitly derives implications that can be empirically tested. The researcher must implicitly take these steps before conducting any empirical work. The reason for this is that he must have a hypothesis and theory in order to collect the relevant data.

Researchers have different methodological assumptions about the nature of reality, the role of theory and the significance of empirical experimentation (Ryan et al. 1992).

The starting point of the interpretive approach is the belief that social practices, such as management accounting practices, are not natural phenomena;
they are socially constructed. Consequently, they can be changed by social actors. This means that we should not be looking for universal laws and generalisations but for the rules, both explicit and implicit, which structure social behaviour. To study social practices in this way it is necessary to look to the relationship between day-to-day social action and the various dimensions of social structure. To study accounting from this perspective requires detailed studies of accounting practices. It is necessary to locate current practices in their historical, as well as their economic, social and organisational contexts. For this purpose, researchers adopt a holistic orientation in which accounting is studied as part of a unified social system and a picture is built up of the systems wholeness, i.e. how the various elements contribute to the individuality of the system. Such studies do not provide the type of predictive theory which is sought by positive theorists. This kind of research enables us to interpret (understand) management accounting as a social practice. A deeper and richer understanding of the social context of his/her work should enable the management accounting practitioner to cope better with the day-to-day demands of the job (Ryan et al. 1992).

Laws which have good predictive power often have poor explanatory power and vice versa. The methodology in accounting is strongly empiricist in tone. The key to this methodology lies in the nature of assumptions and in the linkage between observation and theoretical terms. It appears that the notion of the model as an abstraction of reality is a more meaningful concept for practising researchers to handle than the notion of theory. In the financial disciplines as in the natural sciences, the model is central to the development of any research programme and it is evident in the literature of these various disciplines that schools of researchers develop around particular primary or core models and later subdivide into schools associated with examining the implications and variations of particular assumptions (Ryan et al. 1992).

Inductive reasoning moves from specific observations to broader generalisations and theories. The researcher starts with specific observations, begins to then detect patterns and regularities, formulate some tentative hypothesis to explore and finally ends up developing some general conclusions or theories. Inductive reasoning is also used in this study.

1.4 Research process

We start by introducing the background for the research, the research questions and the set up for research. Next step is to study the literature to find out the
various performance management systems to be used in different situations and circumstances. We are also interested in the process control and the ways to develop controllability.

After that, we focus in more detail to the controllability of university education processes and the performance management systems of the Ministry of Education. The financial models of the Ministry of Education (2004–2006, 2007–2009, and 2010–2012) have been analysed and compared to main elements in controllability analysis. Similarities have been reported in RQ1. After this, a controllability analysis has been performed in the Faculty of Humanities and the Faculty of Technology in the University of Oulu. The analysis has been performed at a department level. The financial models of the Ministry of Education have been compared to the results of the controllability analysis at a department level and according to the year of different models. The results have been reported in RQ2. After we have answers to research questions 1 and 2, we can answer research question 3. We can use the rival explanation “what would happen without?” when answering research question 3. Once we have analysed the financial models of the Ministry of Education and the implications in the departments via the use of controllability analysis, we can answer the question “How to improve the PMS of the Ministry of Education?”

Finally, we can summarise the theoretical and practical implications of the study and offer some ideas for further research.

To establish the quality of the research, the following methods have been used for validation. For the construct validity, multiple sources of evidence have been used. Controllability analysis includes several analyses in itself. The data needed for these analyses is collected from various databases and statistics. Replication logic was used in this multiple case study for external validity. A case study database was established when collecting the data to guarantee reliability of the research. For internal validity, a rival explanation was addressed.
1.4.1 Case study analysis

Case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances. The real business of case study is particularisation, not generalisation. We take a particular case and come to know it well, not primarily as to how it differs from others but what it is, what it does. The first emphasis is on understanding the case itself (Yin 2003).

Yin has defined the case study as a research strategy. Investigation of a phenomenon within its contexts calls for a case study approach. As a research strategy, the distinguishing characteristic of the case study is that it attempts to examine:
a) A contemporary phenomenon in its real-life context, especially when
b) The boundaries between the phenomenon and context are not clearly
evident. Case study research copes with the situation where there are
more variables than data points. Such research should rely on multiple
sources of evidence, with data that is checked by triangulation that is,
supporting data from several different sources (Yin 2003).

According to Yin (2003), there are two possible strategies for case study research:
1) an analysis that focuses on a comparison of the case with existing theory, or 2)
an analysis that emphasises the development of the theory from the case.

Ryan et al. (1992, Yin 2003) have stated different kinds of case studies of
both strategies:

1. Descriptive case studies. This kind of study describes accounting systems,
techniques and procedures currently in practice.
2. Illustrative case studies. These are case studies which attempt to illustrate
new and possibly innovative practices developed by particular companies.
3. Experimental case studies. Accounting researchers have frequently developed
new accounting procedures and techniques which are intended to be helpful
to accounting practitioners. An experimental case study could be used to
examine the difficulties involved in implementing the new proposals and to
evaluate the benefits which can be derived.
4. Exploratory case studies. These studies can be used to explore the reasons for
particular accounting methods. They enable the researcher to generate
hypotheses about the reasons for particular practices. These hypotheses can
be tested subsequently in large scale studies.
5. Explanatory case studies. Such case studies attempt to explain the reasons for
observed accounting practices. The objective of the research is to generate
theories which provide good explanations.

The particular uses made of case study research methods will depend on the
nature of the research and the methodology of the researcher. Case studies are a
research method not a methodology. Case studies can be used for different
methodologies, but they are clearly better suited to some methodologies than
others.

Case studies are sometimes referred to as small sample studies. This
interpretation of case studies as small samples stems from the positivistic
methodology used in much empirical research. It is usually accepted that there is
a role for case studies in generating hypotheses which can be tested subsequently in studies based on larger samples. Thus, it is argued that case studies are particularly appropriate in areas where theory is not well developed (Yin 2003).

It is probably more appropriate to compare case studies with experiments, rather than with surveys; and to apply the logic of replication, rather than sampling logic, to case study research. This means viewing case studies as a method by which theories are used to explain observations. The objective of individual case studies will be to explain the particular circumstances of the case, whereas the objective of a research programme based on case studies in a particular area is to generate theories capable of explaining all the observations which have been made. Such an approach to case study research requires that we look for theoretical generalisations and not statistical generalisations. The former attempt to generalise theories so that they explain the observations which have been made (Ryan et al. 1992).

From a holistic perspective, generalisations and general laws do not explain, only the specific circumstances of the case can be used to explain. The particular social system being studied and its context provide the basis for an explanation. It is the relationships between various parts of the system and the systems own relationship with the larger system of which it is part that serve to explain the system. This type of explanation is what Kaplan (1964) termed the pattern model of explanation. A researcher who favours the pattern model of explanation will view case studies as an opportunity to understand social practices in a specific set of circumstances. Theories will be used to explain empirical observations, and empirical observations will be used to modify theory (Ryan et al. 1992).

Where there is a well-formulated theory and the major research issues are clearly defined, it may be possible to select a critical case which directly addresses these issues. The objective of such a case study would be to determine whether the theory provides good explanations or whether alternative explanations need to be developed (Yin 2003).

The validity of each piece of evidence should be assessed by comparing it with other kinds of evidence on the same issue. This process of collecting multiple sources of evidence on a particular issue is known as triangulation. Four tests have been commonly used to establish the quality of any empirical social research. These four tests are also relevant to case studies:
Table 1. Case study evidence (Yin, 2003).

<table>
<thead>
<tr>
<th>Tests</th>
<th>Case study tactics</th>
<th>Phase of research in which tactic occurs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct validity</td>
<td>Use multiple sources of evidence</td>
<td>Data collection</td>
</tr>
<tr>
<td></td>
<td>Establish chain of evidence</td>
<td>Data collection</td>
</tr>
<tr>
<td></td>
<td>Have key informants review draft report</td>
<td>Composition</td>
</tr>
<tr>
<td>Internal validity</td>
<td>Do pattern-matching</td>
<td>Data analysis</td>
</tr>
<tr>
<td></td>
<td>Do explanation-building</td>
<td>Data analysis</td>
</tr>
<tr>
<td></td>
<td>Address rival explanation</td>
<td>Data analysis</td>
</tr>
<tr>
<td></td>
<td>Use logic models</td>
<td>Data analysis</td>
</tr>
<tr>
<td>External validity</td>
<td>Use theory in single case studies</td>
<td>Research design</td>
</tr>
<tr>
<td></td>
<td>Use replication logic in multiple case studies</td>
<td>Research design</td>
</tr>
<tr>
<td>Reliability</td>
<td>Use case study protocol</td>
<td>Data collection</td>
</tr>
<tr>
<td></td>
<td>Develop case study database</td>
<td>Data collection</td>
</tr>
</tbody>
</table>

Analysing case study evidence is especially difficult since the required strategies and techniques have not been well defined. There are five specific techniques for analysing case studies: pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis (Yin 2003). The best preparation for conducting case study analysis is to have a general analytic strategy, for example, relying on theoretical propositions, rival explanations and case descriptions. For case study analysis, one of the most desirable techniques is using a pattern-matching logic. Such logic compares an empirically based pattern with a predicted one. If the patterns coincide, the results can help a case study to strengthen its internal validity. A second analytic technique is, in fact, a special type of pattern matching, but the procedure is more difficult. The goal is to analyse the case study data by building an explanation about the case. The procedure is mainly relevant to explanatory case studies. The third analytic technique is to conduct a time-series analysis, directly analogous to the time-series analysis conducted in experiments and quasi-experiments. The fourth technique, logic models, has become increasingly useful in recent years. The logic model deliberately stipulates a complex chain of events over time. The events are staged in repeated cause-effect-cause-effect patterns whereby a dependent variable at an earlier stage becomes the independent variable for the next stage. The complexity arises from the fact that multiple stages may exist over an extended period of time. A fifth technique, cross-case synthesis, applies
specifically to the analysis of multiple cases. Cross-case synthesis can be performed whether the individual case studies have previously been conducted as independent research studies or as a redesigned part of the same study. If there are large numbers of individual case studies available, the synthesis can incorporate quantitative techniques common to other research syntheses. Case study analysis is the most difficult stage of conducting case studies (Yin 2003).

The same study can contain more than a single case. When this occurs, the study has to use a multiple-case design. Sometimes multiple-case studies have been considered to involve a different methodology than single-case studies. Multiple-case designs have distinct advantages and disadvantages in comparison to single-case designs. The evidence from multiple cases is often considered more compelling, and the overall study is therefore regarded as being more robust. Any use of multiple-case designs should follow a replication, not a sampling, logic, and an investigator must choose each case carefully. The cases should serve in a manner similar to multiple experiments, with similar results (a literal replication) or contrasting results (a theoretical replication) predicted explicitly at the outset of the investigation (Yin 2003).

There are some weaknesses in case study research. First, there is the difficulty of drawing boundaries around the subject-matter of the case. One possibility is to place limits on the area of study, and to make those limits quite explicit. This will permit a detailed study of the area, and allow other researchers to extend the work into other areas. The second difficulty for case study researchers stems from the nature of the social reality which is being researched. The social reality must be interpreted by the researcher and, thus, case studies represent interpretations of social reality. There can be no such thing as an objective case study. It has to be accepted that case study research provides an interpretation of the social system being studied, not an objective representation. The third difficulty with case study research is the ethics of the researcher’s relationship with his/her subjects. A balance must be struck between the need to obtain access to confidential information and the prospects for using that information in a wider arena either in the study or in publishing the results (Ryan et al. 1992).

In summary, this study is an explanatory multiple-case study.
1.4.2 Units of analysis

As Stake (1995) points out, we do not study a case primarily to understand other cases. Our first obligation is to understand the one. The first criterion in selection of cases should be to maximise what we can learn. Given our purposes, which cases are likely to lead us to understandings, to assertions, perhaps even to modifying of generalisations? Even for collective case studies, selection by sampling of attributes should not be the highest priority. Balance and variety are important (Stake 1995).

Yin (2003) stresses that the simplest multiple-case design would be the selection of two or more cases that are believed to be literal replications, such as a set of cases with exemplary outcomes in relation to some evaluation theory. A more complicated multiple-case design would be, for example, a “two-tail” design in which cases from both extremes have been deliberately chosen. These designs are more complicated because the study should still have at least two individual cases within each of the subgroups, so that the theoretical replications across subgroups are complemented by literal replications within each subgroup (Yin 2003).

In this thesis, the cases consist of all the departments in the Faculty of Technology in the University of Oulu: Department of Architecture, Department of Mechanical Engineering, Department of Process and Environmental Engineering, Department of Industrial Engineering and Management, and Department of Electrical Engineering. All of the departments of the Faculty of Humanities are also included: Department of English Language, Department of Finnish Language, Saami and Logopedics, Department of German Philology and Nordic Philology, Department of History, Department of Information Studies, and Department of Literature and Cultural Anthropology. These two faculties (with all the associated departments) were chosen because their education processes are quite different. In the Faculty of Technology, studies consist of modules that students can choose. Every department has restricted the number and content of modules their students can choose. In the Faculty of Humanities, on the other hand, students have a greater freedom in choosing their courses. Even the sequence of the courses is not so restricted. Many students of the Faculty of Humanities have over 300 credits when they take their master’s degree. Even so, they have problems finding their place in working life. In the Faculty of Technology, in some departments students have gone into working life without actually completing their degree. In many aspects these two faculties are different and together they can offer a broader
picture of the PMS of the university education process. These two faculties with their departments can be seen as polar types of cases.

1.4.3 The sources of evidence

A formal structure and procedure for conducting a controllability analysis has been developed as part of the research project financed by SITRA in 1986 and conducted by Eero Eloranta and Juha Räisänen. It was developed for the use of a researcher who wants to conduct a controllability analysis in an industrial company. This structure and procedure has been used as a basis for data collection in this thesis.

![Diagram showing the collection of data]

**Fig. 4. Collection of Data.**

The data has been collected from various sources. The main sources of data are archival records and documents. Archival reports have been important data sources because departmental data has not been collected and documented as well as on the university level. Since the author has worked as a Management Accounting Manager at the University of Oulu for several years, there is also a strong personal element involved in the subject under study.
Documents that have been used in this study include: annual and financial reports of the University of Oulu, employment statistics of the University of Oulu, KeSu 2008, KeSu 2013, minutes of meeting of the government of university and board of faculties, contracts between the Ministry of Education and the University of Oulu, and financial models of the Ministry of Education.

Archival records that have been used in this study include: standard and special reports from the bookkeeping system AdeEko+ (to 2009) and SAP since 2010, special reports from the cost-accounting system CostControl (- 2009), standard and special reports from the student register database OODI, special reports from the investment database AdeInv, and standard reports from personnel database HEVI (to 2009) and Personec since 2010.

The study paths of students have been studied in the Faculty of Technology and especially in the Department of Electrical Engineering (Silvén et al. 2002). In these studies, the study paths have been seen as stairs; that is the accumulation of credits as a function of time. Illustrated like this, the accumulation of credits is easy to understand as stairs of different height leading to graduation (Rahkonen & Alha 2004). An illustration like this of students that have started their studies in years 1993, 2004 and 2006 is also included in this thesis as part of the data. The years 2004 and 2006 are quite near each other, but they have been chosen to find out the effects of the Bologna process on the accumulation of credits.

The data has been collected according to the formal structure and procedure of the “exercise book” in “Controllability analysis” written by Eloranta et al. (1986). Since the university education process has not traditionally been seen as a production process, all the measures of the controllability analysis are not clear in this context. However, it has been possible to find an equivalent to the measures used in industry. There has been a lot of data available in different databases. The problem has been to find the most suitable data for this analysis.

The structure of the production process is the indicator, which is the most innovative one in this study. After the university reform in 2010, the financial indicators and accounting standards have been similar to those of the private sector.

There have been several changes in the structure of the analysed faculties during the period 2000–2012. The Faculty of Humanities has not had any departments after 2007. The Faculty of Technology has gained the Department of Industrial Engineering and Management as a new department since 2003 and the Department of Electrical Engineering has been divided into three different
departments: the Department of Communications Engineering, the Department of Electrical Engineering and the Department of Computer Science and Engineering.

Following analyses have been made of each department in the Faculty of Technology and the Faculty of Humanities in the University of Oulu. Most of the analyses are made of years 2000–2012. The data is collected by using the organisational structure of the year 2000. However, it has not been possible to get all the information following this structure of the Faculty of Humanities since 2008.

1. *The Mutual analysis*
   - The Financial Status, years 2001–2012
   - Capital Structure, years 2000–2011
   - Working Capital, years 2003 and 2009
   - Cost Structure, years 2003 and 2009
   - Throughput time, students started their studies 1993, 2004, 2006
   - The Use of Capacity, years 2000–2012
   - Current assets, years 2000–2011
   - Summary of the Mutual analysis

2. *The Controllability of Delivery time*
   - Delivery time and reliability, from 1971–
   - Offers made compared to order book, years 2000–2012
   - Markets, years 2002 and 2011
   - Market forecasts
   - Lost margin
   - Summary of the controllability of delivery time

3. *The Controllability of Materials*
   - The structure of current assets, years 2004 and 2009
   - Number of Items, year 2009
   - The cost structure of materials, years 2004 and 2012
   - Lack of materials, years 2000–2012
   - Summary of the controllability of materials

4. *The Controllability of Capacity*
   - State of load, year 2011
- The structure of the production process, students started their studies year 1993, 2004 and 2006
- The production batch size, years 2000–2012
- The structure of labour expenditure, years 2003 (architecture) and 2009
- Summary of the controllability of capacity
2 Literature review

2.1 Organisational control

Organisational control has many meanings and has been interpreted in many ways. Tannenbaum (1968) interprets control as the sum of interpersonal influence relations in an organisation. Etzioni (1968) finds it useful to treat control in organisations as equivalent to power. Organisational theorists have also treated control as a problem in information flows (Galbraith 1973, Ouchi & Maguire 1975), as a problem in creating and monitoring rules through a hierarchical authority system (Weber 1947) and as a cybernetic process of testing, measuring and providing feedback (Thompson 1969, Reeves & Woodward 1970, Ouchi 1979). Control in organisations is achieved in many ways, ranging from direct surveillance to feedback systems to social and cultural controls (Simons 1995).

Organisations are complex and paradoxical phenomena, which can be understood in many different ways. For example, the concept “metaphor” can be used in order to help “...us to see and understand organizations in distinctive yet partial ways” (Morgan 1986:12). The metaphors discussed by Morgan include the following: the machine metaphor depicts organisations as if they were designed and operated like machines. Like machines, organisations are seen as consisting of clearly defined parts with clearly defined interrelationships and are expected to operate like machines i.e. in a routine, efficient, reliable and predictable way. The machine metaphor thus suggests that organisations can be controlled in a mechanistic way to fulfil the goals or objectives of the organisation (Högheim et al. 1989). The normative literature on management control builds upon this metaphor, and Morgan (1986) underlines the fact that the mechanistic mode of thought has shaped our most basic conceptions of what organisation is all about.

Management control is primarily a process for motivating and inspiring people to perform activities that will further the organisation’s goal. It is also a process for detecting and correcting unintentional performance errors and intentional irregularities, such as misuse of resources (Anthony et al. 1989). Strategic planning precedes the management control process. The management control process takes the strategies as given and develops a system for implementing them. The strategic planning process is irregular, whereas management control is a continuous, fairly systematic process. The management control process and the strategic planning process tend to overlap at times, but the
types of analytical tools used, the types of thinking required, and the sources of information differ and need to be explicitly differentiated. Simultaneous with management control processes, task control implements the detailed work needed to achieve organisational goals. Task control refers to the detailed control of individual work procedures. The system consists of three interrelated parts:

1. An identification of points and activities in such areas as schedules, inventory levels, and others where departures from task plans are likely to occur. These will depend on the degree of risk that the activity will go awry and the cost of the task control judged necessary.

2. A selection of control techniques and methods appropriate for each identified area, point, or activity to prevent or correct departures from plans. Different techniques and methods are used for different situations.

3. Constant review to ensure that the system is adequate for control and that employees do not override the control system.

Simons (1995) has adopted the following definition of management control systems: Management control systems are the formal, information based routines and procedures managers use to maintain or alter patterns in organisational activities. Most discussion related to control systems has highlighted the importance of monitoring results of lower-level decisions and activities and have labelled this type of ex post monitoring “output control,” “performance control,” or “results control” (Ouchi 1977, Mintzberg 1979, Merchant 1985). Deviations are noted and corrective treatment is prescribed. The underlying phenomenon is the same for control of an individual, a machine, a department, or a production line. Inputs – labour, information, material, energy, and so forth – are fed into a production or service process that transforms them into outputs of value. The quantity and quality of outputs are measured periodically and compared against pre-set standards. Feedback of variant information allows adjustment of inputs or fine tuning of the process so that future outputs will more closely match pre-set standards. From time to time, based on consistent discrepancies – for example, consistently higher outputs than anticipated – pre-set standards are adjusted. Virtually all writing concerning management control systems refers to diagnostic control systems. In fact, the term management control is usually synonymous with the definition of diagnostic control (Simons 1995).
Business strategy is at the core of the analysis for controlling business strategy. The second level introduces four key constructs that must be analysed and understood for the successful implementation of strategy: core values, risks to be avoided, critical performance variables, and strategic uncertainties. Each construct is controlled by a different system, or lever, the use of which has different implications. These levers are:

1. Belief systems, used to inspire and direct the search for new opportunities;
2. Boundary systems, used to set limits on opportunity-seeking behaviour;
3. Diagnostic control systems, used to motivate, monitor, and reward achievement of specified goals; and
4. Interactive control systems, used to stimulate organisational learning and the emergence of new ideas and strategies.

In business organisations, neither input controls nor process standardisation are viable alternatives for diagnostic management controls. Standardisation drives out creativity and the potential for innovation. Input controls allow maximum creativity but are too costly and carry the risk that organisational goals will be
subordinated to individual self-interest. Diagnostic control systems offer the appropriate middle ground for managers (Simons 1995).

The targets embedded in the formal plans and programs of intended strategies are used to monitor organisational compliance with the strategies. Diagnostic control systems, which monitor organisational outcomes, are therefore essential levers for implementing intended strategies (Simons 1995). For the purpose of developing management control systems, we distinguish between management control and other planning and control activities. Also, we shall distinguish between the control function and other functions of management (Anthony et al. 1989).

Effectiveness and efficiency are the prime criteria for the selection of measures used in diagnostic control systems (Anthony 1988). Management control uses task control to ensure efficient and effective performance at the task level. By effective, Anthony et al. (1989) mean accomplishment: how well an organisation unit does its job of producing an output of products or services or the extent to which the unit produces intended or expected results. Efficiency is used in the engineering sense of economy – as the amount of input used per unit of output. The most efficient organisation unit is the one that produces a given quantity of outputs with a minimum consumption of inputs, or the most output with given inputs. Effectiveness is always related to the organisation’s goals. Efficiency per se need not be related to specific goals. An efficient organisation unit is one that does whatever it does with the lowest consumption of resources; but if what it does – its output – does not accomplish organisation goals, the unit is ineffective.

Control is concerned with overall organisational effectiveness, yet it is in this area that both theoretical and empirical work is weak. Although contingency theories of organisational functioning have received widespread attention, it is notable that very few studies follow through their chain of logic to establish the circumstances in which one form of organisation is more effective than another, rather than stopping short at observing that it exists (Otley 1979).

There exists no generally accepted theory about organisations to support the choices in performance measurement. It follows that, because no conceptualization of organization is comprehensive, no conceptualization of an effective organization is comprehensive. Different models of effectiveness are useful for research in different circumstances (Cameron 1986).

To use diagnostic control systems to control any process, it must be possible to (1) develop pre-set standards or goals, (2) measure outputs, and (3) correct
deviations from standards. The first condition implies that managers know ex ante what quantities and types of output are desired. Diagnostic control is difficult to implement if there is a high degree of novelty in the process to be controlled. For this reason, valid diagnostic controls are notoriously difficult to implement in an R&D laboratory (Simons 1995).

According to Tocher’s (1976) definition, at least four necessary conditions must be satisfied before a process can be said to be controlled. These conditions state that there must exist:

1. An objective for the system being controlled.
2. A means of measuring results along the dimensions defined by the objective.
3. A predictive model of the system being controlled.
4. A choice of relevant alternative actions available to the controller.

This requires a predictive model of the process being controlled, that is, a means of forecasting the likely outcomes of various alternative courses of action. To the extent that such a model is non-existent or defective, the control is impossible and attempted control actions may well be counter-productive (Otley 1980).

Organisations have control systems for behaviours, costs, prices, information, decisions, financial performance, production, inventory, quality, and so forth. There are many ways to classify control systems. We can classify or categorise them with respect to the resource they are supposed to manage (financial control systems, production control systems, and behavioural control systems would be examples of this type). We can also classify control systems with respect to the type of “organisational system” performance they are attempting to control or manage. In general, there are at least seven distinct, although not necessarily mutually exclusive, measures of “organisational system” performance. They are:

1. Effectiveness
2. Efficiency
3. Quality
4. Profitability
5. Productivity
6. Quality of work life
7. Innovation

Every organisation in one way or another has systems designed to monitor, evaluate, control, and manage functions utilising one or more of these seven measures of system performance (Sink 1985, Sink & Tuttle 1989).
Sink and Tuttle (1989) note that their approach or view of measurement is that measurement for control is over-emphasised at the expense of measurement systems designed and developed to help support improvement. The bottom line is whether or not the organisation is achieving its visions of what it wants to or feels it must become. Bottom line, long term, is survival, growth, constantly improving performance, competitiveness, and behaving in accordance to your values and principles. They also propose that the bottom line for any organisation is not profitability or managing to budget.

Measurement as a control device is probably the most familiar and most frequent application of measurement. We measure or someone or something measures for us, we evaluate, and we exert influence or make an intervention on the thing we are measuring in an attempt to control it. Control is an outcome resulting from an intervention. Control is not an output. The intervention we make to establish or re-establish control is one of improvement. It is a common misunderstanding that one controls to establish improvement. The self-control of a process is an improvement intervention. Imposed control is a less improvement intervention than we would like to believe. The effective implementation of a control intervention is directly related to the quality of that intervention and the acceptance of that intervention. If we have high-quality intervention that is not accepted by those who must ultimately implement and maintain implementation of the control intervention, follow-through and actual implementation will be of low quality (Sink & Tuttle, 1989).

2.2 Performance management systems

The theoretical approaches to measuring organisational performance divide into two major lines of study, which are both rooted in the differing ways of understanding an organisation and its purposes. In the goal approach, an organisation is metaphorically seen as an instrument or as a machine. An organisation, which attains its goals, is considered successful. Today, such goal based thinking still forms a solid standard approach, which is rarely bypassed in selecting performance measures (Matikka 2002). The competing perspective is served by the systems approach. It derives from the work of Human Relationists and has been further developed by the systems research in the 1950s (Matikka 2002).

In principle, the method of performance assessment in goal models is straightforward. Once the goals have been recognised, the organisation, which
attains some predetermined objective, purpose, mission or goal, is said to be operating effectively (Strasser et al. 1981, Seashore 1983, Cameron 1986). Seashore (1983) notes that progress towards the goals can also be interpreted as a sign of effectiveness. In the goal model approach, an organisation cannot have any goals as such. Therefore, organisational effectiveness is assessed according to how well the organisation is meeting the needs or satisfying the criteria of the evaluator (Pfeffer & Salancik 1978: 34, Matikka 2002).

Literally, performance measurement is the process of quantifying action, where measurement is the process of quantification and action leads to performance. According to the marketing perspective, organisations achieve their goals, that is, they perform, by satisfying their customers with greater efficiency and effectiveness than their competitors. The terms efficiency and effectiveness are used precisely in this context. Effectiveness refers to the extent to which customer requirements are met, while efficiency is a measure of how economically the firm’s resources are utilised when providing a given level of customer satisfaction.

The level of performance a business attains is a function of the efficiency and effectiveness of the actions it undertakes, and thus:

1. Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action.
2. A performance measure can be defined as a metric used to quantify the efficiency and/or effectiveness of an action.
3. A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions (Neely et al. 1995).

There is no consensus as to performance criteria for organisational systems and there are no consensus regarding operational definitions for the commonly cited performance criteria such as effectiveness, efficiency, quality, or productivity (Sink & Tuttle 1989).

Development of a performance system includes the vision and strategy, the goals of the different views, critical success factors and the metrics. The critical success factors are knowledge, skills, capabilities, resources, features and activities through which the company prospers (Toivanen 2001). They link the goals of the organisation to the strategies. Rummler and Branche (1995) also present connections between the vision and practical metrics for improving performance at the operative level.
Critical success factors at the strategic level must be linked clearly to the business processes, or more likely the real business drivers are necessary for effective performance measurement (Camp 1994, Donovan 1999, Olve et al. 1998, Rummier & Branche 1995). Performance measurement is used for both control and improvement of activities. Measurement enables increased visibility of the quality and progress of a certain task. Measurement helps to justify, manage, and evaluate quality and productivity improvement programs. Measurement goals are also as much about communication as they are about evaluation and targets (Haapasalo et al. 2005).

Both German and Anglo-Saxon literature contain numerous examples of Kennzahlen and key ratios from the 1950s. Their purpose was to provide systematic, concise information for management control. It is emphasised in the literature that the selection of measures was based on experience and hypotheses as to what was important, and that the person receiving the information must be able to understand it well enough to use it. The necessary understanding can be provided primarily in one of three ways:

1. As an *alarm* which leads to closer examination.
2. As a *diagnosis* which may be included in such an examination.
3. As an *accumulation of expertise* on what constitute normal values for the measures, thus furnishing a better basis for taking appropriate action in the future.

From here it was a short step to the discussion in the 1960s and 1970s on hierarchies of means and ends, with a means at one level being an end at the next. Attempts at management by multiple objectives generally lost their momentum in the 1980s. Managers were searching for even more simplified ways to represent cause-and-effect relationships at companies (Olve et al. 1999).

Hitt (1988) and Keats (1988) have found that despite the vast choice of measurement options, researchers have a tendency to leave their audience unaware of the alternative measurement options. When effectiveness measures are used, the authors simply state which measure they selected, rarely justifying
or linking the decision to suggested approaches in the organisational effectiveness literature. Neither do researchers often discuss their reasons for using particular measures or their decisions to employ single or multiple measures.

“If researchers are using inappropriate measures of effectiveness, they may be developing inaccurate normative conclusions. If executives are using inappropriate measures of effectiveness, they may be making inaccurate decisions. Thus, reliable and valid measures of organizational effectiveness are surely needed” (Hitt 1988).

A researcher should clearly state what kind of a performance construct he/she intends to cover by providing answers to a list of seven critical questions drawn up by Cameron (1980, 1986), and Cameron and Whetten (1983):

1. From whose perspective is effectiveness being assessed?
2. On what domain of activity is the assessment focused?
3. What level of analysis is being used?
4. What is the purpose for assessing effectiveness?
5. What time frame is being employed?
6. What type of data is being used for assessments?
7. What is the referent against which effectiveness is being assessed?

Effectiveness is the degree to which the system accomplishes what it set out to accomplish. It is the degree to which the “right” things were completed. At least three criteria need to be used to evaluate degree of effectiveness:

1. Quality: Did we do the “right” things according to predetermined specifications?
2. Quantity: Did we get all the “right” things done?
3. Timeliness: Did we get the “right” things done on time?

To measure effectiveness, we simply compare what we said or intended to accomplish against what we actually accomplished. We can objectively and explicitly or subjectively and implicitly determine the degree of effectiveness (Sink 1985).

Efficiency is the comparison between resources we expected or intended to consume in accomplishing specific goals, objectives, and activities and resources actually consumed. Efficiency is therefore a measure of an organisational system’s performance that focuses on the input side.
Quality is the degree to which the system conforms to requirements, specifications, or expectations. Traditional definitions of quality incorporate the conformity to specifications and a timeliness criterion, which could be considered simply as a kind of specification.

It could be said that one important job of a manager is to determine:

1. What the appropriate priorities or relative weights are for each performance measure?
2. How to measure, operationally, each performance measure?
3. How to link the measurement system to improvement?

In other words, managers have to determine how to most effectively use the control system to cause appropriate changes or improvements. It is clear that the priorities or weightings for each of these performance criteria will vary according to several factors (size of the system; function of the system; type of the system and maturity of the system in terms of employees, management, technology, organizational structure and processes, etc.) (Sink 1985).

Since productivity is connected with a number of other organisational system performance measures (effectiveness, efficiency, quality, profitability, quality of work life, and innovation), it is possible for an organisational system to be productive, effective, and efficient, but not profitable; profitable, but not productive; and effective but not efficient (Sink 1985).

Plant performance is specified in terms of the dimensions of cost, quality, delivery, and flexibility. Business performance is expressed in terms such as growth, profitability, return on investment, market share, and shareholder equity (Pesch & Schroeder 1996).

The idea of presenting a number of different measures in a compact document is not new, and it is no use to make too much of the difference between the balanced-scorecard concept and previous attempts based on key-ratio reports, measures of quality, etc. Measurement is a central element in a variety of concepts, such as total quality management (TQM), business process management (BPM), European Quality Award (EQA), ISO certification, and others. In actual practice, both the balanced-scorecard concept and other methods should be adapted to the needs of the user, so that no absolute comparison of the methods as such will ever be possible. However, the other approaches are generally viewed as more limited in scope (Chanhall & Landfield-Smith 2007). Further, other researchers state that there are a number of models similar to that of Kaplan and Norton (1992). All of them are designed to measure the business
performance and to link the measures used to the company’s overall strategy (Olive et al. 1999, Toivanen 2001, Laitinen 2002).

The Balanced-Scorecard

Robert S. Kaplan and David P. Norton presented the initial thinking on the balanced-scorecard concept in an article in the first issue of the 1992 Harvard Business Review. The balanced-scorecard includes financial measures that detail the results of actions already taken. It complements the financial measures with operational measures on customer satisfaction, internal processes, and the organisation’s innovation and improvement activities – operational measures that are the drivers of future financial performance (Kaplan & Norton 1992).

The balanced scorecard allows managers to look at the business from four important perspectives. It provides answers to four basic questions (Kaplan & Norton 1992):

1. How do customers see us? (Customer perspective)
2. What must we excel at? (Internal perspective)
3. Can we continue to improve and create value? (Innovation and learning perspective)
4. How do we look to shareholders? (Financial perspective)

Customers’ concerns tend to fall into four categories: time, quality, performance and service, and cost. To put the balanced-scorecard to work, companies should articulate goals for time, quality, and performance and service and then translate these goals into specific measures. In addition to measures of time, quality and performance and service, companies must remain sensitive to the cost of their products. Since much of the action takes place at the department and workstation levels, managers need to decompose overall cycle time, quality, product, and cost measures to local levels. That way the measures link top management’s judgement about key internal processes and competencies to the actions taken by individuals that affect overall corporate objectives (Kaplan & Norton 1992).

Disappointing financial measures sometimes occur because companies do not follow up their operational improvements with another round of actions. Quality and cycle-time improvements can create excess capacity. Managers should be prepared to either put the excess capacity to work or else get rid of it. Boosting revenues or eliminating costs by reducing expenses if operational improvements are to be brought down to the bottom line must use the excess capacity. Ideally,
companies should specify how improvements in quality, cycle time, quoted lead times, delivery, and new product introduction will lead to higher market share, operating margins, and asset turnover or to reduce operating expenses. The challenge is to learn how to make such explicit linkage between operations and finance (Kaplan & Norton 1992).

Maisel’s (1992) balances-scorecard model defines four perspectives from which the business should be measured. Instead of a learning and growth perspective, Maisel uses a human-resource perspective in his model. Thus, the difference between Kaplan and Norton’s and Maisel’s model is not very significant. Maisel’s reason for using a separate employee perspective is that management should be attentive to, and should measure, the effectiveness of an organisation and its people (Olve et al. 1999).

The Performance Pyramid

McNair et al. (1990) constructed a model, which they call the performance pyramid. As with the other models, the basic principle is that of a customer-oriented model linked to the company’s overall strategy, with financial figures supplemented by several other key ratios of a non-financial nature. Traditional management-control information needs to be provided only at a relatively high level in the company. The performance pyramid is based on the concepts of total quality management, industrial engineering, and activity accounting.

Lynch and Cross (1992) developed the performance pyramid further. A pyramid of objectives and measures ensures an effective link between strategy and operations by translating strategic objectives from the top down, based on customer priorities, and measures from the bottom up.

The performance pyramid shows a company at four different levels, and provides a structure for a two-way communication system which is needed to institute the company’s comprehensive vision at the various levels of the organisation. Objectives and measures become links between the company’s strategy and its activities. In other words, objectives are translated downward through the organisation, while measures are translated upward (Olve et al. 1999).

There is a series of performance loops embedded in the measurement system. Essentially, the base of the pyramid is a plan-do-check-act circle. Non-financial measures such as on-time delivery, quality, cycle time, and waste (e.g. number of accidents, per cent rework, and scrap) provide a complete control loop, whether for an individual operation or a whole department. The business operating system
level actually consists of a double set of controls: operating and financial. The
former is to evaluate how departments work together in meeting business system
objectives. As far as the end-customer is concerned, the business performed only
as well as the quality, delivery, and performance of the last department in the
business system. Financial reporting completes the control loop used at this level,
translating the operating data into summary cost data for top management.
Moving up the pyramid, the level of detail decreases markedly, as do the
definition and realities of the timeliness and frequency of reporting cycles. In this
loop, the financial and nonfinancial measures may not agree. This may seem
somewhat paradoxical, but quality improvements, better delivery, and faster cycle
time may not translate immediately into improved profits (McNair et al. 1990).

Fig. 7. Performance pyramid (modified from Hannus 1994).

At operative level, short-term performance measurement is used for guidance,
control, managing quality, etc. The benefit-burden ratio of a measure is critical,
but also on the strategic level measures should have high practicality in utilisation
(Camp 1994, Jungman et al. 2004).
Dynamic Performance Measurement System

Dynamic performance measurement system (DPMS) is based on the company’s internal cycle of resources and principle of continuous improvements and it was introduced by Erkki K. Laitinen (1996). DPMS includes two dimensions of external performance: financial performance and competitiveness, and five dimensions of internal performance: costs, production factors, activities, products and revenues (Laitinen 1996, 2001).

EP2M

Adam and Roberts (1993) introduced yet another model, which they call EP2M (effective progress and performance measurement). According to Adam and Roberts (1993), it is important above all else to measure what the company does in four areas:

1. External measures – serving customers and markets.
2. Internal measures – improving effectiveness and efficiency.
3. Top-down measures – breaking the overall strategy down and speeding the process of change.
4. Bottom-up measures – empowering ownership and enhancing freedom of action.

According to Adams and Roberts, the purpose of a measurement system is not only to implement the company’s strategy, but also to foster a culture in which constant change is a normal way of life. Effective measures should permit review and provide decision-makers and strategic planners with rapid feedback.

Family of Measures Approach

According to Sink and Tuttle (1989), the family of measures is probably the most widely used approach to performance measurement. However, it appears that there are as many ways of conducting this approach as there are applications (Sink & Tuttle 1989).

Krajewski, Ritzman and Malhotra (2013) suggest that the specific metrics that analysts choose depend on the process being analysed and on the competitive priorities. Good starting points are the per-unit processing time and cost at each step, and the time elapsed from beginning to end of the process. Capacity
utilisation, environmental issues, and customer (or job) waiting times reveal where in the process delays are most likely to occur. Customer satisfaction measures, error rates, and scrap rates identify possible quality problems (Krajewski et al. 2013).

2.3 Performance indicators

One of the most powerful management disciplines, the one that more than any other keeps people focused and pulling in the same direction, is to make an organisation’s purposes tangible. Managers do this by translating the organisation’s mission – what it, particularly, exists to do – into a set of goals and performance measures that make success concrete for everyone. This is the real bottom line for every organisation – whether it’s a business or a school or a hospital. The metrics and performance measurement are the critical elements in translating an organisation’s mission, or strategy, into reality. Metrics and strategy are tightly and inevitably linked to each other. Strategy without metrics is useless; metrics without a strategy are meaningless. Yet, performance measurement continues to present a challenge to operations managers as well as researchers of operations management. Operating metrics are often poorly understood and guidelines for the use of metrics are often poorly articulated. While there are numerous examples of the use of various metrics, there are relatively few studies in operations management that have focused on development, implementation, management, use and effects of metrics within either the operations management system or the supply chain (Melnyk et al. 2004).

A metric is a verifiable measure, stated in either quantitative or qualitative terms, and defined with respect to a reference point. Ideally, metrics are consistent with how the operation delivers value to its customers as stated in meaningful terms. Metrics provide the following three basic functions (Melnyk et al. 2004):

- Control: Metrics enable managers and workers to evaluate and control the performance of the resources for which they are responsible.
- Communication: Metrics communicate performance not only to internal workers and managers for purposes of control, but to external stakeholders for other purposes as well. Many times stakeholders and users of metrics do not understand the workings and processes of a firm or operation, nor do they need to. Well-designed and communicated metrics provide the user with a
sense of knowing what needs to be done without necessarily requiring him/her to understand the intricacies of related processes.

- **Improvement:** Metrics identify gaps (between performance and expectation) that ideally point the way for intervention and improvement.

The term “metrics” is often used to refer to one of three different constructs: (1) the individual metrics; (2) the metrics sets; and (3) the overall performance measurement system. At the highest level, the performance measurement system level integrates. That is, it is responsible for coordinating metrics across the various functions and for aligning the metrics from the strategic (top management) to the operational (shop floor/purchasing/execution) levels. For every activity, product, function, or relationship, multiple metrics can be developed and implemented (Melnyk *et al.* 2004).

The potential performance indicators can be divided into three categories (Melnyk *et al.* 2004):

- **Outcome indicators** focus on specific characteristics of materials or objects on which the organisation has performed some operation (profit, growth).

- **Process measures** focus on the quantity of activities carried out by the organisation. This type of indicator represents an assessment of input or energy regardless of output. It is intended to answer the question, “What did you do?” and “How well did you do it?” Most efficiency related measures fall in this category (sales per employee, quality).

- **Structural indicators** assess the capacity of the organisation for effective performance. Included within this category are all measures based on organisational effectiveness (the amount and distribution of resources, number of employees).

According to Krajewski, Ritzman and Malhotra (2013), performance can be evaluated in two ways. One way is to measure variables – that is, service or product characteristics, such as weight, length, volume, or time, which can be measured. The advantage of using performance variables is that if a service or product misses its performance specifications, the inspector knows how much by. Another way to evaluate performance is to measure attributes; service or product characteristics that can quickly count for acceptable performance. Attributes are often used when performance specifications are complex and measurement of variables is difficult or costly. The advantage of counting attributes is that less
effort and fewer resources are needed than for measuring variables (Krajewski et al. 2013).

On an operational department or team level, the main variables are quality, time and cost. Time consists of the external delivery time and internal throughput time. Quality and delivery time/reliability are external variables while throughput and costs are internal variables. Examples of indicators for different variables are shown below (Hannus 1993):

- Quality
  - Deliveries according to customer specification/all deliveries, services
  - Customer claims

- Delivery time/reliability
  - Total delivery time to customer
  - Deliveries in time/all deliveries
  - Deliveries of right quantity/all deliveries
  - Defected deliveries/all deliveries

- Internal throughput
  - Set up times
  - Process throughput time
  - Processing time of a certain document, etc.

- Cost and waste
  - Time needed for value adding functions/total throughput time
  - Work needed for value adding functions/total work input

Ittner and Larcker (2003) state that many companies seem to have adopted boilerplate versions of non-financial measurement frameworks such as Kaplan and Norton’s Balanced-Scorecard, Accenture’s Performance Prism, or Skandia’s Intellectual Capital Navigator. Yet the framework’s own inventors rightly insist that every company needs to dig deep to discover and track the activities that truly affect the framework’s broad domains. Using such a framework by itself won’t help identify which performance areas – and which drivers – make the greatest contribution to the company’s financial outcomes (Ittner & Larcker 2003).

Even companies that build a valid causal model and track the right elements can fall down when determining how to measure them. Ittner and Larcker (2003),
for instance, found that at least 70% of companies they investigated employ metrics that lack statistical validity and reliability. “Validity” refers to the extent to which a metric succeeds in capturing what it is supposed to capture, while “reliability” refers to the degree to which measurement techniques reveal actual performance changes and do not introduce errors of their own. Measures can also lose validity and reliability when the methods for evaluating non-financial attributes are inconsistent across the company (Ittner & Larcker 2003).

All performance measurement systems consist of a number of individual performance measures. Following their review of the manufacturing strategy literature, Leong et al. (1990) claim that it is widely accepted that the manufacturing task, and hence the key dimensions of manufacturing’s performance, can be defined in terms of quality, delivery speed, delivery reliability, price (cost), and flexibility. Despite this assertion, however, confusion still exists over what these generic terms actually mean. Wheelwright (1984), for example, uses flexibility in the context of varying production volumes, while Tunälv (1992) uses it to refer to a firm’s ability to introduce new products rapidly. Other authors such as Garvin (1987), Schonberger (1990), Stalk (1988), Gerwin (1987) and Slack (1987) have all pointed out that the generic terms quality, time, cost and flexibility encompass a variety of different dimensions.

Table 2. The multiple dimensions of quality, time, cost and flexibility (Leong et al. 1990).

<table>
<thead>
<tr>
<th>Quality</th>
<th>Time</th>
<th>Cost</th>
<th>Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>Manufacturing lead time</td>
<td>Manufacturing cost</td>
<td>Material quality</td>
</tr>
<tr>
<td>Features</td>
<td>Rate of production</td>
<td>Value added</td>
<td>Output quality</td>
</tr>
<tr>
<td></td>
<td>introduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliability</td>
<td>Delivery lead time</td>
<td>Selling price</td>
<td>New product</td>
</tr>
<tr>
<td>Conformance</td>
<td>Due-date performance</td>
<td>Running cost</td>
<td>Modify product</td>
</tr>
<tr>
<td>Technical durability</td>
<td>Frequency of Delivery</td>
<td>Service cost</td>
<td>Deliverability</td>
</tr>
<tr>
<td>Serviceability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetics</td>
<td></td>
<td></td>
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<tr>
<td>Perceived quality</td>
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<td>Humanity</td>
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<td>Value</td>
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Performance Indicators Relating to Quality

Traditionally, quality has been defined in terms of conformance to specification and hence quality-based measures of performance have focused on issues such as the number of defects produced and the cost of quality. Feigenbaum (1961) was the first to suggest that the true cost of quality is a function of the prevention, appraisal and failure costs. Campanella and Corcoran (1983) offer the following as a definition of these three types of cost:

Prevention costs are those costs expended in an effort to prevent discrepancies, such as the costs of quality planning, supplier quality surveys and training programmes;

Appraisal costs are those costs expended in the evaluation of product quality and in the detection of discrepancies, such as the costs of inspection, testing, and calibration control;

Failure costs are those costs expended as a result of discrepancies, and are usually divided into two types:

1. Internal failure costs are costs resulting from discrepancies found prior to delivery of the product to the customer, such as the costs of rework, scrap, and materials review;

2. External failure costs are costs resulting from discrepancies found after delivery of the product to the customer; such as the costs associated with the processing of customer complaints, customer returns, field service, and warranties.

With the advent of total quality management (TQM), the emphasis has shifted away from “conformance to the specification” and towards customer satisfaction. As a result, the use of customer opinion surveys and market research has become more widespread (Neely et al. 1995).

Total quality management (TQM) is a philosophy that stresses three principles for achieving high levels of process performance and quality. These principles are related to customer satisfaction, employee involvement and continuous improvement in performance (Krajewski et al. 2013).

The TQM concept has been developed systematically in the Japanese manufacturing industry since the 1950s. In Western countries, the awakening happened as late as in the end of 1980. In the manufacturing industry quality was for a long time understood as a technical characteristic of a product and as compliance to specification. In the 1980s, a total quality management concept
was evolved with customer and employee orientation. In the 1990s the quality controls in manufacturing industry and service found each other and we can talk about customer oriented quality management. In TQM internal processes of customer/supplier relations are under investigation and key indicators are customer satisfaction and quality costs. The starting point for TQM is in Kaizen. Kaizen means continuous improvement in small steps with employee involvement. Thus TQM emphasises evolution, not revolution. The TQM inspection is often related to sub processes without questioning the core processes (Hannus 1994).

A process is the transformation of a set of inputs, which can include actions, methods, and operations, into outputs that satisfy customer needs and expectations, in the form of products, information, services or – generally – results. The output of a process is that which is transferred to the customer. In every organisation there are some very large processes – groups of smaller processes called key, critical or business processes. These are activities the organisation must carry out especially well if its mission and objectives are to be achieved.

In an organisation that is to survive over a long term, performance must begin to be measured by the improvements seen by the customer. In the cycle of never ending improvement, measurement plays an important role in (Hannus 1994):

Identifying opportunities for improvement (quality costing).

Comparing performance against internal standards (process control and improvement).

Comparing performance against external standards (benchmarking).

Measures are used in process control, for example control charts, and in performance improvement, such as quality improvement.

Manufacturing a quality product, providing a quality service, or doing a quality job is not enough. The cost of achieving these goals must be carefully managed, so that the long-term effect of quality costs on the business or organisation is a desirable one. These costs are a true measure of the quality effort. A competitive product or service based on a balance between quality and cost factors is the principle goal of responsible management (Neely et al. 1995).

Whatever process is being operated, it must be reliable and consistent. Statistical Process Control (SPC) can be used to achieve this objective. Simple
presentation of data using diagrams, graphs, and charts should become the means of communication concerning the state of control of processes.

All processes can be monitored and brought “under control” by gathering and using data – to measure the performance of the process and provide the feedback required for corrective action, where necessary. SPC is not only a tool kit, it is a strategy for reducing variability, the cause of most quality problems: variation in products, in times of deliveries, in ways of doing things, in materials, in people’s attitudes, in equipment and its use, etc. Control by itself is not sufficient. We have to think “Could we do this job more consistently and on target?” The answer drives the search for improvements (Oakland 1993).

The SPC system provides knowledge of the process capabilities and the sources of non-conforming outputs. Using statistical methods it is possible to take meagre knowledge of the output and turn it into meaningful statements that may then be used to describe the process itself. Hence statistically based process control procedures are designed to divert attention from individual pieces of data and focus it on the process as a whole (Oakland 1993).

Oakland (1993) states that SPC has considerable applications for non-manufacturing organisations, including universities. Data and information on patients in hospitals, students in universities, polytechnics, colleges and schools is available in abundance. If the information were to be used in a systematic way, and all operations treated as processes, far better decisions could be made concerning past, present, and future performance of some service sectors.

Performance Indicators Relating to Time

Time has been described as both a source of competitive advantage and the fundamental measure of manufacturing performance. Under the just-in-time (JIT) manufacturing philosophy, the production or delivery of goods just too early or just too late is seen as waste. Similarly, one of the objectives of optimised production technology (OPT) is the minimisation of throughput times.

Aggarwal (2001) claims that a revolution is occurring in operations management. During the last 15 years, three important approaches – materials requirements planning (MRP), kanban (JIT), and optimised production technology (OPT) – have invaded operations planning and control in quick succession, one after the other. Each new system has challenged old assumptions and ways of doing things. These innovative methods are completely changing not only manufacturing processes but also operations management. Managers face yet
another new alternative with the emergence of flexible manufacturing systems (FMS).

Materials requirements planning (MRP) makes available purchased and company-manufactured components and subassemblies just before they are needed by the next stage of production or for dispatch. This system enables managers to track orders through the entire manufacturing process and helps purchasing and production control departments to move the right amount of materials at the right time to production-distribution stages.

MRP assumes uneven demand, attempts to achieve zero stock outs, and concentrates on setting priorities. It requires that a precise demand forecast for each product is available and that each and every product or subassembly’s bill of materials is accurate. Managers using MRP can calculate the requirements of each and every part of subassembly week by week and identify in advance possible delays or shortages. People in inventory control can then reschedule the affected release dates for orders to try to meet the promised deliveries. MRP requires that every employee be thoroughly and strictly disciplined about feeding updates into the system (Aggarwal 2001).

The optimised production technology (OPT) system calculates the near-optimum schedule and sequence of operations for all a manufacturing company’s work centres, taking into account priorities and capacities. Advocates claim it can simultaneously maximise the use of critical resources and the plant output and minimise work-in-process inventories and manufacturing lead-times or throughput times.

This approach determines priorities for each operation using a weighted function of a number of important criteria, like advantageous product mix, due dates, necessary safety stocks, and use of bottleneck machines. OPT uses a set of management coefficients, which help determine the duration of the fixed interval and the optimal batch sizes for each subassembly or component being processed at each machine or resource. These factors must be carefully established and fine-tuned right at the start (Aggarwal 2001).

A management philosophy now known as the theory of constraints (TOC), although previously known as optimised production technology (OPT) and optimised production timetables (OPT), has changed the thinking about production and operations management in practice, but also in the academic field (Jacobs 1984, Goldratt 1988, Spencer & Cox 1995).

As the former names of TOC indicate, its methodologies were developed first in production management and afterwards it was expanded to performance
measurement (particularly cost accounting), problem solving with thought process tools and project management. In the 1980s, production management methods of TOC were subject to significant research (Aggarwal 1985, Grünwald et al. 1989) and then, in the 1990s, interest turned to throughput accounting, which is a cost accounting method of TOC (Luebbe & Finch 1992).

Goldratt (1990: 19-35) introduces three different performance measures for an organisation to ensure its goal: (1) throughput (T), (2) inventory (I) and (3) operating expense (OE). The first measure is the most important one: Throughput could be defined as the rate at which the company generates money through sales. Throughput is the selling price minus the amounts a company pays to its vendors for the items that went into the products sold, no matter when these items were actually bought. In addition to purchased parts and materials, there are other amounts to be subtracted from the selling price in order to compute throughput. Subcontracting, commission paid to an external salesman, customs duties, and even transportation should be deducted. With delivered throughput a company can cover its operating expenses and provide profits for its owners. The second measurement is inventory. Inventory is defined as all the money the system invests in purchasing things the system intends to sell. This definition departs drastically from convention when referring to material inventory. Operating expense is defined as all the money the system spends in turning inventory into throughput.

Goldratt and Cox (2004) relate the performance measures to the basic theme of making money. They define inventory broadly as “the money still in the system.” Throughput is defined as “the money on its way; this is the rate at which money is generated transforming materials into sales revenue.” Operating expense is all the money the system spends in order to turn inventory into throughput.

All things being equal, increasing the rate at which a product travels from receiving to shipping would have the effect of reducing inventory and consequently reducing money tied up in the system. Process constraints hinder this rate. A bottleneck or constraint is some factor which inhibits the rate at which products can move through the system. They represent a resource that is pressed near or beyond its capacity. Throughput can therefore be increased by reducing the effects of bottlenecks in the chain of production processes.

One of the most important objectives for TOC is to reduce the level of inventory because it has such a significant impact on profitability. According to TOC, profitability is a function of “time” and “inventory.” Reducing the time
required to pass a product through a production system reduces inventory and increases profitability.

The theory of constraints considers throughput as the first priority of management. Only after throughput is increased can inventory be reduced. Achieving these aims will ultimately provide the context in which operating expense can be effectively reduced. This reordering of priorities changes management’s view of what is important, and consequently alters the performance measurement tools used to monitor, control and improve the organisation (Salafatinos 1996).

According to Krajewski, Ritzman and Malhotra (2013), firms must manage their constraints and make appropriate capacity choices at the individual-process level, as well as the organisational level. Detailed decisions and choices made within each of these levels affect where resource constraints or bottlenecks develop. A bottleneck could be the sales department not getting enough sales or the loan department not processing loans fast enough. The constraint could be a lack of capital or equipment, or it could be planning and scheduling.

To Japanese managers, kanban or the just-in-time system is an approach for providing smoother production flows and making continual improvements in processes and products. Kanban attempts to reduce work in progress to an absolute minimum. In addition, the system constantly attempts to reduce lead-times, work-in-process inventories, and set-up times.

Kanban’s core objective is to obtain low-cost, high-quality, on-time production. To achieve this, the system attempts to eliminate stock between the successive processes and to minimise any idle equipment, facilities or workers (Aggarwal 2001). The JIT philosophy is simple but powerful – eliminate waste by cutting excess capacity or inventory and removing non-value-added activities. The eight types of waste that must be eliminated in implementing lean systems are: overproduction, inappropriate processing, waiting, transportation, motion, inventory, defects, and underutilisation of employees (Krajewski et al. 2013).

The kanban approach keeps the setup times and costs at negligible levels. In addition, the company’s suppliers are supposed to act like extended storage facilities of the company itself. Kanban is a pull system; the user department pulls the part of subassemblies from the supplier departments. No extra production or inventories are permitted (Aggarwal 2001). Lean systems use lot sizes that are as small as possible. A lot is a quantity of items that are processed together. Small lots pass through the system faster than large lots since they do not keep materials waiting. Small lots also help achieve a uniform workload on the system and
prevent overproduction. Large lots consume large chunks of capacity at workstations and, therefore, complicate scheduling. Although small lots are beneficial to operations, they have the disadvantage of increased setup frequency. A setup is the group of activities needed to change or readjust a process between successive lots of items, sometimes referred to as a changeover (Krajewski et al. 2013).

Managing supply chains effectively requires more than just good demand forecasts. Demand is the first half of the equation, and the other half is supply. The firm must develop plans to supply the resources needed to meet the forecasted demand. These resources include the workforce, materials, inventories, dollars, and equipment capacity. Operations planning and scheduling is the process of making sure that demand and supply plans are in balance, from the aggregate level down to the short-term scheduling level (Krajewski et al. 2013).

An important outcome of JIT is a disciplined programme for improving productivity and reducing waste. This programme leads to cost-effective production or operation and delivery of only the required goods and services, in the correct quantity, at the right time and place. This is achieved with the minimum amount of resources – facilities, equipment, materials, and people.

Oakland (1994) lists the aims of JIT as follows: The fundamental aims of JIT are to produce or operate to meet the requirements of the customer exactly, without waste, immediately on demand. In some manufacturing companies, JIT has been introduced as “continuous flow production” which describes very well the objective of achieving conversion of purchased material or service receipt to delivery, i.e. from supplier to customer. If this extends into the supplier and customer chains, all operating with JIT, a perfectly continuous flow of material, information and service will be achieved. JIT may be used in non-manufacturing, in administration areas, for example, by using external standards as reference points (Oakland 1994).

Performance Indicators Relating to Cost

The activity-based approach applies to an organisation’s overheads, which have been an increasing percentage of total costs for many organisations. There is some debate about how new the activity-based approach really is, but it was in the mid-1980s that Cooper and Kaplan started to draw attention to the current activity-based approach with their Harvard case studies and other writings. The essence of activity-based approach stems from two main features. First, instead of collecting
overhead costs by departments, various activities are identified and costs are collected in terms of these activity cost pools. Second, a cost driver is identified for each cost pool. Some of these cost drivers may in practice be volume-related but generally most of them are not directly related to the volume of production output (Lapsey & Mitchell 1996).

In practice, managers find that activity performance measures can be used not only to control existing activities but also to encourage problem-solving and improvement. One of the most important advantages of the activity-based approach is the fact that activities cross departmental boundaries (Lapsey & Mitchell 1996).

Another widely documented cost-based performance measure is productivity. This is conventionally defined as the ratio of total output to total input. Hence, productivity is a measure of how well resources are combined and used to accomplish specific, desirable results. Ruch (1982) has pointed out that higher productivity can be achieved in a number of ways, including:

- **Increasing the level of output faster than that of the input (managed growth).**
- **Producing more output with the same level of input (working smarter).**
- **Producing more output with a reduced level of input (the ideal).**
- **Maintaining the level of output while reducing the input (greater efficiency).**
- **Decreasing the level of output, but decreasing the level of input more (managed decline).**

Problems arise with the measurement of productivity because it is difficult not only to define inputs and outputs, but also to quantify them. Craig and Harris (1973) suggest that firms should seek to measure total, rather than partial, productivity.

Performance in quality, inventory turnover, delivery, lead times, and innovation often suffer as the drive to reduce costs prevails. Skinner (1986) notes that when cost constraints drive corporate strategy, flexibility and the ability to develop new products get lost.

Capacity is the maximum rate of output of a process or a system. Managers are responsible for ensuring that the firm has the capacity to meet current and future demand. Otherwise the organisation will miss out on opportunities for growth and profits. Capacity decisions related to a process need to be made in light of the role the process plays within the organisation and the supply chain as
a whole, because changing the capacity of a process will have an impact on other processes in the chain. Increasing or decreasing capacity by itself is not as important as ensuring that the entire supply chain, from order entry to delivery, is designed for effectiveness (Krajewski et al. 2013).

Performance Indicators Relating to Flexibility

Flexibility refers to the responsiveness of the business operating system as a whole.

Flexibility refers to the ability to make significant changes in manufacturing volumes and/or products. It entails high responsiveness to either increases or decreases in customer demand in the short term (substantially less than one year). It also may be related to flexibility to changes in product design such as the acquisition of new product lines and/or the significant modification of existing product lines (Wheelright 1978).

Dependability refers primarily to meeting all delivery commitments for new orders and parts. It includes not only the capability to stock products, but also the ability to manufacture replacement parts quickly (Wheelright 1978).

High task divergence and flexible process flows require more flexibility of the process’s resources – it’s employees, facilities and equipment. Employees need to perform a broad range of duties, and equipment must be general purpose. Otherwise, resource utilisation will be too low for economical operations (Krajewski et al. 2013).

2.4 Historical evolution of operations management

The history of modern operations management is rich and is over two hundred years old, even though its practices have been around in one form or another for centuries. James Watt invented the steam engine in 1785. The subsequent establishment of railroads facilitated efficient movement of goods. With the invention of the cotton gin in 1794, Eli Whitney introduced the concept of interchangeable parts. It revolutionised the art of machine-based manufacturing, and coupled with the invention of the steam engine, lead to the great industrial revolution in England and the rest of Europe. The textile industry was one of the earliest industries to be mechanised. The industrial revolution gradually spread to the United States and the rest of the world in the nineteenth century. The foundations of modern manufacturing and technological breakthroughs were also
inspired by the creation of a mechanical computer by Charles Babbage in the early part of the nineteenth century. Babbage also pioneered the concept of division of labour, which laid the foundation for scientific management of operations and supply chain management that was further improved upon by Frederick Taylor in 1911. Three other landmark events from the twentieth century define the history of operations and supply chain management. First is the innovation of the assembly line for the Model T car by Henry Ford in 1909. The era of mass production was born, where complex products like automobiles could be manufactured in large numbers at affordable prices through repetitive manufacturing. Second, Alfred Sloan in the 1930s introduced the idea of strategic planning for achieving product proliferation and variety, with the newly founded General Motors Corporation offering a car for every purse and purpose. Finally, with the publication of the Toyota Production System in 1978, Taiichi Ohno laid the groundwork for removing wasteful activities from within organisations (Krajewski et al. 2013).

Productivity indicates the ability of all related activity to produce. Instead of independently and separately focusing on the input and output sides, productivity represented a major philosophical shift in how a work system (including a workstation, an assembly line, a process, and a plant) would be analysed for continuous improvement. Initially, productivity measurement and analysis focused on the individual level, especially at the assembly and production lines. The pressure to increase the product volumes while lowering and/or maintaining the production cost helped underline the importance of productivity and the linkage with business planning. Individualistic viewpoints needed to be transformed into what is known today as mass production-uniformity. This uniformity requirement, under the mass production scheme, led to the need to have work standards followed and practiced by all workers alike. Standardisation was associated with this attempt. US industries used productivity as a yardstick to monitor the progress in their production and operational systems. The efforts related to eliminating wastes such as waiting time, rejects, returns, rework, and work-in-process constantly linked to productivity improvement. From the past to the present, business practices have often focused on productivity as one of the key strategic objectives (Phusavat 2013).

The history of operations and supply chains over the past three decades has been steeped in technological advent. The 1980s were characterised by wide availability of computer aided design (CAD), computer aided manufacturing (CAM) and automation. The new millennium has seen an acceleration of this
trend along with an increased focus on sustainability and the natural environment (Krajewski et al. 2013). During the past two decades, productivity measurement tends to incorporate the term downtime – including active maintenance, logistics delays, and administrative delays. The waste sometimes includes the inventory as a result of overproduction, the delay and waiting time, and the unnecessary motions of staff and employees (Phusavat 2003).

Initially, productivity studies focused on blue-collar workers. Recently, measuring workforce productivity has shifted towards a new group called white-collar and knowledge work. Their work nature is quite different from that of the shop floor since late 1970s (Phusavat 2003). Given the trends in the more significant roles of the intangible assets, attention has turned to how much value a firm is able to generate (instead of merely the products and/or services). The intangible assets such as human capital and intellectual properties have replaced the tangible assets when assessing and evaluating a firm’s market value and brand. In summary, the term “value added” represents an overall wealth created through a firm’s operational process and/or provision of services. This wealth is generated by the combined efforts of those who work in the firm (employees) and those who provide necessary capital and investments. Consideration into outsourced services during output generation needs to be included. The benefit of shifting to the value added productivity measurement contributes to another important development in the recent years. This trend is known as near-sourcing. The essential belief here is based on the need to decrease the distance between the source of supplies and the markets (Phusavat 2003).

2.5 Controllability analysis

The main goals of production can be divided into goals of productivity and controllability. Productivity is mainly dependent on events within work operations. On the other hand, controllability is based on events between work operations (work operations have to be understood here in a broad sense). Total productivity can be divided into partial productivity measures: labour, capital and materials. Controllability and productivity are interrelated. Goal conflicts can arise. For example, surplus in capacity improves controllability but sacrifices productivity, while high production load gives high productivity but low controllability (Eloranta 1981).
The controllability analysis was developed in the Helsinki University of Technology in Finland in 1980s. In the development of the controllability analysis, the idea was to use the quantitative information that production control offers. The most important starting point was to discover what is controllable in a production plant and what should be controllable. Controllability is the basis for control. This was the reason to develop a system to analyse and develop controllability of a production plant. This system was developed to analyse the production and material flow and it was called a controllability analysis. The formal structure of controllability analysis was presented in the thesis of Eloranta (1981). The controllability analysis was developed further in a research project financed by SITRA.

Controllability refers to the system’s ability to gain the targets set for it. Controllability is dependent on three factors:

1. the structure of the production system;
2. the adequacy of control parameters; and
3. the behaviour of external variables.

The structure of a production system consists of the dependencies between the input state and output variables. The adequacy of control parameters gives a picture of the adequacy of measures at the operative level that the industrial company can use to affect the internal and external variables that can be affected. The behaviour of external variables is usually more difficult to handle as part of controllability. The market (the changes in it and its irregularity and uncertainty) is the most common external variable that is difficult to affect.

The state of a production system is a constraint that affects the ability to obtain the targets of controllability quickly. In a mathematical systems theory, the state of the system is usually not regarded as a constraint to the controllability, because in systems theory controllability is defined as the ability to obtain a certain state regardless of the time spent or the initial state. From a theoretical point of view, it would be better to use the word “flexibility” instead of controllability when it is important to obtain a certain state of the production system in a restricted time (Eloranta 1981).

Three main measures have been chosen for the operation of a production plant: productivity, controllability and quality. The goals of productivity and controllability are interrelated as shown in the picture below:
Beside the traditional goals of control: delivery time, the use of capacity and current assets, throughput time has also been added as a central goal related to control. Quality has been raised beside productivity and controllability to highlight the areas of focus of production control in the 1980s.

Controllability and productivity should be seen as parts of the measures for profitability. A measure for profitability could be, for example, return on investment. It depends on two variables: the margin of profit and the capital turnover. Of the controllability goals, the turnover of current assets and throughput time directly affect the capital turnover. Other goal variables (the use of capacity and delivery time) indirectly affect the margin of profit.

It is difficult to improve the return on investments by raising the profit margin. That is why we have to focus more on the capital turnover. Capital consists of three elements: liquid assets, current assets and capital assets. Operations control usually affects only sales receivables of the liquid assets. Only machines and equipment are under study as capital assets when we focus on operations control (Eloranta 1981).

Particularly in the mechanical engineering industry, the work in process is the most important item of current assets. Work in process is straightforwardly dependent on the throughput time of the factory. Throughput time of a factory is dependent on the internal controllability properties, but for example the delivery
time of material is by exemption dependent on external controllability properties (Eloranta 1981).

Developing the controllability of production is a part of developing the production strategy. The control means of operational and tactical level are called control principles.

Eloranta (1981, pp. 17–18) provides some fundamental axioms in his doctoral thesis. The first axiom is that “the main function of operations management is control.” Operations management systems provide the organisation with control means for goal attainment. The control function is supposed to dominate other functions. The second axiom is that “controllability is a necessary precondition of control.” Operations management makes sense only if there is controllability in the object system with respect to some of its goals. There is no sense in efforts being made to use of any operations management system if the range of every possible control action is insufficient for the attainment of desired outcomes. The third axiom is that “means of control are required for goal attainment.” The fourth axiom is that “control has to be compatible with organization.” There is considerable choice about the structure of an organisation for different control situations (Child 1977). The need for compatibility between information systems and organisations is widely accepted.

Eloranta (1981) gives one classification of controllability factors in terms of manufacturing systems. He continues that the classification presented is by no means exhaustive in the case of any single production plant (Eloranta 1981). He has broken down total controllability into an oriented network of factors six levels downwards into details according to Ross’ (1977) suggestion that “everything worth saying about anything worth saying must be expressed in six or fewer pieces.”

Classification of controllability factors by Eloranta (1981):

1. Controllability
   1.1 Capacity
      1.1.1 Process factors
         1.1.1.1 Nature of machinery
         1.1.1.2 Process structure
            1.1.1.2.1 Cost of accumulation
            1.1.1.2.2 Layout
            1.1.1.2.3 Crossings
            1.1.1.2.4 Bottlenecks
1.1.1.2.5 Cycles
1.1.1.3 Nature of setups
1.1.2 Sufficiency of normal capacity
1.1.2.1 Availability
1.1.2.1.1 Reliability
1.1.2.1.2 Maintainability
1.1.3 Access to extra capacity
1.1.3.1 Subcontracting
1.1.3.2 Substitute capacity
1.1.3.3 Reserve capacity
1.1.4 Organisational factors
1.1.4.1 Personnel factors
1.1.4.1.1 Quality
1.1.4.1.1.1 Know-how
1.1.4.1.1.2 Skill
1.1.4.1.1.3 Motivation
1.1.4.1.2 Quantity
1.1.4.1.2.1 Absenteeism
1.1.4.1.2.2 Change over
1.2 Delivery time
1.2.1 Organisational factors
1.2.1.1 Company factors
1.2.1.1.1 Dep. on vert. in.
1.2.1.1.2 Financial situation
1.2.1.1.3 Situation in purchase
1.2.1.1.3.1 Supplier reliability
1.2.1.1.3.2 Leadership
1.2.1.1.3.3 Volumes
1.2.1.1.4 Situation in sales
1.2.1.1.4.1 Volumes
1.2.1.1.4.2 Leadership
1.2.1.1.4.3 Customer tolerance
1.2.1.1.4.4 Nature of demand
1.3 Materials
1.3.1 Materials flow
1.3.1.1 Predictability of need
1.3.1.1.1 Predictability of production strategy
1.3.1.2 Deterioration
1.3.2 Product characteristics
1.3.2.1 Assortment
1.3.2.1.1 Vol. of items
1.3.2.1.2 Interchangeability
1.3.2.2 Bill of materials
1.3.2.2.1 Vol. of parts
1.3.2.2.2 Number of levels
1.3.2.3 Work operations
1.3.2.3.1 Volume of operations
1.3.2.3.2 Resources required
1.3.2.4 Technical complexity
1.3.3 Product design factors
1.3.3.1 Volume of customer specifications
1.3.3.2 Lead time of production design
1.3.3.3 Subcontract prod. design

Controllability of delivery time is dependent on controllability of capacity, materials and organisation.

Controllability of capacity is dependent on (Eloranta 1981):

1. Process factors
2. Sufficiency of normal capacity
3. Access to extra capacity
4. Personnel factors
5. Controllability of materials

The nature of machinery, the structure of the physical transformation process and the nature of set ups are called process factors. As for the nature of machinery, it can be light or heavy, flexible or rigid, special or multi-purpose, single or multifunction etc. These characteristics affect costs of extra capacity, idleness and set ups (Eloranta 1986).

There are several features of the process structure affecting controllability: cost accumulation, layout, crossings, bottlenecks and cycles. Labour and materials costs can be accumulated in different ways. In extremes, the major quota of costs is accumulated at either end of the process. In the case of major costs being collected in the very first processing stages, a fluent production flow
is a necessity due to expensive in-process inventories. The other extreme is less sensitive in this respect (Eloranta 1986).

Process layout generally sets the limit for delivery performance within a factory. Functional layout can be justified for short term productivity reasons or by high flexibility to produce different products, but for control purposes it is difficult. With cells and lines throughput time is generally shorter thereby affecting the amount of work-in-process (Eloranta 1986).

A fixed bottleneck in the process simplifies control. Only the availability of resources in the bottleneck has to be checked in the production assignment and scheduling. Other work centres can be taken for granted. However, if the bottleneck is not fixed but varies according to the work contents in the factory, loading is not that easy. Bottlenecks have an impact on WIP, throughput, idleness, costs of extra capacity and delivery performance (Eloranta 1986).

Crossing in the materials flow are critical for fluent progress of work. Cycles present in some processes complicate control because of the physical feedback loops associated with their uncertain behaviour. Crossings and cycles also tend to cost extra set ups in discrete manufacturing processes.

Sufficiency of normal capacity (manpower, machines and tools) is a fundamental prerequisite for effective operations management. Sufficiency of normal and access to extra capacity are related to inventory holding costs, throughput characteristics, idleness, costs of extra capacity, delivery performance and lost profit (Eloranta 1986).

Controllability of materials is broken down into three main factors:
1. Characteristics of materials flow
2. Product characteristics
3. Product design factors

Materials flow is characterised by predictability of need, lead-time of replenishments and assortment. Besides the predictability of net requirements, deterioration including scrap, obsolescence and perishability influence predictability, too. Predictability of product structures and the nature of end product demand influence the predictability of materials needed at every level in the product structures and thereby have an impact on the applicability of long-term contracts. Unpredictability of need causes extra inventory holding costs, lost profit, stock outs and uncertainty in delivery performance (Eloranta 1986).
Long and unpredictable lead-time of materials replenishments gives low controllability. This situation can cause excess in raw materials and semi fabricates stores, lost profit and poor delivery performance.

Volume and interchange ability of materials items are assortment factors. High interchange ability simplifies control by decreasing the need for safety stocks of interchangeable items. If the number of different items is high, control is more difficult compared with one-product cases. It is important that products with high volume values are controlled properly, because even minor variations in their inventory, scrap etc. can be significant for goal attainment (Eloranta 1986).

Product characteristics are divided into (Eloranta 1986):

1. Assortment factors
2. Factors of bill of materials
3. Factors of work operations
4. Technical complexity

Assortment factors were discussed above. A complex bill of materials (several levels and parts in the product structures) affects WIP, throughput time and delivery performance.

If the chain of work operations is long – a lot of work operations and long operation times – the control task is more difficult than in cases with just a few and short work operations. This is due to the fact that each work operation is a source of variance in the product flow and therefore the range of total variance can be high. In a long operation chain there are generally several points where materials issues are made and the materials flow has to be synchronised. Variance in operations timing makes these tasks problematic, which is shown in WIP, capacity utilisation, throughput time, delivery performance, set ups and idleness (Eloranta 1986).

High technical complexity sets a need for qualified personnel and production facilities. High capacity utilisation or short delivery time cannot be expected. Lost profits due to quality problems may turn out to be high and unpredictable.

The variables affecting controllability, the controlling properties, are divided into three classes according to the goals of control:

- controllability of delivery time
- controllability of material
- controllability of capacity
The controllability of delivery time, material and capacity can be divided into components. This way we can get more detailed controlling properties, which we can then divide into internal and external controlling properties (Eloranta 1986). The external controlling properties are factors that occur outside the production system. It is difficult to control them from inside the production plant, but it is vital to adapt to them. The internal controlling properties are only dependent on the operation of the factory and its organisation.

The most important issue related to the controllability of delivery time is: what kind of customer wishes we are able to fulfil without disturbing the other goals of controllability.

The customer needs for change in plans already made may concern:

- the product itself or the specification
- the delivery time of the product
- the amount to be delivered

The delivery time of a production plant cannot be based on magic tricks at an operational level. The delivery time is a feature that relates integrally to the factory and the organisation. The controllability of delivery time affects greatly the other goal properties of controllability. The most important are: delivery time, resistance of the delivery time, lost margin due to delivery time and current asset invested in work in process and stocks. The delivery time is part of the ability to compete of the company (Eloranta 1986).

The controlling properties of material consist of a set of internal and external controlling properties. The most important are:

- the forecasts of need of material and the delivery time of material
- the resistance of the delivery time of material
- the quality failures of material
- the interchangeability of items

The controllability of material affects many goals of control, for example: the turnover of current assets and costs related to it, the delivery time and the costs related to the lack of material and degree of capacity utilisation (Eloranta 1986).

The controllability of capacity greatly affects the operations of the company. The throughput time is in key position when developing operations and their control. The most important factors featuring the controllability of capacity are (Eloranta 1986):
The goal of the controllability analysis is to find out how controllability could be developed in a company. The development of controllability aims to change the production process, operations related to it and rules of joint operations, in a way that it would be possible to reach all the main goals of control simultaneously. The controllability analysis is a technique to find out (Eloranta 1986):

1. the targets of development in production and operations and the priorities of them on a rough level
2. the financial potential of the development of production and its control.

2.6 Performance management of non-profit organisations

2.6.1 Management control in non-profit organisations

Although the precise line between for-profit and non-profit organisations is unclear, the following definition is adequate for non-profit organisations: A non-profit organization is an organisation whose goal is something other than earning a profit for its owners. Usually its goal is to provide services. The definition also emphasises a basic distinction between the two types of organisations. This distinction is the cause of many management control problems that are peculiar to non-profit organisations. In a for-profit company, decisions made by management are intended to increase profits, and success is measured, to a significant degree, by the amount of profits that these organisations earn. By contrast, in non-profit organisations, decisions made by management are intended to result in providing the best possible service with the available resources; success is measured primarily by how much service the organisations provide and by how well these services are rendered. More basically, the success of a non-profit organisation should be measured by how much it contributes to the public well-being (Anthony & Young 1988).
According to Anthony and Young (1988), certain characteristics of non-profit organisations affect the management control process:

1. The absence of a profit measure.
2. Different tax and legal considerations.
3. A tendency to be service organisations.
4. Greater constraints on goals and strategies.
5. Less dependence on clients for financial support.
6. The dominance of professionals.
7. Difference in governance.
8. Difference in senior management.
9. Importance of political influences.
10. A tradition of inadequate management controls.

In a for-profit organisation, the amount of profit provides an overall measure of both effectiveness and efficiency. The absence of a single, satisfactory, overall measure of performance that is comparable to the profit measure is the most serious problem inhibiting the development of effective management control systems in non-profit organisations.

For most important decisions in a non-profit organisation, there is no accurate way of estimating the relationship between inputs and outputs; that is there is no way of judging what effect the expenditure of x Euros will have on achieving the goals of the organisation. Issues of this type are difficult to analyse in quantitative terms because there is no good way of estimating the benefits of a given increment of spending. Since the principal goal of a non-profit organisation should be to render service, and since the amount and quality of service rendered cannot be measured numerically, performance with respect to goals is difficult and sometimes impossible to measure. If an organisation has multiple goals and no good way of measuring performance in attaining these goals, it cannot delegate important decisions to lower level managers (Anthony & Young 1988).

Since the importance of what the organisation does is not measured by demand in the marketplace, managers of public-supported organisations tend to be influenced by the personal convictions of what is important. As a substitute for the market mechanism for allocating resources, managers compete with one another for available resources. Just as the success of a client supported organisation depends on its ability to satisfy clients, so the success of a public-supported organisation depends on its ability to satisfy those who provide resources (Anthony & Young 1988). Most non-profit organisations are service
organisations. Furthermore, many non-profit organisations must provide services as directed by outside agency, rather than as decided by their own management or governing board. Organisations receiving support from the government must conform to the terms of the contract or grant. Moreover, the charter of many non-profit organisations specifies in fairly explicit terms the types of services that can be provided (Anthony & Young 1988). Anthony and Young (1988) conclude that since a non-profit organisation lacks the semiautomatic control that is provided by the profit mechanism, it needs a good management control system even more than a business does. According to them, there has been a prevalent attitude to the effect that the differences between government and business are such that government could not use the management control techniques developed by businesses.

Budgeting is a more important process in a non-profit organisation than in a for-profit organisation. Operating managers of non-profit organisations, especially those whose annual revenue is essentially fixed, must adhere closely to plans as expressed in the budget. Budgeting is therefore perhaps the most important part of the management control process (Anthony & Young 1988).

According to Olve et al. (1999), various measures of performance and ways of describing operations using key ratios have long been tried in municipalities and county government in Sweden. In the 1970s, the Swedish national Audit Office adopted a view of performance measurement which focused on the use of several separate measures to describe performance. This approach has been emphasised now that management by objectives has been adopted at national government agencies; in their requests for appropriations and annual reports, they are to use measures of various kinds to describe their performance and the effects of their activities (Olve et al. 1999).

Olve et al. (1999) found the multi-objective approach of the balance-scorecard concept both reasonable and attractive for non-profit operations. However, measuring the performance of such operations has been attempted before and has often proved difficult.

The capacity of management control practices to define the scope of the notion of strategy may be expected to have a powerful impact on what concerns and interests receive attention in organisations. It is plausible to expect the interplay between strategy, political regulation and management control in the public sector to generate “unintended” consequences with potentially detrimental effects for various constituencies. Novel control practices, such as the balanced-scorecard, have arguably tended to institutionalise notions of strategy as a matter
of aligning performance measurement and organisational action with a narrow set of clearly defined objectives (Modell 2004). It is far from clear whether broader regulatory frameworks are capable of mitigating the risks of adverse consequences of focusing organisational attention to a limited number of measurable objectives. The continuous (re-)construction of the notion of strategy through changing management control practices may be seen as an attempt to address “unintended” consequences as they emerge and require attention (Skærbæk & Tryggestad 2010, Modell 2012).

Recent central government reforms in several countries have been instituted under the dual influence of the striving towards enhanced citizen orientation and the ‘modern’ quality movement, epitomised by such notions as total quality management (TQM) (McGuire 2002, Modell & Grönlund 2006). This signifies a return to operating process considerations, but from a more externally focused and customer-orientated perspective than that associated with the ‘bureaucratic’ values historically dominating central government (McGuire 2002). Potential inconsistencies associated with recent reforms may be reconciled by re-casting citizens as customers and relying on customer satisfaction indicators as proxy outcome measures, closely related to short-term, operating process aspects (Modell et al. 2007).

Modell (2007) states that the difficulties in establishing process-orientated management practices more firmly within Swedish central government may be traced to the constraints embedded in the dominant mode of governance pivoting around the vertically orientated ‘managing for results’ system. The limited progress in implementing process-orientated management practices has also weakened the influence of advocates of such practices, such as the National Council for Quality and Development. This is notably manifested in the recent decision by the Swedish Agency for Public Management not to nurture a more process-orientated approach while integrating other properties of the ‘modern’ quality movement, such as the emphasis on customer orientation, into its performance management model. At the policy level of Swedish central government, there is clear evidence of ‘managing for results’ entailing increasing returns, which preclude alternative performance management models from seriously challenging its institutionalised position (Pierson 2000). Few actors have been compelled to subscribe wholeheartedly to ‘modern’ quality management techniques. Doing so would appear risky and potentially costly as a result of their mixed track record and uncertain future in Swedish central government (Pierson 2000). Instead, some selective adoption of properties
deemed consistent with the ‘managing for results’ model, such as the emphasis on customer satisfaction, is discernible in the recent attempt by the Swedish Agency for Public Management to reconcile this model with the citizen-focused reform agenda. This has reinforced the dominant position of ‘managing for results’ at the expense of process-orientated management practices and underlines the path-dependent and evolutionary nature of change (Modell et al. 2007).

Cavalluzzo and Ittner (2003) found that in the public sector performance measures development and accountability are hindered by factors such as inadequate training, the inability of existing information systems to provide timely, reliable, and valid data in a cost effective manner, difficulties selecting and interpreting appropriate performance measures, lack of organisational commitment to achieving results, and limited decision-making authority. They also found that the GPRA (Government Performance and Results Act) pilots have developed performance measures to a greater extent to meet the Act’s requirements, but do not make greater use of the information. This result is consistent with institutional theories, which contend that implementation of externally-mandated control systems is likely to be symbolic, with little influence on internal operations (Cavalluzzo & Ittner 2003). Geiger and Ittner (1996) suggest that government cost and management accounting systems are primarily implemented to satisfy regulations and legitimate the agencies’ activities to external stakeholders by creating the impression that the agencies are tightly controlling their operations.

In the public sector, empirical and theoretical studies indicate that problems selecting appropriate metrics and interpreting results often stem from four features common to many federal programmes: (1) the complicated interplay of federal, state and local government activities and objectives, (2) the aim to influence complex systems or phenomena whose outcomes are largely outside government control, (3) missions that make it hard to develop measurable outcomes, to attribute results to a particular function or to observe results in a given year, and (4) difficulties measuring many dimensions of social welfare or other governmental goals (Cavalluzzo & Ittner 2003).

With the growing availability of empirical data from performance measurement systems, researchers are going beyond questions of how to “manage for results” and exploring the implications of performance measurement for both individual behavioural responses and organisational outcomes. Despite the wide-ranging use of performance standards and measures in public programmes and the growing use of performance bonuses to recognise high performance achievements,
the inclusion of formal performance standards adjustment procedures in these performance measurement systems is still relatively rare. Most programmes or organisations also set expectations for progress toward performance goals, that is, targets for performance improvements to be achieved in a given time frame. In many public sector performance measurement systems, these targets are annual and, increasingly, they also incorporate expectations for “continuous performance improvements,” a “total quality management” principle (Deming 1986). Few public programmes opt to undertake the final step of developing formal procedures to regularly adjust performance expectations for unanticipated or uncontrollable factors that might thwart progress toward the goals. In this regard, they neglect a corresponding tenet of total quality management that advocates the use of statistical analysis to adjust for factors outside managers’ control in evaluating and managing performance (Deming 1986). The lack of adjustment mechanisms is likely to be particularly problematic for programmes that involve multiple levels of government and numerous organisations. For example, if a national student loan programme is setting performance measures only at the national level, there may be little need to have a formal adjustment procedure, as any shortfalls in performance can be addressed on an ad hoc basis in the agency’s annual performance report. On the other hand, when the federal government rates and ranks states or other sub-national units on performance and recognises or rewards (or sanctions) performance accordingly, failure to take into account relevant factors that are outside program managers’ control can contribute to serious problems and unintended consequences (Barnow & Heinrich 2010).

Modell (2005) states that surveys frequently find than an abundance of financial as well as non-financial performance indicators and internally focused measures reflect inputs and efficiency while relatively little attention is paid to the subsequent outcomes of operations. Outcomes are distinct from outputs in that they reflect the more indirect and often long-term effects of operations on specific groups of citizens or beneficiaries of public services, or society at large in terms of beneficiary well-being and social welfare. In the public sector, performance information has much wider uses and audiences beyond merely serving an instrumental function as a means of managerial control (Modell 2005).

Historically, relatively detailed regulatory frameworks focusing on operating aspects and compliance with the rule of law evolved in most advanced democracies and were long legitimised as necessary vehicles of democratic accountability and control (Hood 1995). The emergence of more explicit notions of strategy and strategic management in the public sector is part of the wider
onslaught on such regulatory frameworks, notably spearheaded by the Reinventing Government movement in the US (Osborne & Gaebler 1992, Gore 1993) but also replicated elsewhere (Luke & Verreyne 2006, Lane & Wallis 2009, Modell 2012). Following the identification of excessive political regulation as a key problem for strategy to resolve, the ideal conception of strategic management has often been one of long-term goal-directedness and pro-active management as opposed to the allegedly reactive and short-term nature of traditional public management practices (Johansson 2009, Lane & Wallis 2009).

The allocation of resources within the Australian Public Service (APS) at a time of considerable constraint, forward budget estimates as the primary documents of allocation were, almost undoubt edly, going to have more force than the organisation’s corporate plans. Effectively, the strategic management cycle of the FMIP (Financial Management Improvement Program) was likely to start at the budget and resource allocation phase, not the strategic-planning phase (Johnston 1998).

New management practices have only partially replaced established ones. Hybrid arrangements straddling the principles embedded in private-sector-style management and traditional public management practices are common and give rise to tensions and paradoxes (Modell 2005). Recent survey-based research would seem to vindicate normative claims regarding the benefits of explicit strategic management in the public sector. Reliance on goal-directed strategic planning has been found to have a positive impact on the performance of public sector organisations (Walker et al. 2010) whilst extensive political influence or an absence of formal processes of strategy formation tend to detract from performance (Andrews et al. 2009). At the same time, however, it is recognised that emerging notions of strategy have not fully replaced, but rather form a complex interplay with, external political regulation of public sector organisations (Andrews et al. 2008, Johansson 2009). There is some evidence of SMA being implicated in this interplay. For instance, SMA techniques, such as the balanced-scorecard, have arguably had an important influence on some regulatory frameworks established to reinforce “arm’s-length” as opposed to more detailed regulation of public services (Modell 2012). A general argument against the use of a rational planning approach in the public sector, with its emphasis on quantification and clear means-ends relationship, is that it is too demanding of knowledge, information and the ability to make informed decisions. McSweeney (1988), in discussing value-for-money audits, examines a number of the difficulties with such an approach. These
include: the lack of a direct and knowable link between intentions and outcomes; the
difficulty of identifying explicit and quantifiable goals; the ability to
manipulate information; and, a concentration on quantification and a lack of
regard for qualitative factors. If systems are implemented and operated in very
rigid ways, major dysfunctional effects may occur. A number of possible adverse
consequences have been suggested, including tunnel vision, sub optimisation,
myopia, ossification and misrepresentation. Hofstede (1981) argues that
consideration must be given to the organisational context in which a system
operates, and highlights the danger that “the more formalized a control system,
the greater the risk of obtaining pseudo control rather than control.” He goes on to
suggest that where outputs are ambiguous and are not easily measured, and where
the effects of management intervention are not well known, the adoption of
mechanistic, rationalistic, techniques-driven management systems are likely to
have unintended consequences (Hyndman & Eden 2000).

Modell (2003) summarises the research of NPM as: Despite the proliferation
of performance indicators in the public sector, surveys as well as more
prescriptively oriented discussion papers often raise concerns over the lack of
conformance of performance management practices to the rational, goal directed
management model underpinning reforms. The development of performance
indicators rarely appears to be guided by formally stated objectives, strategies and
targets and considerable gaps are found in the control cycle whereby performance
measurement is linked to regular evaluation procedures and form the basis for
feedback and forward-oriented goal-setting and planning. A common complaint is
that public sector performance measurement practices generate a plethora of
statistics but little useful information for control. Concerns have also been raised
over the lack of stability in the reporting of performance indicators over time,
which exacerbates analyses and comparisons of performance (Modell 2005). A
primary theme in empirical research informed by this approach has been to
explore how public sector managers and organisations respond to external
pressures to adopt various PM practices (Modell 2003).

The research of performance measurement in public-sector and not-for-profit
organisations has been more like preparing reviews of what is happening in
different countries. The problem is that this kind of research is on a macro level
and so does not provide a benchmark to construct a performance measurement
system. The focus of the research has been, as Modell (2003) states, how to
respond to external pressures to adopt PM practices. It is almost impossible to
find any research concerning implementing a performance measurement system
in a public sector even if this kind of systems have been implemented all around the world.

2.6.2 Performance management of a university education process

Czarniawska et al. (2001) state that the “production” metaphor for a university needs to be taken literally. They further suggest that the product and the production process are inspected and moulded into comparable terms, and the results presented to the potential buyer. The motives for the transformations initiated or executed in Polish or Swedish universities appear to be the same when expressed in market terms: to raise the quality of the production process and thereby to improve the product, and develop a “competitive edge” vis-à-vis the competitors within and outside the higher education organization field.

Czarniawska et al. (2001) continue: if our reading of the contemporary markets is correct, it is difficult if not impossible to assess the quality of the production process and its results in a university. This does not mean, of course, that attempts are not constantly being made. Although everybody knows that teaching evaluations establish only the popularity of the teachers and the quantitative indicators measure what can be measured, but not what it is important to measure, the activity still flourishes. This is due to the fact that the market requires detailed information about both production and product. The buyers, unable to get the information they need, have to satisfy themselves with the information they get (Czarniawska et al. 2001).

Knowledge about the product or its technology is not enough to win over the competition. All competitors obviously claim that their knowledge production is superior to that of others, in terms of the process itself and of its results. If somebody is to decide who the winners are – be they financiers, the media, the students’ parents or their future employers – there must be a common set of criteria upon which to base a decision. If we are to enter the competition for resources, attention or legitimacy, it has to be possible to compare us with others. The university is itself a powerful standardiser as it sets the criteria for higher education certificates. What the university is not accustomed to, however, is to think about itself as an object of standardisation (Czarniawska et al. 2001).

Parker (2002) suggests that funding restrictions have forced many small sized universities to enter the world of mass student education for which they have inadequate infrastructure and resources. For the same reasons, larger universities have been forced to adopt larger class sizes, lower cost contract teaching
arrangements, and lower quality student intakes for fee generation. In response to external environmental pressures, professional managers undertake the internally inconsistent exercise of attempting to extract both cost savings and increased revenue out of a static or shrinking set of resources (Parker 2002).

As Bogt and Scapens (2011) note, in the university sector it seems quite clear that NPM (new public sector management) has had a substantial influence on recent developments. Universities have been subject to various institutional pressures which have led to the introduction of new accounting practices and new performance measurement systems. In many countries, the government funding of universities has become increasingly contingent on their performance in research and teaching. Research performance is usually measured by the number of publications in academic journals, with the international rankings of these journals being used as an indicator of quality. Teaching performance relates to the numbers of students, the degrees awarded, and the “quality” of the education provided. In assessing teaching quality, student experiences and perceptions play an important role (Bogt & Scapens 2011).

Performance indicators and external quality evaluations are an integral aspect of the new model of distant steering, and a number of countries have introduced some degree of performance-based funding. There has been a growing appetite for performance and quality measures from both higher education public and private stakeholders, as well as from the HEIs themselves. Of particular concern to policy makers is the magnitude of non-completion, often perceived as a waste of financial and human resources. In spite of the adoption and development of sophisticated quality assurance systems in most OECD countries over the past two decades, failures and inefficiencies in the learning process have not been eradicated (OECD 2012).

In the framework of performance management, higher education is seen as a process for transforming inputs (notably students’ time, academics’ time, consumables and the services of equipment and buildings) into outputs, which can be broadly classified as relating to teaching, research or some third mission. Outcomes are the products of a university in the long run and include, for instance, building a well-educated society (Boland & Fowler 2000). All of this process is monitored and controlled. At the end, the output and the outcome are measured against pre-established targets and, if there is a difference between these and the actual outputs/outcomes, corrective action occurs. If working well, a PMS should provide information on important matters, promote appropriate behaviour,
provide mechanisms for accountability and control and create a mechanism for intervention and learning (Melo et al. 2010).

Ewell (1999) discovered that one dimension shared by all the commentators of university performance measures is some variant of the input-process-output continuum. In addition, most agree that indicators drawn from all three of these sub-domains are important for policy purposes. The increasingly popular alternative of examining outcomes alone ignores important differences in institutional context, including both invested resources and differences in practice that may be largely responsible for variation in outcomes. Not taking inputs into account when examining outcomes thus risks holding institutions responsible for matters that are beyond their control: a problem prominently illustrated by the use of graduation/completion rates in state-level PI systems despite the fact that most of the variation in this measure results from differing levels of admissions selectivity. These considerations become especially salient when PIIs are linked to resource allocation (Ewell 1999).

Some classification frameworks have been developed to manage the education process. One is the Process Classification Framework. APQC Process Classification Framework for Education serves as a high-level enterprise model that allows educational organisations to see their activities from a cross-functional viewpoint. The PCF enables organisations to understand their inner workings from a horizontal process viewpoint, rather than a vertical functional viewpoint. The PCF does not list all sub-processes within a specific organisation, and every process listed in the framework may not be present in every organisation. However, the highest level for Enterprise Architecture would remain the same. APQC Education was developed in 1996 with the vision of utilising the same strategies that had transformed businesses to enhance the U.S. education system (APQC 2013).

Another important classification is that of UNESCO. UNESCO developed the International Standard Classification of Education (ISCED) to facilitate comparisons between education statistics and indicators across countries on the basis of uniform and internationally agreed definitions. In 2011, a revision to ISCED was formally adopted by UNESCO Member States. The product of extensive international and regional consultations among education and statistical experts, ISCED 2011 takes into account significant changes in education systems worldwide since the last ISCED revision in 1997. The ISCED classification works best at a country level (UNESCO 2011).
The Ministry of Education in Finland used the following criteria for evaluating the performance of a university education process during years 2004–2006. The funding of universities is also related to these criteria:

- Number of entrants
- Number of entrants with a secondary school degree of the same year
- Number of entrants from open university
- Number of registered students
- Number of registered full-time students
- Number of foreign students
- Number of degrees conferred
- External financing/total financing (%)
- Number of visiting students from overseas
- Number of students in open university
- Number of degrees conferred compared to goal levels established in governmental charters
- Median age of students getting a doctoral degree

The Ministry of Education runs a KOTA-database where the most relevant statistics and performance indicators are registered on students, degrees, staff, adult education, financing, cost-accounting, premises, international work and scientific publications. Universities have to report on these topics in their annual reports and financial reports.

Universities have also their own information systems for gathering information about the performance of an education process. Usually the focus is not on a process, but on very fragmented pieces of information. Universities may have adopted ideas of BSC or EFQM theories and concepts, but the connection to these theories may in reality be quite loose.

One problem of the management by objectives approach used by the government of Finland is the binding of targets to budgets. This can lead to a never-ending development of measures, because every aspect of the function has to be measured in the name of fairness. The agencies may be opportunistic or selective – they want to show data that favours them. Due to these risks, many countries have decided to keep the basic grant and reward grants separate (Lumijärvi & Salo 2006).

Caruana and Ewing (1998) state that despite talk of quality, government audits appear to have become more obsessed than ever by numerical measures of performance, which neglect some of its essence. Universities have to balance
accountability with autonomy, while satisfying the demands of overseeing agencies without suffering the damaging effects of subordination. The need to establish and measure performance standards in higher education is widely recognised as is the difficulty to determine the performance measures to be used (Caruana & Ewing 1998).

Modell (2003) has identified the following performance indicators that the National Swedish Agency for Higher Education used in 1999–2001 for financial performance:

- Revenues (total and by funding source)
- Costs
- Net results
- External transfers
- Revenues, costs and net results associated with subsidiaries or holdings
- Equity
- Change in equity
- Grants from research foundations (reported for each foundation)
- Research funding (total and by funding source)
- External funding (%) (i.e. not state grants)
- State grants (%) (research grants separate)
- Maximum allowed state funding of undergraduate teaching
- Value of produced undergraduate education/maximum allowed state funding of undergraduate teaching (%)
- Accumulated value of excess production over maximum allowed state funding of undergraduate teaching
- Accumulated value of unutilised allowed state funding of undergraduate teaching
- Value of produced undergraduate education

According to Modell (2003), comparable performance indicators for undergraduate education reported by the National Agency for Higher Education in Sweden (1999–2001) are:

- Number of entrants
- Number of first-time entrants
- Remaining in second year
- Number of entrants not previously registered at other university
- Number of openings for entrants
- Number of first-choice applicants
- Number of first-choice applicants/number of openings for entrants
- Number of registered students
- Number of registered full-time students
- Number of full-time credits achieved
- Number of full-time credits achieved/number of registered full-time students (%)
- Number of degree conferred
- Number of first degrees conferred
- Number of first degrees conferred/number of degrees conferred (%)
- Number of degrees conferred requiring three years or more of full-time studies
- Average credits per degree
- Graduation with bachelor degree within seven years (%)
- Average credits after three years
- Median age of entrants
- Proportion of entrants
- Male (%)
  - With working-class background (%)
  - With immigrant background (%)
  - Raised by university-educated parents (%)
- Courses with equal gender distribution (%)
- Full-time courses with equal gender distribution
- Proportion of non-traditional students
- Number of visiting students from overseas
- Number of own students visiting overseas universities
- Number of own students visiting overseas/number of students with first degree
- Number of degrees conferred compared to goal levels established in governmental charters
- Number of topics taught at masters level
- Number of master degrees conferred/number of topics taught at masters level
- Transitions to postgraduate education/number of students with completed undergraduate degrees (%)

Modell (2003) further notes comparable staff-related performance indicators reported by the National Agency for Higher Education in Sweden:
Number of staff
- Number of staff (excl. doctoral students)
- Number of teaching staff
- Teaching staff/total staff (%)
- Number of full-time students per teaching staff
- Number of teaching staff with doctoral degrees
- Number of teaching staff with doctoral degrees/total teaching staff (%)
- Number of full professors
- Number of full professors/total teaching staff (%)
- Number of (non-chaired) full professors (individuals)

Modell (2003) concludes that whilst the coupling between most of the performance indicators developed and formally stated in goals for universities and colleges is relatively loose, the goal-directed model cannot be completely rejected as a heuristic informing recent change in performance measurement practices. Modell (2003) continues that, whilst the inert development of more detailed financial performance indicators and direct linkages between resource allocation and quality control has recently come under increasing criticism from a number of actors, the responses of political leaders as well as universities and colleges seem to be characterised by some "hypocrisy". Universities and colleges lobby for radically enhanced funding levels, but display resistance to more clearly account for resource utilisation by developing more detailed financial performance indicators and have taken few pro-active steps in this direction in the past (Modell 2003).

Modell’s (2003) study illustrates how additional insight into the “gaps” in public sector performance management practices can be gained from complementing the relatively static approach adopted in much prior research, seeking to explain logical inconsistencies between formally stated goals and observed performance indicators. Modell (2003) continues that future studies could extend this complementary research approach to the micro level of analysis to assess how gaps between goals and performance indicators within operating-level organisations interrelate with those observed at the macro level of specific organisational fields.

Coate (2009) studied curricula in her article *Curriculum*. She states that the control, agency and power that individual academics possess to design and develop curricula can be eroded as external demands increase, and systematic controls are put in place over programmes of study. Historically, most academics
in universities held a great – almost total – degree of freedom to design and develop curricula as they deemed appropriate. She continues that these expectations of curricula are not only occurring nationally, but are now developed and discussed at supra-national levels. The most obvious example is the Bologna Process, through which the ministers of higher education from 45 countries in and around Europe agreed to harmonise degree structures. The Bologna Process has had a substantial impact on some national systems, in terms of changes to length of degree programmes, and moves towards modularisation or semesterisation. The European Credit Transfer System (ECTS) has increased awareness across different national systems of issues of standardisation of curricula outputs (The Routledge International Handbook of Higher Education 2009).

Thompson (2005) has studied in the not-for-profit setting of universities the issue of constrained versus unconstrained demand in relation to course scheduling. Course scheduling is the determination of which courses are taught on what days and at what times, in which rooms and taught by whom. He sees that ensuring that students can get the courses that they desire is vitally important because it can help ensure that students graduate on time (Thompson 2005).

Goals of production are presented in Figure 8 on page 65. These are quality, productivity and controllability. The goals of productivity and controllability are interrelated. Classification of controllability factors used in the controllability analysis is presented on page 66. They relate to capacity, delivery time and materials. These again relate to productivity and controllability. The management of the material flow (student proceeding) is a relevant part of the controllability. The theory of constraint includes tools and techniques which can also help to manage the material flow in universities. The indicators to be used in this study can be partly found among the indicators of Ministry of Education in Finland and those used in Sweden. However, many indicators have not been used earlier regarding the management of universities. The indicators that have been used in this study are:

- total finance of the department
- capital structure of the University
- working capital of the department
- cost structure of education on department level
- length of studentship
- students per professor and teaching staff
- number of students
- length of studentship compared to standard time
- targets set by the Ministry of Education compared to offer by University
- employed and unemployed students after graduation
- forecast of the Ministry of Education on need for workforce
- lost margin
- number of students classified by semesters
- number of different courses available
- cheap/expensive courses included in degrees
- number of applicants per number of new students
- study paths
- number of new students
- labour costs related to education
3 The empirical context of the research

3.1 The university sector in Finland

The Finnish higher education system consists of two complementary sectors: polytechnics and universities. The mission of universities is to conduct scientific research and provide undergraduate and postgraduate education based on it. Universities must promote free research and scientific and artistic education, provide higher education based on research, and educate students to serve their country and humanity. In carrying out this mission, universities must interact with wider society and strengthen the impact of research findings and artistic activities on society.

Under the new Universities Act, which was passed by Parliament in June 2009, Finnish universities are independent corporations under public law or foundations under private law (Foundations Act). The universities have operated in their new form from 1 January 2010 onwards. Their operations are built on the freedom of education and research, and university autonomy.

Universities confer bachelor's and master's degrees, and postgraduate licentiate and doctoral degrees. Universities work in cooperation with the surrounding society and promote the social impact of research findings.

The structural development of higher education institutions has preceded in recent years on the basis of the institutes’ own development lines. The number of universities has decreased from 20 to 16 and the number of polytechnics from 30 to 25. The universities and polytechnics will be developed with emphasis on their specific characteristics and aims as different, mutually supplementary forms of education with different degrees, degree titles and missions. The financing models in higher education will be developed to give more incentive to cooperation and division of work.

According to the Ministry of Education, the Finnish higher education network is still too fragmented. The targeting of education has not sufficiently accommodated changes in labour market needs. Problems relating to completion rates, attraction and graduate placement are more common in small university and polytechnic subsidiaries. The recent university reform created a basis for further structural renewal. The competitiveness of regions depends on their success in the global market. It is necessary to pool resources into regional knowledge clusters, determine common strategic aims for cooperation and agree on mutual division of
work. Impact will grow through the enhancement of the quality of education and research and the utilisation of research and innovation competencies in business and in working life.

The Ministry of Education sees that the weaknesses in the current higher education system are delayed placement in education, delayed graduation and multiple periods of education. In Finland over 40% of the 20 to 29 age group are in education, whereas the figure in other OECD countries is only 25%. The university degree reform did not shorten study times or bring about any great increases in national and international mobility. The factors slowing down educational progression are the need to work while studying, inadequate student and career guidance, inflexible teaching arrangements, and problems with study skills and motivation. The reform of student admissions in higher education institutions is underway with view to expediting the start of studies. The aim of the reform is to ease the situation in student selection with better availability of information about education provision, a smaller number of programmes and larger programme entities. An electronic application and selection system adopted in 2013 will facilitate the application process for both the applicant and for the higher education institution. At present, the regulation of the higher education system is too detailed. Along with the admission reform, there is need to reform the regulation of educational responsibilities with a view to strengthening the institutions’ capacity for flexibly responding to changes in science, working life and society. With a view to promoting progress in studies and study motivation, the choice of specialisation will take place at a later stage in studies. The university and polytechnic degrees have different aims and contents. Polytechnic graduates mainly enter the labour market after gaining a bachelor’s degree. In universities, students primarily study for master’s degrees. The aim is that university and polytechnic graduates enter the labour market one year earlier than now.

University funding will be linked more closely to credits awarded and to student feedback. The feedback system is being jointly developed by Universities Finland UNIFI, student organisations and the Ministry of Education and Culture (Education and Research Plan 2011–2016, Ministry of Education).

The Funding Model

The government of Finland adopted a performance based steering model in 2004. All the ministries had to set performance targets to the agencies in their field.
These performance targets were usually also a basis for allocating money between the agencies. The idea was to institute a more productive and more efficient government in Finland.

The Ministry of Education has had several financial models for universities during the 21st century. The models were for years 2004–2006, 2007–2009, 2010–2012 and the current one is for 2013–2016. During 2000–2003, the Ministry of Education used a history based model to finance the universities in Finland. However, the Ministry already introduced the new model for financing the universities. Here we focus on the criteria of the model that is related to master’s degrees. The financial models of the Ministry of Education have focused on the master’s degrees after 2004. But even before that the financial model was partly used beside the historical base. The Ministry of Education and the University sign an agreement concerning results and finance. The finance is based on the model and there is only a very small part in the model that is called strategic money. This is the part that the Ministry and the University can discuss in their negotiations before signing the agreement. After 2010 the agreement is made for three years. Before that, the agreement was signed every year. This agreement is the main control mechanism the Ministry of Education uses.

The Ministry of Education and Culture appointed a committee to review the university funding model and make a proposal for its reform. The proposal designed to enable the new funding model to be applied in the allocation of the core funding referred to in Section 49(3) in the Universities Act (558/2009) for 2013.

The committee’s proposal is based on its vision of a good Finnish university in 2020. The aim is a better, more efficient international university system with stronger impact and a better defined profile. The new funding model is one step towards this desired state.

One key change proposed by the committee to the model used in 2010–2012 is a greater emphasis on quality, effectiveness and internationalisation. Funding would no longer be allocated on the basis of target number of degrees, and the relative weight of scientific publications would grow.

The model comprises three main parts: education, research, and other education and science policy objectives. It is proposed that a total of 75% of the core funding would be allocated on the basis of a formula for education and research, of which 41% would be based on educational factors and 34% on research factors. The remaining 25% of the core funding would be based on education and science policy objectives.
The proposed education-based funding criteria are (as % of core funding): master’s degrees awarded by the university (15%), bachelor’s degrees (9%), the number of students completing a minimum of 55 credits (11%, of which 3% is based on data produced by the student feedback system from 2015), credits completed in open university and non-degree studies (2%), the number of degrees awarded to foreigners by the university (1%), incoming and outgoing international student exchanges in the university (2%) and the number of job-holding graduates (1%).

The proposed research-based funding criteria are: doctoral degrees awarded (9%), publications (13%, of which 10% relates to international refereed publications and 3% other scientific publications - from 2015 the number of Finnish Publication Forum classification levels 2 and 3 publications instead of international refereed publications and the number of level 1 publications instead of other scientific publications); competed research funding (9%, of which 3% is international competed research funding and 6% other competed research funding); doctoral degrees awarded to foreigners (1%); and foreign teaching and research personnel (2%).

It is proposed that funding would no longer be based on the target numbers of degrees agreed upon in negotiations between the Ministry of Education and Culture and the universities; these target numbers would only indicate the maximum number of degrees for which each university receives funding. As regards master’s degrees, it is proposed that the current fields of education be grouped into larger entities.

The funding of other education and science policy objectives is proposed to comprise strategy-based funding (10%), field-specific funding (8%) and funding for assigned national tasks (7%). The strategy-based share is determined on the basis of the universities’ own strategy work and it is proposed that monitoring indicators be devised to help in implementation and development. The indicators would not be directly linked to the funding.

The field-specific funding share (8%) is proposed to be allocated to the universities as follows: art universities and fields of art 2.75%, natural sciences 1.5%, technology 1.5%, and medical sciences 2.25%. These funding shares would be allocated to the universities by fields of education in proportion of their total teaching and research personnel.

The funding to be based on assigned national tasks (7%) would comprise funding for national duties which serve social policy or higher education and
science policy aims, funding needed for the coordination of university centres, the funding of the National Library and funding for teacher training schools.

The Ministry would allocate funding to the universities in a lump sum. The university would then distribute the funds at its own discretion (Proposal for a Reform of the University Financial Model from 2013, Ministry of Education).

3.2 The University of Oulu

University of Oulu is an international research and innovation university engaged in multidisciplinary basic research and academic education.

The University of Oulu is one of the largest universities in Finland and has an exceptionally wide academic base. The University encompasses eight fields of study: Dentistry, Economics, Education, Engineering, Health Sciences, The Humanities, Medicine and Natural Sciences. In all, more than 70 different specialist disciplines are represented. In Oulu, the University operates on two campuses: Linnanmaa and Kontinkangas.

The fields of Information Technology, Biosciences and Health, Cultural Identity and Interaction, and Environment, Natural Resources and Materials have been defined as special research focus areas (University of Oulu website).

In 2011 the University of Oulu had 15,864 enrolled students.

The University of Oulu uses the funding model of the Ministry of Education in resource allocation between faculties.

3.3 The faculty of humanities in the University of Oulu

The Faculty of Humanities at the University of Oulu is the northernmost of its kind in Finland, providing teaching and research in practically all the academic disciplines concerned with achievements in the humanities: history, language and linguistics, cultural studies and literature. The Faculty offers a wide variety of teaching and possesses a definite character of its own, two subjects having the only professorial chair in Finland, namely the History of Science and Ideas, and Saami (Lappish) Language and Saami Culture.

In addition to these, the main subjects in the Faculty are Cultural Anthropology, English Philology, Finnish Language, Archaeology, German Philology, History, Information Studies, Literature, Logopedics, and Nordic Philology. A choice of almost 30 subsidiary subjects is available, for example
philosophy, film studies, language technology, art history, Estonian language, French language, phonetics and general linguistics.

The Faculty of Humanities had 1,971 undergraduate students in 2011.

The Faculty of Humanities is responsible for the education of Saami language teachers in Finland. This is organised through the Giellagas Institute.

Studying in the Faculty of Humanities is relatively free. In many fields of study the students can build up their degree depending on where their interests lie. This means that they can also choose minor subjects freely from the Faculty of Humanities, from other faculties at the University of Oulu, or from other universities in Finland or abroad (Faculty of Humanities website, www.oulu.fi).

3.4 The faculty of technology in the University of Oulu

The Faculty of technology has the following departments: Department of Architecture, Department of Mechanical Engineering, Department of Process and Environmental Engineering, Department of Industrial Engineering and Management, Department of Electrical Engineering, Department of Communications Engineering and Department of Computer Science and Engineering.

In the Faculty of Technology, studies consist of modules that the students have to study in a sequence decided by the faculty. The modules consist of courses and exercises.

The Faculty of Technology had 3,340 undergraduate students in 2011 and is the biggest faculty in the University of Oulu.

3.5 The contribution of the European Commission to the education process

3.5.1 The Bologna process

From the start, the three overarching objectives of the Bologna process have been: introduction of the three cycle system (bachelor/master/doctorate), quality assurance and recognition of qualifications and periods of study.

In the Bucharest Communiqué, April 2012, the Ministers identified three key priorities - mobility, employability and quality, and emphasised the importance of higher education for Europe's capacity to deal with the economic crisis and to
contribute to growth and jobs. Ministers also committed to making automatic recognition of comparable academic degrees a long-term goal of the European Higher Education Area.


1. Ensuring a quality higher education system
2. Adopting a two- or three-cycle system of study (BA, MA, PhD)
3. Promoting the mobility of students and academic and administrative staff
4. Introducing a credit system (ECTS) for the assessment of study performance
5. The recognition of levels: adopting a system of easily identifiable and comparable levels
6. The active involvement of higher education institutions, teachers and students in the Bologna Process and student participation in the management of higher education
7. Promoting a European dimension in higher education
8. Promoting the attractiveness of the European higher education area
9. Lifelong learning
10. A European higher education area and a European research area – two pillars of a society based on knowledge

Every second year, Ministers responsible for higher education in the 46 Bologna countries meet to measure progress and set priorities for action.

The Bologna Process calls for the introduction of a three-cycle system (often called bachelor, master, doctorate). This means more than cutting traditional study programs in two or three parts. It is an invitation to re-think the content of learning, to make pedagogy more student-centred and to consider whether a given program of study adequately addresses the needs of graduates; and to consider whether graduates will acquire the knowledge, skills and competences they need to succeed in an ever changing labour market. Universities have begun to describe their modules and study programmes not only in terms of inputs, such as teaching hours or text books, but also in terms of outputs, i.e. learning outcomes: what students know, understand and can do after a process of learning. For this exercise, universities find references in National Qualifications Frameworks, which describe the learning outcomes expected at each level. National Qualifications Frameworks are in turn linked to the overarching European frameworks: the Framework for Qualifications in the European Higher Education Area of Bologna (three cycles) and the EU European Qualifications Framework for lifelong
learning (EQF) (which encompasses eight levels, ranging from basic skills to advanced research competences).

Continuous improvement of quality of teaching and learning is a core task of universities. Institutions can help each other to improve through mutual assistance and benchmarking. Quality assurance also has an external component as institutions are evaluated regularly by an external quality assurance agency. Most agencies are or have applied to become members of the European Association for Quality Assurance in Higher Education (ENQA), which the Commission helped to create in 2000 and supports with Erasmus project grants. Both universities and agencies must comply with the Standards and Guidelines for Quality Assurance for the Higher Education Area, adopted by Bologna Ministers in Bergen in May 2005. Agencies which comply with the standards and guidelines may apply to be listed in the European Quality Assurance Register for higher education (EQAR). The Register is open to agencies operating in Europe, be they national or international, public or private, general or subject-specific. The Commission is supporting the development of a series of subject-specific European quality labels, which could/may lend their standards to existing agencies or become agencies in their own right. Examples include the EUR-ACE label in engineering and the Eurobachelor, Euromaster and Eurodoctorate labels in chemistry.

3.5.2 The European credit transfer and accumulation system ECTS

ECTS is a learner-centred system for credit accumulation and transfer based on the transparency of learning outcomes and learning processes. It aims to facilitate planning, delivery, evaluation, recognition and validation of qualifications and units of learning as well as student mobility. ECTS is widely used in formal higher education and can be applied to other lifelong learning activities.

ECTS credits are based on the workload students need in order to achieve anticipated learning outcomes. Learning outcomes describe what a learner is expected to know, understand and be able to do after successful completion of a process of learning. They relate to level descriptors in national and European qualifications frameworks. Workload indicates the time students typically need to complete all learning activities (such as lectures, seminars, projects, practical work, self-study and examinations) required to achieve the expected learning outcomes. 60 ECTS credits are attached to the workload of a fulltime year of formal learning (academic year) and the associated learning outcomes. In most
cases, student workload ranges from 1,500 to 1,800 hours for an academic year, whereby one credit corresponds to 25 to 30 hours of work.

Credits are allocated to entire qualifications or study programmes as well as to their educational components (such as modules, course units, dissertation work, work placements and laboratory work). The number of credits ascribed to each component is based on its weight in terms of the workload students need in order to achieve the learning outcomes in a formal context. Credits are awarded to individual students (full-time or part-time) after completion of the learning activities required by a formal programme of study or by a single educational component and the successful assessment of the achieved learning outcomes. Credits may be accumulated with a view to obtaining qualifications, as decided by the degree-awarding institution. If students have achieved learning outcomes in other learning contexts or timeframes (formal, non-formal or informal), the associated credits may be awarded after successful assessment, validation or recognition of these learning outcomes. Credits awarded in one programme may be transferred into another programme, offered by the same or another institution. This transfer can only take place if the degree-awarding institution recognises the credits and the associated learning outcomes.

At the European level, the Bologna Qualifications Framework defines the credit ranges that a learner is required to accumulate in order to receive a qualification corresponding to the first and second cycle. The credit ranges for qualifications within National Qualifications Frameworks are compatible with the Bologna credit ranges, even though the former may be more prescriptive and more detailed. At a national or institutional level, progression rules or programme requirements enable learners to progress within a given cycle in order to obtain a specific qualification. These stipulate the credits, for what learning outcomes, at what level, can be accumulated and how. Progression rules may be expressed in terms of the numbers of credits or credit ranges required at different stages within a programme of study (e.g. a minimum number of credits required to pass from one academic year/semester to another). They may also be formulated in terms of detailed rules on what components must and/or can be taken at what stage and of what level (e.g. compulsory courses, optional courses and prerequisites). Progression rules also relate to the number of credits to be obtained at different levels within the National Qualifications Framework. Some qualifications frameworks are also credit frameworks, meaning that they define the number of credits per type of qualification (e.g. master’s). Such credit frameworks set the number of credits to be awarded after the achievement of required learning
outcomes. Progression rules define how learners progress within the learning pathway to achieve this number of credits in a progressive manner. Accumulation of credits is documented in an official institutional Transcript of Record, so that learners can have a record/proof or confirmation of what they have achieved at each stage of their educational pathway (European Credit Transfer and Accumulation System ECTS).

3.6 The controllability of a university education process

According to Eloranta (1986) the goals of production can be divided into the goals of Quality, Productivity and Controllability. The Goals of Controllability consist of Assets, Delivery and Throughput time. Assets can be divided into current, liquid and capital assets. On an operational level, current assets is the most important item of assets because work in process is part of it. The variables affecting controllability are divided into three classes according to the goal of control: controllability of delivery time, material and capacity.

When we want to measure the controllability of a University Education Process, the indicators we use to measure it have to be compatible to the goals of controllability.

The length of studentship can easily be seen as a throughput time of an education process. We know the target for the length of studentship as the Ministry of Education has written it into the Decree and we know the actual lengths of studentships. In this study we first analyse the throughput times of years 2000–2012 in every department. Then we have a look to a longer period of 1970–2012 to see if the years 2000–2012 have been in line with the previous years. We calculate P90, Q3, Median, Q1 and P10 of the lengths of studentships to see the variation.

The ability of a university to deliver in time and according to customer needs can be seen in the employment statistics of the graduates. In this study we use the statistics to show the percentage of graduates that are employed in years 2004 and 2011. We also use the statistics by geographical area to show the markets by area. In this study we have decided to use the market as a final customer. A graduate is sold to the market when he or she has been employed. The other option would have been to consider the Ministry of Education as a final customer and the fulfilled targets as delivery. This, however, would lead us to forget the real labour market. These are the external variables that affect the delivery.
The internal variables that affect the delivery can be illustrated by study paths. They also provide a picture of the structure of the production process and material flow. In this study we use the individual study paths of every single student that has started his/her studies in years 1993, 2004 and 2006 in the departments under study. These pictures also show the place of potential constraints in the education process.

Current assets is seen in this study as work in process and stock. We use the number of students divided into groups according to the amount of credits they have. The groups are equal to the study semesters. We use the inventory reports of 2004 and 2012. These reports also include the number of students who have over 300 credits and should have already taken their diplomas. These reports also illustrate the material flow.

The goal of the controllability analysis is to find out how controllability could be developed in a company. The developing of controllability aims to change the production process, operations related to it and rules of joint operations, in a way that it would be possible to reach all the main goals of production (quality, productivity and controllability) simultaneously.

The Ministry of Education in Finland is responsible for the steering of the university education process as a whole. It is not enough to study the control process inside one department of a university to find out if it is controllable or not. We have to look through the whole chain of control to find ways to develop the controllability of the university education process.
4 Results

4.1 Performance management systems in education process
reflection from the ministry of education controls

The variables affecting controllability, the controlling properties, are divided into three classes according to the goal of control: controllability of material, capacity and delivery time. They can also be divided to internal and external controlling properties.

The first finance model of the Ministry of Education 2004–2006 was mostly based on the targets for master’s degrees and doctoral dissertations. Two thirds of the finance was based on targets and one third on fulfilled targets. There were multipliers for different fields of study according to their costs in master’s degrees. Those fields of study that needed equipment or individual guidance of students had bigger multipliers than other fields. A minor part (19%) of the finance was based on the amount of salaries and rents. During 2007–2009 the finance was based on targets for master’s degrees and doctoral dissertations. 23% of the finance was based on historical finance, new students and rents. There was also a new element called “efficiency” and it particularly included the amount of fulfilled master’s degrees.

During 2010–2012 the finance was based 50% on the targets and 50% on the fulfilled targets. There were no multipliers in this model. This model is stated in Decree (771/2009). After the University reform of 2010, the control models have to be stated in a law or a decree because universities are no longer government agencies. Ultimately, 2010 changed the economic situation of universities in Finland. Universities used to have transferable appropriations that gave them financial security. These buffers were removed and this marked a big change for universities that were used to an economically safe circumstance.

During 2013–2016 the Ministry of Education uses a new finance model where no targets or multipliers are included. This model is based on fulfilled targets only. No compensation is given to overproduction. There are some new indicators on which the finance of universities is based on. These new indicators measure the efficiency of the education process. This model is stated in Decree (182/2012). While the financial models have previously been future oriented, this new model seems to focus on the past. It rewards universities for master’s degrees
and extra compensation is given to the master’s degrees that have been accomplished in the past seven years. This means that reward is based on old data.

The financial models of the Ministry of Education have changed so many times during the period 2000–2012 that it is difficult to track the impacts of every indicator used in these models.

The models and the targets for degrees have been valid for three years. Since the throughput time of any master’s degree is five years, the steering of the Ministry of Education is to be understood as indicative more than binding. However, the fulfilment of targets is discussed as if they were binding.

During 1998–2006, the Ministry of Education financed a national Information Industry Programme. This programme was a major national effort focused on information engineering. In the University of Oulu, due to this Programme and the related increase in targets of master’s degrees in this field, the Department of Electrical Engineering in the Faculty of Technology expanded to become the biggest department of that faculty.

The length of the studentship used to be unlimited in Finland. In 2004 it was stated in Decree (794/2004) that universities have to organise courses so that students can get their diplomas in five years. This was due to the Bologna Process. Those students who had started their studies before 2005 had to get their diplomas in 2008 at the latest in most fields and in 2010 in the fields of technology without having to accomplish the bachelor’s degree first.

In line with the restriction on the length of studentship there were amendments in study grants too. According to the Act and Decree concerning Financial Aid for Students, after 2011 students can obtain a student grant for a maximum of 70 months. The student has to be active and study at least 5 credits every study month. Before it was 4, 8 credits per study month.

In the financial models of the Ministry of Education there are many indicators that are related to delivery time. In fact delivery time and throughput time seem to be the main focus in the performance management systems concerning master’s degrees. For example, students that have finished their studies in seven years or less, students that have studied 55 or more credits in a year. Also the restriction of the student grant to 70 months at the maximum is related to the controlling property of delivery time. The Ministry of Education has done a lot to shorten the throughput times in higher education.

Capacity used to be part of the first finance models of the Ministry of Education. Salaries, number of personnel, student/professor – ratio and rents have been included as indicators in the models over time.
However, the indicators that relate to material are not so obvious. The number of students and the number of new students were included as indicators in the early models. These indicators were problematic for a process perspective because the number of new students did not correlate with the number of targets set by the Ministry of Education. When the targets were raised artificially high in some fields of study, the connection to the real production process was non-existent.

The focus of the latest finance models of the Ministry of Education is solely on output/outcome. The Ministry of Education thus behaves like a customer who orders degrees from universities. On the other hand the Ministry is responsible for the steering of universities and performance management is an important part of steering. It seems that the Ministry of Education has not clearly decided if it is a customer of the universities or if it is steering the universities. These are different roles and they need different indicators to measure and manage. If the Ministry of Education is interested in the performance of universities (not only in buying a certain amount of degrees) also including the input and process measures to the finance model would balance the model. It would also help to link the resources to the production in a more timely fashion.

The PMS used by the Ministry of Education include indicators that relate to all the main controlling properties of the controllability analysis. Delivery time (length of studentship, 55 credits per year) is the most important/dominant area. In fact the PMS includes several indicators that are derivative of delivery time. Capacity was featured by the state of load (students per professors) and production batch size (number of new students) in the first models used by the Ministry of Education. Indicators related to material are not included in the latest model, at least not directly, but they were in the early models. Even if the PMS include indicators related to all the main controlling properties of the controllability analysis, they are not comprehensive.

Since the finance models have been changed every three years, there is not a single indicator in the model that has been valid as such for all the years 2000-2012. The education process itself has not changed accordingly during the study period. Controllability analysis anticipates more stable indicators. Because the throughput time (studentship) is very long it is even more difficult to adapt to quick changes in input or output market.

The most serious deficiency in the PMS of the Ministry of Education seems to be the fact that the input/output indicators used in the models do not correlate with each other in a process control sense. This means that the input and output
indicators are collected for the same year data. In a process, input usually has to be before output. Due to this deficiency the indicators are more like statistical data to be followed. What has been found interesting or important has been included in the model for next period. The Ministry of Education is behaving like a customer who orders certain amount of degrees without really steering the education process. As the weights of different study fields and the indicators in the PMS of the Ministry of Education have changed so much and the finance model is volatile to political trends, the development of the management of the production process should be done on a university level where the processes are more stable.

4.2 The implications of performance management systems in university education process

The following analyses, which form the controllability analysis, were made for all the departments in the Faculty of Technology and the Faculty of Humanities in the University of Oulu:

11. The Mutual Analysis
   - The financial status (total finance), 2001–2012
   - Capital structure, 2000–2011
   - Working capital, 2003 and 2009
   - Cost structure, s 2003 and 2009
   - Throughput time (length of studentship), students started their studies 1993, 2004, 2006
   - The use of capacity (students per professor and teaching staff), 2000–2012
   - Current assets (number of students), 2000–2012
   - Summary of the mutual analysis

12. The Controllability of Delivery Time
   - Delivery time and reliability (length of studentship compared to standard time), from 1971 onwards
   - Offers made compared to order book (targets set by the Ministry of Education compared to the offer of university), 2000–2012
   - Markets (employed and unemployed students), 2002 and 2011
   - Market forecasts (forecast of the Ministry of Education)
Lost margin
Summary of the controllability of delivery time

13. The Controllability of Materials

- The structure of current assets (number of students classified by the semesters), 2004 and 2009
- Number of items (number of different courses available), 2009
- The cost structure of materials (courses included in degrees), 2004 and 2012
- Lack of materials (applicants per new students), 2000–2012
- Summary of the controllability of materials

14. The Controllability of Capacity

- State of load (students per professors and teaching staff), 2000–2012
- The structure of the production process (study paths), students started their studies 1993, 2004 and 2006
- The production batch size (new students), 2000–2012
- The structure of labour expenditure (labour costs related to education), 2003 (architecture) and 2009
- Summary of the controllability of capacity

Here we focus on the most important findings of the controllability analysis that was performed in the two faculties of the University of Oulu for 2000–2012. These findings are classified as following: 1. Controllability of Delivery time: 1.1 The Delivery time and 1.2 the Market, 2. Controllability of Materials: 2.1 the structure of current assets and 2.2 Lack of Material, 3. Controllability of Capacity: 3.1 The Structure of Production Process and 3.2 The Production Batch Size. The importance of the findings was valued according to the goal of controllability analysis. The goal is to improve the controllability on a whole and to find out, where is the biggest financial potential. We can identify the most important aspects of the production process to be developed. Financial potential does not mean better financial results in our context, but it means lower cost level and minimising the need for working capital. This is important for the Government and the University, and most of all for the taxpayers, whose money is used in this process.

4.2.1 The controllability of delivery time

4.2.1.1 The delivery time (length of studentship)

Figure 9 provides the real lengths of studentships of the students that have gained their diplomas in the given year. Overtime is calculated by comparing the real length of studentship to the target length in these fields (5 years).

<table>
<thead>
<tr>
<th>Faculty of Technology</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Computer Science</td>
<td>0.45</td>
<td>0.64</td>
<td>0.52</td>
<td>0.25</td>
<td>0.13</td>
<td>0.06</td>
<td>0.03</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Overtime</td>
<td>-0.30</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.30</td>
<td>-0.30</td>
<td>-0.30</td>
<td>-0.30</td>
<td>-0.30</td>
<td>-0.30</td>
<td>-0.30</td>
</tr>
<tr>
<td>Department of Mechanical Engineering</td>
<td>0.25</td>
<td>0.35</td>
<td>0.45</td>
<td>0.55</td>
<td>0.65</td>
<td>0.75</td>
<td>0.85</td>
<td>0.95</td>
<td>1.05</td>
<td>1.15</td>
<td>1.25</td>
</tr>
<tr>
<td>Overtime</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
</tr>
</tbody>
</table>

Fig. 9. Lengths of Studentship 2000–2012

Figures 10–19 identify the real lengths of studentship in each department classified to P90, Q3, Md, Q1 and P10. The data has been collected since the beginning of each field in the University of Oulu.

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Fig. 10. Lengths of Studentship 1970–2012, P90, Q3, MD, Q1 and P10, Department of Architecture.

Fig. 11. Lengths of Studentship 1970–2012, P90, Q3, MD, Q1 and P10, Department of Mechanical Engineering.
Fig. 12. Lengths of Studentship 1970–2012, P90, Q3, MD, Q1 and P10, Department of Process and Environmental Engineering.

Fig. 13. Lengths of Studentship 1970–2012, P90, Q3, MD, Q1 and P10, Department of Electrical Engineering.
Fig. 14. Lengths of Studentship 1970–2012, P90, Q3, MD, Q1 and P10, Department of Industrial Engineering and Management.

Fig. 15. Lengths of Studentship 1970–2012, P90, Q3, MD, Q1 and P10, Department of English.
Fig. 16. Lengths of Studentship 1970–2012, P90, Q3, MD, Q1 and P10, Department of History.

Fig. 17. Lengths of Studentship 1970–2012, P90, Q3, MD, Q1 and P10, Department of Finnish Language, Saami and Logopedics.
During the first decade of 21st century the studentships have been on average shorter than before (1970–1999). However, there are some exceptions. In the Faculty of Humanities in 2008 and in the Faculty of Technology in 2010 the lengths of studentship were exceptional. Due to the Bologna Process, these years were the last when one could take the diploma according to the old rules and
regulations. After that, the old students should have started with a bachelor’s degree first. Since many students that had studied for years decided to take their diplomas at last, the median times of studentships were long.

In the Faculty of Humanities, in all departments, the studentships have been longer after 2010 than before. In the Faculty of Humanities there have always been students who have studied for 15 to 20 years or even longer. After 2000 there have not been such long studentships except in 2008. Since 2010 the very long studentships have not been possible anymore because of the changes in legislation.

In the Faculty of Technology, in the Department of Industrial Engineering and Management and the Department of Process and Environmental Engineering, there have not been big variations in the lengths of studentships even in the long run. In the Department of Architecture the studentships have always been long compared to other departments in the Faculty of Technology. After 2000 the median length of studentship is shorter than before, but there have also been students who have studied for 15 to 20 years. The peak of 2010 is biggest in the Department of Architecture, but it is also evident in all other departments except the Department of Process and Environmental Engineering. In the departments of Mechanical Engineering, Industrial Engineering and Management and Electrical Engineering the studentships have been longer after 2010 than before.

The steering models of the Ministry of Education have affected the length of studentship in all the departments after focus was placed on master’s degrees in the financial models of the universities. The median lengths of studentship have decreased in all the departments of the Faculty of Humanities and the Faculty of Technology until 2010. After that, the median time has increased. This is the first year the students who have first attained their bachelor’s degree got their master’s degree. These are also the years after university reform in Finland.

If we go back to the variables affecting controllability (delivery time, material and capacity), we can see that the performance management systems of the Ministry of Education have affected the delivery time of the departments in the two faculties. Most of all, performance management has affected those students who have studied for a very long time. Since the P10 and Md of the studentships are quite near each other, the extra rewarding of students that have got 55 credits or more per year is not as effective as restricting the total allowable length of study grants.
4.2.1.2 The market

The data relating to the employment situation of new master’s graduates is collected for 2002 and 2011. The annual data had not been available, but the structural changes in the employment situation are slow even if the fluctuation due to financial situation is faster. These two years provide an overall rough trend of the market.

This chapter includes two tables (Table 3 and 4), which show the employment situation (employed or unemployed) of the graduates as a percentage and by geographical area of employment (Uusimaa, Northern Ostrobothnia, Lapland and Other).

Table 3. Employment of graduates in 2002 and 2011.

<table>
<thead>
<tr>
<th>Employment</th>
<th>Year 2002</th>
<th>Year 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Architecture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>21</td>
<td>23</td>
</tr>
<tr>
<td>Unemployed</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Department of mechanical Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>46</td>
<td>41</td>
</tr>
<tr>
<td>Unemployed</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Department of process and Environmental Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>59</td>
<td>46</td>
</tr>
<tr>
<td>Unemployed</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Department of Electrical Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>121</td>
<td>44</td>
</tr>
<tr>
<td>Unemployed</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Department of Industrial Engineering and Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>28</td>
<td>14</td>
</tr>
<tr>
<td>Unemployed</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Department Of English language</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Unemployed</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Department of History</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Unemployed</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Department of Finnish language etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>36</td>
<td>55</td>
</tr>
<tr>
<td>Unemployed</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Department of German and Nordic philology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>Unemployed</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Employment</td>
<td>Year 2002</td>
<td>Year 2011</td>
</tr>
<tr>
<td>------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Department of Information Science</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Unemployed</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Department of Arts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Unemployed</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 4. Employment by area in 2002 and 2011.

<table>
<thead>
<tr>
<th>Area</th>
<th>2002</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Department of Architecture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uusimaa</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Northern Ostrobothnia</td>
<td>13</td>
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The employment situation was not as good in 2011 as it was in 2002. Unemployment is most significant in the Departments of English Language and Arts. Those graduating from the Department of Arts are employed in jobs that are not academic and that have little or nothing to do with their studies. In 2011 none of the master’s graduates who had studied cultural anthropology were in a job that was related to their studies. Many different sources can contribute to this situation. First, the education may not be in line with the requirements of working life. Second, there are too many graduates compared to the needs of working life, while, third, the concepts employed/unemployed are not so clear in the working places of this field. For example, being an author or an artist is more like a way of life than a job.
In the Faculty of Technology, the employment situation was likewise worse in 2011 than it was in 2002. This was especially true for graduates in electrical engineering.

The graduates of the Faculty of Humanities and the Faculty of Technology have traditionally been employed in the area of Northern Ostrobothnia. In this sense the biggest change has happened in the Department of Electrical Engineering. In 2002 the new master’s graduates were almost solely employed in Northern Ostrobothnia. In 2011 only half of new master’s graduates were employed in that area.

In the Faculty of Humanities, those who graduated in logopedics have found their way to other areas than Northern Ostrobothnia in both years.

When the Ministry of Education decides on the targets for master’s degrees for the next agreement period of three years, it also anticipates how many master’s degrees will be needed for the market. However, the Ministry of Education has not decreased the targets for master’s degrees in the Faculty of Humanities even though there have been big problems trying to employ all the new graduates from some departments. Those graduates from the Department of Electrical Engineering in 2002 found employment quite easily but in 2011 the employment situation had changed and one quarter of the graduates where unemployed.

The target for master’s degrees in the Department of Arts was 32 until 2006. Then it was raised to 36 for 2007–2009 and after that it was decreased to 30 for 2010–2012. Graduates from this department have faced biggest difficulties in securing employment. The Department of History had the following targets: 34 for 2000–2006, 35 for 2007–2009 and 33 for 2010–2012. The Department of German and Nordic Philology had following targets: 32 for 2000–2006, 37 for 2007–2009 and 32 for 2010–2012. These departments also have serious problems related to the employment of graduates. In 2012 all the departments of the Faculty of Humanities had 2 to 5 times more students that had over 300 credits than in 2004. The employment situation seems to be the biggest reason for this kind of accumulation of credits.

The employment of new master’s graduates is one of the indicators the Ministry has used in its financial model for universities since 2013. This does not affect employment itself and it is used to measure the quality of education instead.
4.2.2 The controllability of materials

4.2.2.1 The structure of current assets

The structure of current assets is illustrated by accumulated credits. The accumulation of credits classified by computational semesters is shown in Figures 20–29 by departments. The bars in the figures illustrate the number of students in each class. The accumulated credits for 2004 and 2012 are shown for every department in the Faculty of Humanities and Faculty of Technology. Data from 2004 and 2012 has been used since these are the only years for which data is available. This data cannot be calculated afterwards. In these figures we can see the development of work in process and stock between these two years. 2004 offers a picture of the situation before the university reform and the Bologna Process while 2012 provides a picture what has happened afterwards. Those students who have 0 credits have been excluded. In an optimal situation, each class should be at the level of the batch size (number of new students).
Fig. 20. The Accumulation of Credits (2004 above and 2012 below), Department of Architecture.
Fig. 21. The Accumulation of Credits (2004 above and 2012 below) Department of Mechanical Engineering.
Fig. 22. The Accumulation of Credits (2004 above and 2012 below) Department of Process and Environmental Engineering.
Fig. 23. The Accumulation of Credits (2004 above and 2012 below) Department of Electrical Engineering.
Fig. 24. The Accumulation of Credits (2004 above and 2012 below) Department of Industrial Engineering and Management.
Fig. 25. The Accumulation of Credits (2004 above and 2012 below) Department of English Language.
Fig. 26. The Accumulation of Credits (2004 above and 2012 below) Department of History.
Fig. 27. The Accumulation of Credits (2004 above and 2012 below) Department of Finnish Language, Saami and Logopedics.
Fig. 28. The Accumulation of Credits (2004 above and 2012 below) Department of German and Nordic Philology.
The full university degree is 300 credits. Of that, the bachelor’s degree is 180 credits and the master’s degree 120 credits. No accumulation can be seen in the class 166.7–199.9 credits in 2012, which indicates that there is no constraint between the bachelor’s degree and the master’s degree.

In the Faculty of Humanities, every department has so many students in each class that it should be easy to fulfil the targets for master’s degrees (the work in process is big). The departments have decreased the number of new students in recent years because the Ministry of Education does not pay for the overproduction any more. The students in the Faculty of Humanities have always studied more credits than required (the stock is also big). This tendency has increased between 2004 and 2012. In the Department of English language and History, the number of students who have over 300 credits has doubled. In the Department of German and Nordic Philology it is 2.5 times bigger, in the Department of Finnish language, Saami and Logopedics it is 3 times bigger and in the Department of Arts it is 5 times bigger than it was in 2004.
The class of students that have less than 33.4 credits, has decreased in the Departments of English Language, History and Arts. It has increased in the Department of Finnish language, Saami and Logopedics and in the Department of German and Nordic Philology. The drop-outs can usually be found in this class.

In the Faculty of Technology there are not so many students in every class compared to the target as in the Faculty of Humanities (the work in process is smaller). In the Department of Industrial Engineering and Management and in the Department of Process and Environmental Engineering the number of students is quite small in each class compared to other departments. However, these departments don’t have particular difficulty in fulfilling their targets. In these departments, therefore, the process is most effective. The class of students that have less than 33.4 credits has increased in all the departments except the Department of Architecture. The Department of Architecture is the only department in the Faculty of Technology where the number of students that have over 300 credits has increased significantly. It is the only department in the Faculty of Technology that has stock.

The Faculty of Humanities has for a long time taken on more new students than needed to fulfil the targets set by the Ministry of Education. The faculty also has more students all the time than needed for the targets. This has helped the faculty to get finance according to the amount of students and it has helped the faculty to fulfil its targets. On the other hand, there have always been more good applicants than needed. The indicator of total amount of students will no longer be in the financial model of the Ministry of Education for 2013–2016. This may weaken the finance of the Faculty of Humanities. Since 2007 most departments in the Faculty of Humanities have decreased the number of new students. This is because they don’t get any financial compensation for the overproduction (over the target for degrees set by the Ministry of Education) but these extra students do consume their resources. The Faculty of Humanities has restricted the maximum amount of credits to 310 credits (180 + 130). Since 2008 the Faculty of Humanities has been recognised as one financial entity in order to guarantee more financial flexibility.

The experience of the Department of Electrical Engineering shows clearly the problems related to controlling properties of material. These are: the forecast of need of material and the delivery time of material, the resistance of the delivery time of material, the quality failures of material and the interchange ability of items. Since the Department had problems attracting enough new students, it was not able to produce as many graduates as the Ministry wanted. The Department
therefore had to take students that were not as qualified as before and this made it even more difficult to produce in time and the number of drop-outs increased.

After the ECTS and the two step degree it has been easier to change the field of study during studentship. However, this leads to overflow of material to lucrative fields of study while the situation in other fields may become even more difficult. The changing of study field was most popular in the student group that started their studies in 2004. Many departments encouraged students to change field in order to gain students who already had some credits. This was one of the side effects of the new model.

The steering system of the Ministry of Education has affected the accumulation of credits mostly by restricting the length of studentship and by changes in the legislation regarding student grants. Students have to study 5 credits per study month instead of 4.8 credits. These changes directly affect the students not the universities. Of course, the accumulation of credits affects the length of studentship.

The biggest difficulties in the controllability of the university education process seem to relate to the control of material. The production process is now more ineffective than it was before because there is so much waste (drop-outs). During the 21st century, the steering of the Ministry of Education has moved from the control of input quality to the control of output quantity. The increase in the number of drop-outs reflects this change.

### 4.2.2.2 The lack of materials

The number of applicants and accepted students (2000–2012) is shown in Figure 30 by departments of the Faculty of Humanities and the Faculty of Technology in the University of Oulu. The number of applicants is the number of all applicants, not only those who nominated this field as their first choice. The number of those accepted includes those students who have indicated that they accept the offered place.
In the Faculty of Humanities, the number of applicants has increased during the study period even if the intake of new students has decreased at the same time.

In the Faculty of Technology, the number of applicants has decreased during the study period. Also, the intake of new students has decreased in most of the fields of study.

In the Department of Electrical Engineering, the target for master’s degrees was increased at the beginning of the decade and it was at the same level until 2006. The new target was 205 while the old one was 225. So the drop was not significant. Since 2006 the number of new students has been smaller than the target for master’s degrees each year. The number of applicants first dropped in 2003 and it has dropped even more every year after that. 2010 is the only year in which the Department of Electrical Engineering fulfilled the target for master’s degrees. This was the last year to graduate according to the old rules and regulations.

Fig. 30. The Number of Applicants and Accepted, years 2000–2012.

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| Department of Electrical Engineering |
| Applicants | 1275 | 1295 | 1295 | 1295 | 1295 | 1295 | 1295 | 1295 | 1295 | 1295 | 1295 | 1295 | 1295 |
| Accepted | 822 | 822 | 822 | 822 | 822 | 822 | 822 | 822 | 822 | 822 | 822 | 822 | 822 |
4.2.3 The controllability of capacity

4.2.3.1 The structure of production process

The study path of every single student who started his or her studies in 1993, 2004 and 2006 is shown in figures below by the departments of the Faculty of Humanities and the Faculty of Technology. The study paths show the accumulation of credits as a function of time. Every student has a unique study path. The figures show all the study paths of the students who have started their studies in the same year. Those students who have 0 credits have been excluded.
Fig. 31. Department of Architecture, a) 1993 b) 2004 c) 2006.
Fig. 32. Department of mechanical Engineering, a) 1993 b) 2004 c) 2006.
Fig. 33. Department of Process and Environmental Engineering, a) 1993 b) 2004 c) 2006.
Fig. 34. Department of Electrical Engineering, a) 1993 b) 2004 c) 2006.
Fig. 35. Department of Industrial Engineering and Management, a) 1993 b) 2004 c) 2006.
Fig. 36. Department of English Language, a) 1993 b) 2004 c) 2006.
Fig. 37. Department of History, a) 1993 b) 2004 c) 2006.
Fig. 38. Department of Finnish Language, Saami and Logopedics, a) 1993 b) 2004 c) 2006.
Fig. 39. Department of German and Nordic Philology, a) 1993 b) 2004 c) 2006.
Fig. 40. Department of Arts, a) 1993 b) 2004 c) 2006.
The most obvious change in the education process of all the departments in the first decade of the 21st century is the explosion of the number of drop-outs. It is most visible in the Department of Electrical Engineering.

In the Faculty of Humanities there have not previously been so many drop-outs, but the amount has increased. In the Faculty of Humanities there are drop-outs at every step of the studies. In the Departments of German and Nordic Philology and Finnish, Saami and Logopedics, the biggest group of students have a uniform study path. In the Department of Arts there is the greatest variation between the study paths.

In the Faculty of Technology, the number of drop-outs has increased dramatically if we compare the students who started their studies in 1993 to those who started their studies in 2004 or in 2006. In all the departments except the Department of Industrial Engineering and Management the number of drop-outs is very high. There are drop-outs at every step of the studies. In the Faculty of Technology the drop-outs have accumulated to the first study years. Another point of accumulation is before the master’s degree is completed.

In the Department of Mechanical Engineering, Process and Environmental Engineering and Electrical Engineering the majority of students have a uniform study path even if the number of drop-outs has increased.

The study paths show clearly that the students have not been able to finish their studies in all the departments in five years, even if they have studied actively.

The amount of different courses students can choose has decreased between 2004 and 2009. This has happened in the Faculty of Humanities and in the Faculty of Technology. Even if the amount of different courses inside the field of study has decreased, the variation in study paths has increased visibly. This is due to the ECTS that calls for more flexibility in credit transfer.

4.2.3.2 The production batch size

Figure 41 shows the number of new students and the target for master’s degrees set by the Ministry of Education by departments of the Faculty of Humanities and the Faculty of Technology in the University of Oulu for 2000–2012.
In the Faculty of Humanities, the ratio of new students to targets has decreased during the 21st century while it has increased in the Faculty of Technology, excluding the Department of Electrical Engineering. The Faculty of Humanities tries to decrease the number of students and the overproduction. The Faculty of Technology instead has to take into account the increased number of drop-outs. They need more students to fulfil the same targets. The Department of Electrical Engineering is an exception.

When the number of new students was at the highest level, the Department of Electrical Engineering had problems finding classrooms that were big enough, the quality of new students was not good enough and extra lessons were needed, for example, in mathematics. The Department also realised that all the students in the high schools of the Northern Finland studying physics, chemistry and mathematics wouldn’t be enough to fulfil the need for new students in the Department of Electrical Engineering in the University of Oulu. The Department started a marketing campaign in the high schools to get more applicants. Finally, the Department decided to decrease the number of new students to a more

**Fig. 41. The number of new students and the targets, 2000–2012.**

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realistic level. This was done regardless of the target set by the Ministry of Education. It remained unchanged.

The different departments react to the indicators used by the Ministry of Education in different manners. This is because of the differences in the department level processes. The indicators used by the Ministry of Education have affected the department level processes in a non-straightforward manner. This is because the internal systems try to adapt to the external circumstances. Implications in the department level data can be seen after indicators have been introduced in the finance models of the Ministry of Education. These implications mean both the changes in the output level and in the department level processes. If the indicators generate action that was intended, the implications are satisfactory.

The departments in the Faculty of Humanities have decreased the number of new students to avoid overproduction. They have also restricted the number of total credits to avoid oversized degrees. The Faculty has also amalgamated the departments to get more financial flexibility.

In the departments of the Faculty of Technology the number of new students compared to targets has increased, because the departments need to take in account the increase in the number of drop-outs (waste) and the ineffectiveness of the process. This is particularly true for the Department of Electrical Engineering, which has faced the problem of not having enough good applicants. Less qualified students mean extra work in teaching and student support and an increase in the number of drop outs. The Department of Electrical Engineering has taken control of the education process into its own hands after they found the targets set by the Ministry of Education as unrealistic.

In many departments in both faculties the biggest grouping of students still have a uniform study path, even if the number of drop outs has increased. At the same time, it seems that some students study more quickly than before while a significant number of the students have problems completing their degree.

When studying the education process, it does not seem that finance has t been a critical factor in the University of Oulu in the first decade of the 21st century.

Lengths of studentship (delivery time) have decreased until 2010. After that, they have increased. Those studentships that have been very long have decreased most visibly and after the changes in legislation they have not been possible any more.

Market forecasts (targets) do not correlate to sales (employment). This cause unemployment and oversized degrees in some fields of study.
4.3 Performance management systems development according to controllability analysis

We have performed a controllability analysis to find the most important areas of development in the university education process. The importance is valued according to the biggest efficiency development potential. We found targets for development in the control of delivery time, material and capacity. That is to say, in all the main areas of controllability.

In research question 1 we have analysed the PMS used by the Ministry of Education. In research question 2 we have analysed the implications of the PMS used by the Ministry of Education in the departments of University of Oulu. These implications are found using the controllability analysis. Since the fundamental idea of controllability analysis is to find areas of development in the production process, in research question 3 we analyse the findings in this respect.

“What would happen without” is the key question when we want to analyse the development potential found by using the controllability analysis.

Fig. 42. Data analysing process.
When we compare the existing PMS of the Ministry of Education to the findings of the controllability analysis we discover that the indicators and measures related to capacity have been in place for a long time. This is because government steering has traditionally been resource allocation. Different agencies and units have been given equal resources. This means that, for example, “students per professor” and “students per square meter” have been calculated for decades. The budgets were calculated according to the resources. However, the focus was not on the process but in the fairness between different units. Here the Ministry of Education has behaved like a customer. It has been interested in the output instead of the real process.

To focus more on the real process, the structure of the production process should be included in the indicators. It gives a picture of the performance of the process. It is important to know what happens to every batch as such in the process. Now we know the stories of individuals but not the data of the mass. Indicators and measures to follow the batch through the process to the market are needed. The students per professor ratio or the number of new students do not tell anything about, for example, the number of drop-outs or bottlenecks. Instead the study paths (the structure of production process) show this data immediately.

The controlling property of material is the weakest one in the current PMS of the Ministry of Education. Compared to the indicators in the controllability analysis, lack of materials is the only indicator of this sector in use at the moment. At the moment we know the number of applicants and accepted students in each field of study. We also need data on the lack of classrooms or lack of field courses etc. This means lack of materials inside the process. The most important data of material that is missing is the structure of current assets. It gives an overall picture of performance of the process. It helps us to know if we have enough students for the next semester of the academic year to produce the degrees in time and the quantity Ministry of Education has set as a target. When we know the content of the work in progress in a more detailed level, we can forecast the output more easily and we know if we have lack of material somewhere. We can also find the places in the production process, where the work in process begins to accumulate. This means the bottlenecks.

While the finance of universities is becoming more critical, the financial aspects of the process control have also become more important. Number of items or cost structure of material give an idea where to cut costs when needed. Number of items also shows if the process is too complex, and students have an unnecessarily high variety of courses to choose from.
Delivery time (length of studentship) has always been an indicator that has been followed. Here again the reason to control delivery time cannot be found from process control. Instead the focus has been on student rights and their ability to break into working life. Another indicator of the controlling property of delivery time that has been followed for a long time is the market. This means data regarding the employment situation of the new master’s graduates after they have obtained their degrees. Offers made compared to order book or lost margin have not been calculated as such because they are not so vital to universities at the moment. Instead predicting the number of potential applicants by using the data of the students in high schools would help to set the capacity on a right level in time.

While changing the focus of PMS from resource allocation to management by objectives, the Ministry of Education has taken too long a leap. These objectives have been changed many times during a decade while the studies still take 5 to 7 years. If the Ministry of Education wants to see more action on a quartile level it should be interested in what happens inside the universities. How are the credits accumulating and are the numbers of drop-outs at the same level in all the study fields and universities. This would also help the Ministry of Education to make better forecasts and to set better objectives.

Our study shows that the indicators in the PMS of the Ministry of Education have been selected by the needs of the Ministry. Even if the PMS reflect the main variables of controllability, the indicators are not the most critical from the university education process point of view. Since the indicators in the PMS of the Ministry of Education have changed so much and the finance model is volatile to political trends, the development of the management of the production process should be done on a university level where the processes are stable and where the need for everyday process control lies. At the moment the Finnish universities don’t get up-to-date data of the education process in the faculties or departments for their own purposes. This is another reason to develop the PMS on the university or even in the department level. There is not a “one size fits all” PMS for all the departments because they are not identical and there’s no need to be even in the future.

The areas of development can be found in all the three areas of controllability. As the resource allocation has traditionally been the way to control government units and agencies, the indicators related to capacity can easily be identified in the current PMS of the Ministry of Education. The Ministry of Education has had to control the fairness of the resource allocation. The structure
of production process (study paths) should be included in the PMS because it gives us information about the proceeding of each batch in the process. By using it we can also see the bottle necks and drop-outs on an overall level.
5 Conclusions

5.1 Answers to research questions

In this chapter, the main findings of this study are presented and the theoretical contributions and practical implications of the thesis are assessed. Finally, the implications of the study are discussed and some recommendations for further research are proposed.

This study was conducted in the field of research of industrial engineering and management. The performance management of a university education process was chosen as the research topic. The education process has not previously been studied from this approach. The research in this field has mostly been conducted by education scientists. So the point of view in this thesis is different as it is in the field of industrial engineering and management.

The goal of the controllability analysis is to find out how the controllability could be developed in a company. The developing of controllability aims to change the production process, operations related to it and rules of joint operations, in a way whereby it would be possible to reach all the main goals of controllability simultaneously (Eloranta 1986). This approach gives us new information about the education process and some ideas about how to develop the process.

In this study the research goal was formulated as follows:

*The goal is to find out if the performance management systems of the university education process can be developed by using the mechanisms and indicators of operations management.*

The research problem is presented as questions:

1. How do the performance management systems used by the Ministry of Education to manage the university education process in 21st century reflect the main variables of the controllability analysis?

We have studied the literature to uncover the various performance management systems to be used in different situations and circumstances. Principally we have focused on the performance management systems used in not-for-profit
organisations and in universities. We have also been interested in the process of control and the ways to develop controllability.

The PMS used by the Ministry of Education includes indicators that relate to all the main controlling properties of the controllability analysis. Delivery time (length of studentship, 55 credits per year) is the most important/dominant area. In fact, the PMS includes several indicators that are derivatives of delivery time. Capacity was featured by the state of load and production batch size in the first models. Indicators related to material are not included in the latest model, at least not directly, but they were in earlier models. Even if the PMS includes indicators related to all the main controlling properties of the controllability analysis, they are not comprehensive.

Since the finance models have been changed every three years, there is not a single indicator in the model that has been valid as such for the entire period 2000–2012. Also, the weights of different study fields in the model have changed. The education process itself or the cost differences between study fields have not changed accordingly during the study period. Controllability analysis anticipates more stable indicators. As the throughput time (studentship) is very long, it is even more difficult to adapt to quick changes in input or output market.

The most serious deficiency in the PMS of the Ministry of Education seems to be the fact that the input/output indicators used in the model do not correlate with each other in a control sense. This means that the input and output indicators are collected from the same year’s data, even if input data should be from many years before output. They are more like statistical data to be followed. Information that has been found interesting or important has been included in the model for next period. The Ministry of Education is therefore behaving like a customer who orders a certain amount of degrees without really steering the production process. Because the indicators in the PMS of the Ministry of Education have changed so much and the finance model is volatile to political trends, the development of the management of the production process should be done at a university level where the processes are stable.

2. How have the performance management systems used by the Ministry of Education affected the university education process?

A controllability analysis was performed in all the departments of the Faculty of Humanities and the Faculty of Technology at the University of Oulu. In the previous chapter the main findings of the controllability analysis were reported.
The different departments react to the indicators used by the Ministry of Education in different manners. This is due to the differences in the department level processes and in the level of the processes. The indicators used by the Ministry of Education have affected the department level processes in a non-straightforward manner. Implications in the department level data can be seen after indicators have been introduced in the finance models of the Ministry of Education. These implications include both the changes in the output level and in the department level processes. If the indicators generate action that was intended, the implications are satisfactory.

The departments in the Faculty of Humanities have decreased the number of new students to avoid overproduction. They have also restricted the number of total credits to avoid oversized degrees. The faculty has also grouped its constituent departments together to achieve more financial flexibility.

In the departments of the Faculty of Technology, the number of new students compared to targets has increased because the departments need to take into account the increase in the number of drop-outs (waste) and the ineffectiveness of the process. The Department of Electrical Engineering in particular has faced the problem of not having enough good quality applicants. Less qualified students mean extra work in teaching and student support as well as an increase in the number of drop-outs. The Department of Electrical Engineering has taken the control of the education process into its own hands after finding the targets set by the Ministry of Education to be unrealistic.

In many departments in both faculties the majority of students still have a uniform study path, even if the number of drop-outs has increased. It seems that, at the same time, some students study more quickly than before while a significant number of students have problems completing their degrees at all.

When studying the education process only, it does not appear that finance has been a critical factor in the University of Oulu in the first decade of the 21st century.

Lengths of studentship (delivery time) decreased until 2010. After that they have increased. Those studentships that had previously been very long have decreased most visibly and after the changes in the legislation they have not been possible any more.

Market forecasts (targets) do not correlate to the sales (employment). This has caused unemployment and oversized degrees in some fields of study.

The biggest problems in the controllability of the university education process seem to relate to the control of material. The production process is now
more ineffective than it was before because there is so much waste (drop-outs).
During the 21st century, the steering of the Ministry of Education has moved away from the control of input quality and towards the control of output quantity. The increase in the number of drop-outs reflects this change.

3. How can the performance management systems of a university education process be developed according to the controllability analysis?

The areas of development can be found in all the three areas of controllability. Since resource allocation has traditionally been the way to control government units and agencies, the indicators related to capacity can easily be identified in the current PMS of the Ministry of Education. The Ministry has had to control the fairness of resource allocation. The structure of production processes (study paths) should be included in the PMS because it gives us information about the movement of each batch in the process. By using it we can also identify the bottlenecks and drop-outs on an overall level.

The controlling property of material is the weakest one in the current PMS. Compared to the indicators in the controllability analysis, lack of material is the only indicator of this sector in use at the moment. The most important data of material that is missing is the structure of current assets. It gives an overall picture of performance of the process. It helps us to know if we have enough students for the next semester of the academic year to produce the degrees in the time and the quantity that the Ministry of Education has set as a target. When we have a detailed understanding of the content of the work in process, we can forecast the output more easily and we know if we have lack of material somewhere. We can also identify the places in the production process, where the work in process begins to accumulate. This means the bottlenecks.

Delivery time (length of studentship) has always been an indicator that has been followed. Here again the reason to control delivery time cannot be found from process control. Instead the focus has been on student rights and their ability to get into working life. Another indicator of the controlling property of delivery time that has been followed for a long time is the market. This means data concerning the employment situation of the new master’s graduates after they have received their degrees. Offers made compared to order book or lost margin have not been calculated as such because they are not so vital to universities at the moment. Instead, predicting the number of potential applicants by using data concerning high school students would help to set the capacity at the right level in time.
5.2 Theoretical implications

The discussion regarding the education process has been dominated by education science. The focus of education science is on students and learning. The point of view used to develop the performance management of the education process has been narrow.

While the Ministry of Education has exerted tighter control, the steering process itself has come into focus. This again has been in the interests of administration science, which has focused on the public sector administration.

Operations management can provide a new insight into the management and control of the university education process and the ways to develop the steering. Since the research on performance management and processes in public sector has been limited when it comes to operations management, this study adds vital new results to that field of study. In Finland, competition is getting stronger between universities. This is due to diminishing resources. The population is aging and the tax-rates are already high. Younger generations are smaller and universities have to compete for the best students. After the university reform, many Finnish universities have had to reduce their personnel numbers to cut costs. Cost management is important for universities because the amount of state subsidies and potential fees cannot be raised by the university. They are mostly political decisions. This is why the universities should be interested in getting the best results out of diminishing resources. A new university performance management is therefore needed for Finnish universities.

This study provides some new insight into the research of performance management in non-profit organisations. Anthony and Young (1988) state that, because the principal goal of a non-profit organisation is to render service, and since the amount and quality of service rendered cannot be measured numerically, performance with respect to goals is difficult and sometimes impossible to measure. In this thesis we have found that when we have an operational goal, it is not important if this goal is in a non-profit or business organisation. We can still measure and control the process to attain a pre-set goal. However, even Anthony and Young conclude that since a non-profit organisation lacks the semiautomatic control that is provided by the profit mechanisms, it needs a good management control system even more than a business does.

The findings of this research are consistent with the findings of Cavalluzzo and Ittner (2003) and the institutional theories, which contend that implementation of externally-mandated control systems is likely to be symbolic,
with little influence on internal operations. Geiger and Ittner (1996) even suggest that government cost and management accounting systems are primarily implemented to satisfy regulations and legitimate the agencies’ activities to external stakeholders by creating the impression that the agencies are tightly controlling their operations. Even if this seems to also apply to Finnish university education at the moment, this research has provided an example of how the process could be developed to meet the needs of the universities. Modell (2005) says that, in the public sector, performance information has much wider uses and audiences beyond merely serving an instrumental function as a means of managerial control. We can agree with this, but it is important to realise that without first having the managerial control system in place, it is very difficult to produce relevant and reliable information for the use of this wider audience.

Deming (1986) notes that many public sector performance measurement systems involve pre-set annual targets and they also incorporate expectations for “continuous performance improvements,” a “total quality management” principle. He continues that few public programmes opt to undertake the final step of developing formal procedures to regularly adjust performance expectations for unanticipated or uncontrollable factors that might thwart progress towards the goals. In this regard, they neglect a corresponding tenet of total quality management that advocates the use of statistical analysis to adjust for factors outside managers’ control in evaluating and managing performance. This thesis offers some empirical evidence about those factors that are outside managers’ control in evaluating and managing the performance of a university education process. The most important factor seems to be the accumulation of work in process and the number of drop-outs as part of it.

We can also agree with Walker et al. (2010) that reliance on goal-directed strategic planning has been found to have a positive impact on the performance of public sector organisations.

We can further share the concern of OECD (2012) about the magnitude of non-completion, often perceived as a waste of financial and human resources. In spite of the adoption and development of sophisticated quality assurance systems in most OECD countries over the past two decades, failures and inefficiencies in the learning process have not been eradicated. In fact, our study shows that the university education process is more ineffective now than it was a decade ago.

Ewell (1999) identified that one dimension shared by all the commentators of university performance measures is some variant of the input-process-output continuum. In addition, most agree that indicators drawn from all three of these
sub-domains are important for policy purposes. The increasingly popular alternative of examining outcomes alone ignores important differences in the institutional context. Not taking inputs into account when examining outcomes thus risks holding institutions responsible for matters that are beyond their control. In this thesis we share this concern. The finance model of the Ministry of Education focuses on output. The empirical data of this thesis shows that a larger variety of indicators and measures is needed for proper management of the process.

Modell (2003) has been seeking to explain logical inconsistencies between formally stated goals and observed performance indicators in public sector performance management practices. Modell continues that future studies could extend this complementary research approach to the micro level of analysis to assess how gaps between goals and performance indicators within operating-level organisations interrelate with those observed at the macro level of a specific organisational field. This kind of a study has been performed in this thesis. Some inconsistencies have also been found in the steering of the Finnish university education process when we compare the steering of the Ministry of Education to the indicators and performance in a department of one university.

Our findings are in line with the results of Eloranta et al. (1986): (1) Throughput time can be decreased despite the controllability situation, (2) The work-in-process can be minimised despite the controllability situation, (3) Organisations started to develop their control systems despite the controllability situation. (4) The development of the production controllability is related to situation. By using the indicators of operations management we can identify the critical points of the education process to be developed. These critical points are the same as found in the controllability analyses performed in industry.

Eloranta et al. (1986) also found that the operations management is understood too narrowly in the organisations they studied. They found the relationship between marketing and production to be too weak. This is also true in the performance management process of the university education process. The Ministry of Education decides on the targets without reliable data concerning the production and the market forecast. Eloranta et al. also found that the amount of current assets in the organisations was substantial. Work in process constitutes biggest part of the current assets. There was a need for shorter throughput times. This is also a big problem in the university education process. The work in process is big and it also includes a big element that is not currant or is in risk to deteriorate.
According to Eloranta (1981), the structure of a production system consists of dependences between input- state- and output variables. The adequacy of control parameters gives a picture of the adequacy of measures at the operative level that the company can use to affect the internal and external variables. The behaviour of external variables is usually more difficult to handle as part of controllability. The state of a production system is a constraint that affects the ability to obtain the targets of controllability quickly. In our study we found that the state of the education process affects the department’s ability to obtain targets quickly. Here we could regard controllability as flexibility, as Eloranta recommends.

Eloranta (1986) continues that if the chain of work operations is long – a lot of work operations and operations time – the control task is more difficult than in cases with just a few and short operations. This is due to the fact that each work operation is a source of variance in the product flow and therefore the range of total variance can be high. Variance in operations timing makes the tasks problematic, which is shown in WIP, capacity utilisation, throughput time, delivery performance, set ups and idleness. Since the university education process is very long, usually five to seven years, all the problems that Eloranta has listed can be seen in the university education process. The most significant of these problems is the amount of WIP.

Since the Ministry of Education regards the length of studentship as the most important indicator in its PMS, we can point out that the delivery time of a production plant cannot be based on magical tricks at operational level. The delivery time is a feature that relates integrally to the factory and the organisation as Eloranta (1986) states.

Haapasalo et al. (2006) conclude that for the company success is critical so that the company can control and manage operations effectively. The better the controllability is, the better the ability is to react to changes. They continue that, in order to achieve successful BCS implementation in the energy sector, industry specific features and targets must be considered. In the energy industry, companies seem to have quite similar strategies for similar operations, which may lead to similarities in metrics too. Even so, they still have to create their own implementation process from their own origins. Further, the faculties and departments in the university sector have almost unique metrics because of the steering of the Ministry of Education. They should therefore develop the metrics from their own origins as well.
5.3 Practical implications

We have performed a controllability analysis to identify the most important areas of development in the university education process. The importance is valued according to the greatest financial potential. We found targets for development in all the main areas of controllability.

Resource allocation has traditionally been the way to control government units and agencies. The Ministry of Education has had to control the fairness of resource allocation. The Ministry of Education has quite rapidly during the first decade of the 21st century changed the focus of the PMS from fairness to output and results. This has caused problems in the universities when they have tried to adapt to the change.

According to Eloranta (1981), the external controlling properties are factors that come from outside the production system. It is difficult to control them from inside the production plant, but it is vital to adapt to them. The internal controlling properties are only dependent on the operation of the factory and its organisation. This is also true when we think about the universities and the education process. The steering of the Ministry of Education comes from outside the universities and it is impossible for universities to control the elements of that steering. It is, however, vital to adapt to them, most of all for financial reasons.

The state of a production system is a constraint that affects the ability to obtain the targets of controllability quickly. Eloranta (1981) continues that it would be better to use the word “flexibility” instead of controllability when it is important to obtain a certain state of the production system in a restricted time. In this study we have found that the state of the production system in different departments has affected greatly the implications of the PMS of the Ministry of Education in those departments. Potentially, the traditional resource allocation and its idea of fairness have led to the thinking that even the processes are equal. This study has shown that this is not the real situation.

According to TOC (Goldratt & Cox 2004), profitability is a function of time and inventory. Reducing the time required to pass a product through a production system reduces inventory and increases profitability. Eloranta (1981) notes that controllability and productivity should be seen as part of the measures for profitability. Of the controllability goals, the turnover of current assets and throughput time affect directly the capital turnover. Work in process is straightforwardly dependent on the throughput time of the factory.
In our study we have found that time and inventory are also vital elements in the university education process. The work in process is large and the throughput times tend to be long. The controllability analysis performed gives us some ideas of how to develop the education process in this sense. We need to adapt to the PMS the indicators that measure the work in process and inventory. It helps the universities to make better forecasts and to construct a more efficient education process.

Our study shows that the indicators in the PMS of the Ministry of Education have been selected by the needs of the Ministry. Even if the PMS reflects the main variables of controllability, the indicators are not the most critical from the university education process point of view. Because the indicators in the PMS of the Ministry of Education have changed so much and the finance model is volatile to political trends, the development of the management of the production process should be done on a university level where the processes are stable and where the need for everyday process control lies. At the moment, Finnish universities don’t get up-to-date data concerning the education process in the faculties or departments for their own purposes. This is another reason to develop the PMS at the university level. There is no “one size fits all” PMS for all the departments because they are not identical. In fact, every department should conduct a controllability analysis from its own perspective.

5.4 Reliability and validity of the study

According to Saunders et al. (2009), reliability refers to the extent to which the data collection techniques or analysis procedures will yield consistent findings. The goal of reliability is to minimise the errors and biases in a study (Yin 2003).

The data in this study was collected according to the controllability analysis. The database and the procedure to collect data are demonstrated in the work of Eloranta et al. (1986). Also, the analysis is made according to the controllability analysis.

Yin (2003) presents three kind of validity:

1. Construct validity: establishing correct operational measures for the concepts being studied.
2. Internal validity: establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships.
3. **External validity**: establishing the domain to which a study’s findings can be generalised.

To establish the quality of the research, the following methods have been used for validation. For the construct validity, multiple sources of evidence have been used. Controllability analysis includes several analyses in itself. The multiple sources of evidence principally include documentation, statistics, databases and archival records. Replication logic was used in this multiple case study for external validity. A case study database was established when collecting the data for reliability of the research. For internal validity, a rival explanation was addressed.

Explanation building is a special type of pattern matching technique. The goal is to analyse the case study data by building an explanation about the case. Explanation building is designed to test theoretical propositions, albeit in an iterative manner, rather than to generate theory inductively. The eventual explanations are results of a series of iterations. A cross-case analysis is a technique for analysis of multiple cases. The analysis can probe whether different groups of cases appear to share some similarity and deserve to be considered instances of the same “type” of general case. Cross-case synthesis can be more complex and cover broader issues than simply analysing single features (Yin 2003).

This study includes 11 individual case studies. Six cases (departments) are from the Faculty of Humanities and five cases (departments) are from the Faculty of Technology. These two faculties were selected because they are in a sense polar type. The cases in each faculty were presumed to have similar results. Cross-case synthesis was made of the two faculties. Some features were found to be typical to each faculty. One department had characteristics of its own, because it was supposed to have a large increase in its production volume. At least it had a big increase in finance. During the period of study, finance was also diminishing at the highest level. In the Faculty of Humanities the departments are smaller than in the Faculty of Technology. In a very small department data from one single student can affect total result of the department substantially. Conducting this kind of cross-case synthesis relies strongly on argumentative interpretation, not numeric tallies. This method is directly analogous to cross-experiment interpretations (Yin 2003).

Case studies rely on analytical generalisation not statistical generalisation. In analytical generalisation, the investigator is striving to generalise a particular set of results to some broader theory (Yin 2003). The replication logic is the same
that underlies the use of experiments and allows scientists to cumulate knowledge across experiments.

The data display and analysis approach is based on the work of Miles and Huberman (1994). For them, the process of analysis consists of three concurrent sub-processes: data reduction, data display and drawing and verifying conclusions. Data display involves organising and assembling the data into summary diagrammatic or visual displays. A display allows the researcher to make comparisons between the elements of the data and to identify any relationships, key themes, patterns and trends that may be evident. In this way the use of data displays can help the researcher to interpret the data and to draw meaning from it (Miles & Huberman 1994, Saunders et al. 2009).

Data reduction often forces choices about which aspects of the assembled data should be emphasised, minimised, or set aside completely for the purposes of the project at hand. Validity means something different in this context than in quantitative evaluation, where it is a technical term that refers quite specifically to whether a given construct measures what it purports to measure. Here validity encompasses a much broader concern for whether the conclusions being drawn from the data are credible, defensible, warranted, and able to withstand alternative explanations (Miles & Huberman 1994).

In this thesis, the indicators used by the Ministry of Education in the finance model (delivery time, number of degrees etc.) and the criteria for student aid (delivery time) are compared to the results of controllability analysis by years 2000–2003, 2004–2006, 2007–2009 and 2010–2012. One important factor affecting the process is the European Union’s decision on ECTS. This is out of the control of the Ministry of Education. Other big changes affecting the process cannot be identified despite the financial cuts affecting all the government agencies after 2010 and the university reform of 2010. These changes have affected more the administration than the education process. We have analysed the changes in the education process in the departments of two faculties. These faculties are in one University. Since the performance management system of the Ministry of Education is the same for all universities and the universities in Finland use the same ICT-systems for finance and education, the findings of this research are applicable in the other universities in Finland. Most of the results should also apply to public universities in other countries. According to OECD surveys and classifications, the same kind of indicators and criteria are used by the steering ministries and universities around the world. The biggest differences
are in the methods used for selecting new students. This can affect the motivation of the students and also the number of drop-outs.

5.5 Limitations of the results

The teaching methods or the quality of teaching has not been involved in this study. It is, however, quite evident that they affect the throughput of the education process and also the number of drop-outs.

The students in this study have been seen as material only. Of course students, and most of all their motivation, affect the throughput time and even the chance to being employed after graduation.

This study was done of the Faculty of Humanities and the Faculty of Technology. Other Faculties, for example Medicine, may have their own characteristics. Even so, the big picture is not so different in different faculties.

5.6 Future research

It would be interesting to see results of the controllability analysis made in a public university outside Finland. Are there differences in the results and how much do they differ? This might also help the work of OECD in the field of higher education as well as the governments to implement better steering for higher education.

Future research could be conducted on the ICT-systems of the education process. The ICT-system OODI was first introduced in 2002 in Finland. After 10 years it does not provide the most important data regarding the education process. This is because the statistics and the way to collect data vary so much. It is difficult to process this kind of data in a reliable way. The Bologna Process and ECTS have made the data collection and processing of studies even more difficult. There is now so much flexibility in the study paths that it is difficult to put into statistics.

More detailed data from department level relating to the reasons for different indicators and their level would be very interesting.

Still another interesting topic to research is the issue of drop-outs. This has so far been examined as a question of student motivation or even feelings. It could be studied from a total quality management perspective. How to improve the education process on the whole to reduce the number of drop-outs? Now the quality costs of the drop-outs are high.
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