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Analyzing the Impact of Management Practices on Firm Efficiency

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Summary

A regression analysis was conducted to identify the independent variables that influence the management practices on UK manufacturing firm efficiency. The regression model was specified accounting the eight variables: 1) if incentive compensation is offered, 2) if a company provides training to employees, 3) if flexible job assignment occur, 4) if firm employees more than 50 workers, 5) manager age, 6) manager experience in managerial positions, 7) manager education and 8) if a firm is family-owned.

The regression study performed to quantify these variables shows that the two most influential aspects in controlling a UK manufacturing firm's efficiency are delayed flexible job assignment and increased firm employees by more than 50 workers. Methodology used was OLS estimation procedure as well as Tobit regression.

Manager experience in managerial positions and manager age variables are the strongest positively variables. At the same time, the strongest negatively variables pair are between flexible job assignment and manager age.

Flexible job assignment and family-owned variables increase, tend to decrease all the other examine variables, or in the best case to be without any significance to any of the other variables. By contrast, there are two variables correlated with the majority of other variables with positive value. Those are the incentive compensation is offered and the company provides training to employees.

Περίληψη

Για τον εντοπισμό των ανεξάρτητων μεταβλητών που επηρεάζουν τις πρακτικές διαχείρισης στην αποτελεσματικότητα των κατασκευαστικών εταιρειών του Ηνωμένου Βασιλείου, πραγματοποιήθηκε ανάλυση με μοντέλο παλινδρόμησης Το μοντέλο παλινδρόμησης καθορίστηκε λαμβάνοντας υπόψη τις ακόλουθες οκτώ μεταβλητές: 1) εάν προσφέρεται αποζημίωση κινήτρου, 2) εάν μια εταιρεία παρέχει εκπαίδευση στους εργαζομένους, 3) εάν προκύψει ευέλικτη ανάθεση εργασίας, 4) εάν οι εργαζόμενοι στην επιχείρηση υπερβαίνουν τους 50 εργαζομένους, 5) η ηλικία του διευθυντή , 6) εμπειρία διευθυντικού στελέχους σε διευθυντικές θέσεις, 7) εκπαίδευση στελεχών και 8) εάν μια επιχείρηση είναι οικογενειακή.

Η μελέτη παλινδρόμησης που διεξήχθη για την ποσοτικοποίηση των μεταβλητών έδειξε δύο σημαντικές επιδράσεις σχετικά με τον έλεγχο της αποδοτικότητας μιας κατασκευαστικής εταιρείας στο Ηνωμένο Βασίλειο, οι οποίες είναι η καθυστερημένη ανάθεση εργασίας και η αύξηση των εργαζομένων της εταιρείας άνω των 50 εργαζομένων. Η μεθοδολογία που χρησιμοποιήθηκε ήταν η απλή μέθοδος των ελαχίστων τετραγώνων (OLS) καθώς και η παλινδρόμηση Tobit.

Η εμπειρία διευθυντικού στελέχους σε διευθυντικές θέσεις και η ηλικία του διευθυντή είναι οι ισχυρότερες θετικές μεταβλητές. Ταυτόχρονα, οι ισχυρότερες αρνητικές μεταβλητές είναι μεταξύ της ευέλικτης ανάθεσης εργασίας και της ηλικίας του διευθυντή.

Αύξηση των μεταβλητών ευέλικτης ανάθεσης εργασίας και το εάν μια επιχείρηση είναι οικογενειακή, τείνουν να μειώνουν όλες τις άλλες μεταβλητές εξέτασης ή στην καλύτερη περίπτωση να μην έχουν καμία σημασία για καμία από τις άλλες μεταβλητές. Αντίθετα, υπάρχουν δύο μεταβλητές που συσχετίζονται με την πλειοψηφία των άλλων μεταβλητών με θετικό πρόσημο. Αυτές είναι η προσφορά αποζημίωσης κινήτρου και η παροχή εκπαίδευσης στους εργαζομένους.

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…to my father

Agapios G. Agapiou

you already know why...

Thank you.

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Chapter 1
Introduction

Firms' adoption of structured management practices varies greatly around the world. It has been highlighted that the structure and quality of management practices vary significantly between countries, firms within a country, and even facilities within a particular firm.

Management practices have been related to improved economic outcomes, environmental stewardship and labour treatment. They are defined as explicit and measurable incentives, disciplines, and routines that drive employees' everyday work. Over the last several decades, surveys, training programs and trials have all been used to develop management theory and practice. However, we do not grasp what causes management practice formalization and how it affects performance (Karplus et al. 2021).

Management practice is a combination of analytical tools used by managers in efforts to support them implement a specific management concept. To ensure that a company is functioning smoothly, excellent management practices are required. As each firm has its own management practice, which is considered as a critical need that a firm should establish prior to strategic planning by applying certain aspects, those should be measured at regular intervals to provide a clear image of the firm's development.

Even if manufacturing firms' organizational effects become more complicated, organized management practices and their relationship to efficiency become stronger. The vast variance in firm and performance has become a focus of empirical and theoretical study throughout the social sciences, including economics. Understanding those variations in management practices may assist in explaining differences in firm efficiency. In many cases, the relationship between selected aspects of management practices and heterogeneity of firm efficiency is studied using statistical analysis, which is considered the modern school of management.

Quantitative approaches such as econometric modelling and microeconomic data are increasingly being used by researchers to evaluate the impact of management practices on productivity or to determine why certain organizations embrace strategies while others do not. Among them, the UK Office for National Statistics, that developed the Management and Expectations Survey, one of a few surveys targeted at quantifying the prevalence of structured management methods across a wide range of enterprises in the industrial and service industries.

This thesis aims to achieve better knowledge as per management practices that impact the efficiency of United Kingdom firms. Thesis analysis is based on randomly selected data collected from UK manufacturing firms and by analysing eight variables, as follow: 1) if incentive compensation is offered, 2) if a company provides training to employees, 3) if flexible job assignment occurs, 4) if firm employees more than 50 workers, 5) manager age, 6) manager experience in managerial positions, 7) manager education and 8) if a firm is family-owned. The analysis is based on the statistical tool of regression analysis.

The remainder of this thesis is structured as follows. Chapter 2 provides an overview of efficiency and its various types. Chapter 3 examines management practices and firm performance, focusing on UK management practices by viewing prior works of recent articles, statistical data, and management methods implemented. The methodology of the thesis is examined in Chapter 4, where the objectives, model of analysis and thesis limitations are mentioned. Next, in Chapter 5, data and descriptive statistics as per the relationships between efficiency score and eight independent variables in 155 UK manufacturing firms are analysed. Chapter 6 presents the application to empirical data, results and discussion, while the last chapter concludes.

Chapter 2
Literature Review

2.1. Efficiency and Effectiveness

This thesis is concerned measuring impact of management practises on firm's performance, by means of efficiency. However, what is firm efficiency, and what is effectiveness?

According to the American Management Association, efficiency *"is the comparison of what is actually produced or performed with what can be achieved with the same consumption of resources (money, time, labour, etc.). It is an important factor in determination of productivity*". Effectiveness is *"the degree to which objectives are achieved and the extent to which targeted problems are solved*" (AMA n.d.).

In contrast to efficiency, effectiveness is determined without reference to costs, whereas efficiency means "doing the thing right," effectiveness means "doing the right thing" (AMA n.d.).

2.2. Efficiency Measurement

The papers by Debreu (1951) and Koopmans (1951) mark the origin of discussion on the measurement of efficiency in the economic literature (UP n.d. a).

Efficiency was introduced in the 1950s by Koopmans (1951). In his rather technical monograph, Koopmans defines an efficient point: *"A possible point [...] in the commodity space is called efficient whenever an increase in one of its coordinates (the net output of one good) can be achieved only at the cost of a decrease in some other coordinate (the net output of another good)*". In other words, a point is efficient if the output is maximized given the inputs. Debreu (1951) uses this definition to develop a measure of efficiency, or, in his own words: *"A numerical evaluation of the "dead loss" associated with a non-optimal situation (in the Pareto sense) of an economic system".* The general idea of this measure is to determine the distance between the produced output and the output that could have been produced given the inputs. (UP n.d. a, Meesters 2009).

2.3. Productivity and Efficiency

Productivity, at its most basic level, evaluates the relationship between input and output in a given manufacturing process (Coelli, Rao et al. 1998). In order to measure production activities, productivity is expressed as an output versus input formula. It not only defines the volume of output but also the volume of output in relation to the resources used. The firm's productivity can be expressed as a ratio (Coelli, Rao et al. 1998), as indicated below:

Productivity= Output(s)/Input(s)

The terms productivity and efficiency are often used interchangeably. While the terms productivity and efficiency are sometimes used equally, efficiency and productivity do not have the same precise definition. While efficiency can also be described as a comparison of two components (inputs and outputs), the highest productive level from each input level is considered an efficient situation. Coelli, Rao, and Battese (1998) go on to state that efficiency refers to a company's ability to get the most output from a given set of inputs. A company is said to be efficient if it gets the most output from a given set of inputs (Rogers 1998).

Creating goods and services with fewer inputs or producing more output for the same amount of inputs are two examples of alternative strategies to improve a firm's productivity. As a result, improving productivity means either producing more output with the same number of inputs or requiring fewer inputs to produce the same level of output (Rogers 1998). When the maximum output is produced for a given input level, the highest productivity (efficient point) is achieved. As a result, increases in efficiency are included in productivity growth, because increasing efficiency obviously raises productivity (Rogers 1998). As a result, if a company's productivity growth exceeds that of its competitors or other organizations, it performs better and is regarded more efficient (Jayamaba & Mula 2011).

2.4. Types of Efficiency

Efficiency comes in a variety of forms. The following is a list of the most common economic efficiency types:

2.4.1. Productive Efficiency

Productive efficiency is concerned with producing goods and services with the optimal combination of inputs to produce maximum output for the minimum cost (Tejvan 2019).

Efforts were made to evaluate efficiency by interpreting average input productivity and then constructing efficiency indexes. On the other hand, economists regarded these methodologies as unsatisfying because they had one flaw after another. Traditional least-squares approach for estimating the production function has been criticized because they are incompatible with the notion of the production function. Subsequently, such regression estimates the mean output (rather than the maximum result) given amounts of inputs; the estimated functions are best represented as average or response functions (Schmidt, 1986). As a result, the frontier method, a more well-founded theoretical method for measuring efficiency, was developed (Coelli 1995, UP n.d. a.).

Farrell (1957) was the first to define a primary measure of productive efficiency that could account for various inputs, drawing on the work of Debreu (1951) and Koopmans (1951) (Coeli et al. 1998). Given that the estimated production function showed a certain degree of constant returns to scale, Farrell (1957) assumed that the firms' input and output values per unit observed in the firms would exceed the so-called unit isoquantity curve (Battese 1992). Farrell (1957) proposed that firm productive efficiency consists of two components: technical efficiency and allocative efficiency. These two measures are then combined to measure total economic efficiency (Coeli et al. 1998).

Farrell used an input-oriented approach to demonstrate how to quantify efficiency. Figure 1 illustrates his thesis. This graphic was created by examining a corporation that produces output y utilizing two inputs, x_1 and x_2, with the production frontier $y=f(x_1, x_2)$. The allocative efficiency is measured by the ratio OR/OQ, while the technical efficiency is measured by the ratio OQ/OA (UP n.d. a).

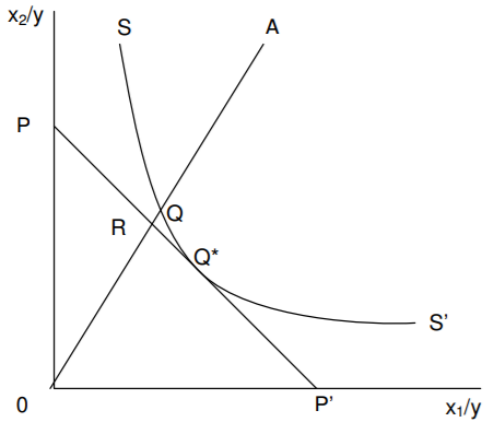


Figure 1: Allocative and Technical Efficiency (UP n.d. a)

2.4.2. Allocative Efficiency

Allocative efficiency (so-called static efficiency) reflects the ability of a firm to use the inputs in optimal proportions, in regards with their respective prices and the production technology (Coeli et al. 1998). This helps determine if a resource needs to be prioritized over one activity. Thus, it is associated with spending limited resources in the areas most suitable for maximizing public value elected civil servants and citizens (Harries 2012).

Allocative efficiency, also known as price efficiency by Farrell, refers to a firm's capacity to select the optimal combination of inputs given input prices. When a company achieves both technical and allocative efficiency, it becomes cost efficient (overall efficient) (Badunenko et al. 2006).

2.4.3. Technical Efficiency

According to the definition, that was initially mentioned by Farrell (1957), a company is technically efficient if it employs the fewest possible inputs to produce a specific result (input orientation) (Badunenko et al. 2006).

Technical efficiency reflects the ability of a firm to obtain maximal output from a given set of inputs (Coeli et al. 1998). In other words, technical efficiency is concerned with making the most of resources allocated and is the province of managers (Harries 2012).

Technical efficiency is classified into two major groups: parametric and nonparametric. Cobb-Douglas production function (dates back to 1928) is a widely used functional form

for empirical analysis of increased output and estimation of total factor productivity (Jiaotong et al. 2016).

Technical efficiency and allocative efficiency are the two components of efficiency in general. Because the firm must first lie on the production frontier to maximize profits, allocating efficiency implies technical efficiency. On the other hand, technical efficiency does not always imply allocative efficiency because a combination of outputs and inputs can be optimal in terms of production possibilities but not profit maximization (Geamanu 2011, Wongnaa 2016).

2.4.4. Dynamic Efficiency

Dynamic efficiency is the optimal rate of innovation and investment and improves production processes that help the long-term average cost curve. It involves improving allocative and productive efficiency over time. This includes improvements in allocation and production efficiency over time, i.e. developing new or better products and finding better ways to produce goods and services (Dolamore 2014, Pettinger 2019).

Peter Diamond (1965) demonstrated that a competitive economy could achieve a stable state in which there is too much capital. The economy is said to be dynamically inefficient when the population growth rate exceeds the steady-state marginal product of capital or when the economy regularly invests more than it earns in profit (Abel et al. 1989, Luo et al. 2020).

2.4.5. 'X' Efficiency

According to the 'X'-Efficiency theory, increased product market competition will force firm members to produce with more significant effort, bringing the business closer to its boundaries. As a result, firms will produce closer to their boundaries (Frantz 2020).

As per Altman (2020), 'X'-efficiency provides some light on the impact of minimum wages and labour unions on employment. Standard economic theory predicts that these variables will have a negative impact on the economy by reducing employment—making marginal employees unemployed—and by making firms less competitive by raising their average cost. The projected negative consequences of minimum wages and unions need

not occur to the extent that rising wages, whether through minimum wage legislation or collective bargaining, drive higher effort. Thus, productivity compensates the increased labour costs.

2.4.6. Social Efficiency

The term "social efficiency" refers to considering all of a decision's or policy's private and societal costs and benefits. When marginal social benefit equals marginal social cost, social welfare is maximized. Social efficiency entails an effort to consider all individuals' assessments of all economic implications - not only the direct or simply material consequences of such acts. In some circumstances, social efficiency overlaps with the more well-known concept of private-sector efficiencies, such as minimum production costs for a given output maximum profits.

In some cases, the comparison effects of well-being or income standards of various population levels might operate as social efficiency criteria. Since the concept of "social efficiency" exists, it is a set of instruments capable of estimating it (Bohm 1987, Sukharev 2012, Terziev 2019).

2.4.7. Resource Efficiency

Resource Efficiency is the output achieved relative to the consumption of a resource. This is an important sustainability metric as improving recourse efficiency tends to reduce the environmental impact of economic activity and is focused on using resources and how they contribute to our well-being and economy (EC 2012, Tejvan 2019).

Resource efficiency entails ensuring that natural resources are produced, processed, and consumed in a more sustainable manner, hence reducing the environmental impact of the product consumption and production over their entire life cycles. In addition, resource efficiency improves the ability to meet human demands while respecting the earth's ecological carrying capacity by providing greater wellbeing with less material usage (UN 2010). As per EC (2012) resource efficiency is more concerned with the pressures put on the natural environment than the state of the natural environment. It aims to limit the risks linked with scarcity and the security of the supply of resources. It increases productivity, resulting in higher economic growth and employment. Jobs and growth

potential are heavily influenced by sectoral structure, trade, and employment patterns (Ewijk 2018).

2.4.8. Mechanical Efficiency

The mechanical efficiency is a measurement of how successfully it turns input work or energy into a useful output. The output work is divided by the input work to arrive at this amount (Dunlop 2019, Weinstein et al. 2004).

In the late 19th and early 20th centuries, mechanical efficiency was expanded to include biology, labour management, economics, and personal discipline (Dunlop 2019).

2.4.9. Process Efficiency

Process efficiency refers to a human resource's capacity to carry out a task so that it consumes the least amount of effort and energy possible. It is a condition in which a process is carried out correctly. The goal is to make implementation easier by achieving more results with fewer resources. By decreasing waste and optimizing resource usage, process efficiency allows for the best savings and performance. In order to improve the efficiency of business operations, a company must concentrate on improving the actual output. It should also compare current processes to previous or completed processes to spot flaws and waste (Kolinski et al. 2014, BPM n.d.).

2.4.10. Operational Efficiency

Operating efficiency is the % ratio of the actual output of a piece of equipment, department, or plant compared to the planned or standard output (Kolinski et al. 2014). Deepa (2021) states that every industrial firm relies on operational efficiency. It is judged in terms of achieving strong, long-term, and growth-oriented results, regardless of whether the country is established or developing. The profitable, efficient, and sensible use of resources available to an organization according to clearly laid down financial policies relating to the operation is referred to as operational efficiency.

The ability to translate strategic goals to tactical and operational levels determines effective analysis of operating efficiency. Operating efficiency concerns the organizational

and technological components of a manufacturing process optimization and rationalization (Kolinski et al. 2014). Operational efficiency directly impacts a company's profit margin and is considered a crucial driving force for businesses. It is the systematic management of a company's resources to achieve maximum results and entails putting in place both appropriate and cost-effective (Deepa 2021).

2.4.11. Economic Efficiency

Economic efficiency is a term used to compare the results of a given economic activity to work required to complete it. It is the most important qualitative aspect of economic growth since it ensures that the outcome grows in absolute terms while exerting the same amount of work. It aims to reduce the number of resources allocated to a unit of effectiveness (Geamanu 2011, Wongnaa 2016).

The economic efficiency of investments is an important metric for the growth of both businesses and the economy. Only profitable investments are considered efficient; the overall cumulative profit earned over the life of an economic investment strives to recoup the full cost of the investment and ensure an additional profit whose maximum is one of the company's goals (Geamanu 2011).

2.4.12. Business Efficiency

A situation in which a company maximizes advantage and profit while minimizing work and expenditure is referred to as business efficiency. In other words, business efficiency is the quantity of work a firm can generate concerning the amount of time, money, and resources required. Thus, a business's efficiency measures how well it can transform things like materials, labour and capital into services and products that produce revenue. All firms, large and small, are affected by inefficiency. Because of the abundance of resources available in larger firms, inefficiencies may go unnoticed. Regardless of their industry, small firms may not be able to survive or grow due to inefficiencies. Lack of basic managerial and entrepreneurial skills, inefficiency, lack of access to necessary capital for growth and development, vocational curriculum that is unrelated to technical and managerial skills required by entrepreneurs, lack of accurate information related to the risk of lending money to small businesses, as well as over-regulation of the small business

sector are the main challenges to the long-term survival and viability of small businesses and enterprises (Heide et al. 1998, Kasim et al. 2018, Turyahebwa et al. 2013).

2.4.13. Market Efficiency

Market efficiency is measured in terms of marketing costs and margins and the correlation of price changes in different markets for the same product.

One of the earliest classifications of market efficiency levels argues that markets might be efficient at three levels depending on what information was reflected in prices. Because the current price reflects the information contained in all previous prices when it is under weak form efficiency, charts and technical analyses that rely solely on past prices will not be beneficial in identifying undervalued stocks. In semi-strong form efficiency, the present price reflects all public information (including financial statements and news reports), and no technique based on exploiting and massaging this information would be beneficial in identifying undervalued companies. Under strong form efficiency, the current price reflects all publicly available and privately held information, and no investor will be able to regularly find undervalued stocks (Raju et al. 1982, NYU n.d.).

If markets are efficient, the best estimate of value is the market price, then the valuation process becomes one of justifying the market price. If markets are inefficient, market prices may differ from true values, and the valuation process aims to determine a reasonable estimate of this value. Because of their ability to recognize undervalued and overvalued companies, those that do valuation well will be able to make 'higher' returns than other investors. However, to achieve these better returns, markets must correct their errors - i.e. become efficient over time (NYU n.d.).

Chapter 3
Management Practices

3.1. Management

The term management has been defined in various ways by various authors. According to George R. Terry, *"Management is a distinct process consisting of planning, organising, actuating and controlling, performed to determine and accomplish stated objectives by the use of human beings and other resources".* Peter Drucker define it as "*Management is a multi-purpose organ that manages business and manages managers and manages workers and work".* According to Harold Koontz, "*Management is the art of getting things done through and with people in formally organized group"*. "*The art of getting things done through people" was* Mary Parker Fallett management outline (Devi n.d., UOU 2018).

The most notable management definitions, organized by concept are described as follow (Devi n.d., UOU 2018):

a) Functional management concept: as a process of what a manager does.
b) Human relation management concept: as a technique of completing tasks.
c) Leadership and decision making management concept: as an art and science of decision-making and leadership.
d) Productivity management concept: as a technique of increasing productivity.
e) Integration management concept: as the coordinator of human and material resources.

Management is the total of all those concepts. It included, among others, the concept to secure men, material, and machinery at a low cost or even monitor, supervise, control and oversee their performance and others (Devi n.d., UOU 2018).

3.2. Management Practices

Management authors, such as Dessler 2004, Sutherland & Canwell 2004, Van Assen et al. 2009, have describe management practices as an entity of analytical tools used to assist managers at work in applying a chosen management idea. On the other hand, Rigby (2001) proposes another definition of management practices, as tools characterised as concepts, processes, and exercises (Nedelko & Potocan 2016).

Managers use management concepts and ideas to create and apply various management tools and techniques in the workplace (Nedelko & Potocan 2016).

Over the years, various management theories and concepts have been developed to support and improve the work and behaviour of companies (Nedelko & Potocan 2016). Scholars have classified management theories in many ways. Koontz (1988) divided it into six categories: (i) management process school, (ii) empirical school, (iii) human behavioural school, (iv) social system school, (v) decision theory school and (vi) mathematics school.

Hitt et al. (1979), on the other hand, divided the evolution of management into three broad categories: (a) classical management theory, (b) neo-classical management theory and (c) modern management theory (Devi n.d., Hussain et al. 2019).

The classical management approaches (1900 to 1930) developed toward the end of the nineteenth century and the beginning of the twentieth. Under this category, systematic management, scientific management, bureaucratic management, administrative management and human relations management approaches. It emphasized a rational, scientific approach to management research to transform organizations into efficient operational units. The study of management concepts and functions, organizational authority structures, total organization management and ways and means to make organizations more efficient were all part of classical management theory (Devi n.d., Hussain et al. 2019, UP n. d. b).

According to the neo-classical school of thought (1930 to 1960), traditional theory and its principles are contradictory, which solely concentrated on motivation through monetary rewards and provided techniques to carry out operations without taking into account the

temporal factor, which is prone to change. The neo-classical school emphasized human orientation and paid attention to workers' desires, time needs, attitudes, and behaviours (Behavioral Sciences) (Devi n.d., Hussain et al. 2019). The neo-classical management approaches (UP n. d. b) are the quantitative, organisational behavioural, systems theory, and contingency management approaches. However, both classical and neo-classical management techniques failed to provide precise instructions on implementing a comprehensive, practical, and integrated management style that could be used effectively by all employees at all levels of all organizations (Hussain et al. 2019). The components of flux, interdependence, ambiguity and multiplicity have increased the complexities in the dynamics in which organizations work and function. As a result of these factors, creating a single universal management principles template that can be applied to all types of organizations and individuals has become unrealistic and inapplicable. Thus, modern management theory was introduced (Hussain et al. 2019, UP n. d. b).

As per modern management theory (1960 onwards), the three main elements of the organization that have been shaped under modern management philosophy are the (i) Quantitative Approach to Management (Operations Research), (ii) Systems Approach to Management and (iii) Contingency Approach to Management (Devi n.d., UP n. d. b).

Furthermore, the different needs, goals, reasons and possibilities of individuals and organizations play an equal role in the current management philosophy (UP n. d. b).

The modern school of management focused on rationality and the application of management to specific conditions. Quantitative methodologies were utilized to examine the role of management in modern organizations throughout digitalization and computer usage (UP n. d. b).

In another aspect, authors (Rigby 2001, Sutherland & Canwell 2004, Sapkauskiene & Leitoniene 2010, Potoan et al. 2012) define their management phases as follows: (1) Concept – a broad, well-developed, and well-defined basis for considering an idea, (2) Methodology – as a single entity or a group of a closely related collection of methods, rules and disciplinary postulates, (3) Methods – as goal and problem- ordered types of procedures, which are particularly regular and systemic ways of establishing and achieving a specific goal, (4) Techniques – as a means of dealing with technical concerns,

and (5) Corresponding management tools – as a means of putting management principles into action (Nedelko & Potocan 2016).

As per Bloom and Reenen (2007), there are two classes of theories for why excellent management practices differ amongst firms: a) optimal choice of management practices where traditional economic approach considers management as a firm's choice variable. Improving management methods could be costly so that the company will assess the expenses against the projected future advantages and b) managerial inefficiency was the relationship between management practices, and profits is a distinction between the two pure forms of the models. If poor management were only an optimal option with no exogenous efficiency variations between businesses, badly managed firms should be no less profitable than well-managed firms. Good management are related to higher profitability, while poor management generates lower efficiency.

3.3. Management Practices and Firm Performance

Firm performance can be defined in many ways. A natural measure of firm performance is a productivity ratio: the ratio of outputs to inputs, where larger ratio values are associated with better performance. Performance is a relative concept (Coeli et al. 1998).

Researchers are increasingly using econometric modelling and microeconomic data to estimate the impact of management practices on firm performance or why some firms adopt practices while others do not. Micro data that describes the productivity of individuals, teams, and other units within businesses (such as stores) are becoming more widely available. The quantitative (social) studies that have been published focus on related themes rather than management techniques directly (Shaw 2009).

Among other studies is the one by Ichniowski et al. (1995) and Bandiera et al. (2005), where they explain one set of key characteristics of insider econometric research. As per the authors, the researcher must find a management practice that has altered within the firm or across a group of firms that are quite a similar model it as per management approach in a way to define why in some organizations or people gain more than others. The next step is to attempt to model fundamental economic behaviour to extrapolate the findings of an insider study to other companies or industries. The micro data collected

should balance homogeneity and heterogeneity. The more homogeneous the units stand for stronger researcher's case modelling of the production function. Nevertheless, to quantify the effect of HR practice on productivity, there must be heterogeneity, or variation, in HR practice across persons or stores (Shaw 2009).

According to Ichniowski et al. (1995), the human resource management strategies influence productivity in seventeen US steel companies. Certain modern work practices such as incentive compensation, teamwork, training, and flexible job assignments, according to Ichniowski's productivity function, have a favourable impact on a company's productivity (Jelinek 2007).

As per Bandiera et al., (2005) paper, employees have social preferences by contrasting their productivity under relative incentives. Individual effort has a negative externality on others, with their output under piece rates, in which it does not (Jelinek 2007).

In another aspect, Nick Bloom and John van Reenen's (2007) published paper discussed how management techniques differ across countries and industries. The information/data was acquired through interviews (Jelinek 2007).

Bertrand and Schoar (2003) look into the movement of top individual managers across US firms and discover that it has a major impact on performance. They discovered certain patterns in managerial decision-making that point to variances in management styles. They have also examined how aggressive managers use financial methods to help their companies succeed (Jelinek 2007).

Bresnahan et al. (2002) look into the causes and effects of relative demand for skilled workers. They conclude that complementing workplace organization changes occur in a cluster and that services and IT investments are significant components of a skill-based technical change (Jelinek 2007).

In Chiang Kao and HSI-Tai Hung's (2005) paper, management performance was measured and associated with performance indicators. Production, marketing, financial, and human resource management are all part of their management process.

3.4. Great Britain's Management Practices

The link between management practices and productivity has received considerable attention in the theoretical literature on productivity and empirical studies within the research community (ONS 2015, 2016). However, most studies on management methods are limited as they are focused on the manufacturing sector. The Office for National Statistics (ONS) and the Economic Statistics Centre of Excellence (ESCoE) developed the Management and Expectations Survey (MES), which is one of a few surveys aimed at measuring the prevalence of structured management practices for a wide range of businesses in the manufacturing and service industries (ONS 2016).

Bloom and Reenen analysed raw survey data from the United Kingdom in 2007 and discovered a very wide range of management techniques among businesses. One of the robust aspects arising from the analysis of largescale firm-level databases, according to Criscuolo, Haskel, and Martin (2003), is the extremely high degree of heterogeneity between business units. In 2020, a plant at the 90th percentile of the labour productivity distribution had five times higher labour productivity than a plant at the 10th percentile.

A substantial number of businesses that are poorly managed, with inefficient monitoring, targets, and incentives are appears. The below Figure illustrates the distributions of the raw management scores (simple averages across all 18 practices for each firm), with 1 indicates worst practice, 5 indicates best practice in 151 UK observations (Bloom & Reenen 2007).

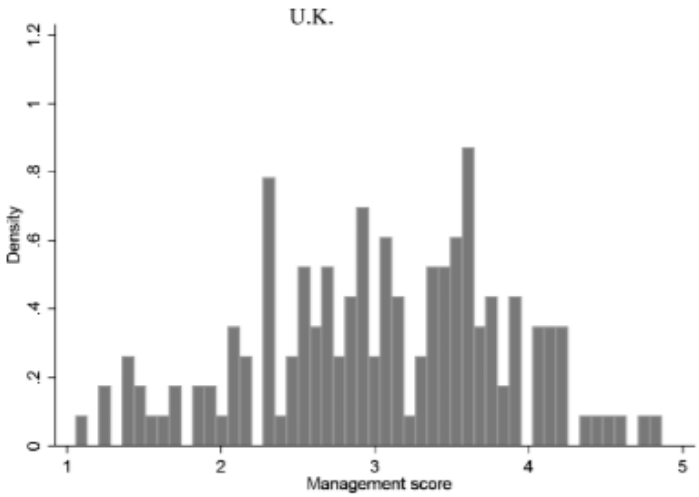


Figure 2: Distribution of Management Scores in the UK (Bloom and Reenen 2007).

The findings of Bloom and Reenen (2007) revealed that two factors appear to play a significant role in the observed diversity in management practices: i) product market competition: higher levels of competition are strongly associated with better management practice and ii) family firms: the chief executive officer (CEO) is chosen by primogeniture (the eldest male child) tend to be very badly managed.

Bloom and Reenen highlight the role of product market competition in increasing productivity in their paper *"Measuring and Explaining Management Practices Across Firms and Countries"* since the productivity-enhancing impacts of competition work by improving average management practices. Second, the emphasis on family management caused the United Kingdom's relative industrial decline in the early twentieth century, and this phenomenon is still significant today. The influence of human resource management (HRM) is a third related strand that also finds that these management practices are linked to firm performance.

ONS article "*Management practices and productivity in British production and services industries - initial results from the Management and Expectations Survey: 2016"* mentioned that the structured management methods were found to be more prevalent in the services industry than in the manufacturing industry, in larger enterprises than in smaller firms, in foreign-owned firms than in domestically-owned firms, and in non-family-owned businesses than in family-owned businesses. According to conditional analysis, there is a statistically significant link between management practices and labour productivity, with a 0.1 rise in management score associated with a 9.6% increase in productivity (ONS 2016).

According to Bloom et al. (2013), the empirical literature, in particular, has discovered that the use of structured practices is tightly linked to improved productivity, profitability, innovation and growth. As a result, understanding differences in management practices may explain differences in productivity performance both within and across countries (ONS 2015).

MES management practices score was created to quantify differences in management practices across firms. These variances are related to turnover, profitability, and productivity, and they differ considerably across and whining the countries (Bloom et al.

2017, ONS 2021a). In other words, MES gathers thorough information about a company's management practices, future expectations and other observable business characteristics (Schneebacher n.d.).

The management practices score takes into account four aspects of management:
a) continuous improvement, or how firms respond to difficulties,
b) the implementation of key performance indicators (KPIs),
c) the use of targets, and
d) promotional, training, and underperformance practices in the workplace (ONS 2021a).

To receive a management practice's score equal to zero, a firm must disregard existing issues, make promotion decisions based on criteria other than merit, and fail to track KPI measures or create goals. Firms would need to consistently assess processes to reduce future problems, utilize suitable and routinely reviewed performance measurements and targets throughout the business, and apply merit-based hiring, promotion, and training techniques to get a one on the other hand (ONS 2021a).

In previous studies, management methods have proved to be favourably, strongly, and significantly related to indices of business success. Even after controlling for several possible confounders, the Office for National Statistics (ONS), the United Kingdom's largest independent producer of official statistics and recognized national statistical institute discovered that management practices are positively associated with labour productivity using data from the first wave of the MES for 2016 (ONS 2021a).

MES 2020 received comments from around 12,000 British firms in its second wave. Some of these companies have already responded to MES 2016, allowing for tracking changes in management techniques over time in the same company. Others responded to additional ONS business surveys, allowing to integrate data on management techniques with information on the firms' other actions and outcomes, such as whether they engage in R&D or broader innovation (Schneebacher n.d.).

In a continuation of this, an article that was released on May 2021 from ONS, entitled as *"Management practices in Great Britain: 2016 to 2020",* mentioned that according to MES - 2020, the mean management practices score across enterprises in the United Kingdom

was 0.58 in 2019 and 0.60 in 2020, with median scores of 0.60 and 0.63, respectively on a scale of 0 (no management practices adoption) to 1 (complete implementation). The values vary significantly across size bands, sectors, and geographical areas. Regarding geographical areas, Scotland made the greatest progress, and with the South East, both got 0.62 mean management scores in 2020, while Wales had 0.57, which was the lowest one. The 2020 mean management practices score is up 0.1 points from the previous wave, collected at the end of 2016. The absence of a long tail of poorly managed micro-firms is primarily responsible for this shift.

Section	2019 mean	2020 mean	2019 median	2020 median
Overall Management Practices	0.58	0.60	0.60	0.63
Continuous Improvement	0.76	0.82	0.67	1.00
Targets	0.70	0.70	0.68	0.68
Employment Practices	0.52	0.54	0.54	0.58
Key Performance Indicators	0.39	0.42	0.44	0.44

Table 1: Great Britain -mean and median management practice scores by management practice categories, during 2019 to 2020 (ONS 2021a).

The continuous improvement had the highest mean score and the largest change among the four management score categories - as those mentioned above -growing by 0.06 points between 2019 and 2020. In both 2019 and 2020, key performance indicators (KPIs) received the lowest scores. Over the same years, employment practices improved slightly from 0.52 to 0.54, but targets remained unchanged. The below Figure presents the average management practice scores by management practice categories of Great Britain from 2019 to 2020. As illustrated, most firms have adopted targets and continuous improvement, but KPIs are lagging.

The data illustrate below concerns population of interest covers businesses in production and services industries with the employment of at least 10, in Great Britain. Furthermore, the MES sample excludes firms in sections A (Agriculture, Forestry and Fishing) and sections K and L (Financial and Insurance Activities) (ONS 2021a, Schneebacher n.d.).

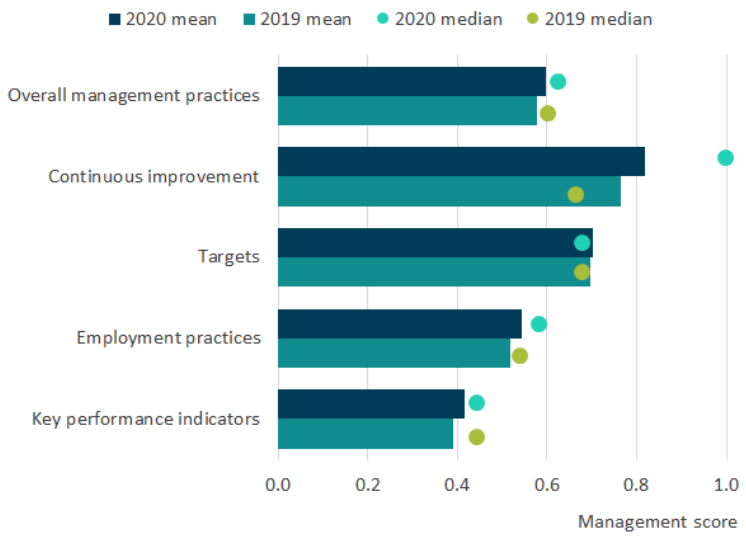


Figure 3: Average management practices scores by management practices categories, Great Britain, 2019 to 2020 (ONS 2021a).

In comparison to 2016, the distribution of firms has migrated rightward and become more concentrated around the mean in 2019 and 2020, as shown in Figure 4.

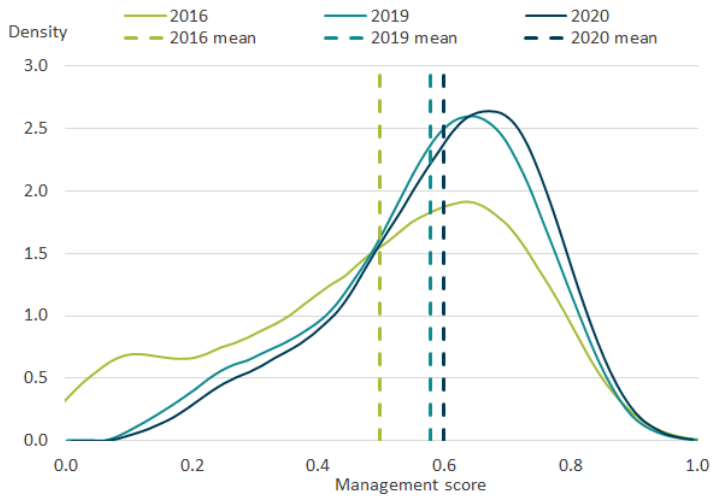


Figure 4: Changes of overall management practices scores, whole sample, Great Britain, 2016 to 2020 (ONS 2021a).

As per management practices by firm size, industry, and region, significant diversity is observed. When examining changes in management scores across size bands over time, it becomes obvious that the general improvement is mostly due to the loss of a significant tail of poorly managed small businesses (employment: between 10 and 49). Scores vary by region and sector, although these discrepancies are rather constant over time (ONS 2021a). In a previous paper by Awano and Robinson (2016), the significant differences in average management practices scores across a variety of business characteristics, such as employment size, multinational status, and family ownership status, was mentioned. On

a scale of 0 to 1 - with 0 representing the least structured management practices and 1 representing the most structured management practices - the findings revealed that the average management score of all manufacturing businesses with ten or more employees was 0.56. Though, there were differences across business types, with larger establishments (≥250 employees) scoring higher at 0.79, multinationals scoring 0.71, and family-owned and non-family managed establishments scoring 0.70. Nevertheless, these groups account for a small proportion of the British manufacturing sector, with only 5 out of every 100 businesses in the large (>250 employees) employment size group and only 16 out of every 100 businesses being a multinational. In contrast, most manufacturing businesses are small, with 74% falling into the 10 to 49 employment size category and an average management score of 0.51. Moreover, 64% of manufacturing businesses are family-owned, and nearly 9 out of 10 (87%) are family-owned and family-managed. Approximately 8 out of every 100 manufacturing firms are family-owned and non-family-managed (ONS 2015).

Large enterprises (250 or more employees) are better managed than small firms in all years, except 2016, when there is a trace of catch-up among the smallest firms. Figure 5 uses kernel density estimation to describe the distribution of enterprises by management score for various size bands and years. The lower tail of the distribution of smaller organizations is more apparent, consisting of a group of companies with far less structured management procedures. The prevalence of structured management methods increases across each size band, with large businesses clustered more in the upper tail of the distribution (ONS 2016 & 2021a).

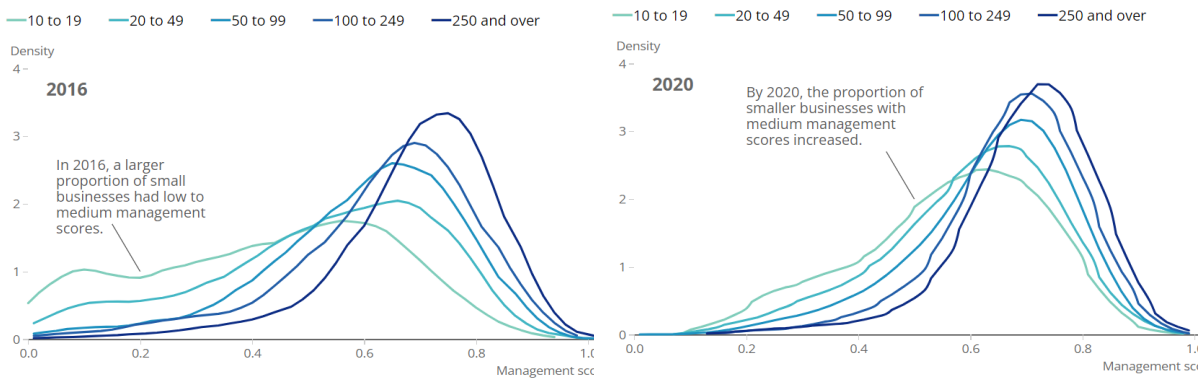


Figure 5: Distribution of management practices scores by employment size bands, Great Britain, 2016 (left) 2020 (right) (ONS 2021a).

As per management scores among the industries, a variety also exist. Service firms such as private education, health and the arts perform the best management score (mean score of 0.63 in 2020), while real estate firms have the worst best management score with a mean score of 0.55 in the same year. All other industries have a median firm above a score of 0.6. These industry comparisons do not control for variations as per company size or ownership structure, and thus the comparison reflects compositional effects in part. (ONS 2021a).

The box and whisker plot below represents the percentile distribution of enterprises for broad industry groups in 2020. The management scores of the better-performing industries differ significantly from those of the worst-performing industries. While the upper tail of the distributions appears to be consistent across industries, the fraction of enterprises at the lower end of the distribution varies significantly. The average discrepancies in management practices score between industries are driven by the extent of this lower tail of more minor well-managed enterprises (ONS 2021a, Schneebacher n.d.).

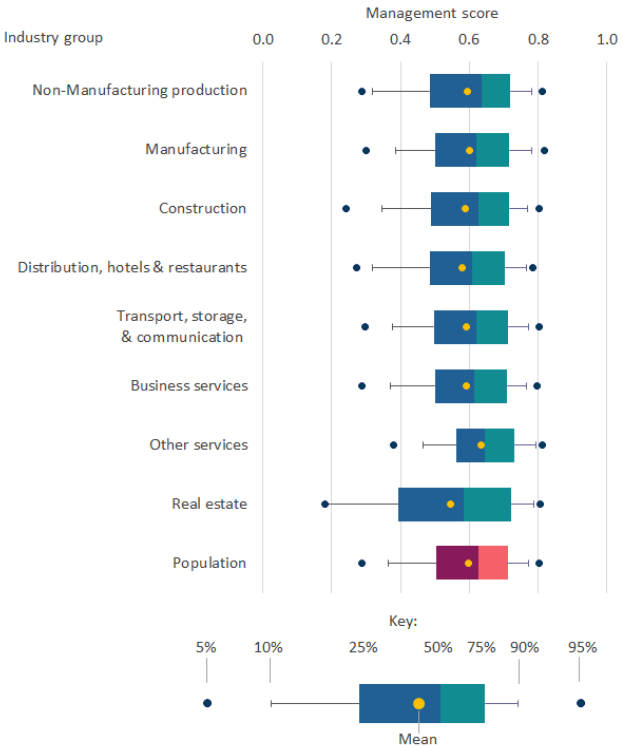


Figure 6: Percentile distributions of management practices scores by industry groups, Great Britain, 2020 (ONS 2021a).

Data reveal significant variation across large regions. London had the greatest average score of 0.54 in 2016, while Scotland and the North East had the lowest average score of 0.44. In 2020, the position shifted dramatically: Scotland has improved the most and currently shares the top spot with the South East with a mean score of 0.62. On the other hand, Wales gets the lowest average score of 0.57. The general gap between regional norms reduced between the first and second waves of the Management and Expectations Survey.

With a management score of 2.8, Bloom et al. (2012 and 2013) conclude that UK hospitals and retailers are the best managed in their worldwide sample and emerging economies. In 2010, Bloom et al. conducted interviews with managers and clinicians at 100 UK hospitals' orthopedic and cardiology departments. They discovered that higher management scores were linked to improved patient outcomes (as measured by survival rates from heart attacks and general surgery) and other productivity metrics (such as average length of stay and finished consultant episodes per patient).

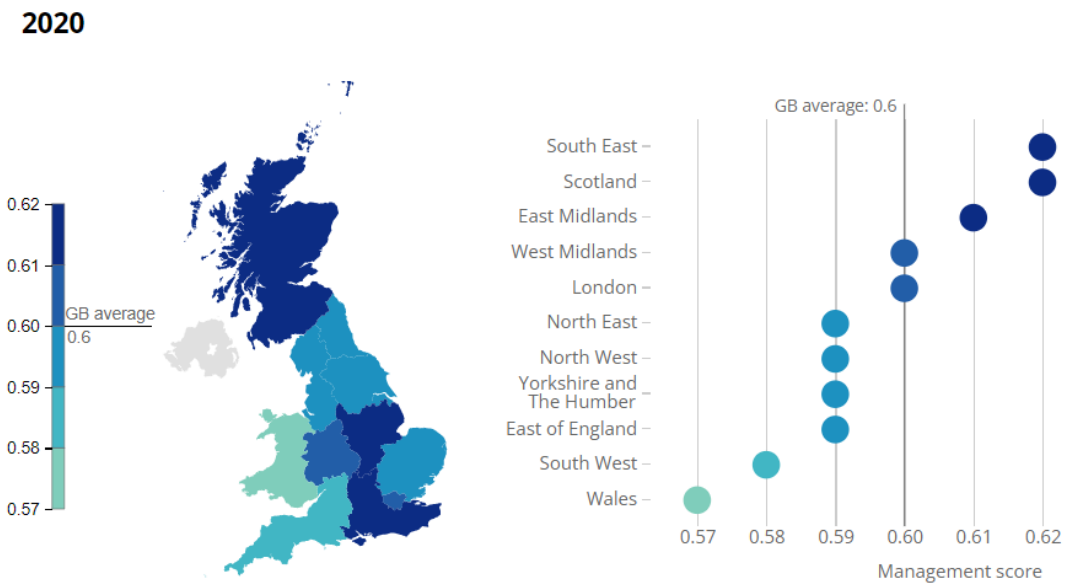


Figure 7: Mean management practices score, Great Britain, 2020 (ONS 2021a).

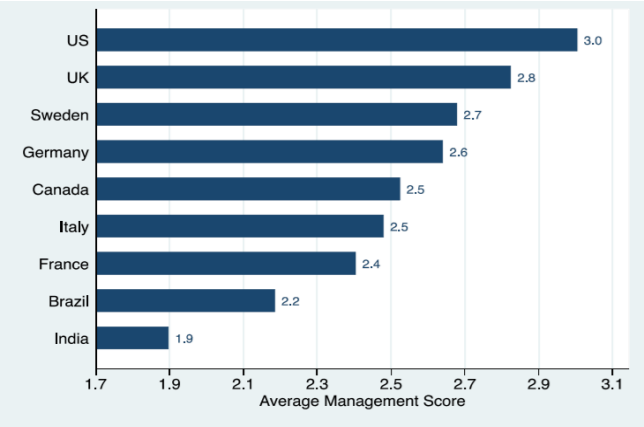


Figure 8: Country management scores: Hospitals (Bloom et al. 2013).

In another aspect, Bloom et al. reported a year later that UK schools have the highest management scores, with an average of 2.9. One reason for this could be that in the 2000-2010 decade, UK schools have undergone a series of changes to improve administration, as McNally mentioned (2010).

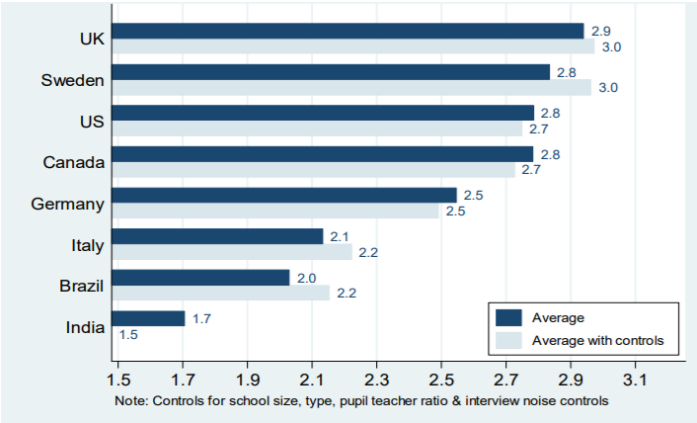


Figure 9: Country management scores: Schools (Bloom et al. 2014).

McCormack et (2013) examine if the variations in UK university management are linked to differences in performance. They found substantial variance in management quality across universities and that scores differ between older, research-intensive universities and newer, more teaching-oriented universities. Furthermore, these variations are linked to differences in performance. Higher management scores are linked to improved performance on externally evaluated research and teaching measures. These findings support the control of resources (academic and non-academic spending and staff/student ratios) and lagged performance.

As previously stated, industry comparisons do not relate to differences in business size or ownership structure and, therefore, in part, reflect compositional effects. In the article *"Management practices, homeworking and productivity during the coronavirus (COVID-19) pandemic"*, regression analysis is used to account for variations in these observable parameters (ONS 2021b). Findings reveal that firm size, age and employee human capital are the primary predictors of excellent management in British enterprises. They have not altered considerably during the coronavirus (COVID-19) epidemic. During the pandemic, good management practices made it easier for businesses to adapt to novel practices like homeworking and internet sales. Thus better-managed enterprises maintained their labour productivity advantage over comparable competitors (ONS 2021a, Schneebacher n.d.).

The standardized coefficients from an Ordinary Least Squares (OLS) regression of management score on observable company characteristics and fixed industry-region effects are shown in the below Figure.

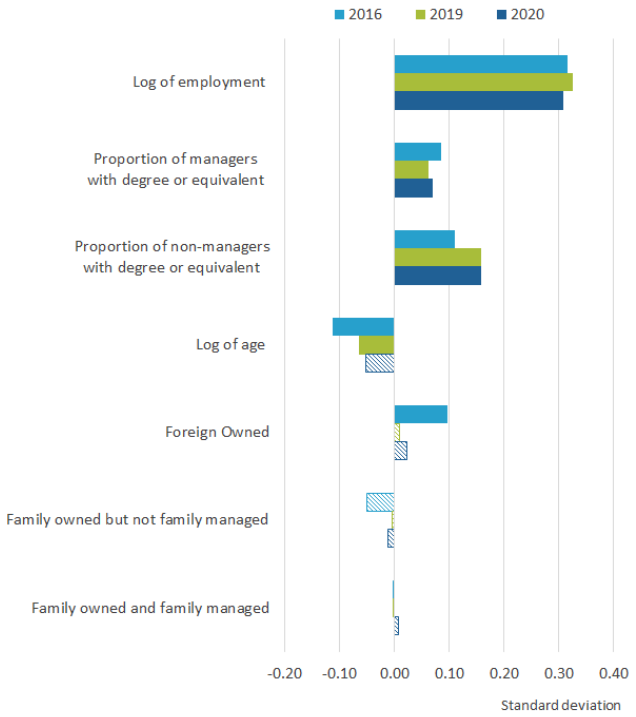


Figure 10: Standardised coefficients from an OLS regression of management score on observables and industry-region fixed effects, Great Britain, 2016 to 2020 (ONS 2021b).

Factors of excellent management have remained fairly consistent, even into the 2020 coronavirus (COVID-19) pandemic, as the sign of the coefficients never changes between

years, and the size and statistical significance of all variables are comparable across years 2016, 2019 and 2020 (ONS 2021b).

The overall response rate in the sample was 24%. However, there were differences in response rates between size bands, industries and geographies. With a response rate of 16%, the largest companies were the least likely to respond, while medium-sized businesses had the greatest response rate at 30%. This is consistent with the Management and Expectations Survey 1 (MES-1) and its predecessor, the Management Practices Survey.

The industries with the lowest response rates were private healthcare, internet shopping, and hospitality, which faced the greatest changes to their business model due to the 2020 coronavirus (COVID-19) pandemic. On the other hand, retail, wholesale, and construction had the highest response rate of 32%. Response rates ranged from a low of 20% in London to a high of 27% in South West and South East (ONS 2021a).

The Table below shows that observables only explain a small fraction of the variation in response rates for the entire sample, with an R-squared near zero. Better-managed companies respond to the survey at different rates than poorly managed companies. (ONS 2021a, b).

Variables	Response to MES (1)	Response to MES (2)	Response to MES (3)	Response to MES (4) (linked firms)	Response to MES (5) (linked firms)
Employment (scaled by 100)	-0.000540***	-0.000487**	-0.000535***		-0.000128**
	(0.000205)	(0.00195)	(0.000194)		(0.0000609)
Turnover (scaled by 1000)	-0.000***	-0.0000107**	-0.000**		-0.000
	(0.000)	(0.000)	(0.000)		(0.000)
Foreign Ownership			-0.0285***		
			(-0.00559)		
Score 2016				0.317***	0.316***
				(0.00549)	(0.00550)
Observations	50,712	50,712	50,712	14,896	14,896
R-squared	0.001	0.006	0.007	0.17	0.17
Industry fixed effect	No	Yes	Yes	Yes	Yes
Region fixed effect	No	Yes	Yes	Yes	Yes

Notes

- Standard errors in parentheses.
- Stars after coefficients denote significance at conventional significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
- Figures are rounded to three significant figures.
- Population of interest covers businesses in production and services industries with employment of at least 10, in Great Britain.
- The MES sample excludes firms in section A (Agriculture, forestry and fishing) and sections K and L (Financial and insurance activities), and results are weighted to reflect the population of firms.

Table 2: Ordinary least squares regression of Management and Expectations Survey response rate on observable firm characteristics, Great Britain, 2020 (ONS 2021a).

Chapter 4
Methodology

4.1. Research Objective

The impact of management practices on a firm's efficiency has been widely discussed. This thesis aims to develop a better understanding of the management practices that influence the efficiency of United Kingdom firms, as according to the existing literature, there is a noteworthy variation in management practices in terms of turnover, profitability, and productivity. Thesis analysis is based on randomly selected data collected from UK manufacturing firms.

The overall objective of this thesis is to investigate the impact of management practices on the efficiency of UK firms.

Additional specific objectives have been set in order to accomplish the current aim:

- Conduct a thorough literature review to determine existing management practices in the United Kingdom.
- To investigate how United Kingdom firms perceived and implemented the concept of management practices by analysing the data collected
- To identify and assess how management practices apply in United Kingdom firms.
- To identify the level of impact for each management practice variable on the overall business success.
- To identify the management practices variables with significant efficiency, impact the UK firm's success and overall performance.

4.2. Regression Model

Regression analysis is a statistical tool used to quantify the relationship between independent variables (called X) and a single dependent variable (called Y) based on

previous observations. The correlation coefficient may indicate that the eight variables (in our case) are associated with one another, but it does not give any idea of the kind of relationship involved. It can be used to determine the strength of a relationship between variables and to predict how they will interact in the future.

As mentioned, we have eight independent variables X_{1i}, ... X_{8i}, and thus the regression model is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + e \qquad Eq.1$$

Where:

Y: technical efficiency score

X_1: incentive compensation is offered

X_2: company provides training to employees

X_3: flexible job assignment

X_4: firm employees more than 50 workers

X_5: manager age

X_6: manager experience in managerial positions

X_7: manager education

X_8: family owned

β_i: parameters of independent variables X_1, ..., X_8 $(i = 1,...,8)$

e: disturbance term

We need to state also, that some of the independent variables that are included in a regression model are qualitative and hence not numerically measurable (X_1, X_2, X_3, X_4, X_8). A dummy variable, also known as an indicator variable, is a created variable that represents an attribute having two or more categories. Dummy variables are a kind of qualitative variable that can be converted to a quantitative variable. Once the variables have been quantified, standard regression procedures can be applied. Frequently, a dummy variable is a variable that has just two possible values: 0 or 1.

The model in Eq.1 was initially estimated using an OLS estimation procedure. However, the model was also estimated using a Tobit regression because the dependent variable (technical efficiency) is bounded in the unity interval.

4.3. Limitation

The limitations of this thesis are discussed in this subchapter, which refers to the characteristics or methodology that impacted or influenced the application or interpretation of our results.

Below we set our thesis limitation:

a) The findings may not represent all UK manufacturing firms given the restricted data of UK manufacturing firms analysed (randomly selected 155 firms), which is one of the thesis's limitations. As a consequence, results' reliability may be low.
b) Another drawback is that more variables (x) affect efficiency for which data were not available and hence are excluded from the analysis.
c) Last but not least, the influence of variables on efficiency can be non-linear, even though we assume it is linear in the thesis estimation.

Chapter 5
Data and Descriptive Statistics

In our thesis, we quantify the relationship between efficiency score and eight independent variables in randomly selected 155 UK manufacturing firms, which is considered as our sample.

The eight independent variables analysed were:

1) X_1: incentive compensation is offered, as a dummy variable and with value 1, otherwise zero
2) X_2: company provides training to employees, as a dummy variable and with value 1, otherwise zero
3) X_3: flexible job assignment, as a dummy variable and with value 1, otherwise zero
4) X_4: firm employees more than 50 workers, as a dummy variable and with value 1, otherwise zero
5) X_5: manager age
6) X_6: manager experience in managerial positions
7) X_7: manager education
8) X_8: family owned, as a dummy variable and with value 1, otherwise zero

The independent variables are selected, as were considered as significant variables that influences the management practices on firm efficiency.

The X_1 variable compensation connect income to performance, allowing managers to make real-world decisions (Lee and Hwang, 2019). Variable compensation refers to the portion of a person's total monetary income that is not included in fixed pay. In addition, variable compensation is provided to potentially improve performance, reward and motivation (Lindström & Svensson 2016).

The X_2 variable is selected as the training and development activities of employees are critical to the success of businesses all around the world. These ways not only provide an opportunity for employees to develop their abilities but also for companies to increase employee productivity and improve company culture (Maryville University n.d.). Today, the majority of organizations put an emphasis on staff training. Training can be defined as organizational activities that can be used to force the desired set of employees' behaviors and attitudes, such as organizational commitment. The availability of various training programs and training aids in the achievement of specific outcomes such as employee commitment and turnover intention (Priyanka, 2016).

Flexible job assignment variable allows employees to balance their professional and personal life, resulting in job satisfaction and good performance, as well as an overall improvement of the organization. Work flexibility is critical, and with digital improvements and enhanced technology, employees can work from anywhere even with an internet connection (Davidescu et al. 2020). Flexible work arrangements have been defined as self-management strategies that provide employees flexibility over how they manage and distribute their time, attention, and energy (Weidemarr & Hofmeyr, 2020)

Firm size is one of the determinants of firm performance and, in particular, demonstrates the profitability of a firm. Large firms have more resources and expertise in product creation, technology innovation development, and, of course, stronger business strategy, marketing, and e-commerce implementation. However, they are frequently inflexible in the face of market and strategic changes. Meanwhile, smaller firms have greater freedom in managing organizational machinery, product innovation, and market strategy (Hung et al., 2021).

X_5 variable (manager age) was also included in the thesis, as firms that embrace manager age diversity, like other forms of diversity, reap enormous benefits. However, it also causes difficulties. Different generations have different expectations and needs, and professional relationships might suffer as a result (Birkinshaw et al. 2019). Especially when the case in as per CEO age, as per Kunze et al. (2013) the reported that as a CEO ages, the firm sees reduced investment, lower sales growth, and poorer profitability, but also a better probability of survival, implying a trade-off between the managerial styles of younger and older CEOs.

Manager experience in managerial positions, is considered as significant variable in firm efficiency as manager efficient perspective contends that managerial characteristics of top managers, such as education, age, and experiences, can predict organizational strategic outcomes (Milana & Maldaon 2015). When a firm operates in less developed institutional environments, manager experience may be an especially important factor to consider, as it is believed, for example, that managerial knowledge about institutions reduces uncertainty and makes expectations about business opportunities more accurate and realistic (Balsmeier & Czarnitzki 2014).

X_7 variable - manager education, is included as the seven variable as management strategies such as monitoring and applying appropriate incentives appear to have a big impact on business productivity, and manager education can explain wide differences in productivity among enterprises (Queiro, 2015). According to La Redaction. (2017), the contribution of managerial education of the top manager (i.e. CEO) to business productivity is nearly five times more than the contribution of education of the firm's non-management personnel.

The last variable examine (X_8), was the family owned. In today's markets, family firms are the most common form of ownership. Family firms are defined as one or more members of a family holding great control over the company due to their significant percentage of ownership (capital). Family firms are supported by three pillars: direction/management, family, and ownership. The long-term perspective of family firms, which originates from the purpose of transferring ownership to the next generation, motivates owners to suffer less from business myopia, and investments are more efficient to better monitor managers' behavior. Many family businesses remain for generations not because they are more efficient or successful, but because they meet their owners' socioemotional requirements to pursue non-economic goals (Alves and Gama, 2020).

In Annex the data summaries are presented. 155 UK manufacturing firms' efficiency score and the relevant variables results are mentioned.

As per those data, the % efficiency score in grouping percentages range of 5% versus the UK manufacturing firms is demonstrated in Figure 11 as a clustered bar.

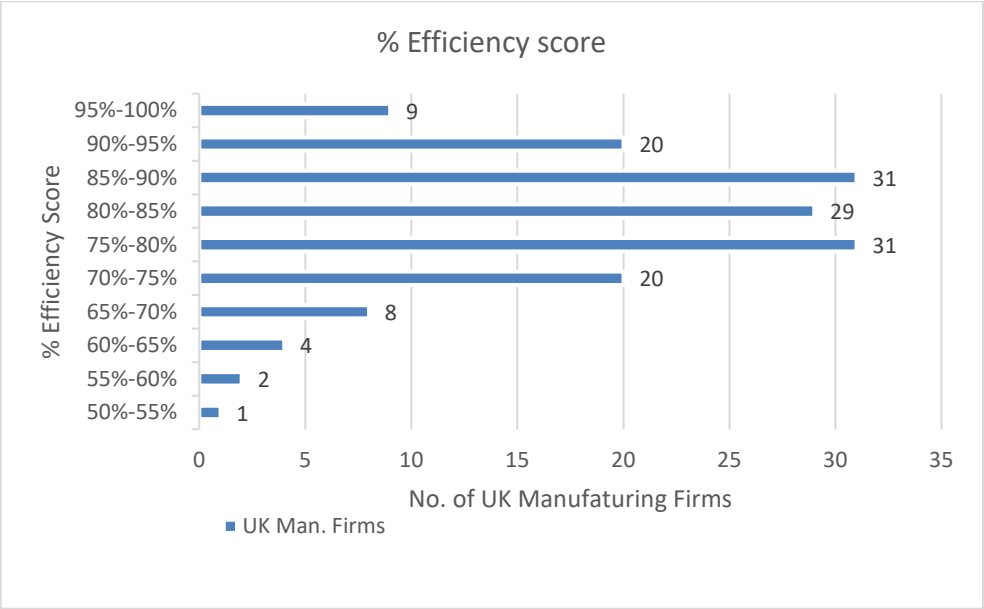


Figure 11: % Efficiency score distribution in UK manufacturing firms

By prioritizing the UK manufacturing firms as per efficiency score, we conclude that we have an impressive efficiency score of more than 75% in 120 out of 155 firms. Only three firms' efficiency scores lay between 50 -60, while 32 firms have a score of 60 – 75%.

The individual variables in relevant groups are summarized in Tables 3-7 and Figures 12-22, with the relevant efficiency score.

According to the first variable examined X_1, only 15% of UK firms provide incentive compensation, whereas the remaining do not. However, it is observed that all 24 firms that offer incentive compensation are associated with high-efficiency scores — greater than 84%. On the other hand, 29% of firms that do not provide incentive compensation (38 out of 131) have such a high-efficiency score of 85%.

(X_1) Incentive compensation is offered	Total UK Man. Firms
No (value =0)	131
Yes (value =1)	24

Table 3: (X_1) Incentive compensation is offered distribution in UK manufacturing firms.

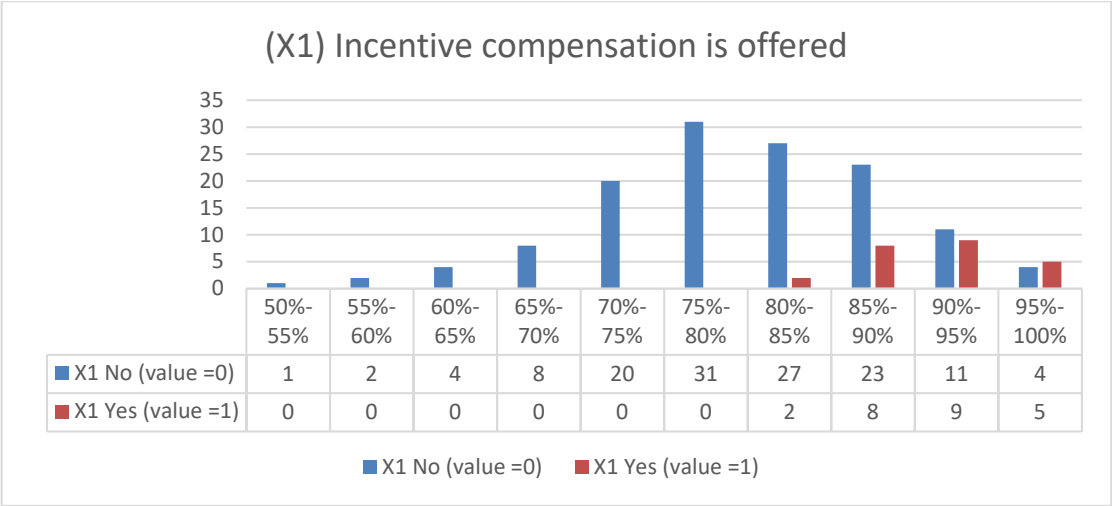


Figure 12: Bar chart of distribution of % efficiency score as per variable X_1 in UK manufacturing firms.

Nearly a third of UK businesses provide employee training (X_2 variable), with efficiency scores ranging from 60% to 97%. The majority of those businesses, up to two-thirds, have an efficiency score of more than 80%. The efficiency score of 4 out of 10 firms (i.e. 55 firms) that do not provide training to their employees are having efficiency score greater than 80%.

(X_2) Company provides training to employees	Total UK Man. Firms
No (value =0)	108
Yes (value =1)	47

Table 4: (X_2) Company provides training to employees distribution in UK manufacturing firms

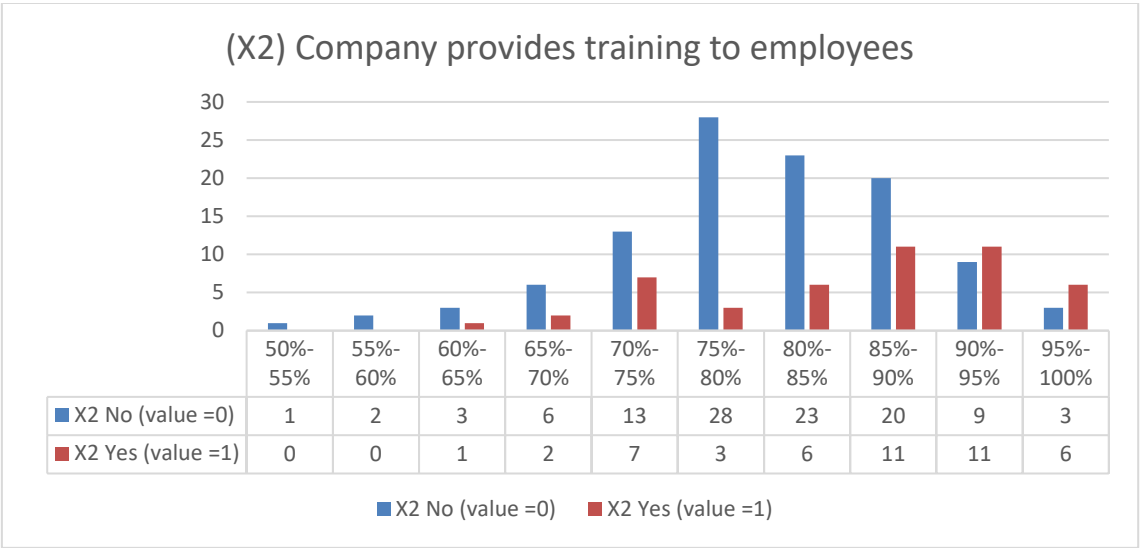


Figure 13: Bar chart of distribution of % efficiency score as per variable X_2 in UK manufacturing firms

Flexible work assignment, the third examine a variable, is used in a lower percentage of UK manufacturing firms than the previous two. Approximately 20% of firms offer flexible job assignments (34 out of 155 UK firms), which are normally distributed on an efficiency scale. 13 firms have an efficiency score of less than 75%, 17 firms have a range of 75% to 90%, and only four have a score of more than 90%. Nearly two-thirds of firms that do not offer flexible job assignments have a more than 80% high-efficiency score.

(X_3) Flexible job assignment	Total UK Man. Firms
No (value =0)	121
Yes (value =1)	34

Table 5: (X_3) Flexible job assignment distribution in UK manufacturing firms

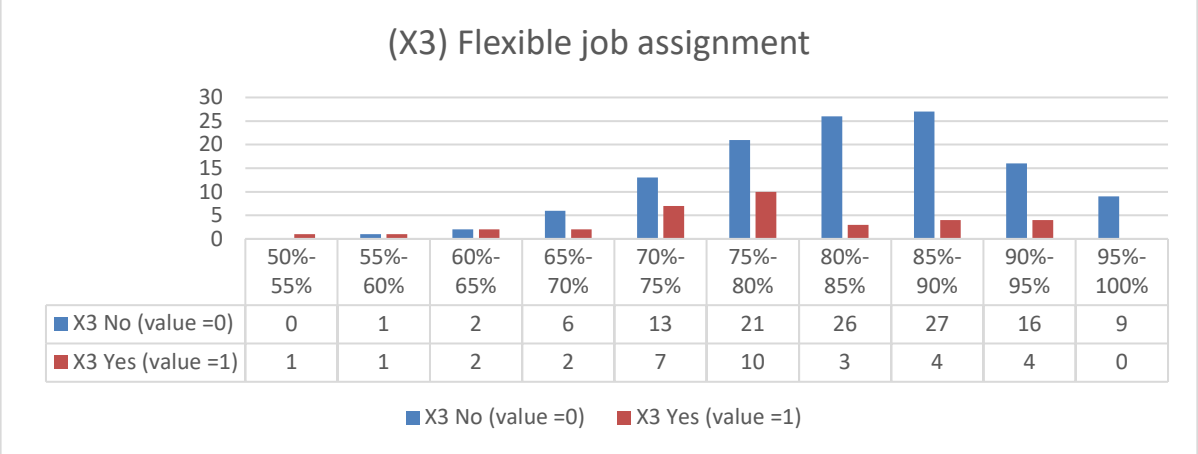


Figure 14: Bar chart of distribution of % efficiency score as per variable X_3 in UK manufacturing firms

Even though only 19 firms' employees more than 50 workers (X_4 variable), it is impressible that almost all of them (18 firms) have a high-efficiency score equal to more than 85%. Firms employees with less than 50 worker efficiency scores are dispersed into low, medium and high-efficiency scores. Forty-three firms with less than 50 workers have an efficiency score of above 85%, 77 have a score within 70 and 85%, while the remaining firms have less than 70%.

(X_4) Firm employees more than 50 workers	Total UK Man. Firms
No (value =0)	136
Yes (value =1)	19

Table 6: (X_4) Firm employees more than 50 workers distribution in UK manufacturing firms

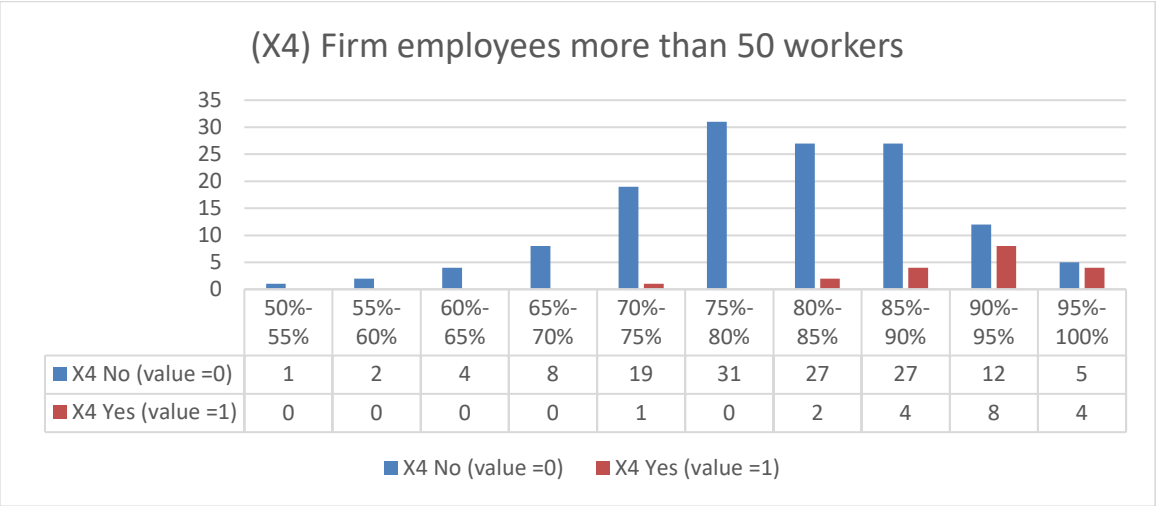


Figure 15: Bar chart of distribution of % efficiency score as per variable X_4 in UK manufacturing firms.

The fifth variable under consideration, manager age, was classified as follows: a) the manager's age was less than 30, b) the manager's age was between 30-39, c) the manager's age was between 40-49, d) the manager's age was between 50-59, and e) the manager's age was greater than 60. In Figure 16, we can see the pie chart of manager age distribution in UK manufacturing firms

The manager age was between 50 and 59 in more than one-third of the total UK organizations assessed, with 49 firms having an efficiency score of 75 per cent or above. Following that, manager age was found to be between 30-39 in 36 UK enterprises, linked with rather a low-efficiency score, as the highest observed was almost 85%. In a slightly lower number of firms (33) where manager age was 40-49 years old, the results are different, as half of them are associated with efficiency scores above 85%.

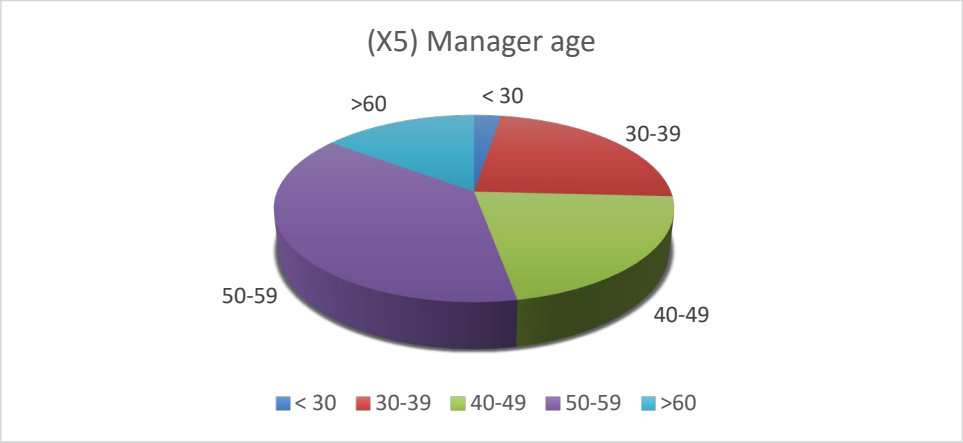
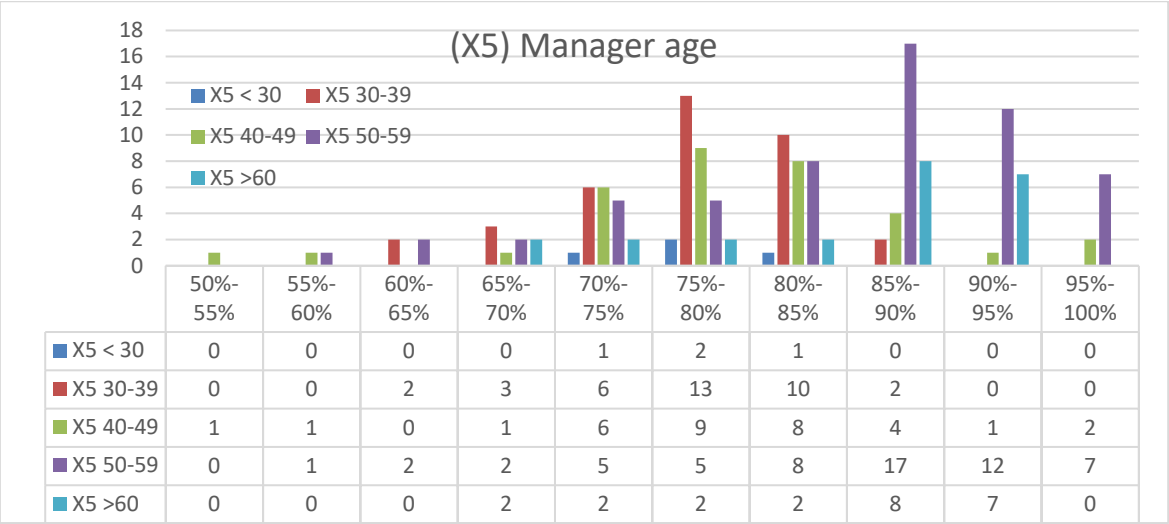


Figure 16: Pie chart of (X_5) Manager age distribution in UK manufacturing firms



	50%-55%	55%-60%	60%-65%	65%-70%	70%-75%	75%-80%	80%-85%	85%-90%	90%-95%	95%-100%
X5 < 30	0	0	0	0	1	2	1	0	0	0
X5 30-39	0	0	2	3	6	13	10	2	0	0
X5 40-49	1	1	0	1	6	9	8	4	1	2
X5 50-59	0	1	2	2	5	5	8	17	12	7
X5 >60	0	0	0	2	2	2	2	8	7	0

Figure 17: Bar chart of distribution of % efficiency score as per variable X_5 in UK manufacturing firms

Manager experience in managerial positions was included as the sixth variable of efficiency score and was a group in seven clusters as follow: < 5, 5-9, 10-14, 15-19, 20-24, 25-29, >30. Only two firms have managers with over 30 years of experience, yet both have an exceptional efficiency score of more than 90%. The relevant efficiency score is either low or medium in most firms, 40 out of 155 firms where the manager experience is between 5 and 9. with the highest being 86 %. 26 of 40 firms have an efficiency score of less than 80%. When the manager's experience is between 25 and 29 years, we have an amazing efficiency score, with the lowest being 87 per cent and the greatest being 97%.

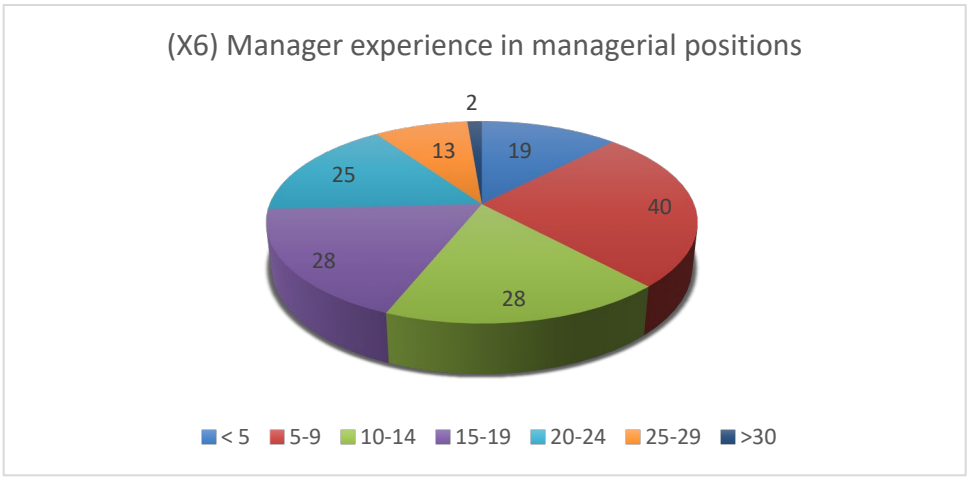
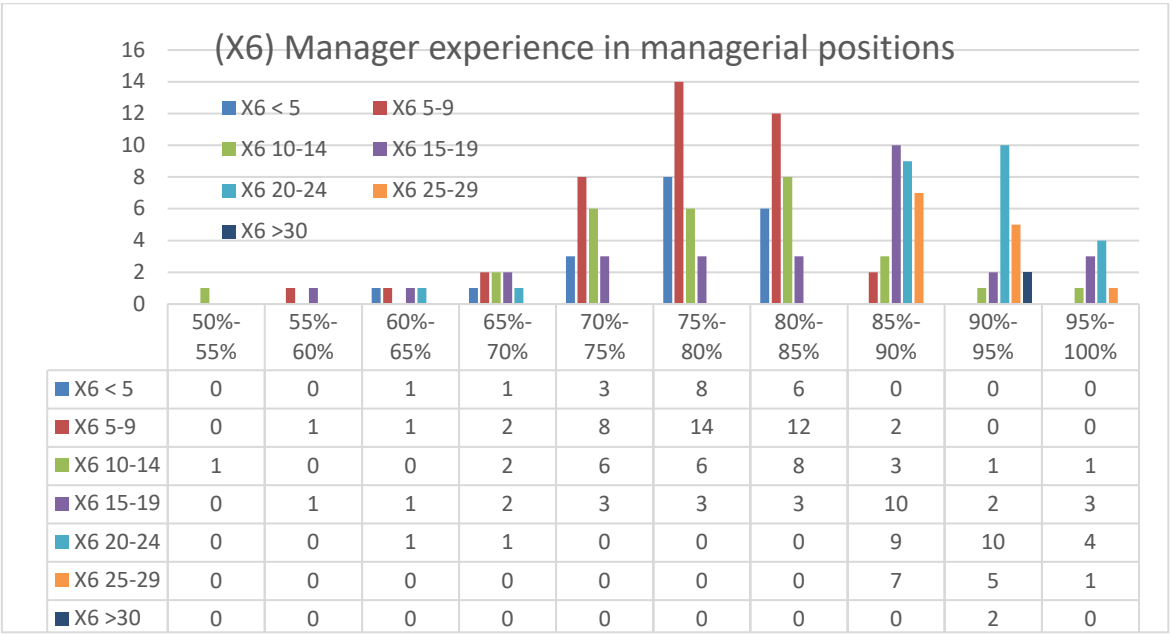


Figure 18: Pie chart of (X_6) Manager experience in managerial positions distribution in UK manufacturing firms



	50%-55%	55%-60%	60%-65%	65%-70%	70%-75%	75%-80%	80%-85%	85%-90%	90%-95%	95%-100%
X6 < 5	0	0	1	1	3	8	6	0	0	0
X6 5-9	0	1	1	2	8	14	12	2	0	0
X6 10-14	1	0	0	2	6	6	8	3	1	1
X6 15-19	0	1	1	2	3	3	3	10	2	3
X6 20-24	0	0	1	1	0	0	0	9	10	4
X6 25-29	0	0	0	0	0	0	0	7	5	1
X6 >30	0	0	0	0	0	0	0	0	2	0

Figure 19: Bar chart of distribution of % efficiency score as per variable X_6 in UK manufacturing firms.

The manager education variable was also divided into two-year groups, beginning with a manager education of 12 years and ending with more than 22 years. One-third of firms have managers with education of 18-19 years, and 31 of them have an efficiency score of more than 85%. Almost half of the firms studied (71 firms) had managers with an average age of 16-17 years, and 50 of those firms have an efficiency score of 85%.

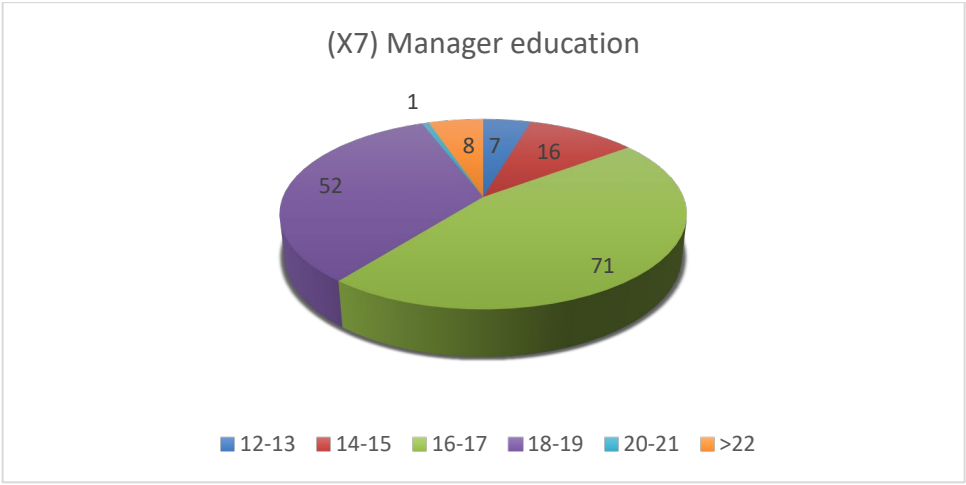
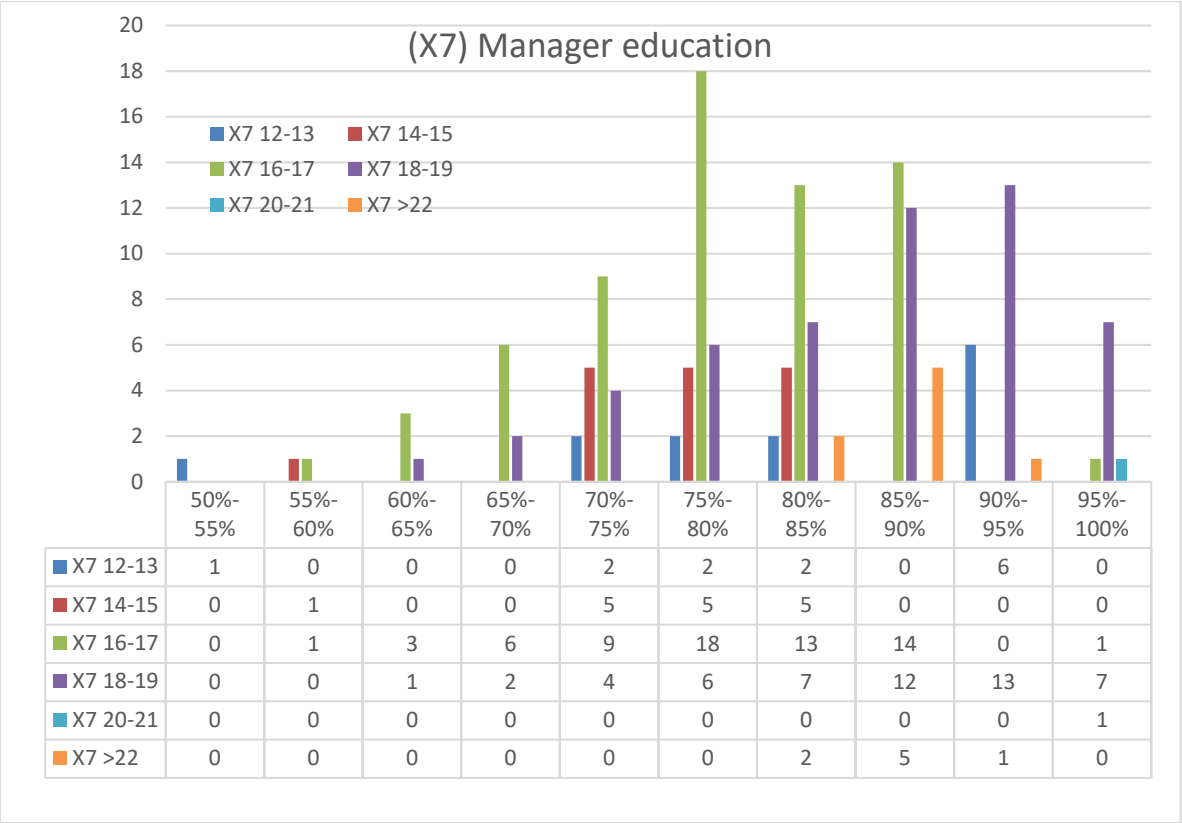


Figure 20: Pie chart of (X_7) Manager education distribution in UK manufacturing firms



	50%-55%	55%-60%	60%-65%	65%-70%	70%-75%	75%-80%	80%-85%	85%-90%	90%-95%	95%-100%
X7 12-13	1	0	0	0	2	2	2	0	6	0
X7 14-15	0	1	0	0	5	5	5	0	0	0
X7 16-17	0	1	3	6	9	18	13	14	0	1
X7 18-19	0	0	1	2	4	6	7	12	13	7
X7 20-21	0	0	0	0	0	0	0	0	0	1
X7 >22	0	0	0	0	0	0	2	5	1	0

Figure 21: Bar chart of distribution of % efficiency score as per variable X_7 in UK manufacturing firms

The last variable to be examined was a family-owned firm marked as X_8. These firms account for exactly one-fifth of all firms, with the majority having an efficiency score of less than 80% and only 11 scoring more than 80%. Firms that are not family-owned, on the other hand, have a higher efficiency score. More than half of them, 76 out of 124, have an efficiency score of more than 80%. The efficiency score of 37 non-family owned firms is between 70% and 80%, while the remaining non-family owned firms (10 firms) is below 70%.

(X8) Family owned	Total UK Man. Firms
No (value =0)	124
Yes (value =1)	31

Table 7: (X_8) Family owned distribution in UK manufacturing firms

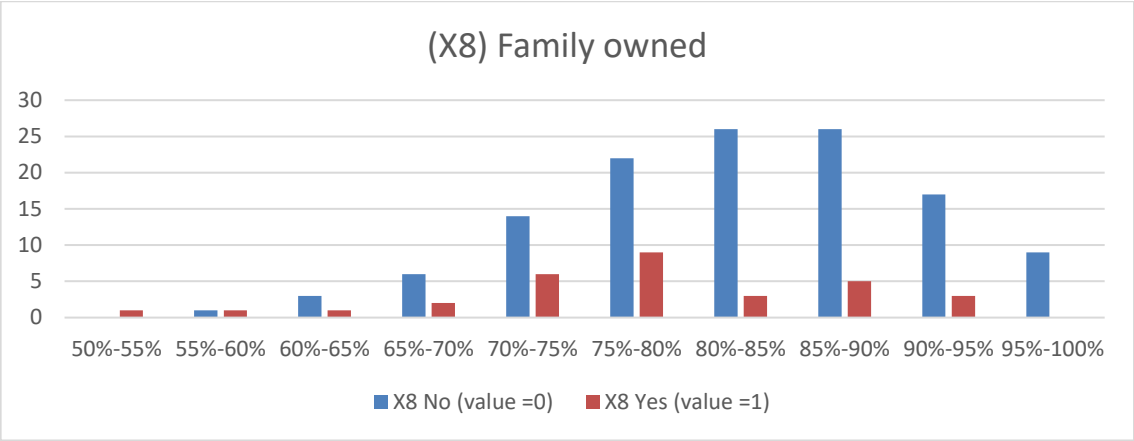


Figure 22: Bar chart of distribution of % efficiency score as per variable X_8 in UK manufacturing firms

Data variables minimum, maximum, and average are tabulated below. The average efficiency score of 155 UK manufacturing firms is considered as high as is 81.5 %, in a band of 51.8% to 97.1%. 15% of firms offer incentive compensation, and in a double percentage, firms provide training to employees. In a low percentage of 22%, firms provide flexible job assignments, and in an even lower percentage of 12%, firm employees more than 50 workers. Average manager age – variable X_5, is approximately 50 years, with the average manager experience in managerial positions to be 13.5 years. Average manager education is 16.75 years' while one fifth is the family-owned firms.

The data variables minimum, maximum, and average are tabulated below. The average efficiency score of 155 UK manufacturing firms is 81.5%, in a band of 51.8% to 97.1 %. 15% of firms provide incentive compensation, and in a duplicate percentage, firms provide staff training. Companies give flexible job assignments in a low proportion of 22% of cases, and in an even lower percentage of 12 per cent of cases, firms employ more than 50 workers. The average manager age – variable X_5 – is nearly 50 years, with management experience in managerial positions to be 13.5 years and with manager, education to be 16.75 years. The last variable, family-owned businesses, accounts for one-fifth of all firms.

	Efficiency score	X1	X2	X3	X4	X5	X6	X7	X8
Min	0.51786	0	0	0	0	29	2	12	0
Max	0.97126	1	1	1	1	69	35	22	1
Average	0.81585	0.15	0.30	0.22	0.12	48.97	13.63	16.75	0.20

Table 8: Min, Max and Average of Variables X_1 - X_8 and Efficiency Score.

Chapter 6
Results and Discussion

6.1. Correlation Coefficient

A correlation coefficient is used in statistics to describe a pattern or relationship between two variables. In this sub-section, we calculate the correlation coefficient between each pair of variables, and then we present the results in a matrix (Table 9). In the efficiency score regression model, the correlation matrix of all variables is the following:

	x1	*x2*	*x3*	*x4*	*x5*	*x6*	*x7*	*x8*
x1	1							
x2	0.1832	1						
x3	-0.0976	-0.0105	1					
x4	0.3294	0.1814	-0.0080	1				
x5	0.2996	0.1727	-0.1545	0.1351	1			
x6	0.4119	0.2311	-0.0830	0.2084	0.8756	1		
x7	0.3979	0.1645	-0.0784	0.0681	0.2127	0.3269	1	
x8	0.0089	0.0561	0.0468	-0.0393	0.0188	-0.0612	-0.1040	1

Table 9: Correlation matrix of the variable

The applied color gradient (green –white –red color scale) indicates where each value falls within that range (positively-zero-negatively variable correlation, respectively).

Elements with correlation matrix are positive, it follows that each pair of variables is positively correlated with each other, while at the same time elements with correlation matrix are negative, it follows that each pair of variables is negatively correlated with each other. Finally, a value of 0 shows that there is no link between the pair of variables.

Based on the above correlation matrix, we can find the correlation of each pair of variables. Below we present each variable correlation with any other variable examined.:

- X_1 variable - incentive compensation is offered.

X_1 (incentive compensation is offered) has its greatest is positively linked with X_6 (manager experience in managerial positions) in a value of 0.4119, followed by X_7

(manager education) with a value of 0.3979. In other words, incentive compensation offered variable increases with increased manager experience in managerial positions (X_6) and manager education (X_7). A less strong positive correlation is also observed with other variables, such as X_2 (company provides training to employees), X_4 (firm employees more than 50 workers) and X_5 (manager age), with a value 0.1832, 0.3294 and 0.2996 respectively. A negative correlation indicates that one variable increases while the other decreases, and vice-versa is observed in only one variable X_3 (flexible job assignment) with a value of -0.0976. An (almost) zero correlation is observed with X_8 (family-owned), meaning that there is no link between the variable of incentive compensation offered and family-owned.

- X_2 variable - company provides training to employees

There is a weak positive correlation with most of the other variables (X_1, X_4, X_5, X_6, X_7), with the less positively correlation to be for the variable X_7 (manager education) and the stronger positive correlation of variable "company provides training to employees" to be with variable X_6 (manager experience in managerial positions). All remaining variables with positive correlation lay in 01645 to 0.2311. A very weak negative correlation is observed only with variable X_3 (flexible job assignment), in a value of -0.0105, which stand for that the increase of variable of a company providing training to employees has a weak negative reflection of flexible job assignment variable. Almost insignificant correlation is observed with the X_8 (family-owned), as already observed and with X_1 variable (incentive compensation is offered).

- X_3 variable - flexible job assignment

The majority of mentioned variable correlations with other variables are negatively linked, and only one of them is with (almost) zero correlation X_8. (family-owned). The strongest negative correlation exists in a variable X_5 (manager age) in a value of -0.1545, followed by variables X_1, X_6, X_7, X_2 and X_4 that ranged between -0.0976 to -0.0080.

- X_4 variable - firm employees more than 50 workers

All types of correlation exist for the specific variable. Starting with no correlation observed with variable X_7 (manager education), the value is positively very low (0.0681), almost zero. The stronger negative correlation is observed with variable X_8 (family-

owned), with a value -0.0393, while the stronger positive correlation is detected for X_1 the variable. Remaining variable X_2, X_5 have positive correlation, while all the other variables are negatively linked with X_4 variable.

- X_5 variable - manager age

Manager experience in managerial positions variable (X_6) is by far not only the strongest positively variable correlation with the specific variable we examine (i.e. X_5), but the strongest positive correlation variable pair exists in our variable list, reaching a value of 0.8756. At the same time, we observed that the specific variable also has the strongest negatively correlation with any other variable pair that we examine. That is with X_3 variable - flexible job assignment, with a value -0.1545. Almost no correlation is observed with variables X_8. (family-owned), while all the not mentioned until now, variables are positively related with manager age variable.

- X_6 variable - manager experience in managerial positions

As stated before, the strongest positively variable is with manager age variable (0.8756). Positively relations exist also for X_7 (manager education), X_1 (incentive compensation is offered), X_5 (manager age) and X_2. (company provides training to employees), in a value range of 0.1645 to 0.3979. No correlation is revealed for X_4 (firm employees more than 50 workers), while variables X_3 (flexible job assignment) and X_8. (family-owned) are negatively linked with manager experience in managerial positions variable, with a value of -0.0784 and -0.0612, respectively.

- X_7 variable - manager education

All other variables are either with no correlation with the specific variable or are negatively linked with this one. The strongest negatively correlation for the specific variable exists with X_8. (family-owned) with a value of -0.1040. In the same negative connection are the variables X_4 (firm employees more than 50 workers) and manager experience in managerial positions variable (X_6). For the remaining variables, we can state, as already mentioned previously, that there is no correlation.

- X_8 variable - family owned

The same trend as X_7 a variable is observed with the last examine variable. Only negatively correlations exist and, in the best case, to variables with no correlation with the specific variable. One of the strongest negatively correlation pairs is with X_8 (family-

owned) with a value -0.1040, followed by X_6 a variable (manager experience in managerial positions), with a value of -0.0612. In the same trend also variable X_3 (flexible job assignment), while not mentioned variables are with insignificant positively related with X_8 variable, and that we can state that there is no link between them.

To sum up, the strongest positively variable pair that exists is between X_6 and X_5 variables (manager experience in managerial positions variable and manager age variable respectively) with a value of 0.8756. At the same time, the strongest negatively variable pair is between X_3 variable - flexible job assignment and X_5 - manager age, with a value of -0.1545.

X_3 variable - flexible job assignment and X_8 variable - family-owned, are two variables that are either negatively correlated or with no correlations with any other examined variables. The last one indicates that flexible job assignment and family-owned variables increase, tend to decrease all the other examine variables, or in the best case, to be without any significance to any of the other variables.

By contrast, X_1 (incentive compensation is offered) and X_2 (company provides training to employees) are two variables that correlated with most other variables with positive values. This indicates that when increasing the incentive compensation offered and when a company provides training to employees, those variables tend to increase all the other variables.

Last but not least $X_4 - X_7$, variables are related with the other variables by all types of correlation (negative, zero and positive). Thus these variables are correlated with each other with every type of correlation.

6.2. Regression Models

Based on data, as per Annex and using the 'regression' function from the Data Analysis toolbox of Excel, we estimate the regression model. The OLS Estimation results are given in Table 10. Using the Tobit model, we also estimate the linear relationships between variables when left- or right-censoring in the dependent variable (Table 11).

R Square	0.515261608		
	Coefficients	**Standard Error**	**P-value**
Intercept	0.653181301	0.064930453	2.06E-18
X Variable 1	0.027723846	0.017287497	0.110942757
X Variable 2	0.015060324	0.011736003	0.201434755
X Variable 3	-0.048047546	0.012775139	0.000244288
X Variable 4	0.055517827	0.016946807	0.001315332
X Variable 5	-0.001386779	0.001090239	0.205397169
X Variable 6	0.005519972	0.001538398	0.000453824
X Variable 7	0.009371984	0.003041438	0.002462919
X Variable 8	-0.033969089	0.013204331	0.011092334

Table 10: OLS Estimation results

Log likelihood = 210.63435			
Eff.	**Coefficients**	**Standard Error**	**P-value**
X Variable 1	0.0277238	0.016778	0.101
X Variable 2	0.0150603	0.011390	0.188
X Variable 3	-0.0480475	0.012399	0.000
X Variable 4	0.0555178	0.016447	0.001
X Variable 5	-0.0013868	0.001058	0.192
X Variable 6	0.0055200	0.001493	0.000
X Variable 7	0.0093720	0.002952	0.002
X Variable 8	-0.0339691	0.012815	0.009
Constant	0.6531813	0.063017	0.000

Table 11: Tobit results

Where:

Label	Variable
X1	Dummy: 1 if incentive compensation is offered, zero otherwise
X2	Dummy: 1 if company provides training to employees, zero otherwise
X3	Dummy: 1 if flexible job assignment, zero otherwise
X4	Dummy: 1 if firm employees more than 50 workers, zero otherwise
X5	Manager age
X6	Manager experience in managerial positions
X7	Manager education
X8	Dummy: 1 if family-owned, zero otherwise

The fitted regression equation as per OLS estimation results is:

$$Y = 0.653 + 0.028X_1 + 0.015X_2 - 0.048X_3 + 0.056X_4 - 0.001X_5 + 0.006X_6 + 0.009X_7 - 0.034X_8 \quad Eq.2$$

Efficiency is measured on a scale of 0 to 1, with 1 indicating that the unit is relatively efficient and 0 indicating that the unit is inefficient. Thus, based on equation 2, the greatest add value of efficiency score (Y) is considered the variable X_4 (firm employees more than 50 workers), given that all the other explanatory variables remain the same.

The formula estimates that for each increase of one unit in the variable X_4 (firm employees are more than 50 workers), the expected efficiency score is predicted to increase by 0.056. In the same way, we explain for variables X_4 increase of one unit in the variable X_1 the expected efficiency score is predicted increase by 0.028. However, variables X_3, X_5 and X_8 increase by one unit will decrease the efficiency score by 0.048, 0.001 and 0.034 units, respectively, given that all the other seven explanatory variables are equal. If all variables are equal to zero (i.e., no variable links with the efficiency score), the expected efficiency score will be 0.6532.

The value R^2 is 0.515, which states the measures of the proportion of the variation in efficiency score variable (Y) explained by our independent variables ($X_1 - X_8$). As the value is approximate 0.5, half of the variance in the outcome variable is explained by the model. 51.5% of the efficiency score variability is explained by the incentive compensation offered, the company provides training to employees, the flexible job assignment, the firm employees more than 50 workers, the manager age, the manager experience in managerial positions, the management education and last with the family-owned firms.

The standard errors of the coefficient estimates are in a range of 0.002 – 0.065. For coefficients β_0 up to β_8 the standard error are: 0.065 (for β_0), 0.018 (for β_1), 0.012 (for β_2), 0.013 (for β_3), 0.017 (for β_4), 0.002 (for β_5), 0.002 (for β_6), 0.004 (for β_7) and 0.014 (for β_8).

A p-value approach is an alternate approach of "t stat". In cases where p-value>0.05, we strongly support the null hypothesis, therefore accept H_0 and reject H_1 (example in for β_0, the null hypothesis is $H_0 : \beta_0 = 0$ and alternative hypothesis is $H_1 : \beta_0 \neq 0$).

The p-values of β_0, β_3, β_4, β_6, β_7 and β_8 are ranged from 0.0000 to 0.0111, much lower than 5%, so there is no support of the null hypothesis. Therefore, the intercept and the coefficients of X_3, X_4, X_6, X_7 and X_8 are statistically significant. The remaining p-values, β_1, β_2 and β_5 are higher than 5%, so the null hypothesis stand. The relevant coefficients are statistically insignificant.

As per Tobit's results, the fitted regression equation is:

$$Y = 0.653 + 0.278X_1 + 0.151X_2 - 0.480X_3 + 0.556X_4 - 0.014X_5 + 0.055X_6 + 0.009X_7 - 0.340X_8 \quad Eq.3$$

For the censored dependent variable, the estimated Tobit model maximum likelihood equals 210.63. As the log-likelihood value is considered high, this stands that the model fits better to the dataset.

According to $Eq.3$, for every unit increase in a variable X_4 (firm employees greater than 50 workers), the estimated efficiency score rises by 0.556. If the variable X_1 increases by one unit, the estimated efficiency score rises by 0.278. However, increasing variables X_3, X_5 and X_8 by one unit reduces the efficiency score by 0.480, 0.014, and 0.340 units, respectively, assuming all other explanatory factors are equal. If all variables are set to zero (i.e., no variables are linked to the efficiency score), the expected efficiency score is 0.653, which is the same result as predicted by OLS Estimation results.

Comparing the Tobit model and OLS estimation model, we can observe that the same variables positively increase the efficiency score and with the same trend. X_4 Variable is considered as the most significant variable that affects positively the efficiency score, followed by X_1 variable. Both models predict that variables X_3, X_5 and X_8 are negatively correlated with the efficiency score. If no variables are linked to the efficiency score, then the predicted estimated efficiency score is the same in both models.

The standard errors of the coefficient estimates are in a range of 0.010 – 0.167. For coefficients β_0 up to β_8 the standard error are: 0.168 (for β_0), 0.114 (for β_1), 0.124 (for β_2), 0.164 (for β_3), 0.010 (for β_4), 0.015 (for β_5), 0.030 (for β_6), 0.128 (for β_7) and 0.630 (for β_8).

The p-values of β_0, β_3, β_4, β_6, β_7 and β_8 are ranged from 0.000 to 0.009, much lower than 5%, so there is no support of the null hypothesis. Therefore, the intercept and the coefficients of X_3, X_4, X_6, X_7 and X_8 are statistically significant. The remaining p-values β_1, $\beta 2$ are higher than 5%, so the null hypothesis stands.

Chapter 7
Conclusion

The research was carried out in 155 UK manufacturing firms by testing the management impact on firm efficiency, using statistical analysis tools regression analysis. Eight variables were used as a proxy for firm efficiency.

The varieties correlation coefficient of variables results was analyzed. The results revealed that the strongest positive correlation variable exists between manager experience in managerial positions and manager age variable. In other words, managers experience gains with the increase of manager age. On the other side, manager age negatively impacts the flexible job assignment variable. This is considered as the strongest negatively variable pair that was examined in the thesis. In another aspect, firms with more flexible job assignments and family-owned variables tend to either reduce all other examine variables or are insignificant for the other variables. All of the other examined variables tend to grow as the firm's variables of "company provides training to employees" and "incentive compensation is supplied" increase. An almost no correlation between the eight variables is also observed, considering an absolute value of correlation being less than 0.015. Those where the following variables pair:

a) incentive compensation offered and family-owned.
b) company provides training to employees and flexible job assignment
c) flexible job assignment and firm employees more than 50 workers
d) firm employees more than 50 workers and manager education

Furthermore, the following variable pairs show also a weak correlation, considering an absolute value of correlation being less than 0.100:

a) incentive compensation offered and if flexible job assignment
b) company provides training to employees and family owned firm
c) flexible job assignment and manager experience in managerial positions
d) flexible job assignment and manager education
e) flexible job assignment and family owned firm
f) firm employees more than 50 workers and family owned firm

g) manager age and family owned firm
h) manager experience in managerial positions and family owned firm

Based on Tobit model analysis, our independent variables account for more than half of the variation in efficiency score, implying that the regression model explains at least half of the variance in the outcome variable. Furthermore, the outcome has shown that the coefficient of firm employees more than 50 workers were statistically significant. At the same time, the flexible job assignment is considered as statistically insignificant among the eight variables examined. The p-values determine that three variables are considered insignificant. Those are the incentive compensation is offered, the company provides training to employees and the manager age variables.

Overall, the data presented here provide a deeper understanding of how diverse variables affect the level of firm efficiency. The regression study performed to quantify these effects shows that the two most influential aspects in controlling a UK manufacturing firm are delayed flexible job assignment and increased firm employees by more than 50 workers. Our findings from this broad group of companies generally align with previous research. Management practices were more common in larger organizations than smaller firms, non-family owned enterprises than family-owned businesses, and non-flexible job assignments than flexible job assignments.

Despite some limitations, the thesis gives a good idea of how different variables affect each other. Further, its potential in looking at other new independent variables makes it attractive to determine UK firm efficiency and improve the model. Such variables are firms' type, firms' age, firms' size, firms' location (region), turnover and foreign firm owned.

The thesis dataset has the potential to assist comprehensive study on other variables of differences in management practices in UK firms, such as geographical effects. In addition, to explore firms' variances in management practices at more heterogeneous levels of efficiency score. Furthermore, an assessment of the relationships between the 2019 coronavirus (COVID-19) pandemic and how firms' efficiency scores affect it will be good to be part of future research in this area.

Annex

Efficiency Score of 155 UK Manufacturing Firms.

a/a	Eff	x1	x2	x3	x4	x5	x6	x7	x8
1	0.51786	0	0	1	0	44	11	12	1
2	0.57450	0	0	0	0	42	9	15	0
3	0.58663	0	0	1	0	51	18	16	1
4	0.60201	0	0	1	0	52	19	16	0
5	0.60789	0	1	0	0	54	21	16	0
6	0.63257	0	0	1	0	38	5	18	1
7	0.64782	0	0	0	0	37	4	16	0
8	0.66008	0	0	0	0	38	5	16	0
9	0.67189	0	1	1	0	61	18	18	1
10	0.67681	0	0	0	0	64	11	16	0
11	0.67849	0	0	0	0	58	15	18	1
12	0.67851	0	0	1	0	56	23	16	0
13	0.68061	0	0	0	0	44	11	16	0
14	0.68858	0	0	0	0	38	7	16	0
15	0.69156	0	1	0	0	37	4	16	0
16	0.70265	0	0	0	0	33	5	18	1
17	0.71263	0	1	1	0	37	4	18	0
18	0.71279	0	0	0	0	29	2	16	0
19	0.71337	0	1	0	0	39	6	12	0
20	0.71384	0	1	0	0	40	7	15	0
21	0.71397	0	0	1	1	41	8	15	1
22	0.72072	0	0	0	0	42	9	16	0
23	0.72866	0	0	0	0	44	11	16	0
24	0.72926	0	1	0	0	42	9	15	1
25	0.73073	0	0	1	0	51	18	15	0
26	0.73096	0	0	0	0	52	13	16	0
27	0.73119	0	0	0	0	54	11	12	1
28	0.73463	0	0	1	0	38	5	15	0
29	0.73930	0	0	0	0	37	4	16	1
30	0.74096	0	1	1	0	38	5	16	0
31	0.74276	0	0	0	0	61	18	16	0
32	0.74653	0	0	0	0	64	15	18	0
33	0.74816	0	1	1	0	58	12	16	1
34	0.74835	0	1	0	0	56	13	16	0
35	0.74839	0	0	1	0	44	11	18	0
36	0.75117	0	1	0	0	38	5	16	1
37	0.75167	0	0	1	0	37	4	18	0
38	0.75232	0	1	1	0	33	2	16	0
39	0.75376	0	0	1	0	37	4	16	0

40	0.75452	0	0	1	0	29	5	16	0
41	0.75689	0	0	1	0	39	6	16	1
42	0.75972	0	0	1	0	40	7	18	0
43	0.76210	0	0	0	0	41	8	18	0
44	0.76640	0	0	1	0	42	9	16	0
45	0.77110	0	0	1	0	44	11	12	0
46	0.77145	0	0	1	0	42	9	15	0
47	0.77349	0	0	0	0	51	18	15	0
48	0.77474	0	0	0	0	52	11	16	0
49	0.77835	0	1	0	0	54	15	16	1
50	0.78128	0	0	0	0	38	5	15	0
51	0.78129	0	0	0	0	37	4	15	0
52	0.78418	0	0	0	0	38	5	16	0
53	0.78660	0	0	0	0	61	14	12	1
54	0.78826	0	0	0	0	64	18	15	1
55	0.78951	0	0	0	0	58	10	16	1
56	0.78994	0	0	0	0	56	10	16	0
57	0.79057	0	0	0	0	44	11	16	0
58	0.79257	0	0	0	0	38	5	18	0
59	0.79353	0	0	0	0	37	4	16	0
60	0.79579	0	0	0	0	33	3	16	0
61	0.79621	0	0	0	0	37	4	18	1
62	0.79646	0	0	1	0	29	3	16	0
63	0.79855	0	0	0	0	39	6	18	0
64	0.79904	0	0	0	0	40	7	16	1
65	0.79948	0	0	0	0	41	8	16	0
66	0.79954	0	0	0	0	42	9	16	1
67	0.80074	0	0	0	0	44	6	16	0
68	0.80322	0	0	0	0	42	9	18	0
69	0.80803	0	0	0	0	51	9	18	1
70	0.80828	0	0	0	0	52	11	16	0
71	0.80881	0	0	0	0	54	13	12	0
72	0.81005	0	0	0	0	38	5	15	0
73	0.81108	0	1	0	0	37	4	15	0
74	0.81175	0	0	1	0	38	5	16	0
75	0.81407	0	0	0	0	61	14	16	0
76	0.81690	0	1	0	0	64	11	15	0
77	0.82275	0	0	0	0	58	15	15	0
78	0.82338	0	0	0	0	56	14	16	0
79	0.82557	0	0	0	0	44	11	12	1
80	0.82679	0	0	0	0	38	5	15	0
81	0.82827	0	0	0	0	37	4	16	0
82	0.82998	0	0	0	0	33	4	16	0
83	0.83092	0	0	0	0	37	4	16	0
84	0.83101	0	0	0	0	29	2	18	0
85	0.83291	0	0	0	0	39	6	16	0
86	0.83677	0	0	0	0	40	7	16	0
87	0.83990	0	0	0	0	41	8	18	0
88	0.83997	0	0	1	0	42	9	16	0

89	0.84134	1	0	0	0	44	11	18	1
90	0.84177	0	1	0	0	42	9	16	0
91	0.84391	1	0	0	0	51	18	22	0
92	0.84540	0	1	0	0	52	19	16	0
93	0.84620	0	1	1	0	54	14	22	0
94	0.84965	0	0	0	1	38	5	18	0
95	0.84999	0	1	0	1	37	4	18	0
96	0.85103	0	0	0	0	38	5	16	0
97	0.85233	1	0	0	1	61	19	16	1
98	0.85338	0	0	0	0	64	22	18	0
99	0.85665	0	1	0	0	58	23	18	0
100	0.85753	0	0	0	1	56	21	16	0
101	0.85828	0	1	0	0	44	11	16	1
102	0.85996	0	0	0	0	38	5	18	0
103	0.86592	0	1	0	0	52	19	18	0
104	0.86764	0	0	0	1	48	15	16	0
105	0.86783	0	1	0	0	52	19	22	1
106	0.86805	0	0	0	0	44	11	18	0
107	0.86866	0	1	0	0	54	19	16	0
108	0.87050	0	0	0	0	55	17	22	0
109	0.87352	0	0	0	0	56	15	16	0
110	0.87391	1	0	0	0	57	14	22	0
111	0.87653	1	1	1	0	59	29	18	1
112	0.87679	0	0	0	0	57	24	18	0
113	0.87698	0	0	0	0	66	29	16	0
114	0.87923	1	1	0	0	67	24	16	0
115	0.87985	0	0	0	0	69	26	18	0
116	0.87985	0	1	0	0	53	20	18	0
117	0.87987	0	0	1	0	52	19	16	0
118	0.88316	0	0	0	0	53	20	16	1
119	0.88453	0	1	0	0	69	26	18	0
120	0.88597	1	0	0	0	69	26	18	0
121	0.88892	0	0	0	0	67	24	16	0
122	0.88892	1	0	0	0	59	26	22	0
123	0.88918	0	1	1	0	59	26	18	0
124	0.89238	0	0	0	0	53	20	16	0
125	0.89485	1	0	0	0	52	19	22	0
126	0.89890	1	1	1	1	48	15	16	0
127	0.90162	1	1	0	0	52	19	22	1
128	0.90198	0	1	1	1	44	11	18	0
129	0.90497	1	0	0	0	54	21	18	0
130	0.90816	0	0	0	0	55	22	16	0
131	0.91206	1	0	1	0	56	23	16	0
132	0.91414	0	0	0	0	57	24	18	0
133	0.91619	0	1	0	1	59	26	18	0
134	0.91677	1	1	0	1	57	23	16	0
135	0.91700	0	0	0	1	66	22	16	0
136	0.91962	1	1	0	0	67	21	18	1
137	0.92131	0	0	1	1	69	26	18	0

138	0.92135	1	0	0	1	53	20	16	0
139	0.92373	0	1	0	0	52	19	18	0
140	0.92546	1	1	0	0	53	20	19	0
141	0.92583	0	0	0	0	68	35	18	0
142	0.92870	0	1	0	0	69	26	18	0
143	0.92887	1	1	0	0	63	30	18	0
144	0.93785	0	0	1	0	61	28	18	0
145	0.94773	1	1	0	1	59	26	18	0
146	0.94935	0	1	0	1	53	20	16	1
147	0.95002	1	0	0	1	52	19	18	0
148	0.95219	1	1	0	1	48	15	18	0
149	0.95430	0	1	0	0	52	19	18	0
150	0.95501	0	1	0	0	44	11	17	0
151	0.95619	1	1	0	1	54	21	19	0
152	0.95838	1	0	0	0	55	22	20	0
153	0.95902	0	1	0	0	56	23	18	0
154	0.97035	0	0	0	0	57	24	19	0
155	0.97126	1	1	0	1	58	25	19	0

Where:

Eff	**Efficiency score**
x1	Dummy: 1 if incentive compensation is offered, zero otherwise
x2	Dummy: 1 if company provides training to employees, zero otherwise
x3	Dummy: 1 if flexible job assignment, zero otherwise
x4	Dummy: 1 if firm employees more than 50 workers, zero otherwise
x5	Manager age
x6	Manager experience in managerial positions
x7	Manager education
x8	Dummy: 1 if family owned, zero otherwise

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