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Managerial Practices, Location and ICT: Productivity of UK Aerospace Firms in Business Clusters

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For Kay.

If I only have one privilege, it's being your husband.

DECLARATION

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

ABSTRACT

Globalisation and Information and Communications Technology (ICT) once appeared to be allies attempting to thwart the notion of the local economy. Recently, and somewhat paradoxically, policymakers and firms appear to be harnessing ICT to foster the development of local economies. To compete globally, firms are frequently looking locally, often by co-locating in industrial districts ('clusters'). Despite similar access to ICT, software, and government policies designed to ameliorate productivity impeding variables, wide gulfs continue to appear in ICT-led productivity between firms in different countries, within the same country, or within the same region or cluster. Attention is increasingly turning to the role that management practices may play in explaining such variations.

Concomitant to, or perhaps as a result of this focus, the relationship between ICT and productivity warrants further consideration, with the recognition that ICT by itself cannot affect competitive capacity: it can only be productive if it is appropriately embedded in the organisation and is a function of managerial practices and skills.

This dissertation has been undertaken at the nexus of ICT, managerial practices and spatial orientation. It has a firm-level focus and will rectify a current methodological and sampling deficit to provide answers on how and why managerial practices affect ICT both within and between organisational settings, and how this in turn influences productivity.

A multiple embedded case study design has been utilised, nested in the aerospace sector in the UK. The research utilises both qualitative and quantitative empirical methodologies and is multi-disciplinary, working across the Information Systems Group in the Department of Management and the Centre for Economic Performance at the LSE. Ontologically, the research ascribes to the assumption that technology is neither omnipotent nor uncontested, and impinges on the terms by which individuals interact with one another, influencing the individual-world interaction and affecting the behaviour of the organisation as a social system. Success or failure can ultimately depend on the negotiation of practices, with information systems capable of mediating productivity.

By addressing the current lacuna at the overlap of the principal themes being explored, this research makes an original and relevant contribution on a topical issue that transcends borders, culture and language.

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The seeds for this doctoral journey were sown by my parents who from a young age instilled in me the value of learning, and for this I will always be indebted.

My interest in exploring the influence of technology on information was fuelled when I first read T.S. Eliot's poem, *Choruses from the Rock*, and was struck by its profound insights, written in 1934:

Where is the Life we have lost in living?
Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?

I am indebted to two of my earlier academic mentors who also kindly agreed to be referees for my PhD application: Professor Wade Chambers, who cultivated my interest in these social science themes in his exceptional Masters programme in science and technology, and Professor Henry Ergas, who supervised my research projects during my MBA and provided invaluable guidance.

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This dissertation would not have been possible without the close collaboration with both the LSE's Centre for Economic Performance (CEP) and McKinsey and Company. I am indebted to Professor John Van Reenen, Nick Bloom and Raffaella Sadun from the CEP, who 'took me in' and trained me in the use of a key methodology. I would not have completed my final data revisions without Mirko Dracas' enviable stats skills at the CEP, to whom I owe my thanks. My gratitude extends to my 'train buddies' John Dowdy and Stephen Dorgan from McKinsey and to Pedro Castro, who generously provided their time and whose firm developed the management practices tool.

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1. Introduction: Problem Description

Even by the 1990's, it appeared that globalisation and information and communications technology (ICT) were allies attempting to thwart the notion of the local economy. In somewhat of a paradox, policymakers have continued to target the fostering of local economies in the belief that in order to compete globally, firms have to first look locally, often by co-locating in industrial districts ('clusters'). Given such firms have similar access to ICT, software, and government policies designed to ameliorate productivity impeding variables, why do wide gulfs continue to appear in ICT-led productivity between firms in different countries, within the same country, or within the same region or cluster?[1] The plethora of business cluster literature does not address this question but reflects the ubiquity of what Martin and Sunley (2005; p4) call, "the rush to employ 'cluster ideas' that has run ahead of many fundamental conceptual, theoretical and empirical questions." This study will make a contribution by assessing ICT-led productivity within business clusters and the influence of managerial practices.

It is becoming increasingly recognised that ICT use is a function of management practices, and not merely defined by the possession of hardware, software, communications technologies or services.[2] Success or failure ultimately depends on the negotiation of practices with information systems capable of influencing the behaviour of organisational participants and ultimately, making a contribution to the firm's productivity.[3] Although the literature is replete with economic investigations of productivity, a lacuna exists at the nexus with managerial practices and ICT use, which becomes acute when couched in the context of the firm's location. The limited studies on managerial practices do not offer either an 'up close' firm level assessment, or a more detailed review of ICT. This study addresses both, in addition to framing such an investigation within the milieu of business clusters in the complex operating environment of the UK aerospace sector. Such an investigation is congruent with the topical interest expressed by policy makers and economists on understanding the causes of national productivity lags between and within countries, and whether clusters should be promoted as one means of addressing this, as iterated in the European Commission's report on clusters (2002; p9): "Could clusters be one way to achieve the Lisbon Summit goal of making Europe the most competitive and dynamic knowledge-base economy in the world by 2010?"

[1] Liebenau, 2000.
[2] Bloom at al, 2005.
[3] Ibid.

In contrast to the economic notion of 'unexplained residuals' as panacea for productivity this study investigates explainable factors through a multiple case study approach that fuses a quantitative and qualitative assessment with an at-a-distance and in situ examination of the firm, as supported by Scholz & Tietje (2002; p14): "The embedded case design allows for both qualitative and quantitative data and strategies of synthesis or knowledge integration." Through a multidisciplinary investigation of the effects of managerial practices on ICT driven productivity within the technology-intensive aerospace sector, this study makes an original contribution by rectifying a methodological and sampling deficit, addressing the unanswered questions of *how* and *why* ICT use is affected by managerial decision making within organisational settings such as business clusters. The results of this study are intended to be both relevant and valuable to a broad audience that includes policy-makers, firm managers, and researchers.

2. Literature Review

2.1 Productivity and ICT: What's the Problem?

> "The relationship between information technology and productivity is widely discussed but little understood."
>
> Brynjolfsson 1998.

A key premise investigated by this study is that managerial practices affect a firm's use of ICT, which in turn can affect its productivity. ICT has revolutionised the structure of management and the nature of competition in the emerging global economy, with the dictum, "ICT by itself doesn't matter" more relevant than ever as ICT continues to become more readily accessible and prevalent. ICT can only be productive if it is properly embedded within the organisation, and where it is a function of management practices and skills.[4] Where these are absent, ICT is often operated on a "low-tech, low-skill equilibrium" resulting in sub-optimal productivity at the firm level, and ultimately, at the macroeconomic level (Bloom et al, 2005). Managerial factors cannot be assessed in isolation. Clarity on their influence on ICT-driven productivity represents a better understanding of productivity itself.

2.2 Defining Productivity and Asset Utilisation

In contrast to a more traditional definition of productivity as the ratio of outputs consumed to resources expended, Mankiw (1988, p11) incorporates a labour perspective citing the concept as "the quantity of products and services produced from each hour of a worker's time." Brynjolfsson and Hitt (1998; p1) iterate these elements, but highlight measurement issues:

> Productivity is a simple concept. It is the amount of output produced per unit of input. While it is easy to define, it is notoriously difficult to measure, especially in the modern economy. In particular, there are two aspects of productivity that have increasingly defied precise measurement: output, and input.

These give rise to variability in measurement techniques and a lack of a genuine productivity theory, with only a spectrum of measurement concepts evident. Brynjolfsson (1998; p50) orients the notion towards technology, defining productivity as the fundamental measure of a technology's contribution, and stating that "the irony is that while we have more raw data today on all sorts of inputs and outputs than ever before, productivity in the information economy has proven harder to measure than it ever was in the industrial economy." What is 'measured' depends on the researchers intentions however, with approaches almost as varied as their hypotheses. This study qualitatively assesses both the influences on ICT-driven productivity, and a key firm-level indicator

[4] Lefebvre et al, 1997; Suitaris, 2001.

of this: sales per employee ('labour productivity'). This is one of the two key productivity measure utilised by the only study currently quantifying managerial practices at the Centre for Economic Performance at the LSE (Bloom et al 2005). The second indicator measures how productively the firm's *assets* are utilised via its return on capital employed (ROCE). Both of these have proven to be relevant for inclusion in this study and permit further correlation and assessment to occur with other variables.

2.3 ICT and Productivity: Measurement Issues and the IT Productivity Paradox

> "Productivity means adopting new technologies and new techniques for production."
>
> Brynjolfsson and Hitt, 1998.

The problem of quantifying the use of ICT is not new. Ever since Robert Solow (1956) stated, "we see the computer age everywhere except in the productivity statistics," and claimed that labour and capital only accounted for a proportion of total growth, the search has continued to accurately measure the unexplained proportion of productivity purportedly caused by technological progress.[5] However, most studies on ICT and productivity either adopt an econometric approach, which decreases the significance of firm activity, or adopt an information systems (IS) perspective which decreases the significance of the aggregate effects of ICT (ibid). Both approaches tend to utilise data gathered at a combined industry level, or limit their productivity assessments to large firms,[6] with most productivity studies neglecting the multi-causal nature of variations witnessed. This study addresses these shortcomings by assessing the actual use of ICT through a case study approach and supplementing this with data gathered directly from the firms on key indicators of ICT including expenditure, IT staffing levels, hardware purchased, ERP , and others. This extends the current research that only utilises these measures as a proxy of ICT use, including PC penetration, without delving 'beneath the surface' to assess why and how it is utilised (Liebenau, 2000).

The paradox of IT productivity is that despite organisations investing in the latest technology to increase efficiencies and profits, the failure to redesign and reorganise delays the return on investment.[7] Limited studies using micro-level data to explore ICT investments have been led by Brynjolfsson and Hitt (1998; 2003) posit that investment in technology may yield substantial excess returns, but that measurement deficiencies have prevented this from being reported in the past. Although this debate continues, consensus appears to exist that firm-specific factors can have an impact on the benefits extracted from ICT investments (Bloom et al, 2005).

2.4 An Integrated Problem: Identifying the Influences of ICT Use

[5] Also known as 'the Solow residual'.
[6] Brynjolfsson and Hitt, 2000.
[7] Santos and Sussman, 2000.

Bailey (1992) blames a historical lack of research in ICT and productivity on two factors: (i) an absence of high quality data on managerial practices, and, (ii) measurements occurring in an inconsistent manner across countries and firms. Bailey's research was precipitated by Mundlak's (1961) work which identified the effects of 'managerial quality' on technology and productivity. Bertrand and Schoar (2003) continued this stream of research by examining the impact of the management styles and strategies of CEOs and CFOs on the use of ICT and firm performance. Similarly, Bloom et al (2005) researched the practices of middle managers as influencers of productivity and the use of technology and provided a toolset for quantifying practices. These studies portray practices as part of the organisational structure and behaviour of the firm that evolve over time with successive leaders[8] with greater competition also found to yield both higher productivity and better management practices amongst younger firms (ibid). Other studies have found that organisational practices and strategies influence the value of ICT investments, including internal work organisation.[9] Recent research theorises however that ineffective monitoring, targets and incentives result in lower productivity and inefficient use of ICT, irrespective of location.[10]

Although some research has begun to identify the influence of managerial practices on ICT-driven productivity, this overwhelmingly does not address the key problems of *why* and *how* this occurs. Combes et al (2005; p1) reinforce this observation with their focus on labour: "Despite a very large number of extensions, many important dimensions of these models remain under-explored...imperfect labour mobility, labour force participation, have all attracted the least attention." Van Zoest brings together ICT, productivity and managerial practices:

> Evidence has shown that effective deployment of ICT, or the failure to do so, are determinants of productivity growth far more important than ICT expenditure. In order to get the most out of their ICT, companies will have to make sophisticated use of ICT and manage the process of change required to embed technology in the company organisation (2003; p4).

Hitt (2003; p213) also highlights the deficit in the inclusion of managerial practices in current ICT and productivity research by positing that "what is notably absent from the studies on ICT and productivity, is the role of management practices."

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[8] Bloom et al, 2005.
[9] Brynjolfsson and Hitt, 1998.
[10] Bloom et al, 2005

2.5 ICT, Productivity and Managerial Practices: Perpetuating the Productivity Paradox?

> " Senior managers, a major source of resistance to change, also conceive and execute strategy, including the firm's technology direction."
>
> Santos and Sussman, 2000.

It is becoming recognised that productivity should not be expected from ICT alone, but rather, that it should be accompanied by appropriate management efforts.[11] Organisational and managerial practices are posited as being complementary to the production process: "The use of and investment in ICT requires complementary investments in skills, organisation, innovation and investment and change entails risks and costs as well as bringing potential benefits," (OECD, 2004; p11). The traditional position has been that ICT is primary and that management is secondary, but an emerging body of work has advocated the reversal of this view, with productivity posited as coming not from ICT, but from management methods underpinned by ICT.[12] Recent OECD analysis (ibid) depicts the impact of ICT and e-business strategy on firm performance as being positive overall, but that ICT should not be viewed as a panacea in itself. The perpetuation of the ICT productivity paradox is believed by many researchers however to be due to a failure in strategic thinking, and, resistance to change by senior management (ibid). The influence of senior managers on firm performance, including through the adoption of technology, has been highlighted in the literature, but this is not generally assessed further:

> What is notably absent from all of these studies is the role of IT management practices...which can have a substantial effect on performance. IT is not simply something that is purchased...but can be shaped by the effectiveness of the management process (Hitt,1999; p215).

2.6 Strategic Failure

Strategy is often identified in the literature as an influencer of ICT decisions with productivity growth occurring as a result of 'working smarter' and when technology strategy is congruent with other organisational goals, with Brynjolfsson and Hitt (1998) positing that:

> The greatest benefits of computers appear to be realised when computer investment is coupled with other complementary investments; new strategies, new business processes and new organisations all appear to be important in realising the maximum benefit of IT.

This view reflects the belief by Santos and Sussman (2000; p431-432) that successful firms are comprised of senior managers whose worldview implicitly incorporates the threat posed by the IT paradox:

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[11] Bloom et al, 2005.
[12] Santos and Sussman, 2000.

> Senior managers are the only ones who are in a position to make the structural and strategic decisions necessary to take full advantage of the technology and who have the macro level view of the organization to see how the technology can best be utilized.

The misalignment of strategic expectations can contribute to the paradox of ICT productivity, influenced by differing 'world views' between senior managers and IT professionals:

> Although IT personnel often drive new application development and may prompt senior managers to think about IT strategically, they often lack the necessary business perspective and must therefore resort to "efficiency"- driven products (Santos and Sussman, 2000; p432).

The notion that the use of ICT in this manner can treat 'organisational ills' is challenged by Brynjolfsson and Hitt (1998; p11), who state that "computerisation does not automatically increase productivity, but it is an essential component of a broader system of organisational changes." This study positions ICT within the continuum of organisational activity, quantifying and qualifying managerial influence, and making it one of the only efforts to do so.

2.7 Resistance

> " ICT represents a threat to managers because it challenges their sense of control, confidence, and competence. This threat more often than not translates into resistance."
>
> Argyris, 1985.

Managerial resistance to the implementation of ICT is a relatively new phenomenon (Santos and Sussman, 2000). Whilst the literature offers some possible explanations for this, it generally fails to provide the basis for such resistance or to address the effect of this on the adoption of ICT. Resistance is also posited to contribute to the perpetuation of the ICT productivity paradox:

> Failure to strategically leverage the potential of IT explains only part of the IT paradox. The other major contributing factor is senior management's inability to overcome the resistance to change created whenever IT is initially introduced or when managers migrate from one system to another (Santos and Sussman, 2000; p432).

Although senior managers may publicly embrace ICT change, they may covertly resist it, either intentionally or unintentionally. ICT implementation often involves complex technical issues and a high degree of interaction between individuals, with the latter posited to have a greater impact on an individual's adoption of ICT than technical factors (ibid). This extends to the potential effect on ICT of the relationship between senior managers, including the CEO and the IT manager, which may affect ICT investment and use (Feeney el al, 1992). The impact of individuals on ICT, and the effect of ICT on individuals, may vary between firm types, with this area also under-researched but addressed by this study.

2.8 Comparing Firm Types: Introducing SMEs

The inclusion of three of firm types in this study permits an assessment of the central themes across differing organisational environments: SMEs, large and very large firms. The addition of SMEs is believed to be essential due to this firm type being the most prevalent in most developed economies with 18 million SMEs existing in the EU, responsible for 67 per cent of jobs and 59 per cent of GDP (OECD, 2004). In the UK, SMEs represent 99 per cent of all businesses, accounting for 4.3 million firms, 55 per cent of employment and 51 per cent of GDP.[13] Nine out of ten SMEs in OECD countries are equipped with computers (OECD, 2004) and eight out of ten have internet penetration (ibid). Access to and use of ICT can permit SMEs to become or remain profitable, exploiting their intellectual property, with more productive firms also more likely to adopt a greater numbers of advanced ICTs (Baldwin, 2002). Complementary investments in skills, organisational change and innovation are also posited to be instrumental in facilitating the successful use of ICT and the optimising firm performance, with their absence believed to impact the economic returns of ICT (OECD, 2004). Despite the dominance of SMEs in developed countries, the literature overwhelmingly addresses ICT-driven productivity at an aggregate industry level, or via productivity assessments within large firms, which represent around one per cent of the total number of enterprises in developed countries.[14] The contribution of SMEs to innovation and more recently, to regional development, is becoming increasingly recognised but is still seldom researched in detail:

> SMEs are the basic operation unit of economic activity in the Community, because of their role in economic activity and regional development and also because of their dynamism, productivity, adaptability and innovation capacity (CEC, 1990, p. 1).

The inclusion of small firms in the study can provide a more granular assessment of themes due to six identified attributes, drawn from the literature: (i) smaller firms are integral to economic development (OECD, 2002); (ii) managers in these firms may innovate and adopt of ICT differently to large firms as a result of greater flexibility in adapting to changes in the market (ibid); (iii) a smaller firm provides a more transparent measurement of the use of ICT (Niosi and Zhegu, 2005; Suitaris, 2001); (iv) the CEO/owners are usually involved in many organisational process including strategy and ICT (Caldeira and Ward, 2002; Lefevre et al 1997; Suitaris, 2001); (v) the rationale for the adoption of e-business by smaller firms often involves different processes and justification than for larger firms (OECD, 2002); (vi) innovative activity by smaller firms may provide an incentive for other smaller firms to enter the market, particularly if lower barriers to entry exist (ibid). As with other sectors,

[13] SME Statistics 2004, published by www.sbs.gov.uk/smes.
[14] Brynjolfsson and Hitt, 2000; OECD, 2004.

SMEs also comprise the majority of firms in aerospace.[15] The inclusion of varying firm types in this study provides results that can be of greater relevance to policy makers by highlighting results between these and either validating or challenging the often homogenous policy development practice of 'one size fits all' The lack of accurate, firm-level data has hindered this, which this study seeks to address.

2.9 Linking Firms, Productivity, Managerial Practices and Location

ICT use by firms can impact their productivity and transform their business links, with these formed with external entities and often accruing from locality amongst other factors (Krugman, 1991). In contrast, management practices are internal to the firm and impact how ICT is used to enhance productivity (ibid). Utilising firm-level analysis, these two strands of enquiry (locality and managerial practices) are converged, with the extent to which firms remain spatially bound explored. In the process, the paradox is addressed that although globalisation and ICT may appear to be undermining local economies, public policy and strategic firm behaviour may reveal the opposite, with a key question explored: are local context and actions reinforcing that 'locality is important'? It is often argued that innovation performance and productivity are higher amongst geographically proximate firms compared with geographically dispersed firms due to the developed links between them[16]. It has also been posited that the full benefits of a cluster approach may be specific to certain sectors, or to stages in their evolution, particularly by sectors engaged in intensive technology-driven R&D, including aerospace. A lack of research exists at the nexus of these themes as identified by Steinfeld and Hugger (2005; p1):

> The role of information and communication technologies (ICTs) in the development and maintenance of local industrial clusters has not received a great deal of attention by this research community. This is surprising, given the attention policy makers and researchers pay to the role of communications infrastructures as an input to local and regional economic success.

This study aims to bridge this lacuna through its integrated exploration of the identified themes.

2.10 Clusters and Sector Specific Virtual Networks

2.10.1 Definition and Issues

The European Union's *SME Observatory* define business clusters and clustering, whether physical or virtual, as new and advanced forms of business organisation and networking with their creation market driven and as a result of SMEs wanting to strengthen their competitiveness through

[15] Niosi and Zhegus 2005.
[16] Baptista, 1996; Porter, 1990.

cooperation strategies.[17] No harmonised theory of clusters exists however. Michael Porter's (1998; p197) definition of clusters is arguably the most eulogised and widely utilised, positing that clusters are the geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institution in particular fields that compete but also co-operate. This reflects the agglomeration of firms linked by input-output exchanges on the basis of their production complementarities in particular, but is often criticised for its lack of a spatial range or limits that denote boundaries, and for its high elasticity.[18] This criticism is also levelled at other cluster typologies which are often seen as vague, heterogeneous, inconsistent, and 'all encompassing' as they incorporate an ever widening array of multi-industry downstream/lateral /upstream participants in their schema (Martin and Sunley, 2003). The recurring criticism in the literature of many cluster theories is the often random and creative process inherent in defining the cluster's boundaries that has implications for replication, validity and reliability when reviewing cluster research.[19] Martin and Sunley (ibid, p31) highlight the difficulties with the cluster concept: "Ultimately, it seems that it is impossible to definitively support or reject clusters with empirical evidence, as there are so many ambiguities, identification problems, exceptions and extraneous factors".

This study seeks to overcome some of these issues and addresses an omission in the cluster literature: a lack of analysis of the internal elements of firms located in clusters.[20] Lawson and Lorenz (1999) posit that some forms of localised tacit knowledge are mapped onto firm routines, with practices driving a firm's innovativeness, adaptability, and productivity, an that access to tacit knowledge of nearby firms may also be an essential driver of agglomeration. These routines can only fully be explored through firm-level analysis, which the current cluster research appears to be bereft of, with the emphasis on external firm factors that are embedded in the local environment, and clusters generally treated as occurring and existing in isolation to many elements of their environment (ibid). The interactions between embedded local and firm-based factors such as skills, technology, and managerial practices are not addressed at all by current cluster research but are explored in this study.

2.10.2 Sector Specific Virtual Clusters

The concept of inter-organisational networks encompasses a plethora of definitions that are shaped by the vantage point of the author and encompass both spatial and virtual connectivity and communication. This study is aligned with Alter and Hage's (1993) definition of networks as

[17] http://ec.europa.eu/enterprise/enterprise_policy/analysis/doc/smes_observatory_2002_report3_en.pdf
[18] Martin and Sunley, 2003.
[19] Ibid.
[20] Niosi and Zhegu, 2005; Martin and Sunley, 2003.

'unbounded or bounded clusters of organisations that constitute a basic social form that permits inter-organisational interactions of exchange, concerted action and joint production', within which virtual clusters are explored. These can assist in the organisational exchange process through the mitigation of risk and uncertainty, and the sharing of resources and knowledge required to foster innovation and a competitive position, including through the development of strategic relationships and alliances (ibid). This study assesses the extent to which proximity cluster attributes are present in virtual clusters and their influence on the success of the participating firms. The ability to harness high capacity global ICT networks can be a key success factor, and one that also confers outsourcing capability which may encourage firms to replace in-cluster trading relationships with remote links, decreasing the benefits of cluster participation and reducing local cooperation.[21] Alternatively, ICT networks may allow firms located within and outside of a cluster to reach global customers and suppliers. In an increasingly internationalised milieu, as the notion of regional development continues to blur the boundaries between 'local' and 'distant', this study explores if this also reduces the distinction between a physical and virtual cluster.

2.10.3 Identifying Clusters

No uniform method of cluster identification exists, or for the measurement of boundaries (Martin and Sunley, 2003). Some researchers are critical of attempts to define clusters amongst a 'naturally dispersed' distribution of firms in the economy, citing the perceived inadequacy of any measurement method but acknowledge that certain sectors with a high dependence on 'new economic knowledge', such as industry and university R&D centres, technology parks, may benefit from co-location.[22] Studies of the biotechnology and aerospace sectors in the UK have identified 'hot spots' where firms are concentrated in 'clusters'.[23]

The starting point for this research is the acceptance that geographical concentrations of aerospace firms exist in the UK, based on a number of key information sources including the UK Standard Industrial Classification of Economic Activities (SIC) from the *Office of National Statistics* and the sector's leading national industry body, the *Society of British Aerospace Companies* (SBAC). In addition, well documented research has highlighted the establishment and existence of aerospace clusters for decades.[24] The cluster element of this study explores whether the benefits of co-location cited by cluster researchers are prevalent amongst the firms sampled across a number of key criteria including skills transfer and acquisition, outsourcing, and ICT sharing.

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[21] Cairncross, 2001.
[22] Rosenfeld, 2002.
[23] Beaudry et al; 2000.
[24] Beaudry, 2001.

2.11 'Flying High': Introducing the Aerospace Sector

This study targets firms within a number of aerospace clusters in UK, the world's second largest in terms of sector employment and revenues (Beaudry, 2001). The sector epitomises the 'local-global' paradox and is characterised by two diametrically opposed forces: industry consolidation to gain economies of scale (with high R&D spending occurring by the firms at the apex of the sector (primes)), and increasing competition from overseas firms coupled with many local firms reciprocating, including establishing their own offshore facilities (Beaudry, 2001). In addition, the sector is capital and ICT intensive with a strongly polarised supply chain that is dominated by a smaller number of primes that contract work either directly to smaller firms, or to other larger sub-contractors. This structure results in a high degree of sub-contracting and collaboration between the various levels of contractors (Beaudry, 2001) with many being technology and ICT-intensive and according to some researchers, benefiting from co-location (David and Rosenbloom, 1990). Other researchers have posited that in some circumstances, virtual networks are utilised in lieu or in conjunction with, a spatial presence (Bahrami, 1992). The limited literature on clustering within the sector highlights that the industrial district tradition of agglomeration encompasses a broad cross-section of firms, including very large firms and SMEs:

> Most large aerospace clusters thus consist of one or several OEMs surrounded by hundreds of small and medium-sized tier 4 suppliers of components and parts. In aerospace clusters, knowledge spillovers are technology based and centred on supply chain management linking the OEMs and their suppliers (Niosi and Zhegu, 2005; p12).

Figure 1 on the following page depicts this segmentation of firms. A cross-section of small, large and medium firms are included in this study, reflecting the tiers in this pyramid. SMEs are an important component of this study and represent the majority of participating firms in the UK aerospace sector.

The DTI's (2003; p15) project team on aerospace identified large variations in productivity across the firms in the sector, but this did not offer any explanation as to the possible cause for this, despite the need to improve firm performance in the sector being identified by the Government as a priority:

> In 2001, productivity of the UK Aerospace sector was 85 per cent of that of the US ....that many companies can improve performance is illustrated by the 20-40 per cent productivity improvement of SMEs...Industry needs to develop and deploy best practice processes in manufacturing and in project management.

Despite acknowledgement in the literature that many aerospace firms face moderate to low entry barriers and have the same access to ICT (Niosi and Zhegu, 2005), no research has occurred to assess the variability in their performance. Beaudry (2001; p428) states that, "previous research suggests some interesting dynamic properties in the emergence, growth and longevity of clusters, but these issues have received very little theoretical analysis in the economics literature to date." This study addresses this lacuna by exploring properties that may affect the performance of aerospace firms in clusters, including how they are managed and use ICT in complex product systems that reflect much of the sector.

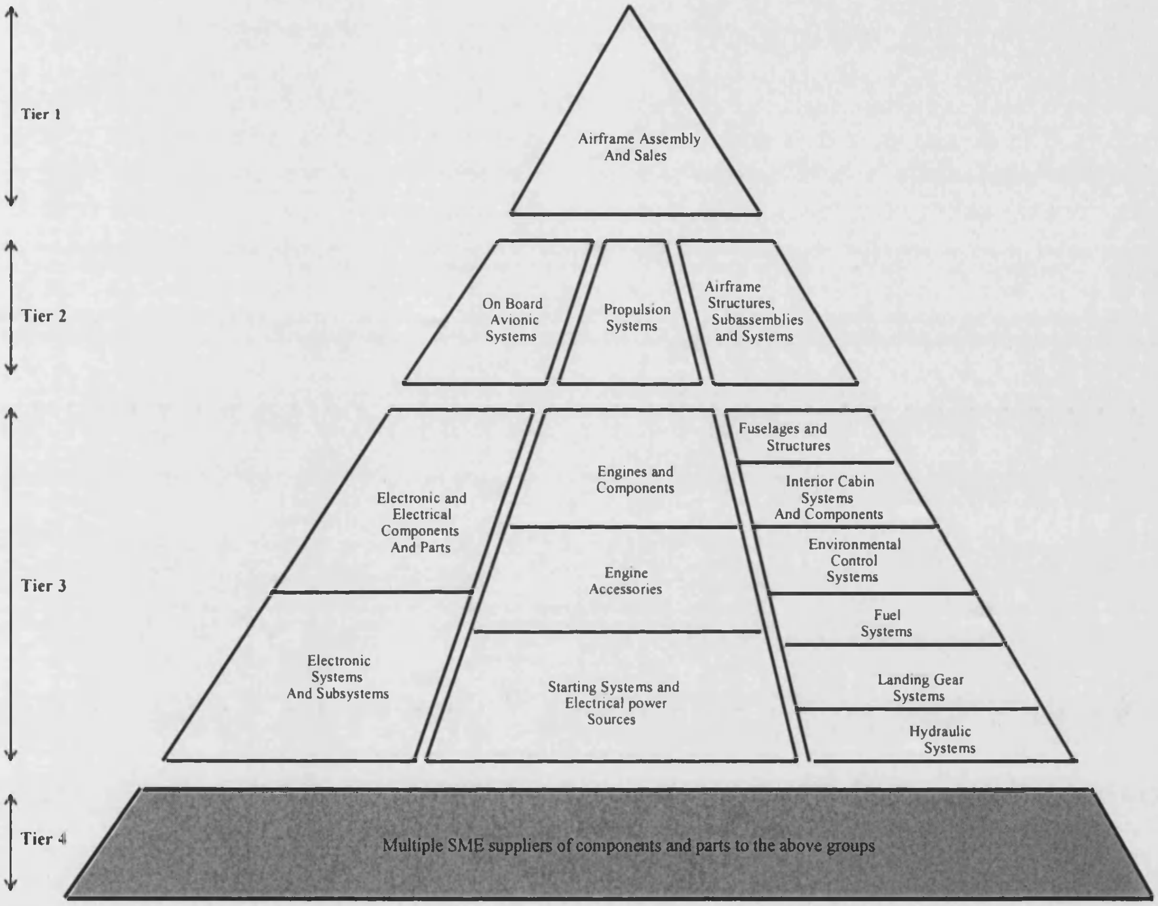

Figure 1: The aerospace producers pyramid (Source: Niosi and Zhegu, 2005)

2.12 Complex Products and Systems

The role of complex products and systems (CoPS) has gained prominence since the 1980's, reflecting the development of large item, customised, engineering-intensive goods which are seldom, if ever, mass produced (Hobday and Brady, 1998). Research into CoPS permits a better understanding of the innovation process, and the development and production of final products that exist in more complex production environments, including the use of technology and ICT. The notion is agnostic of sectors and is as applicable in aerospace as it is wherever complexity exists in the production process. An overview of CoPS is relevant for this study, for many of the firms explored utilise complex ecosystems that reflect the attributes of CoPS. Three major characteristics of CoPS distinguish them form other systems (ibid):

(1) They are made up of many interconnected, often customised, elements that include including control units, sub-systems and components. These are often structured in a hierarchical manner.

(2) They exhibit non-linear and continuously emerging properties, with minor changes in one part of the system often resulting in major alterations in other parts of the system.

(3) Often, a high degree of user involvement occurs in the innovation process, resulting in the requirements of the economic milieu affecting the innovation process directly, versus through the market as in a standard model.

A number of other attributes of CoPS highlight the dynamic interplay between actors:

- The existence of a higher number of customised, interconnected components with greater feedback between them.
- Emerging properties over time as the production systems respond to the economic environment and the innovation demands of large users.
- The presence of a high degree of precision and customisation in design and production.
- Products are most often used as intermediate goods by other large firms and are not for mass market consumers.
- Goods that are characterised by a bilateral oligopoly, with products often oriented to the needs of large sophisticated business users

The aerospace sector is replete with firms employing CoPS across many areas including wing manufacturing, fuselage production, avionics, wheel manufacture ring, engine design and build, and others. Other firms utilise CoPS to produce components for aerospace, but the sector represents only a proportion of their total business, including firms engaged in the production of rivets, plastics, wiring, fuel tanks, power units, lighting, and others. An example of CoPS is aircraft engine control systems, which also reflects a strong reliance on technology, including ICT, particularly through the evolution of systems from analogue to digital (Prencipe, 2000).

Management practices are not explicitly explored in CoPS literature, but some research has highlighted the benefits that accrue when alignment occurs between practices promoting innovation and efficiency on operations. This was the case in the development of the aerospace sector's wide chord fan blade that permitted major efficiencies for gas turbines by Rolls Royce, in a programme that commenced in the 1970's and spanned 15 years (Prencipe, 1997). A key success factor was the embedded belief in the Company that such a widechord blade provided this huge advantage (ibid;

p311). The role of its management played a pivotal role in pursuing this, as did the internal stock of technical knowledge. A complementary success factor highlighted by some of the literature on CoPS in aerospace is the capability of a firm to manage its ties with a network of suppliers (Prencipe, 2000). This study explores elements of this in the context of firms' relationships with their suppliers and customers both within and outside of their business cluster. Research in CoPS in aerospace posits that technological knowledge is 'localised', path-dependent in its development and context dependent (Prencipe, 1997). Work in this area in aerospace has shown little updating since the late 1990's, with this study bridging this gap by exploring some of the more recent trends in how firms interact with other firms and the degree to which this is localised. CoPS research in aerospace has put forward the view that firms with greater technological competence and resources retain core technical skills whist allocating some production to external parties, with Prencipe (ibid; p1275) stating that "although hiving off the production of components that constitute the outer core of the engine, Rolls-Royce holds a full design capability over them". This was supported by the results of this study, which discovered that a greater acceleration of outsourced production was occurring both by firms utilising CoPS and smaller firms than is currently reported in the literature, with the majority of firms agnostic of the interacting firms location.

The role of ICT in CoPS in aerospace has not been extensively researched, but limited work has revealed an increased uptake in ICT due to the continued reduction in the cost of computer processing power amongst firms both reliant on this, and those utilising it for communicative reasons (Hobday and Brady, 1998). The flight simulator industry has been identified as a key example of the former, with ICT ranked as the second highest change inducing factor since the 1950's, only behind regulatory factors promoting its accredited use in pilot training (ibid). Technology was a facilitator in this CoPS industry characterised by inter-relationships between multiple actors: "The supply infrastructure was made up of flight simulator integrators, large aircraft manufacturers and a chain of suppliers which produced flight simulator components, sub-systems, software and services...Over the decades, successive innovations were negotiated between the various actors resulting in new flights simulator markets and the exploitation of technological change" (ibid, p38). This enhanced use of ICT in CoPS aerospace complements operational efficiencies and facilitates the virtual connectivity of partners: "The application of digital pre-assembly to engine externals of the Trent 800 enabled the concurrent engineering by the Rolls-Royce and Boeing teams, although they were geographically separated." (Hobday and Brady, 1998; p315). The role of ICT and the migration to digitisation in firms utilising CoPS in aerospace is also being driven within firms, with firm-level managerial decisions affecting deep elements of the production process, as illustrated by market leaders in the turbine engine market: "Compared to the first-generation blade, the second-generation fan blade was a substantial technological improvement since it involved also a re-think and a re-organisation of the different phases (from design to manufacture) underlying the development of the fan blade" (ibid; p314). Although CoPS literature provides a relevant and deeper understanding of complex production environments including aerospace, it is bereft of the exploration of management practices, and mirrors the lacuna discovered in other fields such as information systems. This study bridges this divide, exploring and quantifying management practices in the CoPS intensive sector of aerospace.

2.13 Managerial Practices

> "Human factors are more likely to cause failure than hardware and software deficiencies."
>
> Howland, 2000

The literature lacks a concrete definition of management practices. This is largely due to the general use of the term and an absence of research that focuses on the notion as an influencer of firm activities and performance. This study's utilisation of the notion of management practices is congruent with a broader definition of the terms 'management' and 'practice'.

"Management"[25]: *the process of leading and directing all or part of an organisation through the deployment and manipulation of resources.*

"Practice"[26]: *the actual application of a plan or method, as opposed to the theories relating to it.*

The managerial practices utilised by this study reflect these definitions, with an emphasis on 'leading' within a manufacturing and technology-driven environment. The importance of management practices has not been adequately explored in IS literature, and is only touched upon in influential work by Knights and Murray (1994), who explored the introduction of information systems in the organisational setting. These authors posit that the use of IS in the organisation is a political process where the two sides of technology (those developing it versus those using it), continuously position and re-position themselves in order to maximise its chance of success, and to distance themselves from any failure. Managers are depicted as the protagonists of this process, who define many of the 'elements of power' in the organisation (ibid). A further social science perspective on the role of managers as influencers in the use of technology in the organisation comes from Knights and Willmott (1999), who posit that the labour process in a capitalist environment is the outcome of, and conditional upon, the efforts of workers and managers to organise their respective identities. This tension is explored in this study through an assessment of the relationship between the CEO and the IT manager, and the views of other employees on ICT and managerial decision making.

[25] en.wikipedia.org/wiki/Management
[26] http://www.askoxford.com/concise_oed/practice?view=uk

Betrtand and Schoar (2003; p1170) have attempted to quantify the effect of managerial decision making by tracking individual managers in firms over time in order to assess any possible effects on firm performance, asking: "How much do individual managers matter for firm behaviour and economic performance? Research in finance and economics so far has given little consideration to this question". These researchers concluded that, "...top executives vary considerably in their management styles....raising questions as to why managers may behave so differently in apparently similar economic environments." They discovered that firms achieving better performance were also better governed in general, with managers commensurately receiving higher compensation. These IS and productivity studies are in the minority of those addressing managerial behaviour in firms however and do not quantify the effects of these or undertake qualitative firm-level analysis, which this study undertakes.[27] The role of key decision makers is explored by some researchers, with the conclusion reached that the CEO plays a crucial role in driving the firm's direction, strategy, and setting 'acceptable practices' (Lefebvre et al, 1997). This this may lead to sub-optimal performance when family members fill such roles and enjoy 'amenity potential', and where primogeniture has been implemented, with succession for firm management defaulting to the oldest son (ibid). Some literature reports that in the case of inherited family firms, family ownership has a mixed effect on firm profitability, but that family management has a substantially negative effect.[28] This study assesses firm ownership and its effect on, and how it is affected by, managerial practices and ICT.

The link between managerial behaviour, technology and firm performance is explored by a minority of researchers that include by Bloom et al (2007) and Lefebvre et al (1997; p857).

> Different CEOs interpret the same external environment differently, and these different interpretations lead to the formulation and enactment of distinctive technology policies and to different innovative actions. These differences ultimately affect organisational performance.

A number of researchers define managerial practices that are *strategic* in nature and include business plans; vision statements; memos; technology plans; memos and presentations (ibid), whilst others highlight more *operational* practices.[29] Buhalis and Deimezi (2003; p319) are amongst the limited number of researchers who unite these two strands, concluding, "the main inhibitors for the exploitation of new technologies are lack of knowledge, poor management skills and qualifications for both entrepreneurs and employees." This study explores both of these aspects of managerial practices, assessing the effect of managerial practices including if employee qualifications affect ICT use and firm performance. Suitaris (2001) provides the most detailed assessment of the strategic factors posited to influence ICT adoption by SMEs, which are divided into two groups: (i) *corporate*

[27] Lefebvre et al, 1997; Suitaris, 2001.
[28] Bloom and Van Reenen, 2006.
[29] Suitaris, 2001.

practices that include budgeting, planning, decision making, and, (ii) *top-management characteristics* that include CEO background, management attitudes and perception of the environment. A number of these elements are assessed by this study. Currently, the research undertaken by Bloom et al (2005) utilises one of the only tools quantifying managerial practices and has proven to be a robust indicator of firm performance, with strong significant correlation occurring between these two variables in surveys conducted in over 5,000 firms.

The relationship between IT investment and firm performance is complex and multifaceted, and mediated amongst other factors by company strategy and managerial practices, with Van der Zee and De Jong (1999; p138) positing:

> Business success increasingly depends on the organization's ability to fuse the power of IT into the fabric of business processes and business networks. The continuously growing importance of IT requires organisations to integrate IT decisions within their common planning and decision-making processes at all organizations levels.

This study assesses these themes from both a strategic and operational perspective, including the role of ICT in communicating with suppliers, customers and employees; the degree of ICT literacy of the CEO; previous success with IT/ICT implementation, and others. This reflects the view expressed by Bloom et al (2005; p2) that practices are more than the attributes of senior managers in the firm, but instead are part of the organisational structure and its behaviour. The approach utilised by this study incorporates the work of the London School of Economics' Centre for Economic Performance (CEP) and global management consultancy McKinsey and Co into a single sector, fusing a managerial practices measurement tool with qualitative analysis, and assessing the conclusion reached by Bloom et al (ibid) that many firms are badly managed with ineffective monitoring, targets and incentives and that better managerial practices are significantly associated with higher productivity. The approach undertaken by these researchers utilised secondary data and telephone interviews but did not undertake any in situ investigations. Although contributing to the current deficit on quantifying managerial practices and providing a valuable proxy for firm performance, the absence of direct observations does not 'peel the organisational layer' to reveal the underlying reasons for the results, or explore the role of ICT in greater granularity. This lacuna presents an opportunity for further firm-level research to occur, focusing on the actual use of ICT and the factors affecting this, as well as those affected by it. Managerial practices are integral to this effort, and are assessed in this study alongside with ICT use and location. The interrelationship between these elements underpins this study, with the results both making a contribution to reducing the deficit in the current literature, in addition to identifying numerous avenues for additional research efforts.

3. Research Methodology

3.1 Problem Statement

Despite the ubiquity of ICT and software in many nations and the prevalence of government policies designed to ameliorate productivity impeding variables, evidence highlights disparities in productivity between firms in different countries and within the same country.[30] These policies include 'knowledge creation', 'best practices' ICT adoption and enhanced technology development via a number of modes including the encouragement of spatial and virtual proximity modes. Although research identifies business clusters as acting as catalysts for technology adoption and innovation, ICT-related elements are poorly addressed with current activities most often limited and inconclusive.[31] An assessment of ICT cannot occur in isolation however, and must be couched within the context of managerial practices, which affect multiple aspects of a firm's operation, including its location.[32] No research exists at the nexus of the themes of *managerial practices, ICT use* and *location*, which this study seeks to redress. This is indicated by the shaded area in figure 2 on the following page, which also depicts a number of the major contributors to the themes explored.

This study is ensconced within the ICT-intensive and geographically clustered sector of aerospace, with a number of research questions facilitating the investigation. Figure 2 also depicts the relevance of the literature on CoPS, reflecting the technology intensive capital goods evident in much of aerospace that underpin the provision of services and manufacturing capability in the sector (Ying-Teo and Khim-Teck, 2006). The author's previous experience working in the sector has contributed to the development of an approach that is believed to be both relevant and addresses the shortcomings in the current research. This is facilitated by the quantification of managerial practices in order to assess their possible effect on the firm's use of ICT, location and ultimately, productivity, and the author's participation as a researcher and interviewer in the significant global study of managerial practices of 5,000 firms undertaken by the CEP and McKinsey and Company in 2006-2007. This study utilises a questionnaire developed by the latter that codifies management practices in a manufacturing and production environment, and was used for the first time in the collaborative arrangement with the CEP. This tool is currently unique in quantifying managerial practices and assessing their potential influence on firm performance, and in the scale of the effort which includes over 5,000 firms.

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[30] Bloom et al, 2005.
[31] Liebenau, 2000.
[32] Bloom et al, 2005.

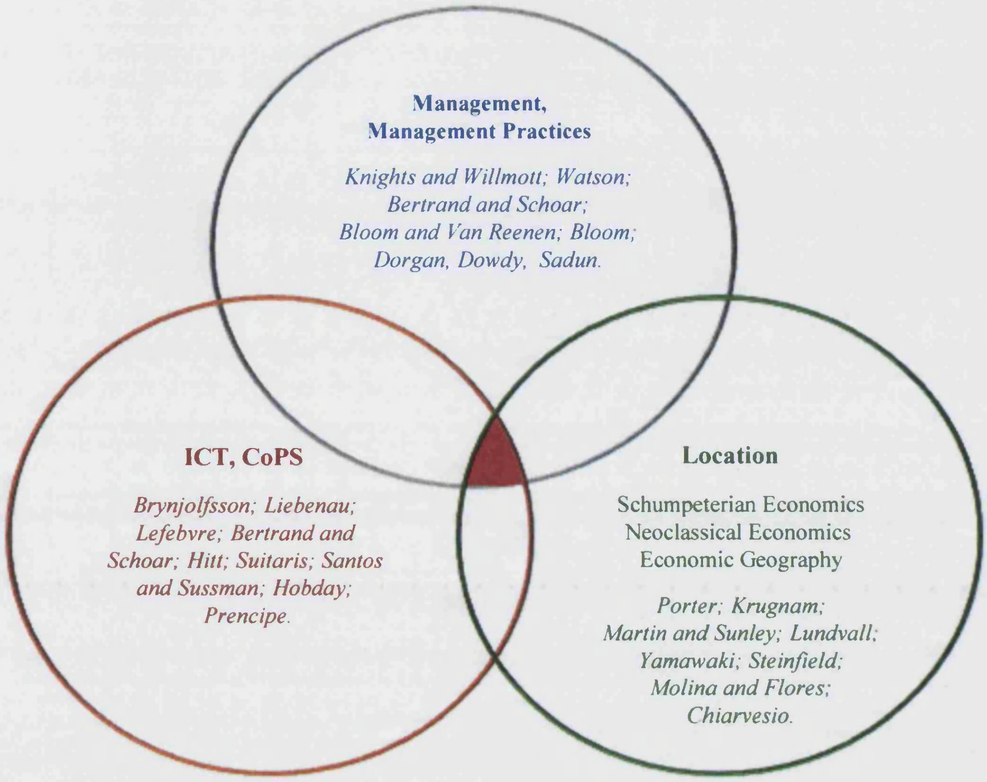


Figure 2: The study's research map

Extensive literature review occurred in addition to discussions with a number of experts in relevant functions such as statistics, economics and information systems at the LSE and elsewhere to assess if a methodology existed that could quantify management practices, and if this could be used to predict firm performance. No corresponding tool was discovered however that offered even the quantification of managerial practices. The management and information systems discipline offered numerous examples of questionnaires developed to test specific hypotheses in the firm, but none of these quantified managerial practices and did not displace the use of the CEP-McKinsey methodology. The ability to attach a value to management practices and assess their possible influence on firm performance and ICT was noticeably absent from the literature, with the exception of this methodology, resulting in it being embedded within this study's conceptual framework. It was subsequently utilised both in its originally intended 'at a distance' form administered by telephone, concomitant to its use 'up close' in firm-level investigations that complemented additional investigative assessment tools drawn from IS/ICT and location literature. The consolidation of these elements into one conceptual framework yields a more holistic approach to the investigation of the study's problem statements, drawing on both qualitative and quantitative disciplines and positioning the firm at the centre of an iterative exploratory process that delves below its 'surface layers'.

3.2 Schema and Conceptual Framework

3.2.1 Schema

The conceptual framework utilised by this study clearly establishes both its *boundaries* and its *depth*. An interdisciplinary approach has been utilised, incorporating elements from IS, economics and management, whilst adhering to the notion that "field experimentation should always include qualitative research to describe and illuminate the context and conditions under which research is conducted" (Cook and Campbell, 1979; p93). Multiple investigative streams provide a clear depiction of tasks, resulting in the synthesis of more structured research that is underpinned by the utilisation of both qualitative and quantitative modes. This research progresses through three stages that incorporate both a qualitative and quantitative approach applied to a sample of 23 firms in the highly clustered aerospace sector in the UK, and which are shaped by the overarching theme of the effect of managerial practices on ICT-driven productivity.

The investigative process commences with an initial 'at a distance' stage involving the use of both narrower and more open-ended questionnaires administered via the telephone in order to assess the firm's managerial practices, ICT use and managerial views on location. This occurs with one individual with production responsibility, or comparable such as the CEO, and an IT manager where possible, utilising the relevant questionnaires and guides for each, including the CEP-McKinsey survey. The information acquired provides a reference point for further exploration in the second stage, which occurs in-situ through firm visits. The initial managerial practices survey is replicated with either another individual with production responsibility, or a cross section of individuals where available, including a senior production manager, a supervisor, and a shop floor worker. In a minority of cases, the manager originally interviewed is re-interviewed. Additional ICT information is also collected at this time or in some cases is obtained for the first time. The final stage of the study consolidates the information and undertakes analysis to explore the key themes of the study through a number of hypotheses that draw on the data and observations. A more detailed description of key elements inherent in these stages follows the conceptual framework in figure 3.

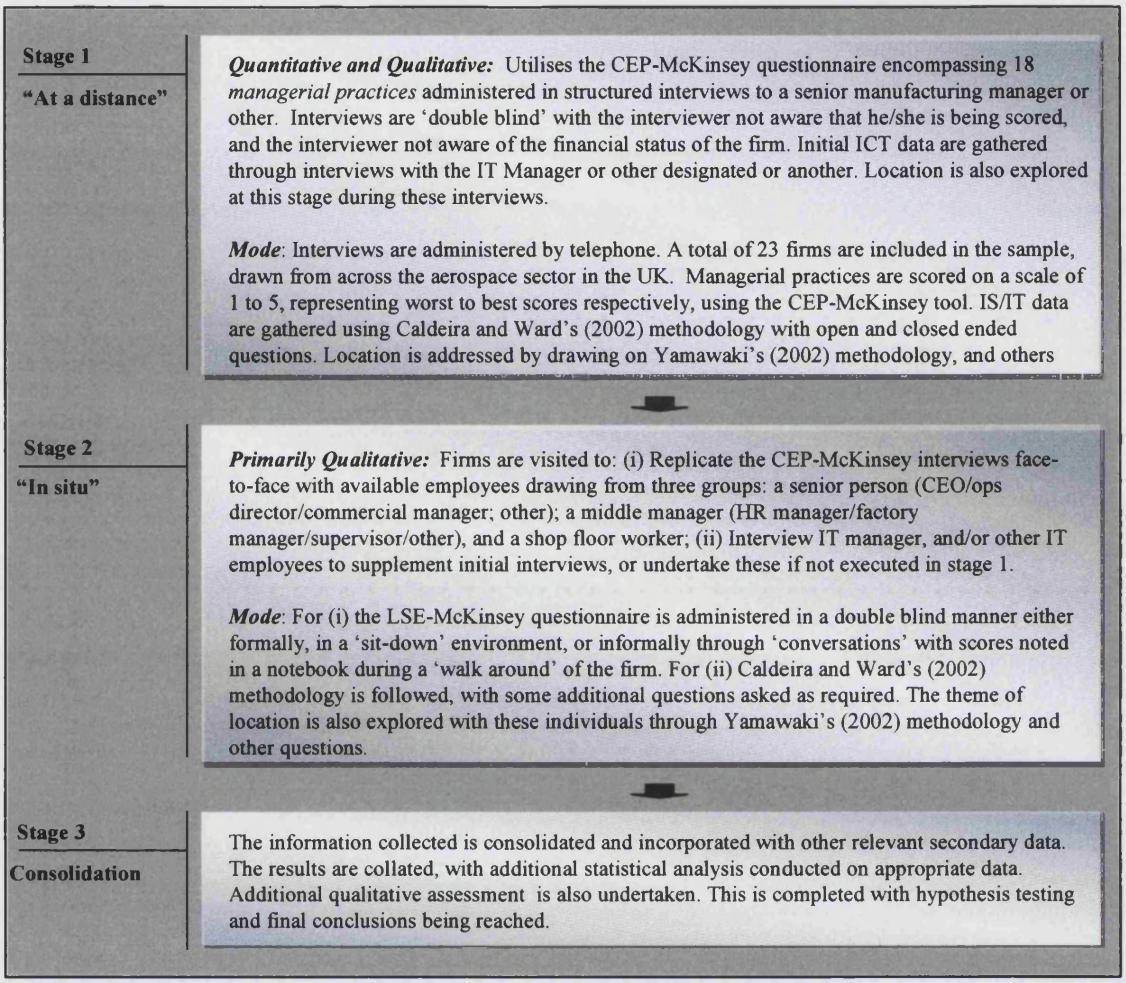


Figure 3: The study's investigative schema

The initial two stages capture the information required on management practices, ICT and location. The second stage draws on additional research to structure an approach that extracts information for the latter two themes, before all of the information is analysed and consolidated in the third stage. The investigative schema for the study is ensconced within a conceptual framework that provides its overall guidance and context.

3.2.2 Conceptual Framework

The study's schema is embedded in the conceptual framework presented in figure 4 which facilitates the assessment of managerial practices in both physical and virtual business clusters as possible influencers on ICT-driven productivity. This framework also establishes the parameters for the exploration of a number of hypotheses, depicted by "Hx", which are defined in section four.

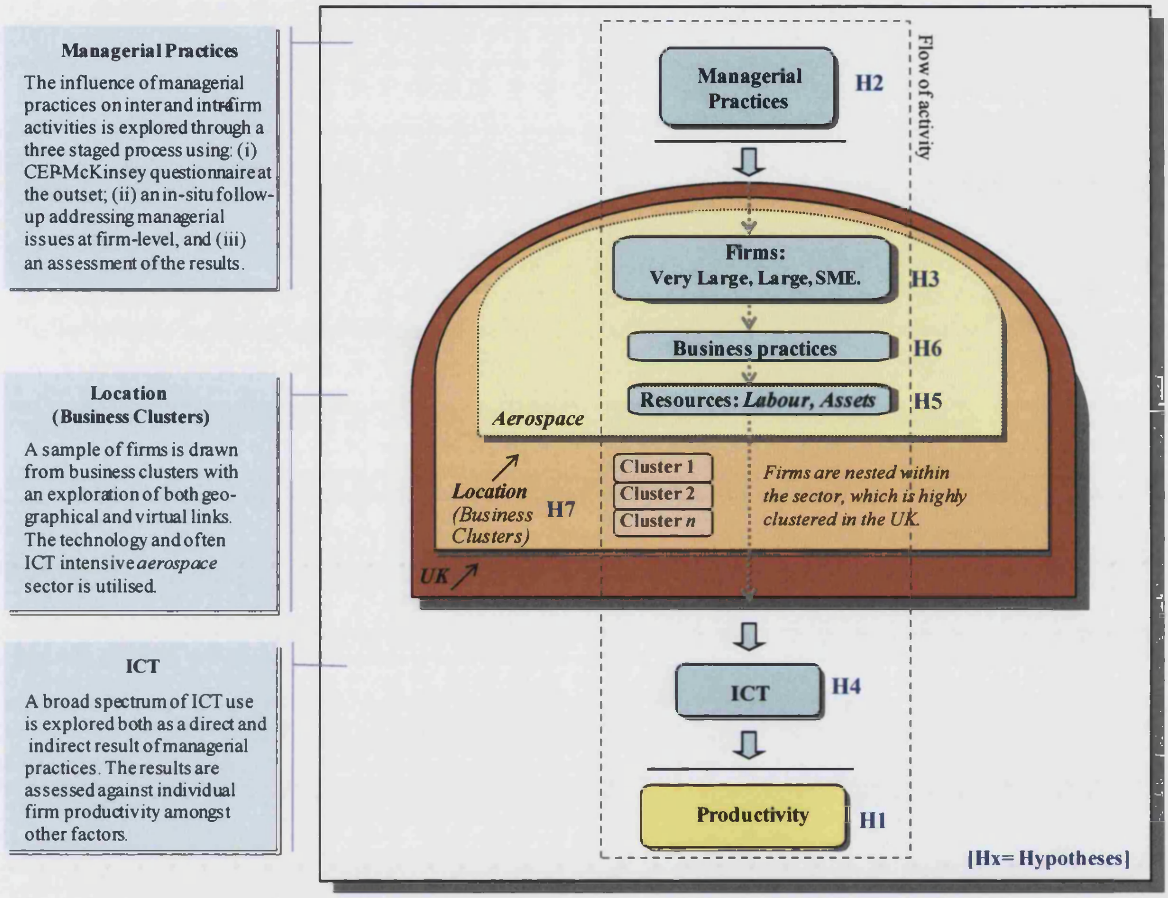


Figure 4: Conceptual framework

The methodology utilised to explore each of the three principal themes of managerial practices, location and ICT within this conceptual framework is presented below.

3.2.2.1 Managerial Practices

3.2.2.1.1 Influencing Activities

The exploration of managerial practices is one of the three anchor themes of the conceptual framework. A lack of relevant theoretical material on the subject can in part be attributed to the ubiquitous use of the concept as a 'heading', which is bereft of specificity. This contrasts with the superfluity of material on productivity, which overwhelmingly seeks to explain efficiency differentials by quantifying inputs (Bloom et al, 2005). Recently however, a bridge has begun to be constructed between disciplines, led by contributions from Brynjolfsson (1998) and Bertrand and Schoar (2003) who were influenced by the earlier work of Mundlak. A reliance on the work of Solow (1956) has only recently begun to give way to attempts to quantify the 'unexplained residual' for growth that is not captured by factor inputs such as capital and labour, and shift the dominant Schumpeterian neoclassical focus to one where the actors are the firm's managers (Bertrand and Schoar, 2003). A number of qualitative and reflexive theoretical perspectives on 'managing' also emerged in the 1990's characterised by contributions from Watson (1994), Watson and Harris (1999), Knights and Millmott (1999) who viewed managing as an embodied activity nested in a social context. This study is congruent with such a viewpoint, with managerial practices assessed as influencers on intra and inter-firm interactions and ICT use, in a clustered milieu in which the sample firms operate.

3.2.2.1.2 Defining and Measuring Managerial Practices

The conceptual framework utilises a two-stage investigative process on a sample of 23 aerospace firms in the UK. In the first stage, this occurs remotely and draws on multiple disciplines including economics, management and information systems, with the CEP-McKinsey tool pivotal to the quantification of managerial practices, supplemented by additional modes that collect information on location and ICT. These are also explored in the second in-situ stage of the investigation. Despite Taylor's seminal work in attempting to inject 'science' into organisational task-driven activities at the turn of the century, no clearly accepted definition of managerial practices has emerged. Much of the subsequent work has been qualitative with the quantification of managerial practices lacking exploration, due to a large degree to the absence of an appropriate methodology. One of the few attributes of 'management practices' evident in managerial literature is *decision making,* with this presented as 'something that managers do.' [33] This characteristic is reflected in this study's framework, which both measures and observes managerial behaviour and actions by firm managers and their employees in order to explore the premise that managers are still in control of the distributed decision making process and are responsible for its conclusions. This theme is also prevalent in the recent research on management practices by Bloom et al (2005) who posit that ultimately it is the decisions and actions of managers that affect their firm's performance. The methodology makes a contribution by reducing the divide between the theoretical exploration of managerial theory as championed by Mintzberg and econometric research that utilises firm level-data via questionnaires administered remotely, as undertaken by CEP-McKinsey.

3.2.2.1.3 The CEP-McKinsey Management Practices Tool

The CEP-McKinsey tool was used to quantify management practices at both the initial at-a-distance stage of this study and in the follow-up in-situ stage. As outlined in section 3.1, this methodology was the only one available option that quantified managerial practices and was adopted for use by this

[33] Knights and Willmott, 1999; Watson 1994; Watson and Harris, 1999.

study. Developed by global consultancy McKinsey and Company over a number of years, the tool was implemented by the LSE in collaboration with McKinsey. A second defining feature of the methodology is the correlation between the results and firm performance. The methodology targets manufacturing firms and was developed for a production environment, although it is currently being adapted for use in services. The robustness of the methodology has been confirmed with its use in two major studies, with the first of these completed in 2005 encompassing 750 firms in a limited number of countries. This was expanded to over 5,000 firms in 10 countries in a second study commencing in 2006. These firms were drawn randomly from a number of databases, with interviews conducted by MBA/Masters students recruited and trained jointly in the use of the methodology by the CEP and McKinsey. In order to ensure unbiased responses and to mitigate the probability that the subjects will provide what they believe is the correct answer, a 'double blind' approach is utilised. The subjects are not informed they are being scored, and the interviewer does not have knowledge of the financial status of the companies being interviewed. Interviewers contact each company from their list of prospects and where successful, establish a time to interview the most appropriate person managing the manufacturing process at the plant. The interviews are subsequently conducted at the designated time agreed with the manager.

The interview progresses through 18 management practices widely utilised by industrial firms, with these grouped into four sections: *operations, monitoring, targets* and *incentives*. The operations section focuses on the introduction of lean manufacturing techniques, how well processes are documented, improved, and why they were introduced. The monitoring section focuses on how an individual's performance is tracked and reviewed, including consequence management. These are followed by a targets section, which assesses the nature of the firm's financial and production targets, how realistic these are, whether they are transparent to others in the firm, and whether they are interconnected. The final section assesses the firm's incentives with a number of practices measured, including promotion criteria, remuneration and bonuses, and the firm's approach to poor performers. Additional firm-level indicators are also captured before the termination of the interview encompassing organisational levels, unionisation, the education of managers and non-managers, and others. These are utilised for further comparative purpose but do not form part of the scoring for the managerial practices. Each of the managerial practices comprises a single question which is individually scored by the interviewer. The questions are administered via a PC, permitting the interviewer to navigate around them and be guided through the process whilst remaining free to concentrate on listening to the subject and scoring them on-screen. Each practice is scored on a scale of 1 to 5, with 1 denoting attributes associated with poorer practice, and 5 denoting attributes associated with the best practices. A four-stepped process has been developed to aid the interviewer in scoring the responses, with a note appearing at the top of each interview page to remind the interviewer that any score is permissible. Table 1 depicts two of the management practices assessed, including the sub-questions that assist in the maximising the scoring accuracy. Appendix A presents the full 18 management practices measured.

Any score from 1 to 5 can be given, but the scoring guide and examples are only provided for scores of 1, 3 and 5. Multiple questions are used for each dimension to improve scoring accuracy.

	Score 1	Score 3	Score 5
(1) Modern manufacturing, introduction	a) Can you describe the production process for me? b) What kinds of lean (modern) manufacturing processes have you introduced? Can you give me specific examples? c) How do you manage inventory levels? What is done to balance the line?		
Scoring grid:	Other than Just-In-Time (JIT) delivery from suppliers few modern manufacturing techniques have been introduced, (or have been introduced in an ad-hoc manner)	Some aspects of modern manufacturing techniques have been introduced, through informal/isolated change programs	All major aspects of modern manufacturing have been introduced (Just-In-Time, autonomation, flexible manpower, support systems, attitudes and behaviour) in a formal way
Examples:	A UK firm orders in bulk and stores the material on average 6 months before use. The business focuses on quality and not reduction of lead-time or costs. Absolutely no modern manufacturing techniques had been introduced.	A supplier to the army is undergoing a full lean transformation. For 20 years, the company was a specialty supplier to the army, but now they have had to identify other competencies forcing them to compete with lean manufacturers. They have begun adopting specific lean techniques and plan to use full lean by the end of next year.	A US firm has formally introduced all major elements of modern production. It reconfigured the factory floor based on value stream mapping and 5-S principles, broke production into cells, eliminated stockrooms, implemented Kanban, and adopted Takt time analyses to organize workflow [these are all forms of lean/modern manufacturing techniques].
(2) Modern manufacturing, rationale	a) Can you take through the rationale to introduce these processes? b) What factors led to the adoption of these lean (modern) management practices?		
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Modern manufacturing techniques were introduced because others were using them.	Modern manufacturing techniques were introduced to reduce costs	Modern manufacturing techniques were introduced to enable us to meet our business objectives (including costs)
Examples:	A German firm introduced modern techniques because all its competitors were using these techniques. The business decision had been taken to imitate the competition.	A French firm introduced modern manufacturing methods primarily to reduce costs.	A US firm implemented lean techniques because the COO had worked with them before and knew that they would enable the business to reduce costs, competing with cheaper imports through improved quality, flexible production, greater innovation and JIT delivery.

Table 1: Example of CEP-McKinsey managerial practices, including scoring guide

The table illustrates the four stepped process utilised by the interviewer in scoring a practice:

(i) The practice being investigated appears in a numbered sequential manner.

(ii) A number of individual sub-questions appear beneath each practice to assist the interviewer in providing the appropriate score.

(iii) As the subject answers each question, the interviewer utilises a scoring grid beneath each series of sub-questions populated with three score headings of "1", "3" and "5". Each of these contains a definition of the practice corresponding to the score which the interviewer can utilise as a guide. The interviewer can provide any score between these points.

(iv) An example of a response that corresponds to the definition in the scoring grid above it represents the final element guiding the interviewer. This is designed to place the corresponding score and definition into a practical context to further aid the interviewer in providing the most accurate score.

The interview questions are deliberately open-ended to avoid being leading. This ensures minimal bias and the most objective response being provided by the subject. The interviewer can continue to ask additional questions as the interview progresses, drawing upon the training the interviewer has received, ensuring these are as open-ended as possible. This process continues until the interviewer believes that an accurate score has been obtained for the practice being assessed. The attributes denoting best and worst practices have been developed by McKinsey through the Firm's extensive operational consulting and research experience and were tested at length prior to their inclusion in the study. A key strength of the methodology is the correlation of scores with firm performance, which was confirmed before both studies occurred. The CEP-McKinsey methodology is currently a unique approach to quantifying the relationship between managerial practices and firm performance which makes it directly relevant for inclusion in this study. No other comparable methodology was identified.

Following the acquisition of 18 scores for each firm, an average score is calculated. All firm scores are anonymised with a number of average scores obtained in order to permit comparisons across sectors, firm types, countries and others. Before the author or any other participant was permitted to undertake any interviews, joint training was provided in the use of the tool by the CEP and McKinsey in 2006 in intensive workshops extending over a two week period. This was followed by a supervised practice phase at the initial stage of the 5,000 firm study across 10 countries. Satisfactory performance during this period resulted in unsupervised telephone interviews being conducted for this study. The use of this methodology as an additional empirical toolkit in the conceptual framework of this study permits a more granular understanding of the interplay between the actions of organisational actors, including their roles and influences, and the potential mediation of productivity through ICT. The correlation between scores and firm performance was verified during the two major studies, reinforcing the methodology's role as a valid measurement device for this study. Scores obtained from the 23 firms facilitate the comparison of individual management practices between firms, in addition to providing an overall comparison of firms through their average scores. Additional statistical analysis is undertaken, coupled with a review of the qualitative information obtained in order to assess the possible role of other variables on firm performance such as ICT. This analysis is ensconced within a broader investigation of location.

The majority of interviews took place during 2006. The initial telephone interviews were followed-up with further on-site visits and interviews with these generally occurring within 3 months of the original interview. As such, the study is not longitudinal and does not assess the management practices in each firm over time, but rather, is a 'snapshot' of these and ICT use at a particular point. This approach is congruent with the CEP-McKinsey methodology that measures management practices within the firm at a single point. This study differs from the CEP-McKinsey approach however with the inclusion of additional interview points for the majority of firms including via an in situ stage, and the incorporation of a granular ICT assessment.

3.2.2.1.4 From Remote to In Situ

The theoretical model seeks to address the overarching question of whether managerial practices affect ICT-driven productivity in business clusters. The integrated approach defined by the conceptual framework accomplishes this objective at a number of levels as depicted in figure 4. First, the initial stage of empirical investigation assesses the firms' managerial practices 'at a distance' utilising the CEP-McKinsey questionnaire administered to a production manager in the main. During this time, additional information related to firm location is also gathered, utilising the methodology from a number of sources including Yamawaki (2000) and Liao and Hong (2007). Second, a telephone interview occurs during this remote-stage with the firms IT manager in order to gather ICT information including ICT-centric practices and related issues utilising a methodology drawn on the IS discipline and the work of Caldeira and Ward (2003), who assessed how IS and ICT was utilised within the firm, building on Pettigrew's work. Third, the in situ stage occurs with a visit to these firms, during which time a number of data gathering exercises occur:

(i) Replication of the initial CEP-McKinsey interview occurs with either an individual or a tier of individuals encompassing the CEO and/or the production manager, a supervisor, HR manager, and where possible, a shop floor worker. It is not possible to replicate the same group of individuals across firms due to a number of factors including the size of the firm; number of employees; organisational levels; commitments, etc. *Interview mode:* During firm visits, interviews are undertaken on a structured basis, with these adhering to the criteria that managers are not aware they are being scored, and that the interviewer is not aware of details regarding the firm's financial position. In the case of interviews conducted 'on the shop floor', where appropriate, these are undertaken on a conversational informal basis. Familiarity with the 18 practices permits these to be recited without the aid of other material, with only a notepad utilised for scoring.

(ii) Where possible, an extension of the initial ICT discussion occurs with the IT manager, or where this individual was not available remotely during the first stage of data collection, this occurs for the first time face-to-face. During this time, a review of ICT occurs, with interviews undertaken with other IT staff and additional users of ICT where these are available. *Interview mode:* Interviews are conducted in both a structured and unstructured format with both open and closed-ended questions, utilising the Caldeira and Ward (2003) framework and supplemented by additional questions defined for the study.

Firm visits varied from half a day to a number of days and were determined by the complexity of the firm's operations; the access obtained; logistical considerations; the demands placed on the author by the participants, and other factors. In some cases, firms were known to the author, which also affected the time allocated for visits. Fourth, following data collection, key financial results were obtained for each firm encompassing its most recent P&L and balance sheet. The final step utilised the conceptual framework to unify these elements providing depth and breadth, facilitating an empirical investigation of the effects of managerial practices on ICT-driven productivity. Figure 5 depicts the methodology utilised to undertake the data collection.

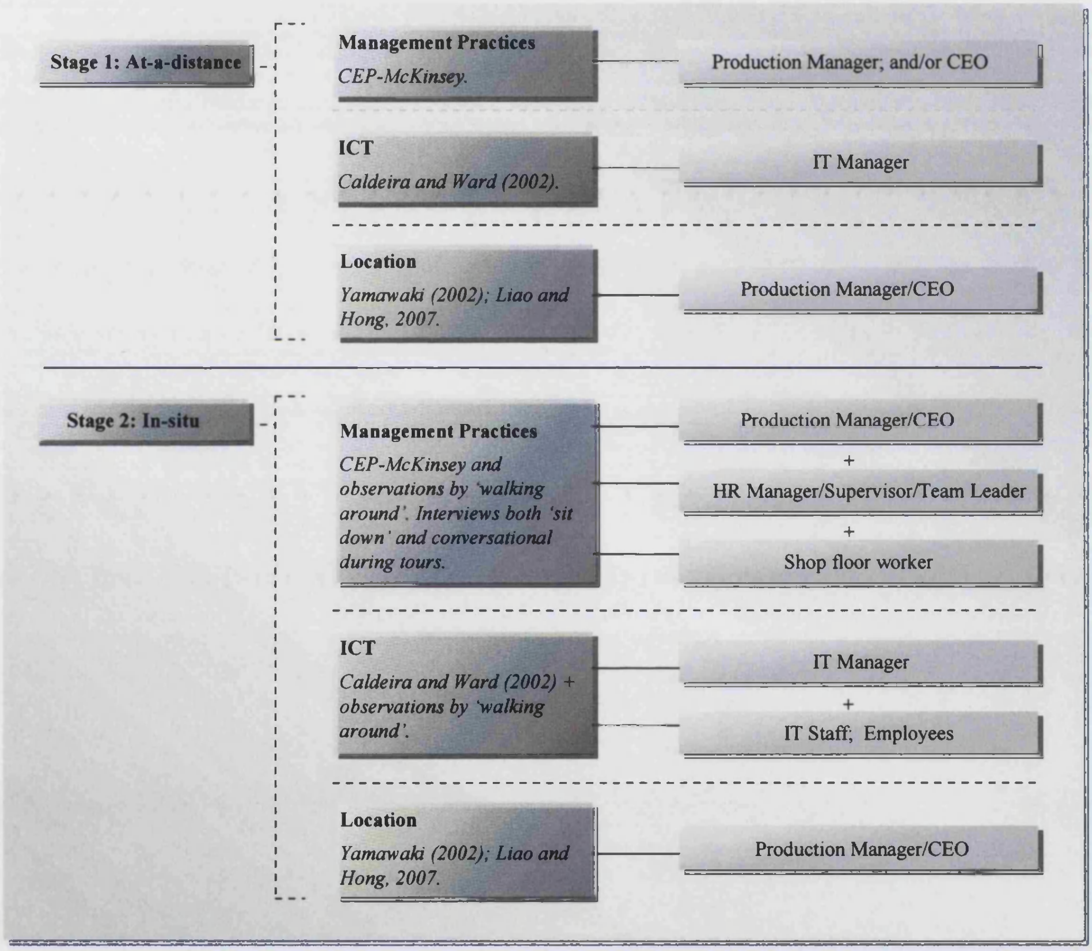


Figure 5: Data collection methodology- stage one and two approach and subjects

3.2.2.2 Business Clusters, the Sector and the Firm: Setting the Context for Investigation

The conceptual framework assesses firms as embedded units in a dynamic environment using a cascading filter:

[Select Country] *UK* → [Select Sector] *Aerospace* → [Select Region] Clusters → *West; East; North West, etc;* → [Select Firm Type] Very large/Large/SME→ [Select Firm] e.g. *"Very large 15"*; *"SME 07"*.

Three types of firm have been defined for this study: SME, large and very large firms, with section 3.3.1.3 depicting this in greater detail. These firms are located at the centre of the conceptual framework and are ensconced in the aerospace sector, which is highly clustered and polarised with a large number of SMEs dominating the supply chain at lower levels in particular (Niosi and Zhegu, 2005).

3.2.2.2.1 UK Aerospace Clusters

The UK aerospace sector is comprised of around 8,000 firms employing 124,000 people directly and 152,000 indirectly.[34] The sector displays a high degree of clustering, with firms geographically concentrated within regions.[35] Chart 1 depicts the distribution of the major UK aerospace clusters as collated by the sector's national industry body, the *Society of British Aerospace Companies* (SBAC).

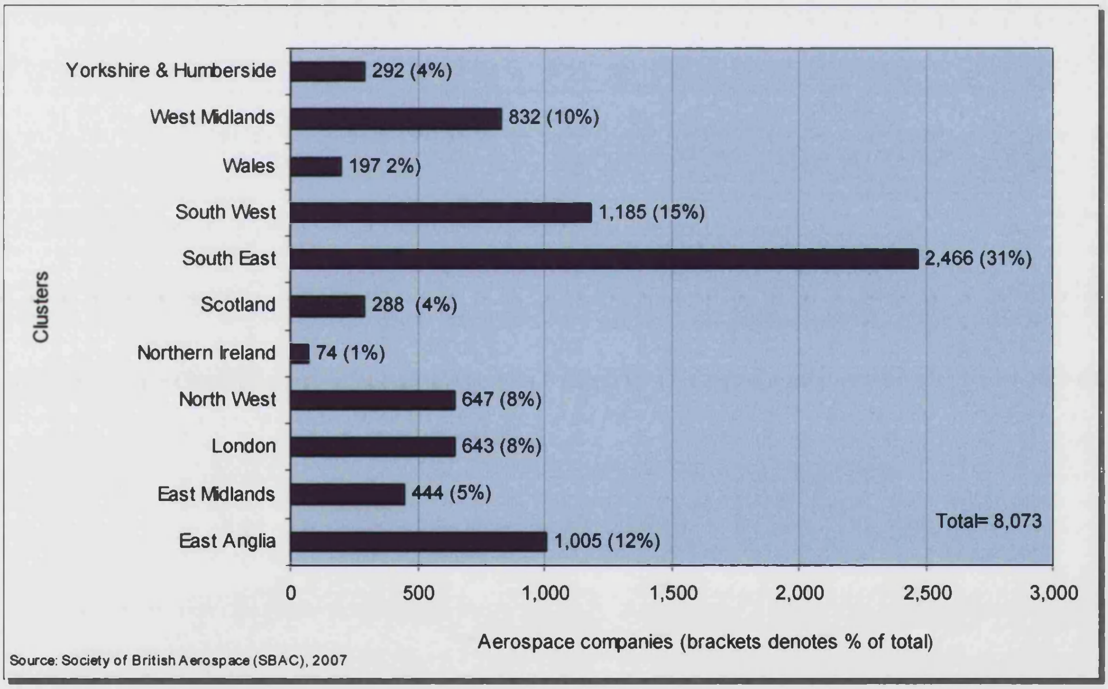


Chart 1: UK Aerospace clusters

The South East cluster contains the largest number of firms, with almost one third of UK aerospace companies located in this region. This represents over twice the number of firms located in the South West cluster (15 per cent), which is marginally larger than the East Anglia cluster (12 per cent). The next highest concentration of firms is located in the West Midlands cluster (10 per cent), with London and the North West each accounting for 8 per cent of the UK's aerospace companies. East

34 http://www.lancashire.gov.uk/office_of_the_chief_executive/lancashireprofile/sectors/aero.asp?sysredir=y
35 House of Commons, 2005.

Midlands, Yorkshire and Humberside and Scotland contain half this number of firms, whilst Wales and Northern Ireland account for 2 per cent and 1 per cent of the UK's aerospace firms respectively. This study explores the principal view prevalent amongst many researchers that firms locate in clusters in order to obtain benefits from agglomeration (Porter, 1990).

3.2.2.2.2 Firm Activities

The sample firms were all engaged in aerospace as their primary business, with the majority undertaking work exclusively within the sector. Around half of the sample undertook more than one activity, as defined by their standard industry classification code (SIC). Table 2 presents the SIC codes defining the firms' activities, segmented by firm type:

Firm Type	SIC Code	SIC Code Description
SME	2811	Manufacture of metal structures & parts
	2852	General mechanical engineering
	2874	Manufacture of fastener screw chain
	3002	Manufacture of computers
	3162	Manufacture of other electrical equipment
	3530	Manufacture of aircraft & spacecraft
	3663	Other manufacturing not elsewhere classified
Large	2524	Manufacture of engines & turbines
	2852	General mechanical engineering
	3210	Manufacture of electronic valve & tubes
	3530	Manufacture of aircraft & spacecraft
	3663	Other manufacturing not elsewhere classified
	4525	Other construction
Very Large	2852	General mechanical engineering
	2911	Manufacture of engines & turbines
	3162	Manufacture of other electrical equipment
	3530	Manufacture of aircraft & spacecraft
	5118	General mechanical engineering
	7522	Defence activities

Table 2: Aerospace activities by SIC code for each firm type

The activities span the spectrum of aerospace production encompassing parts and components, electrical and mechanical systems, significant portions of aircraft assembly, and others.

3.2.2.2.3 Ownership

A total of 23 firms were selected for the sample. These represent four ownership categories:

- *Publicly listed entities:* The firm's shares are listed on a stock exchange.
- *Independent- non-family owned*: The firm is owned by shareholders who do not have a family connection to the firm.
- *Independent- family-owned*: The majority of the firm's shares are owned by a family.
- *Independent- primogeniture:* The firm is owned by a family with "an exclusive right of inheritance belonging to the eldest son" [36] who is placed in control of the business.

The effect of the last firm type of ownership on performance is explored in only a limited number of studies.[37] This study offers a minor contribution to this deficit due to only two primogeniture firms being represented in the sample. Table 3 summarises the distribution of firms by ownership type including a summary of acquisition activity over the past 10 years.

Firm-Type	Public Company	Independent: *Non family owned*	Independent: *Family Owned*	Independent: *Primogeniture*	Acquired in past 10 years	Acquired in past 5 years
Very Large	5 (100%)	-	-	-	-	-
Large	7 (70%)	1 (10%)	1 (10%)	1 (10%)	5 (50%)	5 (50%)
SME	3 (37%)	3 (37%)	1 (12%)	1 (12%)	4 (50%)	3 (37%)
Total Sample	15 (65%)	4 (17%)	2 (9%)	2 (9%)	8 (35%)	7 (30%)

Table 3: Firm ownership summary[38]

All very large firms were publicly listed entities. This contrasts large firms and SMEs, with 70 per cent and 37 per cent respectively of these firms being publicly listed or with a proportion of shares being owned by firms that were. The next largest category of ownership was independent family owned firms, with 10 per cent and 37 per cent of large firms and SMEs belonging to this category respectively (17 per cent of the sample). An equal proportion of firms were divided between the final two categories of independent family owned and primogeniture firms (9 per cent). Half of large firms and SMEs had changed ownership within the past 10 years, with this activity occurring more recently for large firms, primarily during the past five years. Table 4 depicts ownership by firm type.

[36] http://www.merriam-webster.com/dictionary/primogeniture
[37] Bennedsen et al, 2007; Bloom et al, 2006a.
[38] The figures in brackets represent the proportion of the ownership category accounted for by the firm type e.g. '5(100)' indicates that five very large firms were public companies and accounted for 100 per cent of the firms in this category.

Firm Type	Public Company	Independent: *Non family owned*	Independent: *Family Owned*	Independent: *Primogeniture*
SME 06				Yes
SME 08	Yes			
SME 09		Yes		
SME 10		Yes		
SME 12	Yes			
SME 13			Yes	
SME 14		Yes		
SME 17	Yes			
Large 02		Yes		
Large 03	Yes			
Large 05	Yes			
Large 11			Yes	
Large 15	Yes			
Large 16	Yes			
Large 18	Yes			
Large 19	Yes			
Large 20				Yes
Large 21	Yes			
Very Large 01	Yes			
Very Large 04	Yes			
Very Large 07	Yes			
Very Large 22	Yes			
Very Large 23	Yes			

Table 4: Ownership category by firm

3.2.2.2.4 Firm Selection and Location

Twenty three aerospace firms were included in the study, drawn from seven UK clusters. An effort was made for the sample firms to reflect the geographic distribution of UK aerospace firms to a degree, with the final composition defined by familiarity with some firms based on previous employment in the sector, logistical considerations, accessibility, cost, and negotiating appropriate access. It was recognised at the outset of this study that the exact replication of the distribution of UK aerospace firms was not likely to be possible, but this is not believed to hinder the exploration of the major themes in this study encompassing a cross-section of UK aerospace clusters. Before the commencement of the data gathering stage, a project feasibility was undertaken, which estimated that around 20 firms could be managed logistically for this study , with this number also likely to permit subsequent detailed data analysis and assessment. This sample size was also influenced by a requirement to generalise the results, which negated the use of an even smaller sample. The study was not intended to be an 'anthropological' assessment which negated the use of only a small number of firms being assessed over an extended period of time.

The second stage of the firm selection process involved the identification of the UK's aerospace clusters. This drew upon the author's industry experience, in addition to consulting with the UK's largest and national industry body (SBAC), to which the majority of major UK aerospace companies belonged. Following the identification of the UK's 11 major aerospace clusters, 10 initial firms were mapped onto these. These firms were known to the author through previous professional experience in the sector and became the initial sample participants. No effort was made at that stage to obtain information on the firm's performance before the interviews could be concluded (to ensure a blind approach to the firm's results). The firms selected were located in around half of the 7 eventual clusters to be assessed, with a higher proportion of the 10 firms represented by large and very large firms at that initial stage. This was balanced with the addition of SMEs and other large firms in the next stage of selection. These initial 10 firms were believed to be representative of the UK sector due to a number of factors:

- The mix of firms reflected a cross-section of those existing throughout the UK aerospace supply chain including primes, the largest firms in the sector and those that generally commission the majority of downstream supplier activities, and smaller and mid sized firms. Many of these in turn sub-contract work to other firms in the supply chain.

- SIC codes were extracted from a random sample of over 50 SBAC members distributed throughout the UK irrespective of size, in addition to randomly selected SIC codes for another 50 aerospace firms selected from the Amadeus database, which contains information on all UK businesses and the activities they are engaged in. Due to the thousands of firms engaged in general activities, some of which also undertake aerospace work, random sampling occurred from a list of firms engaged only in distinct aerospace activities as defined by a SIC code (e.g. "3530 Manufacture of aircraft and spacecraft"). This SIC codes from this list of firms was compared with the SIC codes from the original 10 firm sample and revealed that a high proportion of activities were present in both, including across varying sized firms and geographical locations.

- The final number of firms included the 10 known firms and an additional number randomly selected from the list compiled from this sampling exercise (see below), which yielded numerous SIC codes, varying clusters and firm sizes, resulting in a representation of the sector.

An additional 15 firms were selected randomly from the SBAC and Amadeus databases as depicted above and added to the original 10 firms. Some further filtering occurred to ensure that firms from the three firm size segments were represented (very large, large, SME). These firms were subsequently approached, with a forecast rejection rate of around 30 per cent factored, which would yield around 10 firms and result in the 20 firm total for the study. A number of clusters were not included due to logistical and cost considerations, including Scotland, Wales and Northern Ireland. The final mix reflected the pyramid structure of the aerospace sector presented in figure 1, with 5 very large firms, 10 large firms and 8 SMEs included. This mix maximised the author's ability to execute the study in the required time, in addition to fulfilling the criteria that the balance of firms offered a representation of the aerospace sector in as random a manner as possible. Only two firms declined to take part in the study with both of these being SMEs. These firms were similar in characteristics to other SMEs agreeing to take part. In both cases, the principal reason provided for non-participation was a lack of time. This resulted in a total sample size of 23 firms, which was marginally greater than the originally scoped 20 firm total.

The selection of half of the sample on a relatively random basis from two sources (SBAC and Amadeus) coupled with the original 10 firms being drawn from across the spectrum of firm size, activities and locations, contributed to the study being representative of the UK aerospace sector. No additional sampling was undertaken on a sub-set of data from alternative sources to verify if the 23 firms' results mirrored those of other sources. This would not have been possible with the time, resource and other constraints of the study. It is recognised that the selection process may not represent a true random methodology and that the potential for bias to enter the selection process exists. The combined approach that included both known firms and random sampling mitigated this as much as possible, with no intention by the author to 'cherry pick' firms. The participants were all firms, with some operating multiple plants. Only one plant per firm was included. One firm in the sample was a parent company that was acquisitive and had in the 18 months prior to the commencement of this study purchased a number of other firms operating different aerospace businesses without the opportunity for these to be significantly influenced by the new ownership at that time. Three of these firms were included in this study.

Chart 2 presents the location of the sample firms. The South East accounts for the largest number of firms in the study, with one third of the sample located in this region, mirroring the ratio of UK aerospace firms found in this cluster. West Midlands was the second highest represented cluster in the sample (26 per cent), with this figure greater than the proportion of aerospace firms located in this cluster in the UK (10 per cent).

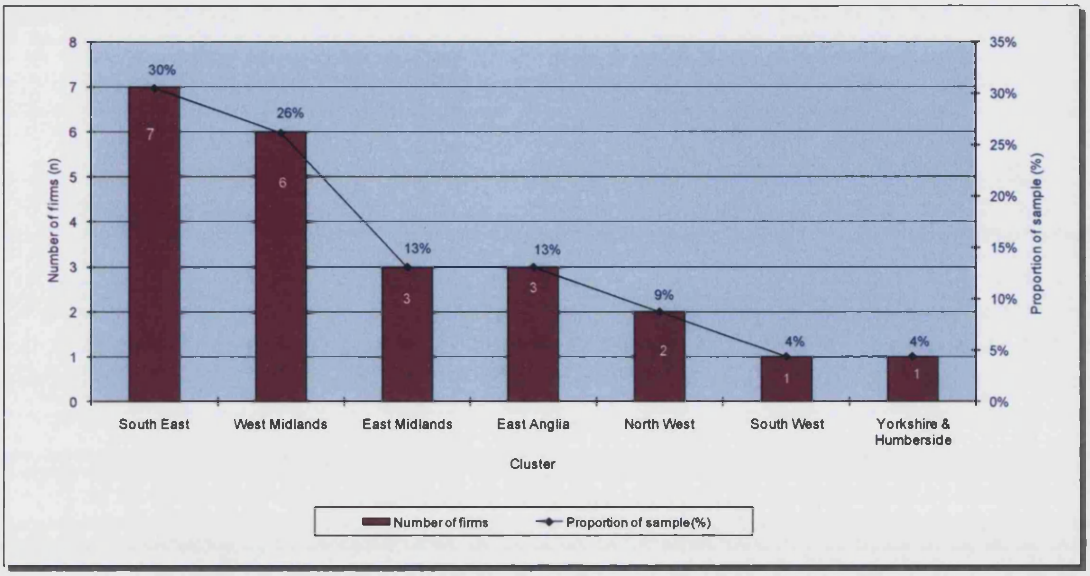


Chart 2: Distribution of the UK sample by cluster

East Midlands and East Anglia each represent 13 per cent of the sample, with the ratio of East Midlands firms greater than the 5 per cent of firms located in the cluster. The proportion of sample firms from East Anglia matches those located in the cluster (12 per cent). The North West accounts for 9 per cent of firms in the sample, closely matching those in the cluster. Firms in the South West account for 4 per cent of the sample, which is less than the number of firms located in this cluster in (15 per cent). The proportion of the sample from Yorkshire and Humberside matches the representation of UK aerospace firms in these counties (4 per cent). Chart 3 presents the distribution of the 13 counties encompassed by the clusters included in this study.

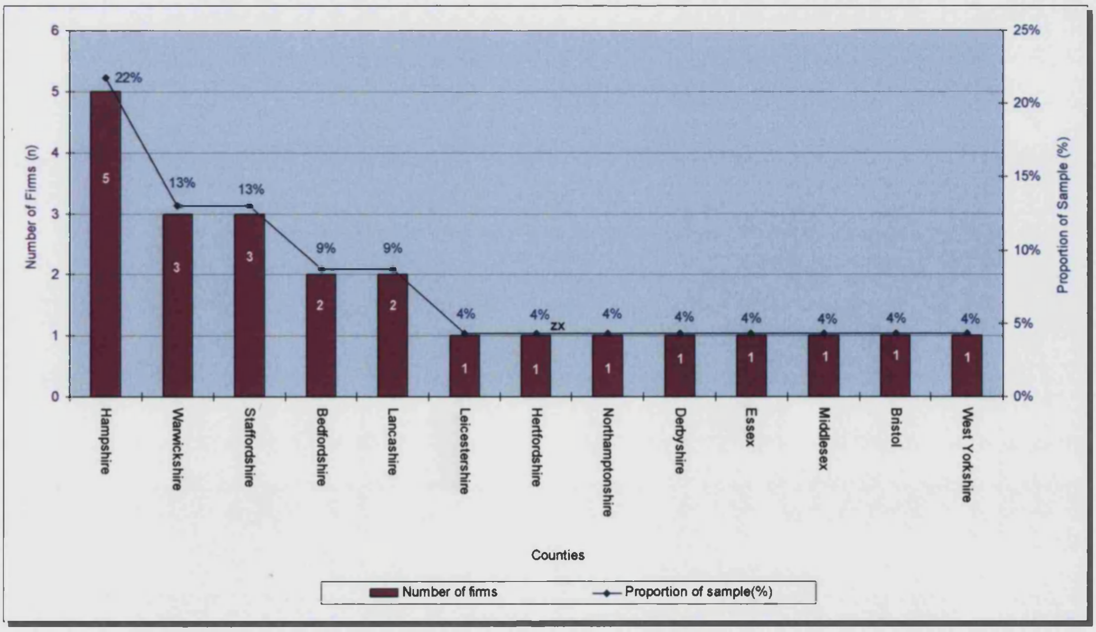


Chart 3: Distribution of sample by UK Counties

Hampshire accounted for almost one quarter of the sample, whilst Warwickshire and Staffordshire represent 13 per cent of the sample each. Bedfordshire and Lancashire represent the next largest group (9 per cent), with the remaining counties each accounting for 4 per cent of the sample.

3.2.2.2.5 Size

The 23 firms in the sample employed a total 27,000 people. Chart 4 depicts the distribution of the firms based on their number of employees.

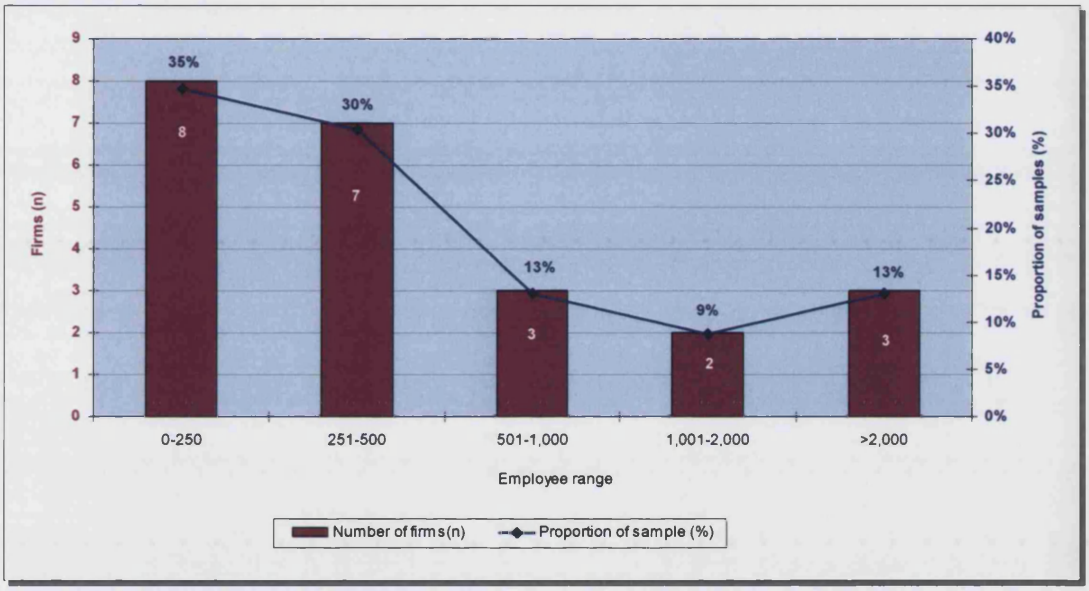


Chart 4: Distribution of sample by employees

Over one third of the firms employ fewer than 250 people and are small and medium sized enterprises (SMEs) utilising the European Commission and the UK Government definition of an SME: "Employment does not exceed 250 people and the firm's turnover is ≤€50 million per annum, and/or their annual balance sheet is ≤ €43 million"[39]. No 'micro firms' were included in the sample, which are defined by the EC as firms that possess fewer than 10 employees and ≤ €2 million annual turnover, or ≤ €2 million annual balance sheet. Of the SMEs, two were 'small firms', employing ≤50 employees and with ≤ €10 million annual turnover, or ≤ €10 million annual balance sheet. Of the 8 SMEs in the study, 6 fall under the EC definition of 'medium firms', employing greater than 50 people, but less than 250, and having an annual turnover ≤ €50 million, or an annual balance sheet of ≤ €50 million. Forty per cent of the sample firms employ 251-1,000 people, with around one third of these employing 251-500 people and 10 per cent employing 501-1,000 people. Three quarters of the sample firms employ fewer than 1,000 people, whilst around 10 per cent of firms employ 1,000-2,000 people, and over 2,000 people respectively.

[39] EC, Article 2 of the Annexe of Recommendation 2003/361/EC.http://eurlex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=en&numdoc=32003H0361&model=guichett

3.2.2.3 ICT

3.2.2.3.1 Cutting across the Study

The Commission of the European Communities (2001) stated that "Europe will only become a centre of e-business if European SMEs are fully committed to using the internet as a leading-edge business tool." European firms, including SMEs do not appear to be adopting ICT at a rate that is sufficient to close a 'productivity gap' with more developed countries like the United States (ibid). A lack of empirical studies results in insufficient ICT data encompassing usage, software utilised, ERP, and other firm-level ICT information. Lucchetti and Sterlacchini (2004; p3) iterate this view:

> There are a number of studies based on simple measures of ICT adoption, but only a few have used comprehensive and sophisticated indicators...At the same time, the impact of ICTs on different variables (skilled employment, productivity, export performances) has been widely examined while little attention has been devoted to the issue of why some firms are more ICT-intensive than others.

This study will make both a theoretical and empirical contribution to addressing this gap, utilising an integrated methodology that although nested in aerospace, is agnostic of sector. Despite leading contributions on managerial practices and productivity by Bloom et al (2005) these studies do not address this theme or ICT issues in situ, or in a greater qualitative manner either up-close or remotely. The paucity of overall studies has resulted in a lack of available data which this study's conceptual framework addresses, including the notion that ICT and managerial practices do not exist 'parallel' in the firm, but rather, are interwoven. An investigation of ICT needs to recognise both its influencing factors, and the organisational elements it also influences. This requirement is embedded in the investigative approach of the conceptual framework.

3.2.2.3.2 Quantifying ICT Use and its Effect

The CEP-McKinsey managerial practices facilitates the codification of practices and their effects, including how they influence the adoption and use of ICT, with recognition that this can occur both as a direct and indirect result of managerial practices (Bloom et al, 2005). This study's methodological approach explores both ICT practices and general managerial practices. The detailed managerial practices defined by CEP-McKinsey tool are utilised and supplemented with an ICT-centric investigation that draws on selected literature. The combined framework facilitates the assessment of ICT both at a distance and up close, facilitating a salient investigation within the broader parameters of the firms location.

3.2.2.3.3 Assessing the ICT-Managerial Practice Interplay and Location

The use of ICT includes e-mail, the internet and telecommunications (Lucchetti and Sterlacchini, 2004). In the aerospace sector, the use of advanced ICT includes CAD, CAM, LANs and EDI (ibid).

Such technology is controlled by human capital that is complementary to the technology it controls (ibid). A potential influencer on the deployment of people is their level of education (Lucchetti and Sterlacchini, 2004). The distribution of education, training, and experience amongst the firm's workforce is investigated by this study, as are ICT-centric issues, general technology practices and the use of ICT. Figure 6 outlines the framework utilised to explore this, drawing on Caldeira and Ward (2003) (See Appendix B).

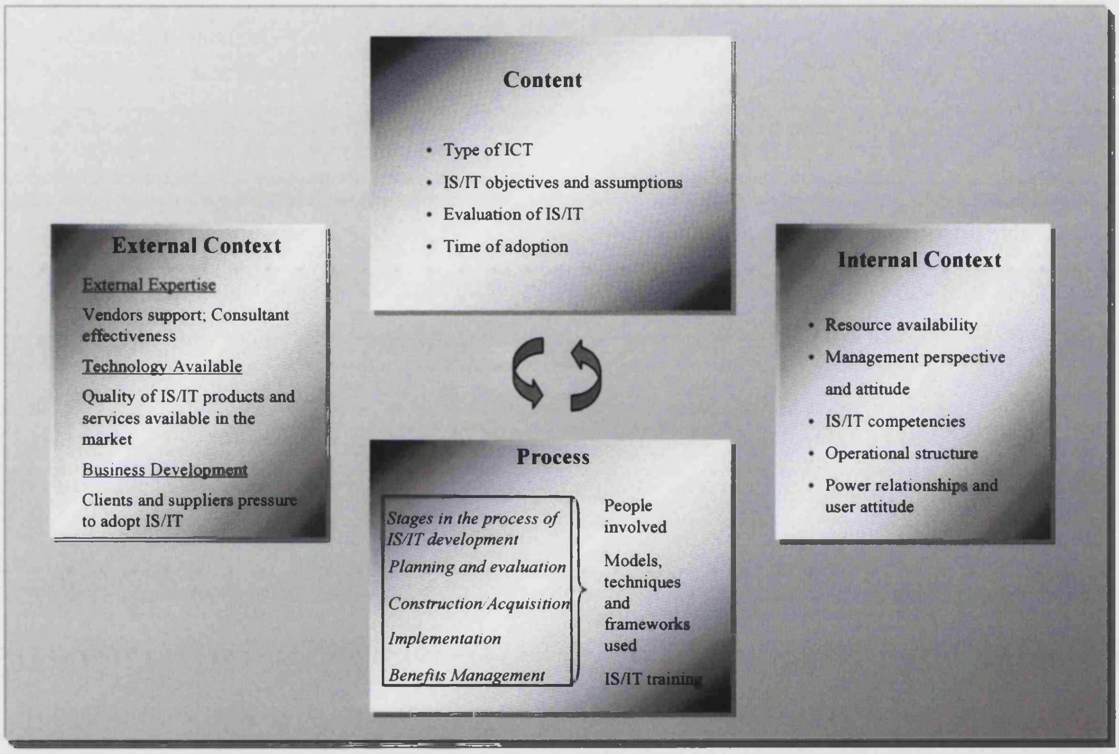


Figure 6: Framework for assessing IS/IT within firms (Source: Caldeira and Ward, 2003)

The conceptual framework also addresses the potential role that location may have on a firms operations, with Cagliano et al (2001; 470) reflecting a widely held view in cluster literature that "location effects are important and are related to the widespread knowledge on specialised technologies…the national location of the company may influence performance." The same authors comment on managerial practices by stating that "another source of excellence that has also been reported for SMEs is of course managerial practices, even if this subject is less developed in the literature….for SMEs a key to the successful improvement of performance and competitive success is the adoption of advanced managerial practices" (ibid; p471). Such research confirms the relevance of the conceptual framework developed for this study, in addition to this making contributions in a number of under-researched areas.

3.2.2.4 Bringing i All Together

By placing the firm at the centre of this study, the diffusion and effects of managerial practices can be explored within a specific sector. This schema incorporates the at a distance quantitative assessment of the sample firms through the use of the CEP-McKinsey questionnaire and additional discussions to obtain information on location and ICT use, with a subsequent qualitative in-situ investigation. This approach is uncommon in the fields of information systems, management and economics, and generates a data stream across the spectrum of firm activities, maximising the opportunity to address the research questions and make a significant contribution in the process. The utilisation of both qualitative and quantitative approaches is congruent with Miles and Huberman's evaluative criteria (1984) and is infrequently found in the literature, confirming Jick's (1979; p604) conclusion some thirty years earlier that "research designs that extensively integrate both fieldwork (e.g. participant observation) and survey research are rare". The study's research methodology accomplishes this and is presented in the following section, which precedes the hypotheses.

3.3 Empirical Investigation

3.3.1 Research Design: Case Study Approach

This study utilises both quantitative and qualitative methods. Although this approach is not dominant in IS research it is still widely supported.[40] Utilising Yin's typology (1994), the study of managerial practices and ICT use in firms in aerospace clusters lends itself to a case study approach following positive answers to three key questions as depicted in figure 7.

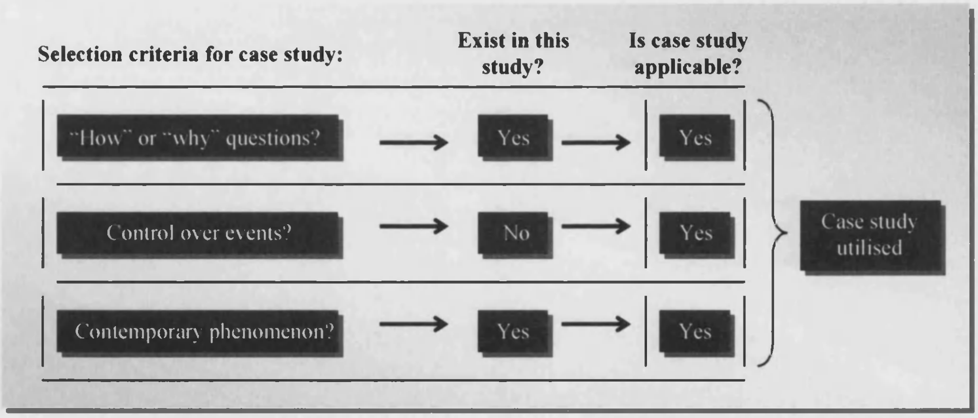


Figure 7: Study approach and filters (Source: Yin, 2002; p5)

Following the selection of the case study method as the most appropriate mode for undertaking empirical investigation, the choice existed between the use of a single or multiple case study approach. In order to select the most appropriate option, Yin's (1994) five criteria were juxtaposed

[40] Yin, 1994.

against the characteristics of this study yielding the following outcomes: (i) the study does not represent a critical case; (ii) the area of investigation does not comprise an extreme or unique case; (iii) the study may be representative; (iv) the study lends itself to external investigation, reducing the possibility that the results will be revelatory; and (v) multiple site visits occurred for a fixed duration, which negates the criteria required for a longitudinal study. These responses to the five criteria negate the use of a single case study as defined by Yin (ibid). In addition, the use of a single case study does not provide sufficient effect, or allow for replication logic to be followed (ibid). A multiple case study approach permits this to occur and is also congruent with the exploration of the hypotheses in a variety of organisational environments. This study fulfils the criteria characterising a multiple case study with each case containing clear measures of data, and the investigation not conducted at an abstract level (Yin, 1994). In addition, any case can serve a specific purpose within the overall scope of the design and return to the larger unit of analysis at the conclusion of the last case study (ibid). This avoids a common pitfall of embedded studies, when the original phenomenon of interest becomes the study's target, and not its context (ibid). The research design for this study has been driven by the conceptual framework, which tests the influences of managerial practices on ICT-driven productivity in business clusters, defining the conditions under which this occurs. The study also followed a flexible design paradigm as the empirical stage unfolded.

3.3.1.1 Number of Cases

Yin (2002, p53) states, "the analytical benefits from having two (or more) cases may be substantial....they will have immeasurably expanded the external generalisability of [your] findings" (ibid). *Generalisability* was a factor influencing the selection of the number of case studies to be included, but was also considered with respect to practical logistical considerations. The issue of generalisability was highlighted by Lee and Baskerville (2003; p241) "In a case study, the researcher may appropriately strive to develop a theory that is generalisable within the case setting... a theory may never be generalised to a setting where it has not yet been empirically tested and confirmed". The results of the research could be generalised to the aerospace sector, although due to the successful results gained by the CEP-McKinsey study of 4,000 manufacturing firms across sectors it is believed that the 'setting' in this case could be wider and encompass manufacturing. The requirement for generalisability has resulted in the selection of 23 case studies, which are believed to provide an adequate breadth while still maintaining depth. This figure has been arrived at following logistical, operational and methodological considerations that permit this study to be completed in as timely manner as possible. The number of cases also meet the necessary design test issues of construct, internal, and external validity and reliability (Yin, 2003), with Miles and Huberman (1984) stating, "the main goal is to strengthen the conceptual validity of the study" (p31).

3.3.1.2 Unit of Analysis

The research questions fulfil the role of study propositions (Yin 2003), directing the research to seek evidence for the influence of managerial practices at a number of levels within the organisation. Multiple units of analysis have been identified, with the primary unit of analysis being *the organisation.* A nested exploration within a clustered environment leads to a further unit of analysis being the organisation's partner firms, in order to explore how they might be affected by spatial issues and the sharing of practices and ICT within their organisations and with other cluster participants. This study has delved deeper, observing various work teams and individuals within the organisations to better understand the effect of managerial and ICT practices. These work-teams and individuals represent further units of analysis, with practices more easily observed at the task-level. A comparative methodology is applicable, which promotes the use of multiple case studies to explore themes across numerous subjects, with these defined as 'embedded cases studies' (Yin, 1994).

3.3.1.3 The Empirical Object and Site Selection

The empirical object for this study is the firm, with three types defined: *SMEs, large* and *very large.* SMEs are the only firm-type to possess a widely accepted definition that is relatively consistent across countries and between governments and standards bodies including the EC and the UK Department of Trade and Industry, as depicted in table 5.

SME Classification Criteria	**Medium**	**Small**	**Micro**
Maximum number of employees	<250	<50	<10
Maximum turnover (in million €) or	= €250	= €10	= €2
Maximum balance sheet total (in million €)	= €43	= €10	= €2

Table 5: SME classification criteria[41]

No definitions or generally accepted guidelines exist on the segmentation of firms larger than an SME. In the absence of this, this study has selected cut-off points for such firms, with two further categories of firms defined: 'large' and 'very large'. The distinction between the two was made on the basis of employees or revenues, as depicted in table 6, with the figures displayed in $US across all three. The turnover figures for medium and small firms have been converted from Euros[42] into $US, whilst the two firm categories (large and very large) have been segmented at the outset in $US. This currency has been used to maximise the international audience for the study. Table 6 summarises the three firm type criteria.

[41] European Commission (2005), p14. No micro firms are included in this study.
[42] Euro to $USD exchange rate of 1.29 utilised as an average for July, 2007.

Firm Category	Criteria
SME	50-250 employees, or, revenues between US$12.9m-US$322m.
Large	251-899 employees, or, revenues between US$323m-US$423m.
Very Large	>900 employees, or, revenues >US$423m.

Table 6: Large and very large firm categories

It is recognised that alternative figures for these classifications will affect the number of firms classed as large and very large, and alter the ratio of these within the study. The figures selected are the result of preliminary research to determine values believed to reflect large firms in the absence of any universally accepted criteria. The firms selected for the study are nested in aerospace business clusters in the UK, with table 7 depicting the selection methodology defined in section.

Country ⇨	Sector ⇨	Location ⇨	Firm type
UK	*Aerospace*	*Midlands; S.E. England etc*	*SME, Large, Very Large*

Table 7: Site selection filter

3.3.2 Data Collection

3.3.2.1 Theoretical Sampling

This study utilises multiple-case sampling to gather observational evidence from SMEs, with the results incorporated with other data gathered via the first stage of investigation, and compared with other industry and firm-level data. The data are purposive because the universe has already been defined using Erickson's (1986) generic funnelling sequence and applied to the subjects for this study which are firms operating within clusters in the aerospace sector. Miles and Huberman (1984; p31) posit that that the prime interest of a multiple-case study is conceptual, and that a sampling frame should be guided by the research questions in a pre-specified theoretical framework. This study adheres to this notion, with the research questions establishing the foci and boundaries for sampling decisions within the firms.

3.3.2.2 Data Collection Strategy and Modes

Qualitative and quantitative evidence is collected in order to address the research questions. Yin (2003) defines six principal modes of data collection, with the study utilising five of these: documentation, archival records, interviews, questionnaires, direct observations, and physical artifact. Participant observation is not utilised for the study. These multiple sources of evidence facilitate data triangulation with "any finding or conclusion in a case study likely to be much more convincing and accurate if it is based on several different sources of information through a corroboratory mode" (Yin, 2003; p98). Multiple data collection modes have been utilised for this study, which include documentation; archival records; interviews; direct observations; physical artifacts; questionnaires and secondary data. These are each briefly covered below.

3.3.2.3 Documentation

Documentation is the object of explicit data collection plans (Yin, 2003). Documents provide insight into the codification of some managerial practices, in addition to providing the evidence for others. A number of documents have been assessed, including public domain and company documents.

3.3.2.4 Archival Records

Some archival records have been used in conjunction with other sources of information including production data, manufacturing data, operational information, organisational charts and others. These depict the strategic impact of managerial decisions, including those affecting technology and ultimately, productivity.

3.3.2.5 Interviews

> "Undertaking a live dialogical encounter overcomes the alienation in which a text finds itself".
>
> Gadamer, 1995.

The interview is arguably one of the most powerful tools at the disposal of the social researcher (Yin, 1994), but is also one of the most complex in terms of its contextual elements (Miles and Huberman, 1984). Structured and semi-structured interviews have been undertaken with a cross section of individuals where available, encompassing its head (CEO), the technology manager (IT manager), and other senior managers (HR, finance, operations, others) and employees. Their roles in the firm are different and represent a cross-section of perspectives:

CEO: A key individual in the firm, often defining managerial practices and involved in many elements of the business (Lefebvre et al, 1997; Suitaris, 2001).

CTO/CIO/IT Manager: Strategically and operationally in a position to affect the adoption and use of ICT within the SME (Lefebvre, 1997; Suitaris, 2001). The interplay between the CEO and the IT Manager is of significance in assessing ICT adoption).

Senior Managers: Encompasses CFO, HR Director, Operations Director, R&D Director. Together with the CEO and CTO, they often set strategy, and are the principal conveyors of managerial practices (Holm et al, 2002).

Employees: Arguably the most affected by managerial practices Their work practices can have an impact on ICT and firm productivity (Caroli and Van Reenen, 2001).

Table 8: Interview subjects, roles, and key related research

3.3.2.6 Direct Observations

Direct observations are an integral element of the study, distinguishing it from other purely quantitative studies on managerial practices, ICT and location conducted remotely. Direct observations permit an assessment to be made on the effects of managerial dictums across the organisation, as depicted by Zuboff (1988).

3.3.2.7 Physical Artifacts

ICT represents the key artifact for investigation, with the firms selected from the technology-centric aerospace sector, reflecting varying degrees of ICT adoption, implementation and use.

3.3.2.8 Questionnaire

The questionnaire represents a key mode of data collection for this study, obtaining both qualitative and quantitative information. Its use is congruent with both of these objectives, with cumulative advantages accruing to this study by combining both methods. The questionnaire has been utilised to obtain information for all three of this study's principal themes of managerial practices, location and ICT. The CEP-McKinsey questionnaire follows a structured approach with the additional ICT and location questionnaires including both structured and open-ended questions that permit greater latitude in obtaining relevant tangential information.

3.3.2.9 Secondary Data

Additional data are sourced and cross-referenced with observable results including company financial accounts, publicly available company information, Office of National Statistic SIC codes, and other sector information.

3.3.3 Interpretative Methods

3.3.3.1 Quantitative Data

Stage one of the study utilises the CEP-McKinsey questionnaire on managerial practices, in addition to open ended questionnaires on location and ICT drawn from relevant literature. All of these are initially administered via the telephone. The managerial practices survey is subsequently replicated within firms, whilst ICT and location questions are explored further as part of the wider assessment of practices, ICT use and location. The CEP-McKinsey questionnaire has already been utilised in two studies encompassing almost 5,000 firms across 10 countries, with the author trained in its use through participation in this research. A degree of training and interview skills are required in order to ensure it is administered correctly in order to mitigate bias through leading questions, and to ensure that the appropriate score is given that reflects the status of the firm's actual practices. The results of the questionnaire are subsequently utilised to explore the study's central themes, including a cross reference to databases containing individual company financial information. To date the CEP-McKinsey study has not been applied to an individual sector, with this study representing the first research effort to do so.

3.3.3.2 Defining a Strategy for Interpretation

This study utilises theoretical propositions to define the overarching investigative strategy, which also underpins the formulation of the initial research questions, reflecting the approach defined by Yin (2003; p109): "Data analysis consists of examining, categorizing, tabulating, testing, or otherwise recombining both quantitative and qualitative evidence to address the initial propositions of a study." The study's central propositions maintain a focus on data of relevance, with 'why' and 'how' questions continuing to guide case study analysis. The two alternative analytic strategies depicted by Yin (2003) of rival explanations and developing a case description have not been deemed relevant and are not utilised.

This study does not track subjects over an extended period which negates it being a time-series analysis. The use of explanation building is also not utilised, as this study is predicated on a gradual iterative process with the eventual explanation potentially differing from that defined at the outset. This analytic technique is also optimal where the causal links surrounding a phenomenon are complex and difficult to measure in a precise form (ibid). This is not the case in this study, which quantifies these links at the outset, and incorporates quantitative data at subsequent points. Pattern matching, which utilises non-equivalent dependent variables to plot patterns, is also not utilised, for this method relies on all results occurring in a predicted manner, with the initial proposition becoming destabilised where this does not exist. Similarly, rival methods as patterns are not utilised, with this requiring the development of rival theoretical propositions, with the proven validity of one invalidating the use of others (ibid). This study does not undertake these or the use of a logic model, which utilises interventionist events and linear sequencing. The remaining option, cross-case synthesis, is congruent with both a multiple case study approach and the conceptual framework developed for this study, and has been adopted for use.

3.3.3.3 Cross-Case Synthesis

Cross-case synthesis offers significant benefits when a multiple case study approach is utilised, and when this consists of at least two cases (Miles and Huberman, 1984). Yin (2003; p133) states, "having more than two cases could strengthen the findings [of cross-case synthesis] even further". This approach yields a number of significant benefits for this study: (i) it can treat the embedded case studies as either independent research studies or as a pre-designed part of the same study; (ii) it accommodates larger number of case studies by incorporating quantitative techniques; and, (iii) it accommodates an increasing level of complexity, allowing issues beyond a single feature to be covered. Replication logic is also applied, as this study involves multiple cases. This interpretative method may also permit generalisations to occur within the appropriate boundaries.

4. Hypotheses and Results Overview: ICT, Location and Management Practices

4.1 Hypotheses

A number of hypotheses have been developed that explore this study's central themes. These reflect both the internal (firm-level) and external (macro) environment and are grouped around core themes (H2-H7). In addition, a number of overarching hypotheses were defined which explore the integrated (aggregate) effect of the themes (H1). These encompass the consolidated effect of managerial practices on the firm's performance and ICT, in addition to exploring a number of individual themes directly. Figure 8 depicts the study's principal themes and the corresponding groups of hypotheses (Hx):

Figure 8: Study themes and hypothesis categories

Each of these themes is explored through a hypothesis or hypotheses with a total of 20 developed:

<u>H1: Macro/aggregate level results</u>

H1a: Firms with higher managerial practices scores have a higher level of productivity and return on capital employed (ROCE).

H1b: Poor managerial practices do not result in lower ICT investment.

H1c: ICT investment does not affect the level of productivity and ROCE.

H2: Managerial practices scores

H2a: Firms with higher managerial practices scores have a higher utilisation of ICT in communicating with suppliers, customers, and the sales force.

H2b: There is no difference in the perception of ICT between firms with better and poorer managerial practices scores.

H3: Firm types

H3a: Family owned and primogeniture firms have the same ICT investment and managerial practices scores as non-family owned firms within their firm-type.

H3b: Managerial practices vary between different firm-types, but are similar within the same type of firms.

H3c: A firm's ownership type affects the planning and expenditure approval process for ICT.

H4: ICT utilisation

H4a: Firms adopt e-commerce in a staged manner.

H4b: The perceived level of ICT success affects the degree of further ICT integration.

H5: Labour/Resources

H5a: Wage pressure occurs for skilled people entering aerospace.

H5b: The CEOs level of ICT literacy does not affect ICT investment.

H5c: A higher level of formal education amongst managers and non-managers does not affect ICT investment.

H6: Business practices

H6: Confrontational relationships between the CEO and the IT manager result in lower ICT expenditure

H7: Location

Physical proximity

H7a: Firms cluster to take advantage of access to suppliers and customers.

H7b: Location advantage is related to local skill levels.

H7c: Firms source the majority of their supplies within their cluster and allocate a high proportion of their outsourced production within their cluster.

Virtual proximity

H7d: Virtual clustering occurs with customers and suppliers outside of the firm's geographical cluster.

H7e: Virtual clustering replaces the advantages of physical proximity.

H7f: Virtual clustering is more prevalent amongst larger firms.

4.2 Linking to the Conceptual Framework

A number of these hypotheses link various elements of the conceptual framework presented in section 3.2.2, whilst others explore specific attributes, as depicted in the following schema:

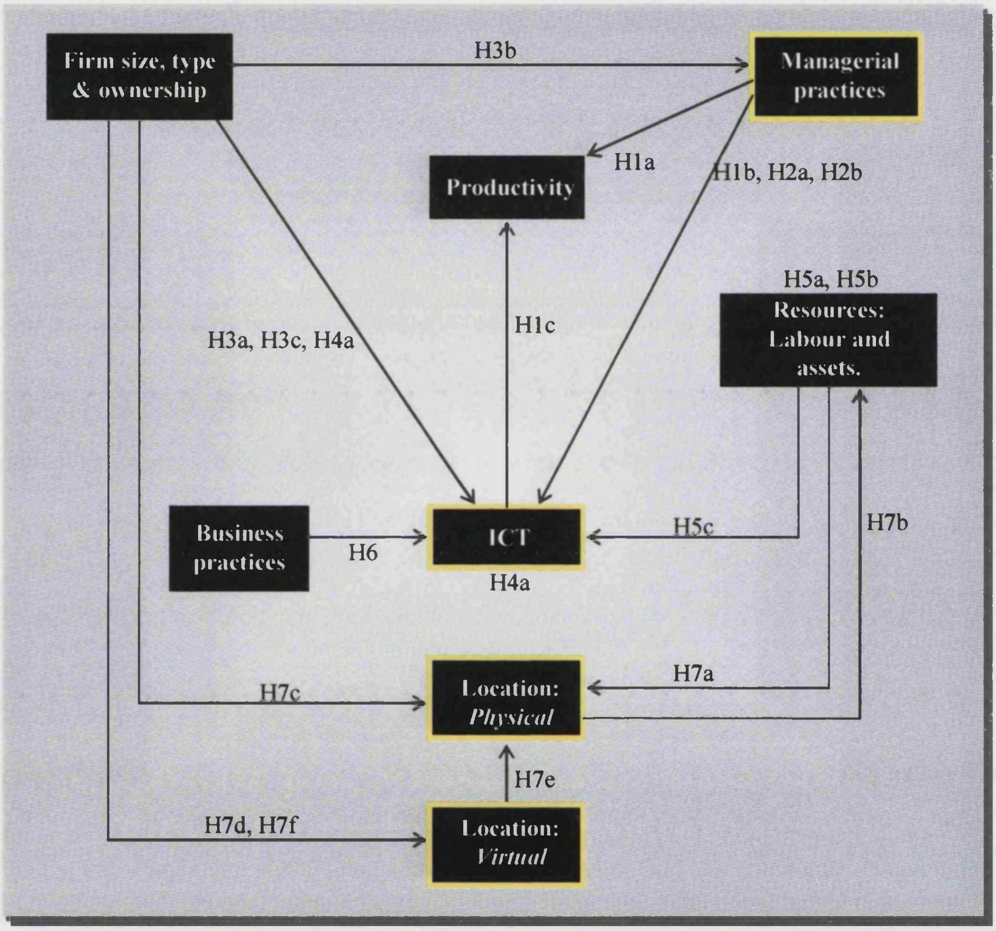


Figure 9: The conceptual model and hypotheses

The model reflects the interrelated and multi-layered environment that can exist within organisations with the yellow-framed boxes denoting the three principal themes of the study: ICT, location and managerial practices. This study is believed to be a true firm-level assessment of the selected themes in an organisational setting, embedding the researcher both in the firm, as well as utilising complementary tools administered remotely, such as telephone interviews and secondary research. This is a more ‘holistic’ approach than is evident in the current management, IS and economics and economic geography literature. The empirical investigation has been designed to be as inclusive as possible with a number of qualitative and quantitative information sources utilised.

4.3 Results Overview: ICT, Location and Management Practices

The following three chapters (5 to 7 inclusive) present the empirical findings of the project, depicting the effect that managerial practise have on technology-centric firms' productivity in their locations, including the mediating role of their ICT. The results were obtained from the output of the methodology defined in chapter 3, which aims to bridge the lacuna identified in the literature in chapter 2. Data for all three areas (management practices, location and ICT) were initially collected via telephone interviews with an operations manager from each company, or an individual possessing significant knowledge of the operational processes at the firm providing the managerial practices data and feedback on location. An IT manager provided the required information on the firm's ICT use. In some firms, this function was managed by another individual such as the finance manager, or the CEO. Following this, site visits were undertaken, with a replication of the initial CEP-McKinsey telephone interviews with a cross section of individuals where permitting, including a shop floor employee and a supervisor. Further data were also collected and observations made by 'walking around' and observing firm activities, with additional discussions occurring with other firm employees. More detailed ICT discussions also occurred at this time the IT manager or other individuals responsible for this function, either for the first time, or to extend earlier telephone discussions. The use of interviews reflects the study's methodological position that testimony is considered to be a reliable source of knowledge under many circumstances whilst in situ observations enrich the data and enhance the limitations of interviews in the knowledge process (Lamproulis, 2007). The use of both of these approaches reflects the accepted position of utilising testimony with observations and inferences (Kyburg, 1983). Data and observations were reviewed and consolidated into three areas that reflect the principal themes of the study, as depicted in figure 10, with the numbers denoting the relevant chapters. These are complemented by a fourth area that investigates other relevant firm level indicators.

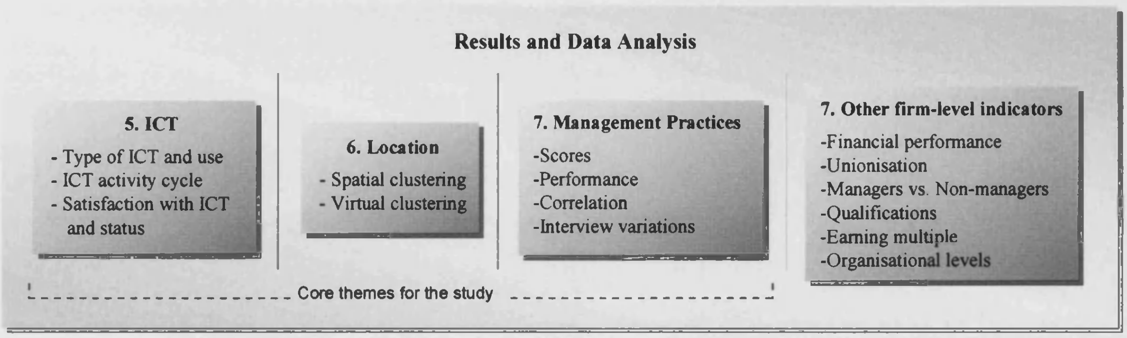


Figure 10: Structure of the Results and Data Analysis sections

4.3.1 ICT Results Overview

The use of ICT within the firm was explored through initial telephone interviews with the IT manager, or the person responsible for this function. These were followed up by site visits, observations and further discussions with the same person and other with IT staff. The ICT investigative process was driven by Caldeira and Ward's (2003) typology as presented in section 3.2.2.3.3, and segmented into four areas: *context, process, internal* and *external context.* Chapter 5 presents the results from 'holistic' investigative framework encompassing the spectrum of ICT and technology activities that explore multiple facets of ICT use within the firm. The subsequent juxtaposition of the data with the study's other central themes of managerial practices and location makes a contribution to the fields of IS, management and economics in a true multidisciplinary manner. The first stage required to achieve this is the identification of the ICT utilised and the pattern of its use. This acts as an enabler for the subsequent investigative stages of the study, drawing upon Caldeira and Ward's (2003) typology, and including other indicators. The final parts of this chapter define and investigate a 23 stage ICT activity cycle in the firm, and undertake an assessment of ICT satisfaction levels and the effects this may have on usage and adoption. The ICT results are juxtaposed on the data and observations from this study's other key themes of managerial practices and location.

4.3.2 Location

The potential influence of the firm's location represents the second key theme of the study, and also utilises remote and on-site interviews. Key employees, including the operations manager or equivalent, were asked a number of questions encompassing the reasons behind their firm's location; the nature of the relationships exist between the firm and its suppliers; the influence of the firm's location on skills; the degree of outsourcing and intra-cluster trade, and other related factors. These focused on the geographical elements of location ('spatial'), before virtual elements were reviewed including the virtual connectivity between the firm and its suppliers and customers; the degree of adoption of virtual connectivity and the drivers for this; the extent of any substitutability of virtual connectivity over geographic location considerations, and others. The methodology for this was drawn from a number of sources, including Yamawaki (2002), whose work on location encompassed many of these themes. The results obtained were both qualitative and quantitative, and provide a detailed cadre of information that identifies the degree to which the firms are clustered, contrasting the majority of literature that utilises other secondary economic indicators. The assessment of both spatial and digital elements of location provide a relevant review of the theme in the context of the 21st Century, with the majority of the literature promoting the benefits of physical co-location, with this predominantly driven by secondary data and bereft of firm-level results.

Chapter 6 presents the results obtained from these investigations, segmented into two sections (spatial and virtual), which reveal the degree of influence of location and the quantification of trading relationships both within the firm's cluster, and outside of it. This establishes the context for investigating the use of ICT (chapter 5) and managerial practices (chapter 7).

4.3.3 Management Practices

Following an assessment of location, chapter 7 investigates the firm's managerial practices using the CEP-McKinsey methodology. The results are segmented into two principal areas: *scores* and *performance.* This approach permits the segmentation of the raw scores by a number of categories including firm-type. The scores are utilised to undertake statistical analysis that is interspersed throughout this section, complementing observations made. An average management practices score is presented for each of the sample firms, with other indicators calculated, including the proportion of firms that reside above and below the firm-type average, permitting an assessment to be made between these. In addition, average scores are presented for each of the 18 management practices per firm-type and for the four categories of practices. The scores permit the assessment of *micro* data for each firm in addition to assessing the potential relationship between the results and firm performance, utilising labour productivity and return on capital employed; two of the performance measurements utilised in the 5,000 firm CEP-McKinsey study. Some statistical analysis is subsequently undertaken, to explore if a significant relationship exists between these two variables and managerial practices in addition to the assessment of anomalies, including firms that obtained high management practices scores but had low performance as measured by productivity and ROCE. Additional statistical analysis is undertaken on the interview scores to assess the correlation between scores obtained from multiple interviews in the same company. The results of this chapter quantify the quality of the firm's managerial practices and triangulate these with the results from ICT and location. In doing so, the use of the firm's ICT can be juxtaposed against decision making in the firm, permitting the comparison between firms, firm types and between practices. The qualitative assessment of other potential influencing factors such as satisfaction with ICT and the nature of the relationship between key individuals in the firm further enhances the data gathered. This establishes the requirements for the discussion of the hypotheses in chapter 8, which is followed by conclusions in chapter 9.

Section II: Results and Data Analysis

5. ICT Results

This chapter presents the empirical findings of the ICT component of the study. As depicted in section 4.3.1, the investigation commenced with a review of the ICT utilised by the firm including communication with suppliers and customers, and communication with the sales force, and is divided into 3 sections (5.1-5.3). Through the development of an activity cycle of ICT encompassing 23 stages, information was subsequently collected, culminating with an assessment of level of satisfaction of ICT in the firm. Figure 11 depicts the structure of the ICT Results section, including the relevant sections in this chapter (5.x).

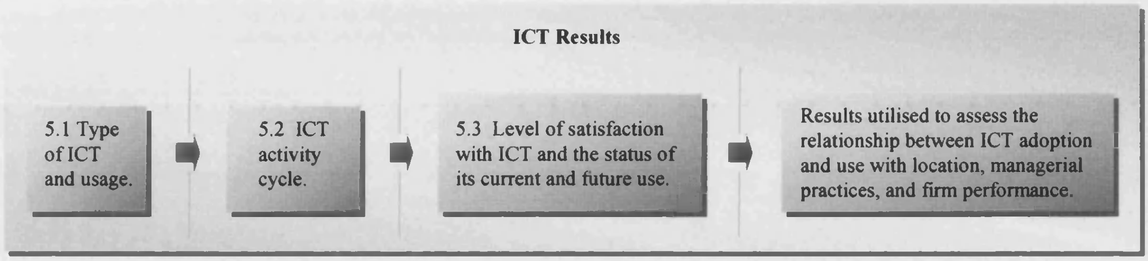


Figure 11: The study's ICT investigative schema

Following these stages, the acquired ICT information is juxtaposed on data and observations gathered from investigations of this study's other key themes of managerial practices, location, and firm performance. This final stage also links the latter and earlier chapters of the study, and in doing so bridges the current gaps in the literature at the locus of the study's key theme. Throughout the study, and particularly in this section, the principal segmentation criterion for firms is *size*. Other options were considered which arguably would also be adequate, including firm ownership. However, it was believed that this would blend some smaller firms with mid sized and larger ones, which would shift the focus away from a clear view of how the various sized firms operated and were managed in relation to each other, including SMEs, which represent the majority of all firms in the UK economy. The use of firm ownership as a segmentation criterion would inhibit this occurring as readily. A further consideration was segmentation based on the position of the firm in the aerospace hierarchy, as defined in figure 1 earlier in this dissertation. This would not facilitate the comparison between SMEs and other firms in the same manner that segmentation based on size would. Any additional benefits that might ensue, such as observations specific to a tier in the hierarchy, are believed to be outweighed by a greater number of results that can be collected from a segmentation based on firm size. Additional work could be undertaken outside of this study that segmented firms according to these criteria (firm ownership, position in the chain).

5.1 Type of ICT and Use

In order to define the ICT utilised by the firm an approach augmenting previous work by Caldeira and Ward (2003) was utilised. This explores 10 areas of ICT within the firm:

1. PC penetration
2. Internet connectivity
3. Hardware replacement
4. ERP use
5. Customer relationships
6. Adoption of ICT
7. Communication with strategic suppliers
8. Communication with the sales network
9. E-commerce
10. Website strategy: Present and future

5.1.1 PC Penetration

The level of PC penetration varied considerably across the firms, from a low of 0.25 PCs per person, to a high of 1.82, as depicted in chart 5.

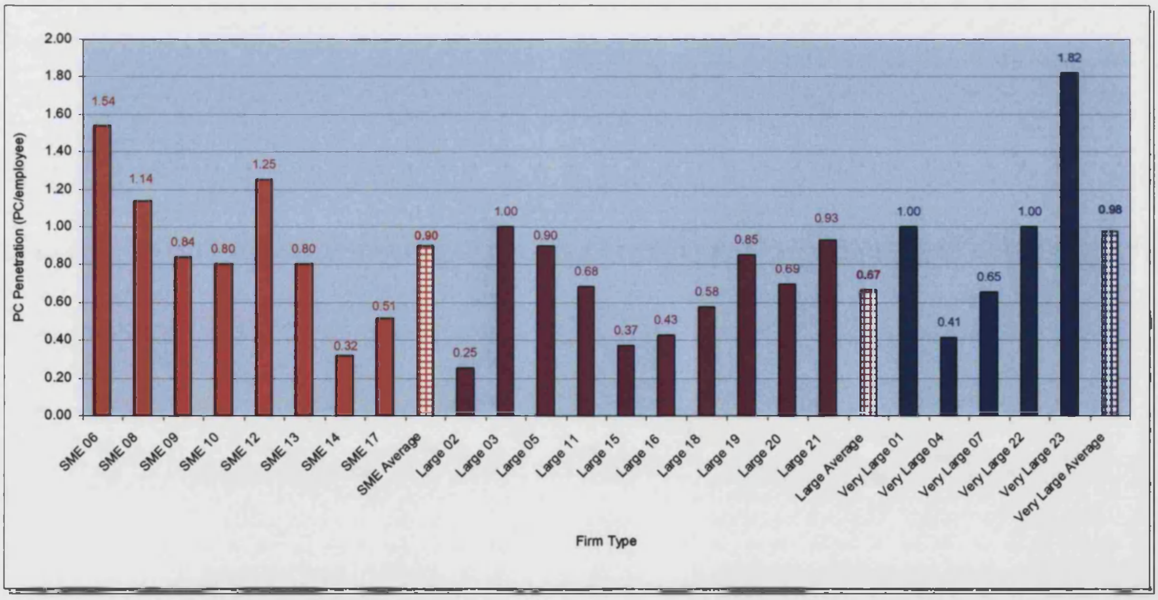


Chart 5: PC Penetration

The mean PC penetration for SMEs, large firms and very large firms was 0.90, 0.67 and 0.98 respectively. The average PC penetration in SMEs reflects the smaller number of employees in many of these firms and a higher number of PCs, with many computers located throughout the manufacturing facility and in offices. The majority of SME managers indicated that an increased diffusion of PCs had occurred in their firms over the past 5 years, primarily on the shop floor in order to allow operations staff better access to ERP and other production data. The variations in the

PC penetration between firm types also reflected the differences in the nature of many of the businesses including the size and complexity of the design, R&D, IT, production, finance, and other departments. Table 9 depicts the PC penetration bands for the sample, with around 80 per cent of firms displaying a penetration greater than 0.50, whilst 30 per cent display a PC penetration of 1.00 and greater. The PC penetration band containing the majority of firms is 0.76-1.00 (39 per cent), followed by 0.51-0.75 (22 per cent) and 0.26-0.50 (17 per cent), indicating that that around 4 in 10 firms have a PC for every worker.

PC penetration band	Firms (%)
1.75 - 2.00	4%
1.51 - 1.75	0%
1.26 - 1.50	4%
1.01 - 1.25	9%
0.76 - 1.00	39%
0.51 - 0.75	22%
0.26 - 0.50	17%
0.10 - 0.25	4%
≥0.50	78%
≥1.00	30%

Table 9: PC penetration levels

Some firm managers indicated that this penetration level represents an increase over the past 5 years, and was due to a number of influences including; pressure from suppliers and major customers to embrace a greater degree of integrated communication and sharing of production data; pressure from senior managers to provide greater access to data and production information in real time; competitive pressure in general requiring the maximisation of efficiencies and reduction of production costs aided through greater visibility to production data. Chart 6 depicts PC penetration versus employees, segmented into five employment bands for ease of comparison.

Firms in the SME band (0-250 employees) display PC penetration ranging from 0.32 to 1.54, whilst those in the next band (251-500employees) display a narrower penetration range between 0.37 and 0.93. The smaller sample obtained for larger firms (over 1,000 employees) does not provide a large number of observations, with all but one firm obtaining a PC penetration of at least 1.00. No statistical significance was found to exist between firm size and PC penetration[43] with PC penetration rates varying across the sample.

[43] This hypothesis was rejected, with an R squared obtained of 0.0223, a P value of 0.4872 and a t-stat or 0.7072.

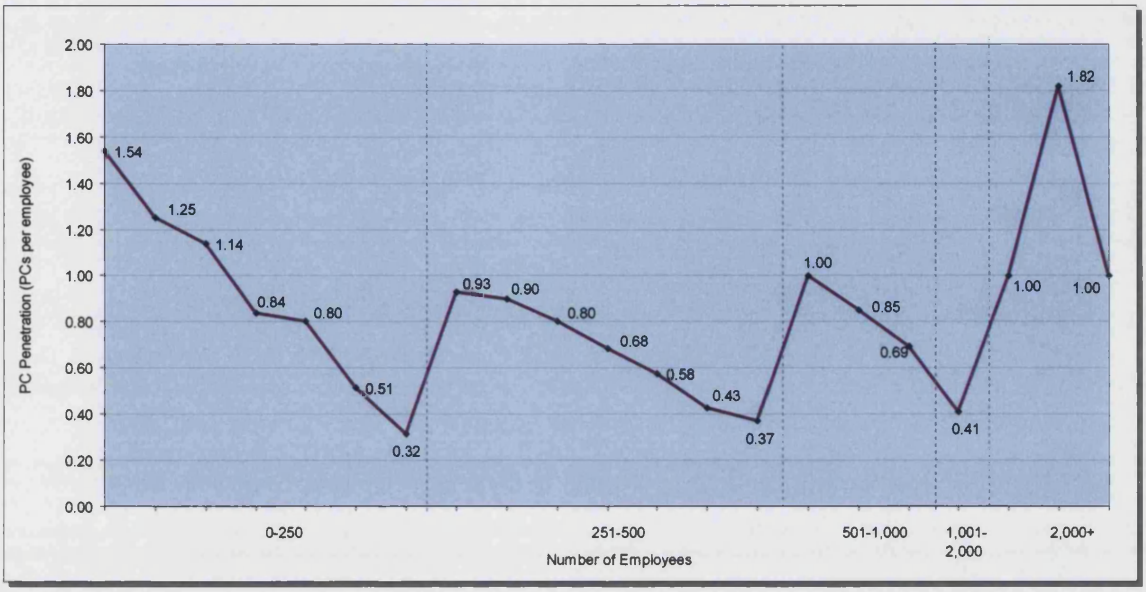


Chart 6: PC Penetration versus number of employees[44]

5.1.2 Internet Connection

All firms were connected to the internet via broadband, with no firm connected for less than an advertised speed of "up to 8MB/second". The last firm connected to broadband in early 2006. In addition to broadband, five firms had implemented virtual private networks between multiple sites with all of these large and very large firms. Internet policy and adoption by smaller SMEs was primarily driven by the benefits that firm managers' believed existed, with this supporting results in the literature.[45] This was also applicable to the development and adoption of VPNs, which were characterised by higher costs and complexity in implementation than broadband. Many firm managers perceived the implementation of broadband as being 'a standard element of ICT'. This was particularly the case for larger SMEs that were either owned by larger companies, or that were characterised by more complex businesses with higher revenues and employees, and had adopted the internet due to business and market-driven decisions which was increasingly being perceived as 'essential', aligning them closer with large and very large firms.).

5.1.3 Hardware Replacement

The purchase of ERP and ICT hardware encompassing computers, servers and printers represents the two largest technology related expenses incurred by the sample firms, excluding plant and

[44] Figures in this table indicate the employee band the firm belongs to only. The position on the x-axis does not represent the relative number of employees in the band. i.e. placement in "0-250" merely indicates that employee numbers are within this range. The penetration figures are presented in descending order in each band with the exception of the last figure.

[45] Karimi et al, 1996.

equipment. A divergence exists between publicly and privately owned firms in their approach to replacing ICT hardware. The majority of publicly owned firms did not exceed a 3 year replacement cycle, with the reasons cited by IT managers including:

> Its corporate policy, so we have to comply.
>
> If we screw up something because our PCs or servers crash because they are too old, it might be our last job for that customer, and we will pay them penalties on top.
>
> Once it's out of warranty, that's it. It's gone. We buy all of our hardware with 3 year on-site support warranties, and if we have a problem the hardware is replaced within a few hours and we get on with it.

A minority of publicly owned firms replaced their hardware in less than 4 years. In contrast, privately owned firms retained their hardware, including PCs, peripherals and servers for 5-8 years, with many IT managers only replacing these if they became faulty, or could no longer support a software upgrade. The earliest replacement of hardware amongst many privately owned SMEs was 5 years, although many firms retained it for 10 years. This was confined to a number of the smallest SMEs in the sample, and utilised for administrative functions such as running basic word processing and spreadsheets. IT managers cited a number of reasons for delaying ICT replacement in smaller firms:

> We just can't afford to replace them that often.
>
> The directors would rather pocket the money than spend it on hardware.
>
> We do replace stuff. Once it has died. Until then, we keep on using it. We have many of our PCs running Windows 98, and they're our fast ones.

The majority of the remaining privately owned firms utilised a "throw away and replace" policy for PCs and servers that developed a fault outside of their warranty period.

5.1.4 ERP

Seventeen ERP solutions were identified amongst the sample firms. In order to facilitate a review, three periods of activity were defined:

- *Early Period*: ≥4 years ago.
- *Current Period*: In the last 4 years.
- *Future/planned Period*: Firm's managers indicated that ERP would be replaced 'with a high degree of certainty' at some point in the future.

A shift in the use of ERP occurred over time. In the early period, 43 per cent of firms did not use a commercial ERP package, but developed their own utilising Microsoft Excel spreadsheets and/or

Microsoft Access. Large commercial ERP solutions such as SAP were installed in just over 10 per cent of the sample firms, with other solutions each accounting for less than 5 per cent of the ERP. Table 10 depicts the shift in ERP adoption over time.

ERP Solution	% of (early) ERP 4+ years ago	% of current ERP < last 4 years	% of future (planned) ERP	Change: early-planned
None- Spreadsheet based	43%	9%	9%	-34%
AMAPS		4%	4%	4%
Avanti		4%	4%	4%
BBCS	4%	4%		-4%
JD Edwards		9%	9%	9%
LanPak	9%			-9%
Mannam	4%			-4%
Pegasus	4%			-4%
PROTOS	4%	4%		-4%
Redthorn		4%		n.a.
RentIT		4%	4%	4%
SAP	13%	35%	57%	44%
Sincom		4%		n.a.
Unity	9%	4%		-9%
Vantage	4%	4%	4%	no change
WDS	4%	4%	4%	no change
Welcome		4%	4%	4%

Table 10: ERP use and change over time

Three major changes were evident: (1) a reduction of over a third in the use of 'home grown' ERP; (2) an increase in the use of the largest commercially available ERP solution, *SAP*, by almost 2.5 times, adopted by around one third of all firms; (3) around one tenth of the sample adopted *JD Edwards,* another large scale commercial solution, which was not represented earlier. Two ERP solutions showed no change over time, *Vantage* and *WDS*, with the management of the firms believing that the solutions were adequate and cost effective. In contrast, two solutions currently being utilised, *Redthorn* and *Sincom,* will be replaced in the future with SAP, with firm managers believing that the latter offered greater congruency with their operational needs. Both firms utilising these were large and publicly owned subsidiaries of acquisitive parent companies, with the head office of both mandating that they adopt SAP. Six other ERP solutions currently being used were flagged for replacement in the future, with all but one of these to be replaced by SAP. Figure 11 depicts the evolution of ERP by firm type. The figure displays the convergence to SAP from a cross-section of firms, which has occurred at the expense of a number of smaller developers of ERP in particular. Over half of the sample firms have implemented SAP, with the other major international ERP provider, JD Edwards, represented by only two firms. The continued penetration of SAP is primarily due to the reduced price for its more 'packaged' SME offering, which resulted in a number of sample firms selecting it over cheaper ERP and over more expensive 'full blown' SAP which is commensurate with higher license fees and which often requires greater customisation. Figure 12 depicts the change in ERP over time, by firm.

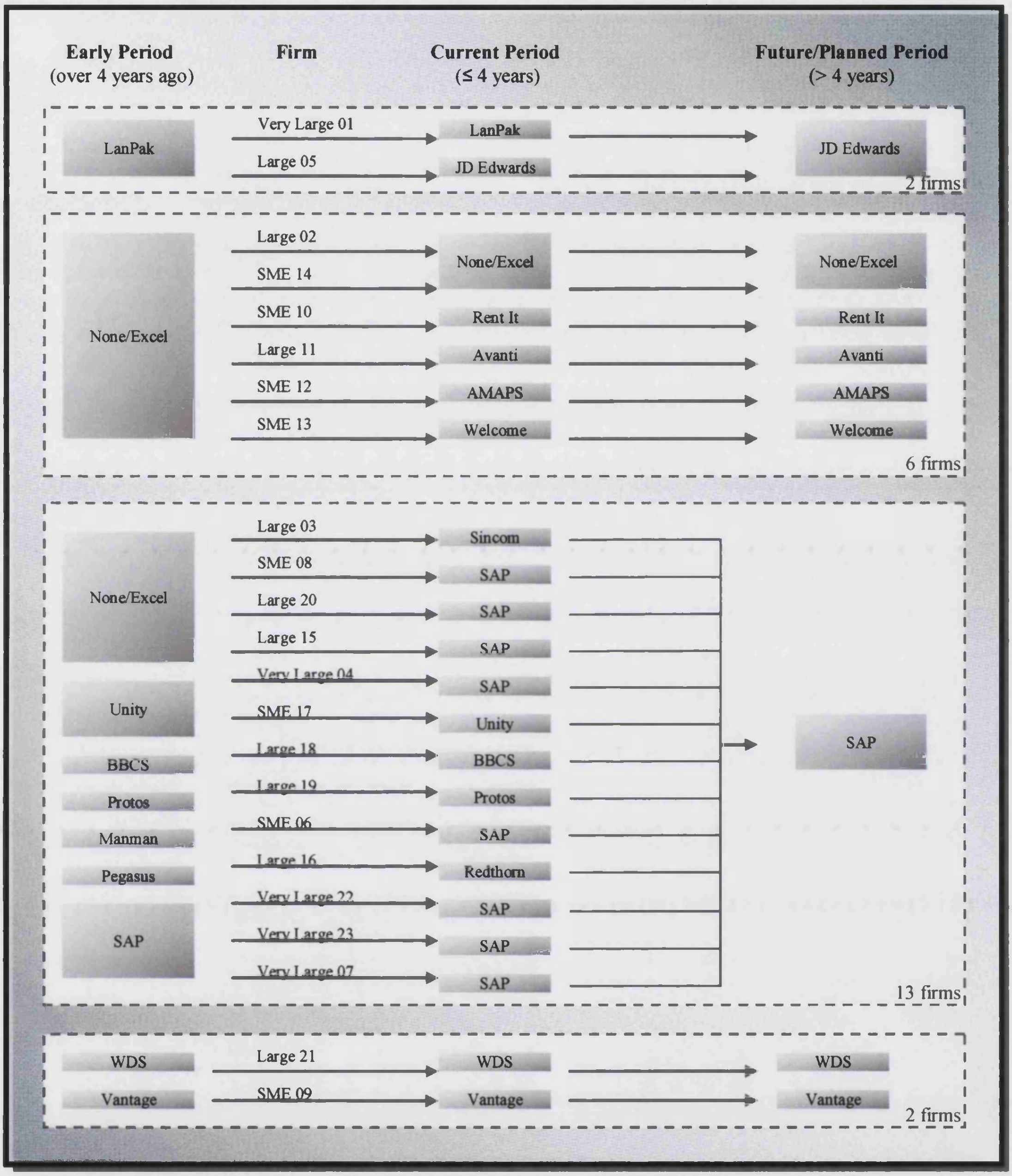


Figure 12: ERP use and change over time by firm

SMEs

Of the eight SMEs in the sample, five were not planning to change their current ERP solutions. The two principal reasons cited by IT managers were cost, and a satisfaction with their current ERP, as reflected by the feedback received: "Our current ERP is cheap and does the job. We don't need to change to anything else that comes with steep prices and expensive maintenance" (IT manager, SME). Two of the remaining three SMEs had adopted SAP, with a third planning to do so. Of these firms, one was privately owned, with the remaining two recently acquired by publicly listed companies. Both of these firms were mandated to adopt SAP by their new head office. Of the 13 firms in the sample adopting SAP around one quarter were SMEs, almost half were large firms, and a third were very large firms. Of the five very large firms, only one was not utilising SAP, with this firm selecting another major ERP supplier, *JD Edwards*. The firm's IT manager highlighted the formal nature of the process he was required to follow in the selection of ERP: "We undertook considerable central (HQ) planning and costing before we selected an ERP solution. Cost was the final stage of the process and came down to getting the best deal we could from them once we knew a bunch of them could do the job."

The propensity for SMEs to adopt more expensive ERP such as SAP was driven by one of three factors: (1) a parent company mandate; (2) the complexity and/or specific demands of the business, and; (3) budget. Of the SMEs adopting SAP, only one was privately owned, with this firm being one of only two primogeniture firms, run by the founder's first born son. Many firm managers provided similar responses as to why SAP had penetrated their firm: "We didn't really consider SAP at first, as we thought it would be prohibitively expensive. My SAP is pre-configured though and comes with templates, and although still more expensive than your fifty grand solutions, it does not cost a million quid". The CEO of one business reinforced this view: "There is no doubt that SAP was more expensive than many comparable ERPs, but we did not believe that it was prohibitively so....we are investing for the long term with what is probably the best ERP around." This reflected a distinct trend amongst SMEs to adopt SAP.

Large firms

Of the 10 large firms in the sample, six selected SAP. Of the remaining four firms, one selected another large-scale ERP provider (*JD Edwards*), whilst two selected lower cost solutions (*WDS, Avanti*). The remaining firm remained without a commercial solution, relying on a home-grown spreadsheet based solution. This firm was privately owned and had not been profitable for the past three years with the firm's directors influenced in their ICT decisions by the company's financial position: "We have managed to build the order book pretty well, but we have also been running significant losses as we grow the business aggressively. We have no plans to change our ERP solution as a result for the moment."

Very large firms

Of the five very large firms, four were existing users of SAP. The remaining firm had migrated to *JD Edwards* in the current period from a less complex ERP (*Lanpak*). Three of the four firms had been using SAP more than four years ago, with only one migrating to SAP in the current period from a smaller-scale ERP solution (*Unity*). This occurred due to the company being acquired, with the new parent mandating the use of SAP across all subsidiaries. All of the very large firms were publicly owned.

5.1.5 Customer Relationship Management and Technology Adoption

The adoption and use of ICT can affect how a firm manages its customer relationship and its competitive advantage (Spanos et al, 2002). Where the technology adopted is aligned with firm strategy, this can lead to lower costs and technological superiority (ibid). Managers provided a mixed response on their perception of the alignment between their firm's ICT and strategy:

> In theory, our ICT should reflect our firm's strategy. In reality, the two aren't always aligned.
>
> IT manager, large firm

> We are sometimes made to buy stuff we don't want because HQ says we have to, and other times we have to fight for things we need, but aren't allowed to buy. It's a merry go round.
>
> IT manager, very large firm

> We generally tend to have what we need, which amounts to a PC displaying data.
>
> IT manager, SME

The relationship between ICT and strategy was not adequately explored, due to the difficulties inherent in the gathering relevant information and the subjective elements involved. Based on discussions with firm managers and a review of ICT at the sample firms, a majority of firms had employed ICT that was adequate in facilitating the execution of their operational requirements. The majority of IT managers confirmed that they were satisfied with the ICT in place at their firm, with this view relatively consistent with those of other at their firm. Twenty one firms in the sample were "print to order" sub-contractors that manufactured a product to specifications provided to them. The remaining two firms were major contractors of work and located at the apex of the aerospace supply chain, with the ability to influence the ICT adopted by downstream firms. Table 11 summarises the customer relationship management as defined by Chiarvesio et al (2004).

Type of relationship	% of Sample
Co-operative	22%
Execution of technical specs	74%
Some elements of both	4%
Total	100%

Table 11: Type of customer relationship

Five firms engaged in a co-operative relationship with customers; three SMEs, one large firm, and one very large firm. The majority of managers in these firms cited a desire to retain business longer term as their principal reason for engaging in this mode of relationship management. No evidence emerged that firms in the sample had established operational infrastructure that was at odds with their strategic intent based on observations and interviews.

5.1.6 Adoption of ICT

Nine classes of ICT were defined, using Chiarvesio et al's typology (2004), with the results of ICT use across the sample depicted in table 12 below. Five types of ICT showed a 100 per cent adoption rate, or a figure approaching this: e-mail; broadband/ISDN; a website; ERP; electronic banking.

ICT Adopted	% of firms adopting
E-mail	100%
Broadband/ISDN	100%
Website	100%
Electronic banking	96%
ERP	100%
EDI	57%
Group-ware	61%
Video conferencing	70%
Ecommerce	61%

Table 12: ICT adoption

Groupware is a relatively new area of ICT activity, encompassing online knowledge-related efforts. Over 60 per cent of firms had utilised groupware to some degree, with managers indicating that this permitted them to share knowledge and circulate information, irrespective of the distance between participants. In some cases, this included the subscription of the firm to a defined number of user accessing online courses. A number of recurring reasons emerged as to why firm managers utilised groupware: lower costs; the ability to reach multiple participants; convenience; faster diffusion of knowledge; ability to assess results quickly and centrally; more objective teaching mode. These results support conclusions that groupware, amongst other data sharing ICT modes, enhances the internalisation process, and the translation of explicit into tacit knowledge (Romano et al, 2001). The use of groupware was most prevalent amongst the largest firms in the sample, and not utilised at all by smaller SMEs, reflecting resource and budget constraints amongst these firms.

The use of videoconferencing displayed a higher adoption rate, with almost three quarters of firms adopting this to some degree. Webcams were the most widely utilised mode of videoconferencing, with more expensive fixed video conferencing hardware confined to a small number of very large firms. Electronic document interchange (EDI) was utilised by firms undertaking Government work, and prevalent across all firm types. More general forms of e-commerce were undertaken by almost three quarters of firms, primarily to make payments and place orders. Firm managers expressed the view that a lack of e-commerce-enabled partners limited the further use of e-commerce. This is congruent with literature identifying this factor as a contributor to the under-utilisation of e-commerce (Zhul, 2003). The distribution of ICT and its use is depicted in chart 7.

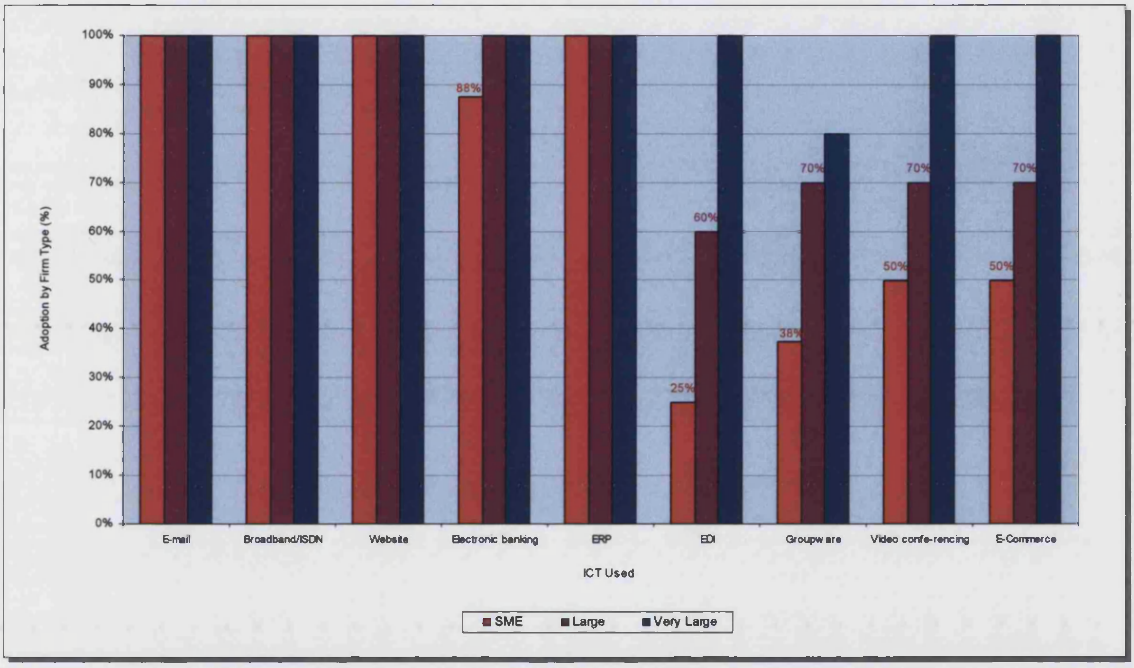


Chart 7: ICT adoption by firm type

The adoption of EDI, groupware, videoconferencing and e-commerce was the lowest amongst SMEs, with a number of reasons cited by SME managers for this including: they are generally sub-contracted by larger firms that secure Government work and have the contractual relationship for the adoption of EDI and e-commerce; many larger firms do not ‘push’ e-commerce requirements to smaller firms they transact with; smaller firms do not have the resources to invest in groupware activities; the execute-to-order nature of the relationship between many SMEs and larger firms did not require the use of videoconferencing.

Four larger SMEs displayed a similar use of ICT as large and very large firms in the sample which was due to two reasons: (1) they possessed the necessary financial and operational resources; (2) their owners mandated that this occurs. Only large and very large firms displayed a 100 per cent uptake of ICT across all of the ICT categories reflecting the financial and operational resources available to them and the strategic intent of managers to utilise these. This often reflected the requirements of the target customers for these firms that included Government, primes, and others.

5.1.7 Communication with Suppliers

Six principal types of ICT were identified and compared, augmenting Chiarvesio et al's list (2004). These were also contrasted to the more 'traditional' mode of meetings. Table 13 summarises the utilisation of these by the firms.

Communication Mode	% of firms adopting High	Medium	Low
Meetings	70%	13%	17%
Telephone	83%	17%	-
Fax	4%	78%	26%
E-mail	91%	9%	-
Videoconferencing	-	-	26%
Integration between software applications	-	22%	52%
CAD sharing	-	-	17%

Table 13: Communication modes with suppliers and overall firm adoption.

Meetings and the telephone were utilised to a high degree by the majority of firms, whilst a very small minority of firms utilised facsimile to a high degree. This was primarily due to the substitution effect from email, with almost all firms utilising this mode to a high degree. Over three quarters of firms utilised faxing to a medium degree with a number of reasons cited: making change requests; placing and confirming orders; sending technical drawings and designs; other administrative communication. The following three sub-sections segment the communication modes with suppliers into *high, medium* and *low*, exploring the key drivers for these.

5.1.7.1 High Use of Communication Modes with Suppliers

Three quarters of SMEs utilised email to a high degree, in contrast to large and very large firms, with every firm in these two latter firm types utilising email to a high degree. Two principal reasons emerged for this: (1) the lower prevalence of a 'corporate culture' within smaller firms, with many managers still preferring to use the telephone for an 'instant' response; and (2) the longevity and age of some managers and operational staff, which resulted in a lower level of e-literacy in some cases; (3) a higher prevalence of owner-managers who often did not use email to a great degree themselves. These factors resulted in a lower use of email and other e-commerce incentives which was reflected in over three quarters of the smaller firms. Chart 8 summarises the proportion of firms adopting the various communication modes to a high degree. It can also be observed that meetings tended to be utilised to a higher degree as the firm size increased, with firm managers indicating that larger more formal cultures necessitated this in addition to being required due to more complex manufacturing processes and related factors.

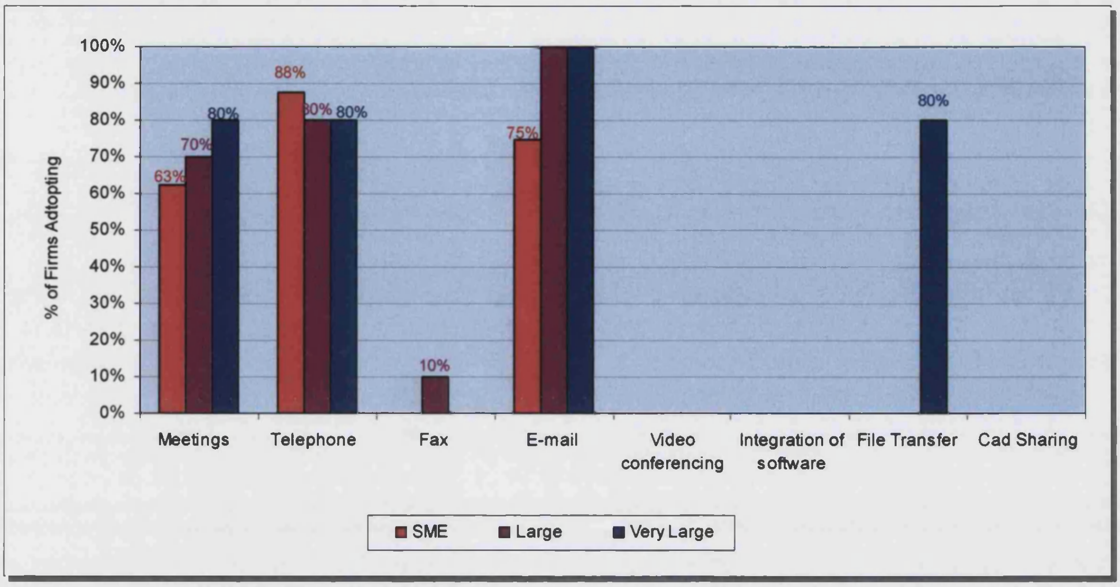


Chart 8: High use of communication modes with suppliers

Only very large firms utilised file transferring to a high degree, with this confined to transmitting technical designs and operational data. Only large firms reported a high use of fax for communication with suppliers, with this utilised by a minority to confirm orders, transmit forms and change requests. No firms undertook a high level of integration amongst varying software solutions or a shared CAD files to a high degree. This supports findings from the European Commission (2005) which indicated that many firms were still not integrating their ICT and related solutions to the degree required to generate optimal efficiency and benefits.

5.1.7.2 Medium Use of Communication Mode with Suppliers

Chart 9 depicts the medium use of ICT by firms in communicating with their suppliers. Meetings and telephone communication were utilised to a medium degree by a minority of firms across firm types, reflecting the use of these to a high degree, as depicted in the previous section. Faxing was utilised by over half of all large and very large firms to a medium degree, contrasting the lower use of by SMEs. Email was utilised to a medium degree by the remaining SME firms in the sample, in addition to those utilising it to a high degree.

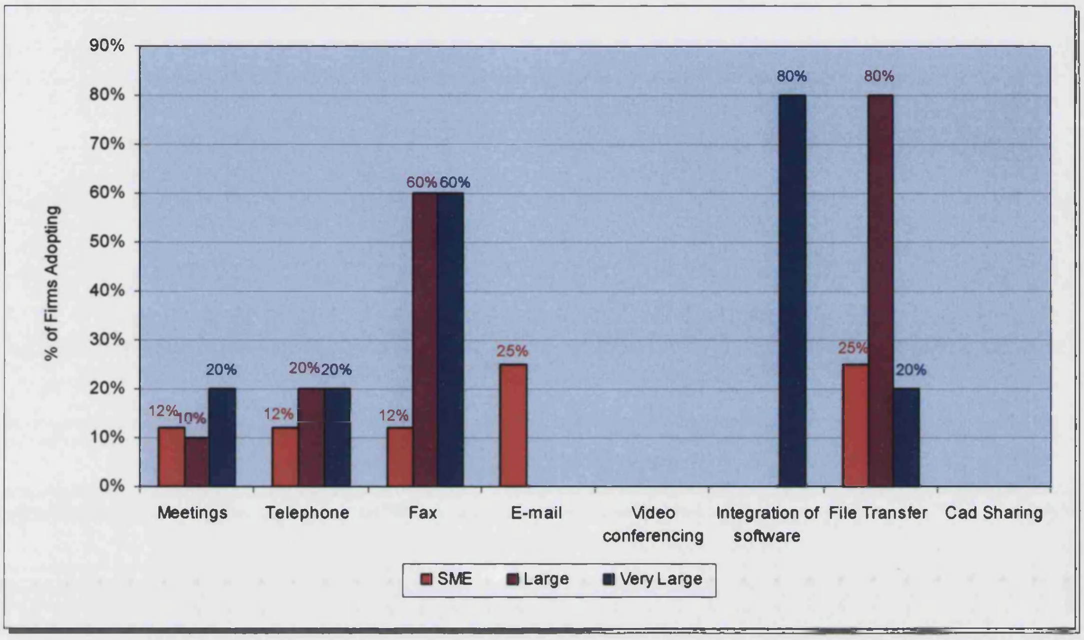


Chart 9: Medium use of communication mode with suppliers

The majority of very large firms undertook software integration to a medium degree to permit CAD and ERP to communicate with back-end data in particular, with no other firm type engaging in this to a medium degree. A high proportion of large firms SMEs and very large firms also engaged in file transfers on a regular basis to a medium degree, with firm managers believing that this area will become one of higher activity in the future.

5.1.7.3 Low Use of Communication Mode with Suppliers

The majority of SMEs displayed a low adoption of some communicative technologies, with only a minority utilising these on a high or medium frequency. This included facsimile use, software integration and file transfer with customers. The results support work highlighting the often polarised nature of ICT adoption amongst SMEs, with many maintaining traditional ICT such as telephony and fax, and investing less in other areas such as e-commerce and groupware (Duan et al, 2002). Chart 10 depicts the firms using ICT at a low level. A minority of SMEs utilised CAD sharing amongst the sample, and did so to a low degree. Firm managers amongst these firms cited cost as the primary reason for low CAD utilisation, with annual licenses often costing US$10,000 per workstation. In contrast a higher proportion of very large firms utilised CAD to share files with customers, with this reflecting the nature of the contractual relationships in place.

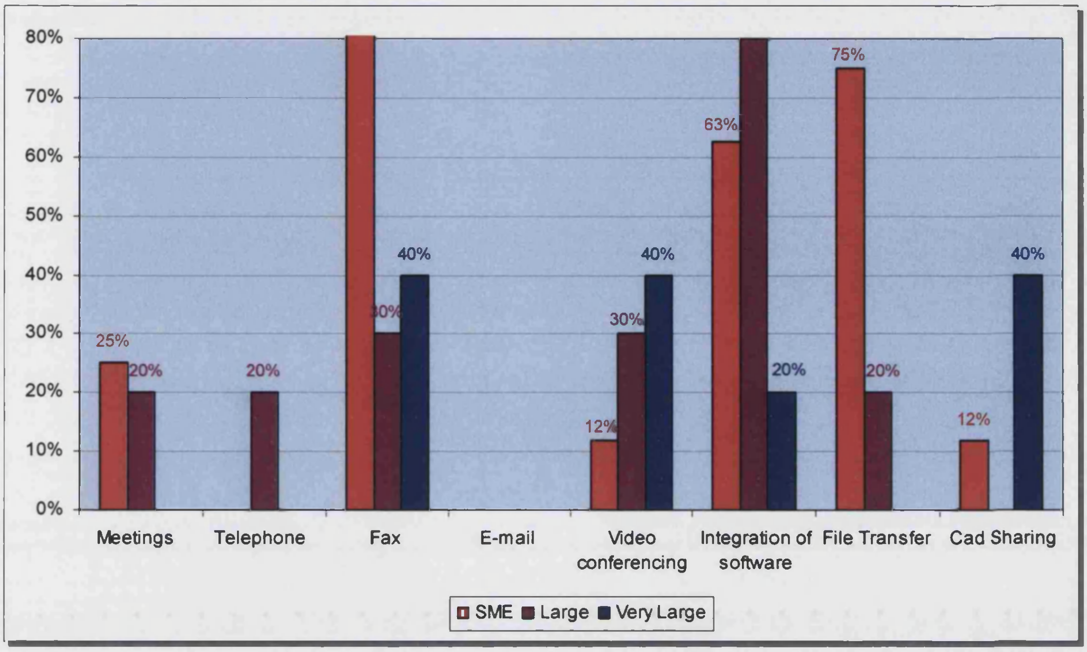


Chart 10: Low use of communication mode with suppliers

The lower level of CAD sharing overall across the sample was predominantly due to the inability of firms to electronically transfer files seamlessly from one CAD solution to another. The approach more generally utilised consisted of converting files to another format and sending these via email to the recipient, who accessed them via non CAD solutions.

5.1.8 Communication with the Sales Force and External Staff

ICT was used by the firms to facilitate communication with their sales force and employees working externally or travelling, as depicted in table 14.

	% of firms adopting		
Communication Mode	**High**	**Medium**	**Low**
Meetings	74%	26%	-
Telephone	96%	4%	-
Fax	-	4%	4%
E-mail	87%	13%	-
Videocon.	-	-	9%
Integration between software applications	-	60%	32%
File transfer	-	35%	65%
Mobiles	100%	-	-

Table 14: Communication with the sales force and external staff

A number of the ICT modes utilised by firms to communicate with suppliers also displayed a high level of utilisation in communication with the sales force including emails and telephony/mobiles. The use of faxing was very low, with this perceived to be a less relevant mode in communicating with a mobile sales force and replaced over time by email and mobile phones, and recently, the convergence of these two with 3G cards for mobile broadband, and Blackberry's. A lower degree of software integration often occurred when compared with communication requirements with customers. Tasks enabling communication with the sales force and remote employees were also often carried out by internal IT staff, in contrast to the use of specialised and more expensive external resources utilised to implement some supplier communication elements. The following sub-sections highlight the high, medium and low use of ICT in communicating with the sales force and external staff.

5.1.8.1 High Use of Communication Modes with the Sales Force and External Staff.

All firms utilised mobile phones to a high degree when communicating with the sales force and external staff, with this mirrored by the use of telephones in general, as depicted in chart 11.

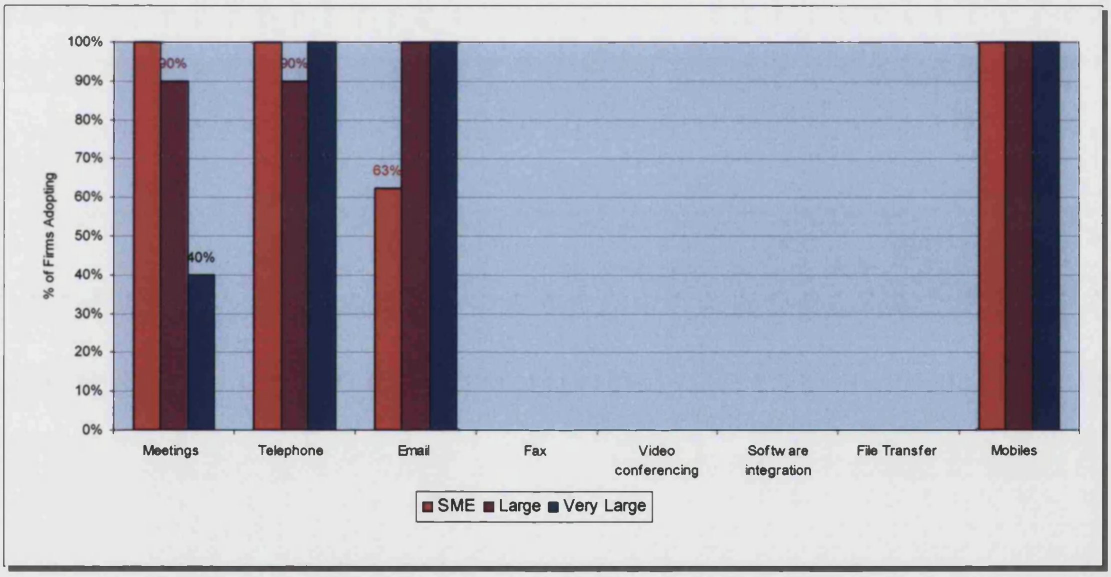


Chart 11: High use of communication modes with the sales force and external staff

Email communication was utilised to a high degree by all firm types, with the exception of SMEs. The principal factors contributing to the lower intensity of email use in communicating with the sales force and external staff amongst these firms included:

- The higher visibility of firm owners who also served as the firm's CEO and wished to be informed 'immediately' of developments, often by telephone.
- Smaller firms possessed a flatter organisational structure with less formality than larger firms, which favoured the use of direct contact than email.

- Some firm managers in SMEs were not as e-literate as their counterparts in larger firms, particularly older managers in family owned firms, and preferred phone communication to email, referring to the latter as “not for me”, or “never use it much”.

A number of SME managers highlighted a key benefit in communicating via telephone: a lack of irrelevant information being transmitted which they believed occurred with the prolific use of email. The smaller more entrepreneurial environment characterising SMEs fostered a greater degree of personal contact between all levels in the firms which resulted in the high use of meetings with the sales force and other staff. A smaller number of large and very large firm managers indicated a higher use of meetings with their sales force, with these firms often possessing a differing organisational and cultural milieu to SMEs that affected their use of ICT:

- Very large firms employed a greater number of dedicated sales and business development staff who were ‘on the road’ more and utilised email and phone contact for reporting and communication.

- Very large and some large firms were geographically dispersed across locations, with a greater use of email and telephones to coordinate sales activities.

Four ICT categories were not utilised by any firms to a high degree when communicating with the sales force: fax; video conferencing; software integration and file transfer.

5.1.8.2 Medium Use of Communication Modes with the Sales Force and External Staff.

The medium use of ICT for communicating with the sales force and external staff displayed greater use than the other two categories (‘high’ and ‘low’). Meetings were utilised to a medium degree by almost two thirds of very large firms, whilst half of all very large firms utilised video conferencing to a medium degree to ‘meet’ with their sales teams and external staff. This was the only instance of video conferencing amongst differing forms of communication with the sales force. This entailed the utilisation of web cams via free services such as Microsoft Messenger (MSN). Chart 12 depicts these and other results.

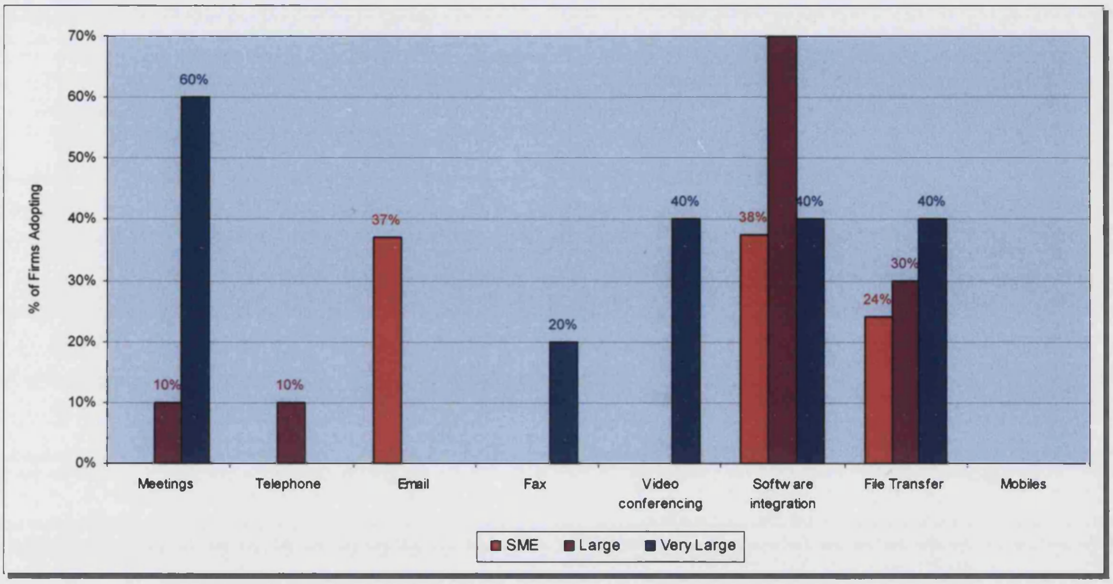


Chart 12: Medium use of communication modes with the sales force and external staff

All large firm managers indicated a medium occurrence of software integration, compared to around half of SME and very large firm managers. The majority of SMEs and a number of large and very large firms only integrated Microsoft Outlook and security software in order to facilitate secure email communication and file transfers. The main differences between the firms that integrated their software were:

- Large and very large firms employ a greater number of IT individuals or utilise a dedicated IT person, allowing for greater levels of integration and sophistication.
- The majority of SMEs employed fewer people than large and very large firms, and had fewer requirements to integrate software applications.
- Fewer employees were 'on the road' in the case of SMEs, resulting in a lower requirement for the integration of communicative products.

Very large firms led the medium use of file transfer followed by large firms and SMEs. The principal files exchanged between the sales force and the firm were: sales proposals, reports, documents and expense claims. A number of factors contributed to file-transfer utilisation differences between firm types:

- A lower requirement to report formally on sales and business development activities occurred in SMEs, which employed fewer people than many large and very large firms and in which there existed a greater degree of visibility of the majority of employees.

- The person often taking a lead or active business development role in SMEs was often the firm's head/owner who did not engage in formal reporting or require for this to occur.

- In cases where the SMEs head/owner undertook sales activities, or delegated this to another employee, the majority of file transfers related to sales proposals, with the remaining file transfers encompassing information that included travel, expenses, and incidental items.

5.1.8.3 Low Use of Communication Modes with the Sales Force and External Staff.

The majority of firms engaged in a lower use of file transfers, with this mode not a principal driver of communication between the firm and its sales force and external employees. Chart 13 depicts the results for the lower use of ICT for such communication.

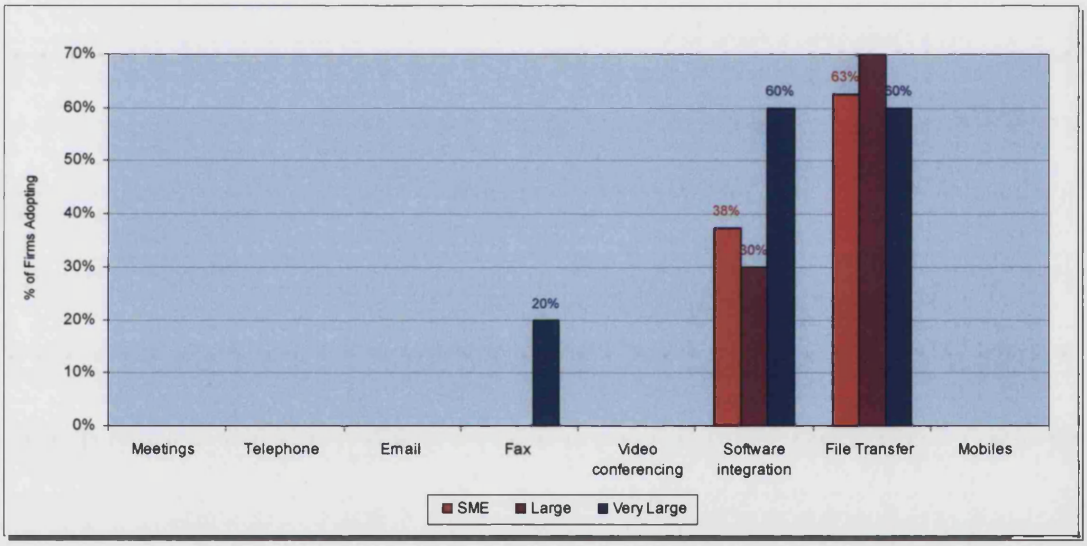


Chart 13: Low use of communication modes with the sales force and external staff

A low occurrence of software integration was evident in over a third of SMEs and large firms, and twice this proportion of very large firms. Managers in the latter did not engage in a great degree of integration to facilitate access with the sales force and external staff, confining this to email solutions such as Microsoft Outlook in the main. The high presence of a lower use of file transfers reflects the use of email without attachments. The pattern of communication with the sales force across all modes (high, medium and low), is congruent with recent research (Chiarvesio et al, 2004).

5.1.9 E-Commerce

The overwhelming majority of aerospace firms are *price takers* in the market, with a small number of very large firms having some ability to affect pricing (Graham and Hartaker, 1998). These are usually primes and are often also involved in international operations. The majority of firms in the sample were price takers, with some exhibiting resistance to the disruption of their existing mode of supplier-customer communication, with a change most often requested by major customers. The use of e-commerce can represent a key stage in the evolution of the use of ICT by a firm, which in turn can have spillover effects into the broader economy if an increasing number of firms adopt it (Graham and Ahmed 2000). Topical investigations have in the past revealed that industrial firms often pass through stages when adopting their e-commerce, whilst some, including many SMEs, do not adopt e-commerce primarily due to cost and security reasons (Daniel et al, 2002). Whilst SMEs account for a third of the sample firms, they represented one tenth of the firms adopting e-commerce. Only one sixth of SME managers cited *cost* as the reason for a lack of e-commerce investment, with no manager citing *security* as a barrier to adoption. This section makes a contribution in its own right to the current research on ICT adoption by firms by exploring the implementation and use of e-commerce, which is often posited to be a key facilitator of digital business with the potential to impact a firm's performance through enhanced transaction efficiencies (ibid). The manner in which this is managed however is integral to this process.

Just under half of the sample had adopted e-commerce, with twice as many large firms and four times as many very large firms embracing this as SMEs. Table 15 depicts the principal reasons cited by firms for not adopting e-commerce in addition to the perception of firm managers on the level of investment made.

		No Investment				Investment			
Firm type	% of firms without e-commerc	Unsuitable to firm's process	Lack of internal resources	High costs	Safety concern of transaction	% of firms with e-commerce	Adequate investment	Inadequate Investment	Low but increasing investment
SME	75%	67%	17%	16%	-	25%	33%	-	66%
Large Firm	50%	75%	25%	-	-	50%	33%	17%	50%
Very Large Firm	0%	-	-	-	-	100%	80%	-	20%
Total	52%					48%			

Table 15: E-commerce adoption by the sample firms

Two thirds of the SME managers adopting e-commerce believed that their investment was low but that this would be increased over time. Around half of large firm managers believed that their firm's investment was low, with this reducing to around a fifth of firm managers for very large firms. A principal contributor to the variation between the results was the size of the investment being made and the complexity of operations being covered. Larger firms are often required to present a formal business case for e-commerce investment which although mirroring many of the areas that SMEs address, encompasses a wider ranging number of dependencies that are 'deeper' including the existence of multiple firewalls, and the use of multiple databases and secure information, amongst others. The use of e-commerce amongst SMEs often involves narrower access points and organisational layers.

One third of SMEs and large firms believed that the level of investment in e-commerce was sufficient, whilst one fifth of managers in large firms did not believe that they had made an adequate investment in ICT. Two principal reasons were cited for this: (i) a miscalculation of the additional features and areas that should be covered, and, (ii) scope creep due to customers demanding additional e-commerce features, and/or integration with their systems. No sample firm entered into e-commerce speculatively in order to be perceived as being a leading firm. Over 90 per cent of firms that had adopted e-commerce had progressed through a number e-business stages summarised below in this section, that managers believed were essential precursors before they adopted e-commerce, supporting the hypothesis by Daniel et al (2002; p254):

> At each stage they (SMEs) will develop certain ecommerce services from which they will gain experience and hence dissipate uncertainty and risk, which will be of benefit whey they develop further services.

The remaining firms undertaking e-commerce did so without progressing through a number of stages. Over half of the firms that had not undertaken e-commerce progressed through some preliminary stages, but had not made the final transition to implementing e-commerce. The adoption of a staged e-commerce strategy amongst firms in this study contradicts earlier results by some researchers who posit that SMEs in particular will follow a path that will best meet the owner's strategy for business growth and not a staged model (Beckinsale et al, 2004). This view assumes an unplanned growth dimension however and that owners of firms do not make stepped changes to their businesses. The results from SMEs in the sample did not support this, with the owners and managers of these firms adopting a staged approach in their digital strategy.

The adoption of e-commerce by SMEs mirrored the approach utilised by larger firms with e-commerce ultimately adopted as a result of one of three principal reasons: (i) to obtain benefits that the owner/manager believed existed, although this was not a primary business driver; (ii) as a result of external pressure, and, (iii) to establish organisational readiness. This is congruent with results by Mehrtens et al (2001) with the results obtained believed to warrant further research to explore the notion that both large and small firms engage in a similar staged manner in the introduction of e-commerce. The majority of firms displayed a common pattern of e-commerce adoption that encompassed a number of stages in the lead-up to the adoption of e-commerce, as depicted in table 16.

Stage 1: Development of local area network (even within smaller SMEs)	
Stage 2: Utilising email to communicate with suppliers and customers	*The order of these varied and was dependent on contextual and other influencing factors.*
Stage 3: Utilising the internet for information purposes	
Stage 4: Exchanging documents electronically	
Stage 5: Developing a website that provides information about the company's products and services online	
Stage 6: Adoption of e-commerce	

Table 16: E-commerce adoption stages

Despite the variation displayed in e-commerce adoption by firms, no firm developed its e-commerce capability without stages 1, 2 , 3, and 5 being established. Around half of the firms implementing e-commerce had exchanged documents electronically before this occurred, with this task identified as an important pre-cursor to the development of business-to-business activities (ibid). Of all the pre-cursors to e-commerce, managers considered the firm's website to be the most strategic and an area of ongoing development. This finding was congruent with research acknowledging the strategic benefits that a website brings to the firm (Mullane et al, 2001).

5.1.10 Website Strategy: Present and Future

All firms in the sample had developed a website. No relationship existed between the sophistication of the website (the number of pages, level of graphics, information, interactivity, etc.) and the firm type with some SME websites more sophisticated than larger firms. A principal factor defining the nature and 'location' of a website was firm ownership: the majority of firms owned by larger parent companies possessed websites within the parent company domain and in general displayed fewer pages and information. Some firm managers believed that this 'masked' their businesses visibility and expressed a preference for a stand-alone site.

Almost all firm managers believed that their company's present website was of greater strategic and operational importance than five years ago, with this reflected by the evolution of many elements over time such as the graphics, information, password access for suppliers and customers, and others. In three quarters of cases, the firm's first efforts at constructing a website were described as 'basic'. Table 17 summarises the aim of the firms' website using Chiarvesio et al's (2004) typology.

Firm type and website time frame	Firm description	Product information	On-line catalogue	Information acquisition from customers	Customer support	Direct sales
SME- Present & Future	100%	100%	25%	25%		
SME- Future				13%	13%	25%
Large- Present & Future	100%	100%	30%	20%	20%	
Large- Future				10%	20%	13%
Very Large- Present & Future	100%	100%	20%	20%	20%	
Very Large- Future				40%	40%	
TOTAL- Present and Future	100%	100%	26%	22%	13%	9%
TOTAL- Future				17%	22%	4%

Table 17: Use of website by firm type

All firms utilised a website to describe the business and its products, with this expected to continue. One quarter of all firms had some form of online catalogue available for their customers. Of the firms making online catalogues and related information available, half required customers to sign in for access. Around one quarter of firms were using their website to capture information from customers including order taking, change requests, and queries. This figure was consistent across firm types, with the largest change observed in SMEs; many undertook did not offer this functionality five years ago. In contrast, around one quarter of large and very large firms reported that information was sought via their website from the outset.

No SMEs integrated their website with back office systems, which was consistent with results from other researchers (Beckinsale et al, 2004). The principal reasons cited by firms included: 'we have no need'; 'our customers don't require it ; 'there are no benefits; and 'too expensive for little or no return'. Almost a fifth of all firms intended to offer the ability to capture customer information in the future. No SME utilised their website to provide customer support, with managers citing a number of reasons for this: "we are too small to manage this"; "we just manufacture to order, so if they have an issue, customers call"; "we are not Boeing"; "we can't afford it". A small proportion of SMEs were planning to offer this in the future, in contrast to a larger proportion of both large firms and very large firms. Managers in the latter two firm types cited customer pressure as the primary reason for providing a greater level of online support. A secondary reason was the belief that this would permit them to deal with queries more cost effectively. A small proportion of firms utilised their website to assist in direct selling, with this confined to very large firms. These firms produced a range of products that could be sold 'as is' in addition to the contract manufacturing of tailored products. Around one quarter of SMEs, and a small proportion of large firms also plan to offer this capability in the future, with managers in these firms believing that direct sales complement products they can offer 'from a catalogue'. Managers in firms that were solely contract manufacturers did not believe that their business was conducive to a direct sales approach.

5.2 The ICT Activity-Cycle

The use of ICT within the firm can affect its organisational structure, strategic decision making, organisational culture, and other operational elements (Daniel et al, 2002). Firms embarking on ICT-enabled organisational change can extend the use of ICT, with technology acting a catalyst for change (ibid). This is often a complicated process involving multiple activities including the planning, purchase, implementation and monitoring of ICT in addition to the establishment of related skills (Brynjolfsson, and Hitt, 1998). This section draws upon research in these and related areas to define a life cycle for ICT that begins with its formative stages as encapsulated by the assessment and planning stage, and concludes post-implementation with the monitoring of its benefits. This is not posited to be a definitive 'end-to-end' schema for ICT adoption and use within the firm, bur rather, as a template that is of relevance for this study. In the process however, it is believed that many of the key activities inherent in the adoption and utilisation of ICT within the firm are captured.

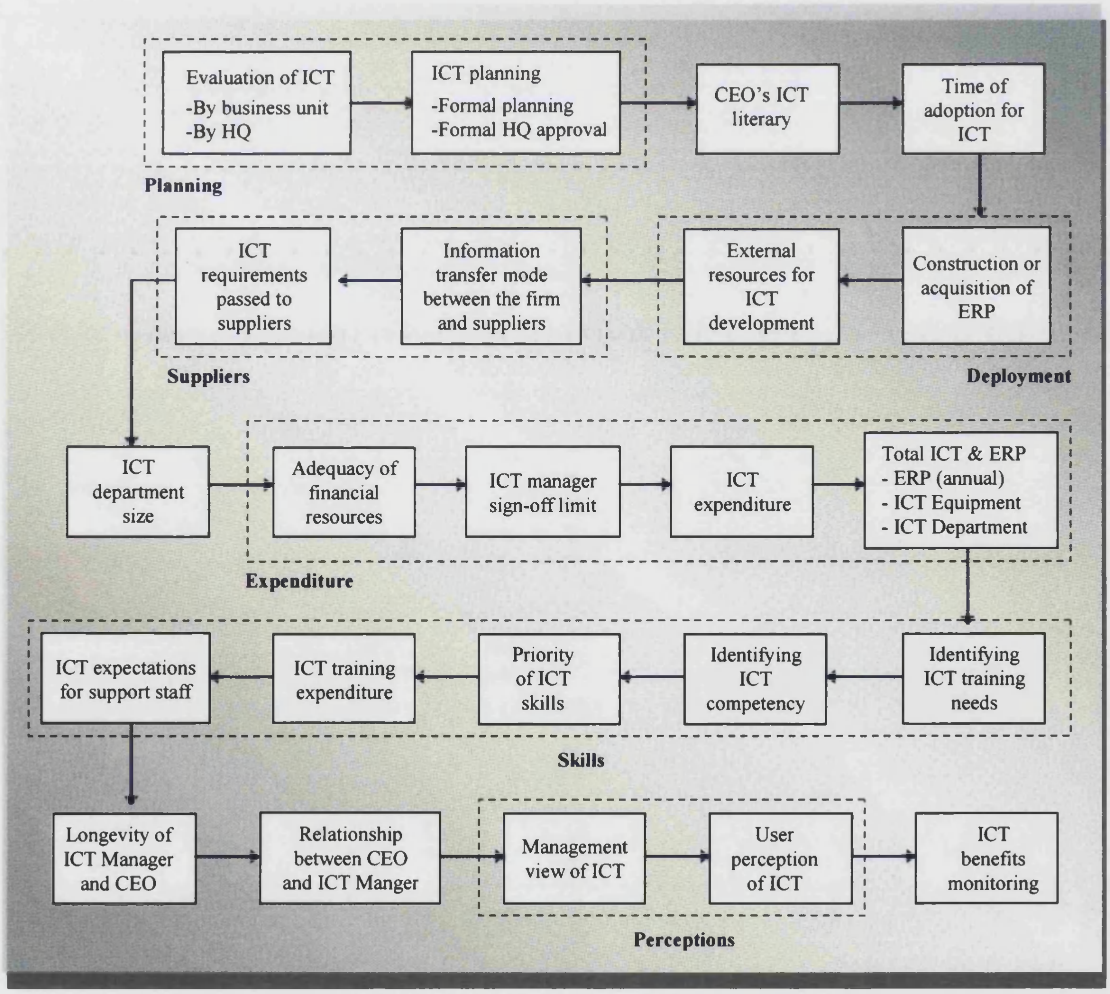


Figure 13: ICT activity-flow model in the firm

Figure 13 presents the ICT activity-cycle, which is segmented into 23 stages covering six areas: *planning; deployment; suppliers; expenditure; skills,* and *perceptions.* Some activities fall outside of these categories and are depicted as a conduit between these. The flow depicts the ICT process from the initial evaluation stage through to the planning stage. This process incorporates the role of other potential mediating influences such as the ICT literacy of the key decision maker of the firm and the level of assistance provided by internal and/or external resources. All of the sample firms were engaged in vertical relationships with suppliers and customers, with many involved in closer cooperation on a voluntary basis, including the exchange of information, whilst in other cases, requirements were 'pushed' between firms.

This study highlights the central role that the IT department plays in the management and implementation of ICT, with the composition of the department's budget and the autonomy of its managers affecting both the activities undertaken, and the interaction with other departments. One of the frequently neglected aspects of ICT within the organisational milieu is the identification of ICT skills, managerial expectations, and the prioritisation and implementation of appropriate training. This uptake, diffusion and enhancement of ICT skills can be influenced by the relationship and managerial practices between the IT manager and the head of the firm however, including the length of time they have been in the firm with this area not adequately explored in the literature.

The tail of the activity cycle is often also little explored in the literature which encompasses the monitoring of ICT, and reveals a gap evident in the literature on of how this integrates into broader firm processes and affects future ICT implementation. The defined ICT activity-flow for the sample firms is reviewed in this section, representing an essential element in the journey to assessing the role of managerial practices in technology mediated firms, and their interaction with ICT. Both are interwoven throughout the organisational fabric.

5.2.1 ICT Expenditure Evaluation and Planning

5.2.1.1 ICT Evaluation

Firms varied in their evaluation of ICT, and the degree to which their head office was also involved in the process. No firms evaluated PCs/laptops, printers, or even servers where these were individual requests. Firm's displayed varying thresholds for the initiation of the formal assessment of ICT, which often involved the acquisition of a larger number of items including PCs the acquisition of multiple servers; the installation of virtual private networks, extranets, and in many cases, ERP. In the absence of an accepted industry-wide definition of what constitutes 'formal' and 'informal' evaluation criteria, the following were developed to act as terms of reference in discussions with firm managers.

> *Formal ICT evaluation:* Adherence to a process encompassing a set procedure or protocols that may be integral to company-policy and which may include adherence to processes and the production of documentation. Non-adherence to these will result in ICT not being acquired. This may include minutes, business cases, board resolutions and other documentation that is required before ICT acquisition can occur.

> *Informal ICT evaluation:* A process that does not require official documentation to be produced before an ICT acquisition can occur and which does not form part of any required procedure. This may include ad hoc notes, financial analysis or other documentation.

Utilising these criteria, the degree of assessment of ICT was investigated amongst the firms. The results indicated that around two thirds of all firms did not undertake any form of ICT evaluation prior to its acquisition. In contrast, almost one quarter engaged in a formal evaluation process, and a minority undertook an informal degree of ICT evaluation. Table 18 summarises the findings for ICT evaluation both at the business unit and HQ level.

Evaluation of ICT by business unit	**None**	**Informal**	**Formal**
Very Large	40%	-	60%
Large	80%	10%	10%
SME	63%	25%	12%
Total Sample	65%	13%	22%
Evaluation of ICT by HQ			
Very Large	20%	-	80%
Large	40%	10%	50%
SME	100%	-	-
Total Sample	52%	9%	39%

Table 18: Evaluation of ICT

The majority of SMEs and large firms did not undertake any evaluation of ICT at firm-level, in contrast to very large firms, with around forty per cent of these carrying out the formal assessment of proposed ICT expenditure. Around one quarter of SMEs undertook the informal evaluation of ICT, with a smaller proportion of large firms also doing so. No very large firms engaged in the informal assessment of ICT, at either firm-level or within head office (HQ). Firm managers indicated that if their firm's policy did not require the formal evaluation of ICT, an informal assessment was not undertaken; "why should we bother?" (IT manager, very large firm). This firm type also engaged in the highest degree of formal ICT planning, with sixty per cent of very large firms undertaking this activity, which was around five times as frequent as that occurring in SMEs and large firms.

Around half of the HQs did not undertake any evaluation of ICT, with a minority undertaking an informal assessment. The remainder undertook the formal assessment of ICT with the majority of firm managers depicting a prescribed process they were required to follow, including providing the relevant head office department with the details of proposed expenditure "as defined in company policy (documentation)." Table 19 depicts the ICT evaluation and planning status of firms, their HQ, and the firm's ownership type. Four SMEs possessed a HQ (SME 06, 08, 12 17) but none were required to adhere to a formal evaluation process. In contrast, the majority of very large firms and around half of large firms had a HQ which undertook the formal evaluation of ICT.

Firm type	Evaluation of ICT/ERP: Business Unit	Evaluation of ICT/ERP: HQ	Firm Ownership	Formal ICT Planning
SME 06	Formal	Informal	Independent: Primogeniture	Undertaken
SME 08	None	None	Public	Not undertaken
SME 09	None	None	Independent: Non-Family	Not undertaken
SME 10	Informal	None	Independent: Non-Family	Not undertaken
SME 12	None	None	Public	Not undertaken
SME 13	Informal	None	Independent: Family	Not undertaken
SME 14	None	None	Independent: Non-Family	Not undertaken
SME 17	None	None	Public	Undertaken
Large 02	None	Informal	Independent: Non-Family	Not undertaken
Large 03	Informal	Formal	Public	Undertaken
Large 05	None	Formal	Public	Undertaken
Large 11	None	None	Independent: Family	Not undertaken
Large 15	None	None	Public	Not undertaken
Large 16	None	None	Public	Undertaken
Large 18	Formal	Formal	Public	Undertaken
Large 19	None	Formal	Public	Undertaken
Large 20	None	None	Independent: Primogeniture	Not undertaken
Large 21	None	Formal	Public	Undertaken
Very Large 01	Formal	Formal	Public	Undertaken
Very Large 04	None	None	Public	Not undertaken
Very Large 07	Formal	Formal	Public	Undertaken
Very Large 22	None	Formal	Public	Undertaken
Very Large 23	Formal	Formal	Public	Undertaken

Table 19: ICT evaluation and firm ownership

This was not mirrored by activities within these forms however, with only around 10 per cent of them engaging in the formal evaluation of ICT. This was often cursory, and provided to HQ which subsequently undertook its own more detailed formal assessment. The ownership of the firm appeared to play some influencing role in the evaluation of both ICT and its planning.

5.2.1.2 ICT Planning

A number of firms undertook ICT planning at firm level, in addition to their HQ also undertaking this. ICT planning was generally managed by the same individual who conducted the evaluation of

ICT which in the majority of cases was the IT manager. A number of general observations on ICT planning were made:

- The level of formal planning increased with firm size, with around 80 per cent of very large firms undertaking some form of formal ICT planning, contrasting 60 per cent of large firms and 25 per cent of SMEs.
- The total number of firms engaging in formal planning was just over half, indicating that almost as many did not undertake this task, with this being more prevalent in smaller firms.
- The majority of SME managers perceived ICT planning as costly and time-consuming, particularly with respect to the cost-benefits for their sized firms and the lack of complexity of operations.
- Smaller firms' managers undertook rudimentary ICT planning, with this often confined to a review of the hardware requiring replacement within the planning period.
- As the size and complexity of the firm increased, a greater number of managers undertook ICT planning at the local level.
- An increase in the in size and complexity of the firm generally resulted in a greater degree of central ICT planning, managed by a HQ.
- The sophistication of ICT planning tended to mirror the size and complexity of the firm with larger firms, and those belonging to publicly listed parent companies, often utilising more advanced assessment methods to establish the firms' ICT use and future requirements.

The results supported recent research positing that as firm size and complexity increased, a greater propensity existed for ICT planning to occur (Temtime, 2003). A further factor supporting the lower incidence of planning was the limited 'forward looking' view of that was evident amongst many sample SMEs, which was reflected by their incremental investment in ICT, and was congruent with some research (ibid). This incremental nature of ICT investment was also reflected in the approach to e-commerce. A closer review of the ICT planning results by firm-type provides a more granular assessment of both managerial practices and ICT utilisation.

Very large firms

A lack of ICT evaluation by HQ occurred only in one very large firm (very large 04). The firm was one of a number that had been acquired during the past 2 years and was still in the process of being 'turned around'. As a result, there was some trepidation on the part of the CEO to engage in large scale ICT spending until stabilisation had occurred within the operating firms, with the exception of

SAP. This was being rolled out in a staggered manner across all group companies and was considered to be 'the cornerstone' of future information flows and operational planning. The firm had requested its SAP supplier to provide a detailed cost-benefit analysis before it would commit to the decision to purchase the solution. This firm contrasted other very large firms, with three of the five undertaking ICT evaluation formally both at the local and HQ level (very large 01, 07, 23), whilst one (very large 22) undertook this only at HQ. All three dual-evaluation firms (firm-level and HQ ICT assessment) belonged to international groups that utilised formal evaluation techniques to assess ICT investments. This included:

- Cost-benefit analysis
- Competitive assessment of products/services
- Business cases
- Gating process

For very large firms complying with HQ ICT evaluation criteria, a number of common practices and protocols were observed, segmented by major expenditure classes:

- PCs: All parent companies had negotiated preferred supplier arrangements with a number of global PC manufacturers including *HP, Dell, Compaq, IBM, Acer* and others. The firms were free to select their PC requirements from one of these suppliers. In all cases, they could order directly, utilising a unique identifying code. The parent company was subsequently notified by both the supplier and the firm of any orders placed. The length of the preferred supplier arrangements varied from 2-3 years.

- Servers: A mixed scenario was observed with one of the four firms' (very large 23) HQ dictating the use of a particular supplier for the purchase of severs. In the case of the other three very large firms, IT managers were able to select from an approved list of suppliers and had to subsequently follow a formal request process for the purchase of a server. In some cases, this included a pro forma cost-benefit analysis. This was sent to HQ after the CEO and the finance director of the firm had approved it. If approved by HQ, the firm could purchase the items locally. The reasons cited for HQ approval included the tracking of major ICT investments and ensuring that the businesses were not purchasing ICT that was incompatible with the group's short and medium term requirements.

- ERP: The ERP evaluation and selection for all very large firms was undertaken by HQ. This involved the most significant amount of time allocated for any ICT decision, and with the exception of one firm (very large 04), a multi-functional team assessed ERP investments comprised of operational, IT and finance resources. Detailed documentation was produced in order to gain this approval. In the majority of cases, the local firms were required to pay for ERP from their own funds, with some instances of cost sharing occurring.

Large firms

Only one large firm undertook the formal evaluation of ICT (large 18). The firm had recently been acquired by a listed company, with a new CEO installed. This individual possessed a strong financial and operational background and implemented a more formal approach to ICT evaluation, including the completion of business cases for ICT investments greater than US$5,000. The site was replete with older PCs and servers in particular (with an average age of 3 years) with an accelerated replacement cycle commencing. A central HQ ERP mandate had recently occurred, requiring SAP to be rolled out across all firms. All other formal ICT decisions made locally related to PCs and servers. The IT department within HQ was also required to approve any hardware purchase that was non-PC related, regardless of its size, in order to ensure that operating businesses were not ordering 'excessive' ICT which might lead to anomalies with other similar operating units. This firm's CEO characterised his firm as 'a sore thumb' due to his parent company not undertaking any formal ICT evaluation. The CEO actively supported his IT manager, with whom he appeared to enjoy a positive working relationship. Only one other large firm engaged in any evaluation of ICT (large 03). This firm had been acquired by a large international group within the past 2 years and was undergoing considerable structural and organisational changes as a result. An informal evaluation of ICT occurred, with the IT director providing the CEO and the operations director with an assessment of the benefits for any proposed ICT request that was not PC related and which was in excess of his signing limit. This usually occurred via an email and was discussed at weekly management meetings. The firm reported to a UK HQ which in turn reported to a US HQ. Any ICT investments that were defined as having an enterprise implications, such as servers or ERP were forwarded by the local CEO to the UK HQ's IT department for final approval. HQ defined and managed ERP for the group with no businesses permitted to engage in any ERP related activity unless it had been directed to do so by HQ.

All other large firms did not engage in any evaluation of ICT. The remaining large firms included three independent firms (large 02, 11, 20) representing three different types of ownership: family owned, non-family owned and primogeniture. These firms did not engage in any formal CT planning, nor did ICT form any component in the annual planning process beyond an expenditure line in the firm's budget. In the case of the independent non-family owned firm (large 02), an informal approach to ICT evaluation existed. Although the firm operated a number of smaller sites, the central site where the management team was located was not defined as a HQ. The firm was run by a 'hands on' CEO who was assisted on ICT issues by the commercial director who also acted as the IT manager. Informal ICT planning consisted of the commercial director developing a note with a financial summary of any proposed ICT spending that was in excess of PC expenditure and included servers, support contracts and related expenditure. The firm was only one of two in the sample that did not possess an ERP solution, with a 'home grown' solution using Microsoft Excel and Access utilised. The senior management team was cognisant of the benefits of ICT, but they did not believe that a need existed to formalise the evaluation or planning of ICT. This was also indicated by the commercial director also acting as the IT manager in a secondary role.

The second independent firm was family owned (large 11) and did not engage in any form of ICT evaluation or planning. No separate HQ existed, with all ICT decisions undertaken by the CEO and the IT manager. If any ICT decision needed to be made, the IT manager would inform the CEO if this involved expenditure greater than for purchasing a small number of PCs. This occurred verbally, or via an email with confirmation to proceed provided by the same means. The remaining independent large firm (large 20) was one of the two primogeniture firms in the sample. This firm was also characterised by a lack of a HQ function and the absence of any ICT evaluation or planning. An IT director managed the firm's ICT and was also involved in broader commercial areas of activity. If any ICT expenditure was to occur that was outside of the spending limits of the IT director, it would be referred to the CEO for approval.

All of the remaining five large firms were publicly owned and did not undertake any form of ICT evaluation (formal or informal). Of these, the HQ function of two firms (large 15, 16) did not undertake any form if ICT evaluation, nor were the operating businesses required to. In one of these firms (large 15) a confrontational relationship was observed between the CEO and the IT manager. The latter was not permitted to engage in any ICT expenditure, including PCs. The business had been acquired by a publicly listed parent company attempting and was in the midst of a 2 year plan for improvement, with the belief held by the CEO that the ICT function was 'a pain' and did not warrant any additional expenditure, despite all of the businesses servers and the majority of its PCs being outside of warranty periods. The CEO was required to pass on any requests for ICT expenditure to HQ, but he overtly refused to approve any within the business. The second firm lacking any ICT evaluation at firm-level and by the HQ department (large 16) had also been recently acquired by a publicly listed entity. The firm was in a loss making position with a directive by the parent CEO to streamline its business through the reduction of costs. As a result, all ICT expenditure had been frozen with no evaluation deemed to be required. This reflected the general view at the HQ of the parent, which did not undertake any evaluation of ICT or planning for technology.

In the three remaining publicly large firms (large 05, 19, 21), the lack of ICT evaluation at firm-level was balanced by some degree of informal ICT evaluation by HQ. The first firm in this group (large 05) did not engage in any ICT evaluation and relied on directives from HQ as to what ERP and type of ICT could be purchased. HQ also undertook some degree of ICT planning, with forecasts and costs defined on a rolling 3-year basis. The results were shared with the business unit managers who have an opportunity to amend them if they believe that they were not accurate. As a result of the ICT evaluation process, the local firms were free to select their own ICT supplier. This resulted in heterogeneous hardware existing amongst firms in the group. The IT manager was free to purchase ICT within his spending limits and referred higher expenditure items to the CEO for approval, such as multiple orders or servers.

The second firm (large 19) was part of a group of companies which were required to adhere to corporate HQ guidelines on ICT specifications and purchasing. No ICT evaluation occurred at the firm-level, with activities undertaken by HQ. These were confined to ERP tasks in particular, with considerable work undertaken to assess ERP succession options to the current solution. Further evaluation had occurred for enterprise servers and the securing of preferred suppliers for these which the businesses were required to purchase from. Any expenditure above the IT manager's threshold required sign-off from the CEO, and secondary approval from HQ. The key reason cited for this by HQ was the minimisation of 'unnecessary' ICT spending. HQ undertook considerable ICT planning at a group-level in order to determine ICT requirements and to provide global suppliers with forecasts and obtain volume discounts from preferred suppliers. A large HQ team of over 20 was utilised to undertake both the evaluation of ICT and the formal planning for all technology, using financial models and databases. The third firm (large 21) was part of a large international group, with HQ undertaking the formal evaluation of ICT. This did not occur at the local firm-level, with the IT manager relying on HQ to provide guidance on larger ICT expenditure and ERP. HQ also undertook ICT planning, and developed the narrative for the ICT component of strategic plans based on the information provided by the operating businesses. The latter was usually in the form of a pro forma being completed by the firms which depicted the hardware they utilised; the warranty period and time remaining; upcoming requirements (special orders) and other criteria. The IT manager was permitted to purchase ICT from approved supplier lists, but he was firstly required to submit the proposed expenditure to HQ for approval, before he could submit this to his CEO for final approval, regardless of his spending limit. This often led to a lengthy and conflicting process if spending approved by HQ was rejected by the CEO. This was exacerbated due to the CEO being required to fund ICT locally and due to the often confrontational relationship between the CEO and the IT manager.

SMEs

Of the eight SMEs in the sample, three undertook some form of ICT evaluation with two of these undertaking an informal evaluation (SME 10, 13) and one undertaking a formal evaluation (SME 06). The remaining five SMEs (SME 8, 9,12, 14,17) did not undertake any form of ICT evaluation at the local level. Three SMEs (SME 8, 12, 17) were part of a large group that was publicly listed.

5.2.2 Formal and Informal ICT Evaluation

Only one SME undertook a formal ICT evaluation (SME 06). The SME was one of two primogeniture firms in the sample, managed by the son of the founder. He strongly believed in the merits of a structured evaluation and planning for ICT, and was supported by an IT manager who oversaw the function across a number of sites. Each one was made to undertake formal ICT planning and ICT evaluation as part of the budgetary process. Proposed ICT expenditure was evaluated as early as possible with this confined to servers, maintenance contracts and ad hoc items that were not PC related. The informal evaluation process encompassed ERP, and resulted in the firm's managers migrating to SAP in the past 2 years from an older solution. This evaluation involved the IT manager and finance director assessing the costs and benefits of the ERP migration and providing the CEO with a summary of their conclusions. One of the two remaining firms undertaking informal ICT evaluation was an independent non-family owned private firm (SME 10). The CEO was assisted in the evaluation of ICT by the operations manager and the finance manager. The major ICT evaluation activities were limited to ERP, with the firm updating its 'home grown' ERP based on Microsoft Excel and Access, to a low cost rented option. Ad hoc ICT evaluation occurred with respect to sever upgrades, with informal activities consisting of a short memorandum being provided to the CEO with a financial breakdown of the costs involved. Verbal briefings occurred to provide additional background information. No ICT planning occurred beyond this. An informal ICT evaluation process was also evident in the final SME (SME 13). The firm was independent and family owned and employed an IT manager with his major ICT evaluation work confined to the selection of an ERP solution. This firm also upgraded its ERP solution from one assembled using Microsoft tools to a lower cost external one. No ICT planning occurred, with the firm's budgets capturing ICT expenditure as a line item only. All other ICT expenditure, including PCs, servers and support, were summarised before they were implemented, for the CEOs information purpose.

The remaining firms did not undertake any ICT evaluation. Of these firms, three belonged to publicly owned groups (SME 08, 12, 17), whilst two were independent non-family owned (SME 09, 14). Of the latter, one firm (SME 09) had maintained the same ERP solution over time, with managers indicating no intention to alter this in the future. The CEO of the firm did not wish to view any formal or informal valuation of ICT. His IT manager adhered to this, and only referred items to him for approval if they were outside of his authorisation limit. No central HQ function existed for this firm, nor was any formal ICT planning undertaken. This was also the case for the other independent non-family owned firm (SME 14). This firm was the smallest one in the sample in terms of employment, with fewer than 40 people. As a result of its small size, the commercial manager also acted as the IT manager. No ICT evaluation occurred, with the largest expenditure being a single server. When any ICT requires replacement, the CEO is informed by the commercial manager before it is purchased. The company's culture was bereft of the formality and hierarchy witnessed in some larger SMEs and other large and very large firms.

The remaining three SME firms were aligned to publicly listed companies. None of these firms undertook any formal or informal evaluation of ICT. In the case of one firm (SME 08), formal procedures were in place to order and manage the delivery of ICT, but this did not extend to its evaluation. The HQ for the firm undertook formal ICT planning, but this did not include any assessment of ICT expenditure. A dedicated IT manager managed technology at the firm, with his role focused on the operational management of ICT and not its evaluation. The remaining two SMEs (SME 12, 17) were also characterised by advanced ICT corporate policies and procedures for ordering and implementing ICT. In both cases however, the CEO did not believe that any benefits accrued from the evaluation of ICT. No ICT planning was also undertaken, with an estimate of the ICT required being captured by a single a line item in the budget. In the case of one firm (SME 12), the CEO was kept informed of all ICT purchases regardless of their (including PCs). In the case of the other SME (SME 17), the CEO permitted the IT manager to purchase ICT up to his $1,000 authorisation limit. No ICT evaluation was undertaken, with the CEO believing that this was "not something that we need to do". No ICT planning was also undertaken, with the IT manager required to provide an annual summary of the warranty status of ICT equipment and the period of time before these items were out of warranty.

5.2.3 CEO ICT Literacy

> " The central role of the CEO suggests that the characteristics of the CEO are even more critical in the decision of a small business to adopt IS."
>
> Thong, 1999.

The degree to which ICT is adopted by the firm is posited by a number of researchers to be influenced by the ICT literacy of the CEO.[46] This study adopted Thong and Yap's (1995) approach to investigating CEO ICT literacy, including undertaking discussions with other direct reports to the CEO on his/her perceived ICT literacy. This theme was further assessed with respect to the firm's

[46] Thong and Yap, 1995.

managerial practices, with the CEOs literacy potentially being a significant influencer of his/her actions and practices with respect to ICT, its related employees, and others in the firm (Thong, 1999). The following three criteria were utilised to structure the boundaries of these discussions, drawn from Thong and Yap (1999):

- *The innovativeness of the CEO in adopting ICT.* This included whether the CEO was an adaptor of technology or an innovator, and how ICT decision making was approached (including the degree of ICT decision making devolution).
- *The CEOs attitude towards the adoption of ICT.* The attitude of the CEO towards ICT was explored, including whether this is positive, negative, or neutral.
- *The CEOs ICT knowledge.* This included both general knowledge of ICT in addition to the benefits that it could bring to the business.

Following the exploration of these factors with a number of individuals, an overall decision was made if the CEO was believed to be ICT literate, with the following results obtained:

- Sixty per cent of the CEOs of very large firms were ICT literate.
- Forty per cent of large firm CEOs were ICT literate.
- The CEOs of SMEs displayed almost the same ICT literacy level as those in large firms.

Overall, around 43 per cent of the sample's CEOs were ICT literate. The results indicated that as the firm size increased, the CEOs became more ICT literate. This finding is aligned with recent research[47] with a number of observations supporting this:

- The CEOs of larger firms expressed the need for a greater degree of information than their counterparts in smaller firms.
- The organisational structure in larger firms was more complex and contained a greater number of organisational levels than in smaller firms. The resulting information requirements also became more complex, with senior managers often required to possess a better understanding of the relevant ICT used to produce this.
- Many larger firms operated more than one site, requiring a greater amount of information encompassing multiple departments, budgets and related issues.
- The majority of larger firms were part of publicly listed parent entities, which were most often required to install specific hardware and software in order to facilitate the transmission of information and the secure storage of data.

[47] Windrum et al, 2003.

- Smaller firms sometimes suffer from 'resource poverty' (Thong and Yap, 1995) with less funds available for ICT, impacting the level of ICT literacy required for the CEO.

Table 20 summarises the level of ICT literacy by firm:

Firm type	Is CEO ICT literater?
SME 06	Yes
SME 08	No
SME 09	No
SME 10	No
SME 12	Yes
SME 13	No
SME 14	Yes
SME 17	No
Large 02	No
Large 03	Yes
Large 05	No
Large 11	No
Large 15	No
Large 16	Yes
Large 18	Yes
Large 19	No
Large 20	No
Large 21	Yes
Very Large 01	No
Very Large 04	Yes
Very Large 07	Yes
Very Large 22	No
Very Large 23	Yes

Table 20: CEO ICT literacy by firm

Very large firms

The majority of the CEOs in this firm type were classed as being ICT literate, with two firms not displaying such CEOs (very large 01, 23). The CEO of one of these firms (Vary large 01) was employed at the firm for his entire career and had worked at various divisions during his tenure. The firm was characterised by a moderately complex organisational structure and a high dependency on technology with multiple operating businesses. The CEO had progressed rapidly in the organisation and had always been supported by an IT manager: "There was never any need to do anything or learn any more than using my PC, as somebody was always handling IT for me." The second firm's CEO (very large 22) had recently migrated to aerospace from a heavy engineering background and possessed a low degree of ICT literacy. This lack of exposure to ICT was due to similar reasons as for the first firm, with the individual supported in all of his previous roles by either a central IT function, or an IT manager. His current firm was very ICT-centric and characterised by one of the most complex organisational structures encountered both within the UK and internationally. The firm also possessed some of the highest levels of ICT investment and employees in this department, with the CEO comparing this with his previous organisation; "Both organisations are big and complex and dominated by technology. That means that I always have an IT person to rely on. Besides, beyond getting data and using email I don't use much ICT."

The three remaining very large firms were characterised by ICT literate CEOs, with one firm's CEO (very large 04) also the second oldest encountered of the sample. He displayed a considerable grasp of ICT issues and knowledge, in addition to the status of ICT amongst the many subsidiary companies in the group. He was the most 'evangelical' about ICT all of the CEOs within this firm-type, and did not tolerate a lack of ICT knowledge amongst his management team: "I need information fast and accurately. How else can I keep an eye on what is going on? Unlike some of my managers, I like to know about *how* the information is getting to me and around the organisation, which keeps them on their toes when I ask them about it." The second firm within this group (very large 07) was also part of an expansive international organisation with a reliance on ICT. The CEO possessed a strong background within an engineering discipline and had acquired ICT knowledge in the process. Extensive information requirements from a HQ, coupled with complex internal organisational and operational structures, were credited with driving an ongoing ICT-centric culture: "Technology is our business and I like to think that I understand what my IT manager and corporate technology departments are talking to me about." The final firm in this group (very large 23) possessed the largest IT department of any sample firm, with over 100 employees, and was also characterised by complex and large-scale production facilities internationally. The CEO displayed very strong ICT attributes and worked closely with the IT manager. Recent productivity enhancing efforts directed by the corporate technology department enhanced this further, with a focus on utilising ICT at lower organisational levels. The division also recently invested in upgrading considerable ICT infrastructure for its contact and support centres with the CEO being a strong supporter of technology: "We are a technology business, so I like to think that I set the example".

Large firms

Over one half of the CEOs in this firm type were not classed as being ICT literate. In the case of one of the primogeniture firm (large 20), this was due to the CEO not taking an active interest in ICT, despite believing in its benefits. He was the oldest of any of the 23 firms' CEOs and also delegated ICT to a dedicated IT manager. He did not believe that the lack of ICT literacy hindered his ability to utilise communicative technology, although he displayed a distinct lack of use of any ICT beyond the telephone and intermittent email: "When it comes down to it, I prefer the old fashioned way of communicating and leave IT to the experts." The CEO of another large firm (large

11) which was independent family owned, displayed a low level of ICT literacy expressed a diminished level of confidence in ICT as a business aid to productivity: "It's okay to keep me in touch with what our overseas factory is doing through dedicated links and video, and email, but I wouldn't say that I am really a fan of using this." The third non-publicly owned firm's CEO (large 02; independent non-family) did not believe that ICT was 'critical' to his firms' performance: "We use ICT, but I would rather put the money into new production equipment than new PCs." Due to advice from his IT and commercial manager, he recently approved the upgrading of the firm's ERP.

Of the remaining firms (all publicly owned), a strong negative view of ICT was expressed by the CEO of one of these (large 15) who depicted it as 'a pile of crap'. He exhibited a low level of ICT literacy and had frozen ICT investment with many PCs and servers outside of their warranty period, and no redundancy evident for critical systems. A further firm's (large 05) CEO did not possess a high degree of ICT literacy, but despite a confrontational relationship with his IT manager, he adhered to his recommendations and invested in ICT: "I don't like spending the money, but I know I need it to run the various sites we have." A negative view of ICT was also expressed by the CEO of another large firm (large 19), with this providing an explanation for his minimal ICT literacy: "As part of a large group, we get told to spend on IT and I do that. It doesn't mean I have to know the details of how a sever works, and I really don't care. I let the IT manager handle that and I get on with making the money to pay for it all."

The remaining large firms' CEOs were deemed to be ICT literate were publicly listed. One of these firms' CEO managed a business located within a large international group and was undergoing major structural change. He believed that ICT was an integral element of the firms' operations and that despite his employment of an IT manager, he should understand how ICT was imbedded in his organisation: "ICT is an important part of the corporate roadmap, and as someone who has spent time there, I know it from both sides." Another CEO was in charge of a recent acquisition (large 16) for a larger group that required significant investment and effort before it could become profitable. He displayed a high degree of ICT literacy and often defined the ICT work-plan for his IT manager, believing that "if you don't know about your IT, you don't know about a large part of your business." A positive view of ICT was also iterated by the CEO of a firm that was also undergoing a major revamp (large 18), and who displayed a strong grasp of ICT: "There isn't much about IT that I don't know, and if there is something, I make it my mission to find out about it". The CEO of the final firm in this group (large 21) displayed a high level of ICT literacy that was credited to the parent company's use of ICT and its diffusion to the subsidiary firms: "I have always tried to understand ICT. In this company, you need to because our group CEO loves the stuff. If he sends you an email from his Blackberry and you haven't responded straight away, he calls you."

SMEs

Around forty per cent of the SMEs' CEOs were deemed to be ICT literate (SME 06, 12, 14). One of these (SME 06) was the second primogeniture firm in the sample. The CEO was proactive in understanding all facets of the business and operated a very 'hands on' style that extended to ICT: "ICT is key to our success and I always review what we are going to buy and if it's suitable." Another firm in this group (SME 14) was independent non-family owned and the smallest in the sample. It was run by a very hands-on CEO who was supported by an equally hand-on commercial manager who also undertook the IT function. He possessed an adequate level of ICT literacy due in large part to being the key decision maker in a small firm: "You have to be a jack-of-all-trades because the buck only goes around a small number of people in here." The final SME in this group (SME 12) was managed by a CEO who took an active operational involvement in the business and was very ICT-literate: "I spend considerable time understanding what we do and what we need to do it with. That includes ICT." The firm was part of a larger group, but run relatively autonomously.

The remaining five SME CEOs were not deemed to be ICT literate. Two of these were part of a larger public group (SME 08, 17) with one of these (SME 08) run by a CEO who was supportive of ICT, but who displayed a low interest in understanding technology beyond using it for email and extracting ERP information. This view was also mirrored by the CEO of the other SME (SME 17) that was part of a publicly listed group, who saw ICT as: "Something to help me get my email and production data". Two of the other SMEs were independent non-family owned (SME 09, 10).The CEO of one (SME 10) did not take an active interest in ICT, delegating duties to his IT manager, and limiting expenditure where possible. He believed that: "ICT is about computers. I don't like computers. I want to talk to people." In contrast, the CEO of the other independent non-family owned firm (SME 09) held a more favourable view of ICT, utilising his IT manager to undertake all ICT related decisions: "I don't even attempt to understand how our technology works. I just want to know if it does." The CEO of the final SME (SME 13) managed the second smallest firms in the sample with fewer than 50 employees. His level of involvement with ICT in the firm was minimal and confined to authorising ERP spending and PC purchases. This reflected a simple and flat organisational structure.

5.2.4 Rate of ICT Adoption

The literature is bereft of a definition of 'fast' or 'slow' ICT adoption. The absence of this is not believed to be detrimental to an assessment of the speed of ICT adoption, due to the difficulty in harmonising such a definition across heterogeneous firm types: a definition in one firm might be completely inappropriate in another. Due to this constraint, firm managers were asked for their perception of the rate of ICT adoption in their firm, reflecting the use of this approach as an accepted methodological practice (Walsham, 1995): "It is through interviews that researchers can best access participants' views and interpretations of actions and events." Table 21 summarises the rate of ICT adoption as defined by the senior members of the management team.

Time of adoption	Rapid	Moderate	Slow
Very Large	100%	-	-
Large	60%	30%	10%
SME	63%	38%	-
Total Sample	70%	26%	4%

Table 21: Rate of adoption of ICT

Overall, the majority of respondents indicated that they believed that ICT adoption was rapid their firm. All managers in very large firms believed that this was the case, and around 60 per cent in the other two firm-types. Almost forty per cent of SME managers believed that ICT adoption was moderate, with no managers believing this was a slow process. Table 22 summarises the responses.

Firm-type	Time for ICT Adoption
SME 06	Moderate
SME 08	Moderate
SME 09	Rapid
SME 10	Rapid
SME 12	Moderate
SME 13	Rapid
SME 14	Rapid
SME 17	Rapid
Large 02	Rapid
Large 03	Rapid
Large 05	Rapid
Large 11	Moderate
Large 15	**Slow**
Large 16	Moderate
Large 18	Rapid
Large 19	Moderate
Large 20	Rapid
Large 21	Rapid
Very Large 01	Rapid
Very Large 04	Rapid
Very Large 07	Rapid
Very Large 22	Rapid
Very Large 23	Rapid

Table 22: ICT adoption rate by firm

This supports literature that defines a more expedient decision making and implementation process in SMEs due to a flatter organisational structure and the role of owner-managers as decision makers (Salles, 2006). Large firm managers depicted a marginally higher rate of moderate ICT adoption than SMEs, with the former also being the only firm-type for which a response of 'slow' emerged amongst a minority of respondents.

Very large firms

All very large firm managers believed that ICT was adopted rapidly within their company, with responses consistent across such firms. The principal reasons contributing to this included:

- Dedicated IT departments existed which could undertake ICT implementation.
- A broad range of ICT skills were available in-house within IT departments.
- Many smaller ICT expenses (PCs, laptops, software, mobile applications, and others) were within the sign-off authority of line managers and the IT manager.
- A large pool of hardware existed which could often be recycled amongst other users if requested, saving time and expense.
- In-house ICT knowledge often resulted in frequently asked questions or issues being addressed quickly without the need to refer this externally.

Large firms

Managers in six of the eight large firms believed that ICT was implemented rapidly. Four of these were publicly owned firms (large 3, 5, 18, 21), with the remaining two being independent: one of these was non-family owned (large 02) whilst the other was primogeniture (large 20). Three further firms' managers indicated that their ICT was adopted at a moderate speed (large 11, 16, 20), with one of these independently family owned (large 11), and the other two publicly owned. The remaining firm amongst this firm-type was classed as a slow adopter of ICT (large 15) and was publicly owned. Of the two independent firms adopting ICT rapidly (large 02, 20), both had CEOs who were supportive and who worked in close partnership with the IT manager. Of the four publicly listed firms, three possessed large IT departments (large 03, 18, 21) whilst one possessed a small IT department (large 05). Large firms followed a similar ICT adoption pattern as very large firms, whilst the firm with a smaller IT department possessed a proactive IT manager who implemented a rapid-results policy at the firm, despite a confrontational relationship with his CEO.

Two of the three firms displaying a moderate ICT adoption time-line were public (large 16, 19). The IT manager in one of these firms displayed a confrontational relationship with his CEO (large 19) with this affecting his autonomy to rapidly deliver ICT. In the case of the second of these large firms, the CEO was IT literate and wanted to be involved in ICT decisions. At times, this was observed to delay the adoption process. The third firm displaying a moderate ICT adoption rate was an independent family owned firm (large 11) with the IT manager comprising the IT department. Although he had the support of the CEO, he was often not able to adequately meet ICT demands. These observations highlighted a number of the dependencies and inter-relationships affecting ICT adoption rates in larger firms, as depicted in figure 14.

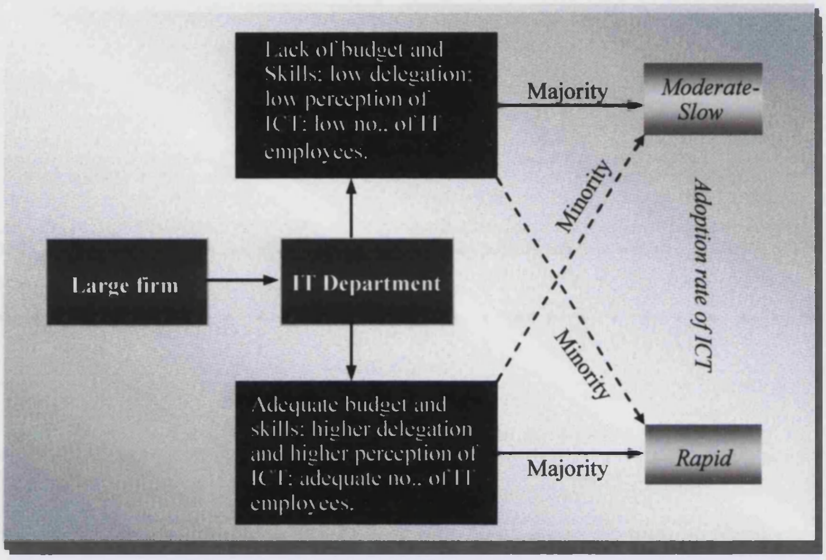


Figure 14: Influences on ICT adoption rates in larger firms

A number of organisational and employee-specific factors were observed to have an effect on the rate of ICT diffusion: the proactivity of the IT manager; the availability of an adequate budget; the skills and experience of the IT manager; the relationship between the IT manager and the CEO; the firm's ethos on technology adoption (driven by the CEO and/or the IT manager); the ability of the IT manager to work autonomously, and the availability of IT staff. In some cases, firms with adequate budgets and resources were observed to still adopt ICT slower, and vice versa, represented by grey dashed lines in figure 13. This was often due to the interplay of other factors, or the dominance of a specific factor such as the intervention of the CEO. These observations support recent literature highlighting influences on ICT adoption within the firm (Windrum et al, 2003). The final large firm (large 15) displayed a slow adoption of ICT. The firm was one of the few in the sample where the management team held a negative view of ICT, and also characterised by a confrontational relationship between the CEO and the IT manager. The firm's CEO had frozen all IT spending due to his belief that the IT manager was 'overspending', with 'emergency' IT only being approved. This was generally also slower in being approved and was confined to the replacement of some older PCs on the shop floor that had ceased to work.

SMEs

The managers of five firms indicated that their business adopted ICT rapidly (SME 09, 10, 13, 14, 17), with the remaining three firm managers indicating a more moderate adoption time-frame (SME 06, 08, 12). Only one of the five firms in the first category had an affiliation with a public entity (SME 17), with the remaining four being independent firms. Of these, three were non-family owned (SME 09, 10, 14), and characterised by very small IT departments (<2 people). The third firm was independent privately owned (SME 13) and also possessed a very small IT department (1 person). Three remaining firms in this firm-type (SME 06, 08, 12) displayed moderate rates of ICT adoption. Two of these had an association with a public company (SME 08, 12) and possessed small IT departments (≤ 3 people). In the case of both firms, the CEOs supported the IT managers, including with the provision of adequate budgets.

The IT managers in two firms (SME 12, 19) had the equal longest tenure within the sample (25 years) with this attribute highlighted by some employees in their respective firms as contributing to a latency in obtaining faster ICT adoption: "The guy wants to retire so we don't expect, or get lightning responses." The third firm (SME 06) was the second primogeniture business, and possessed a larger IT department (4 people). The processes around ICT ordering, implementation and follow-through were less developed than the majority of other firms within this firm-type and resulted in some delays in implementation.

5.2.5 ICT Consultants and External Resources

The use of ICT consultants was assessed, from participation on the development of complex SAP projects, to the installation of a PC. The use of these resources was observed overall to increase in line with firm size and complexity, reflecting recent research (Falk, 2004). All very large firms utilised consultants, with this decreasing to 80 per cent for large firms and 20 per cent for SMEs. In total, around two thirds of the sample firms utilised consultants, with table 23 summarising the results by firm type.

Firm type	Use of Consultants
SME 06	None
SME 08	Consultants
SME 09	None
SME 10	None
SME 12	None
SME 13	None
SME 14	None
SME 17	Consultants
Large 02	None
Large 03	Consultants
Large 05	Consultants
Large 11	Consultants
Large 15	None
Large 16	Consultants
Large 18	Consultants
Large 19	Consultants
Large 20	Consultants
Large 21	Consultants
Very Large 01	Consultants
Very Large 04	Consultants
Very Large 07	Consultants
Very Large 22	Consultants
Very Large 23	Consultants

Table 23: External resource utilisation for the development of ICT by firm

Very large firms

All large firms utilised consultants to assist in the development of their ICT with involvement across a number of areas:

- The design and implementation of ERP.
- Ongoing ERP customisation.
- The design of enterprise infrastructure and architecture.
- Designing back-end and front-end applications including e-commerce, billing solutions, web sites, security applications, and others.
- Undertaking ICT audits.
- Other general ICT tasks

No discernible variations existed between the five very large firms' use of external IT consultants.

Large firms

Two large firms did not utilise any external ICT expertise (large 02, 15). One firm was independent non-family owned (SME 02) with its IT department staffed by one person, who constructed his own

ERP. The individual was an experienced industry professional who displayed a neutral relationship with the firm's CEO, and was able to proceed with implementing the ICT that he defined. The firms' ICT reflected his approach of minimising external dependency as much as possible: "There's no point spending vast amounts of money for things we can do ourselves. Our IT and ERP is home-grown and we want to keep it that way." The second firm (large 15), was owned by a publicly listed entity and also had a small IT department staffed by 2 people. The firm's management held a negative view of ICT with a confrontational relationship existing between the IT manager and the CEO. The use of external assistance was limited as a result of the CEOs outlook in particular. With the exception of one firm that developed its own ERP (large 02), all other large firms utilised commercially available ERP solutions and external assistance to develop and implement these. This approach to the utilisation of external resources by SMEs mirrored the strategy employed by very large firms, reflecting the results found by some researchers (Bracker and Pearson, 1985).

SMEs

Two SMEs utilised external assistance for their ICT (SME 06, 17). These firms were amongst three that had implemented SAP utilising external consultants. One SME was independently owned and one of the two primogeniture firms in the sample (SME 06), with the CEO a strong supporter of new technology and an active participant in ICT issues. The second firm (SME 17) was partly owned by a publicly listed entity, and had also implemented SAP utilising external resources. Some other ICT related work was also undertaken by external companies that had established new LAN and extranet. The remaining SMEs did not actively utilise external assistance with the principal reasons cited by senior managers including cost; a lack of complexity; a lack of resources and the CEOs blockage of this: "Our CEO wouldn't let me do it even if I had the budget. He thinks all IT is wasted money and hates signing-off for anything I give him" (IT manager SME). These results are congruent with some recent research findings on the influences of decision making on small firms (Jocumsen, 2004).

5.2.6 Constructed or Acquired ERP

All very large firms acquired their ERP. A marginally smaller number of large firms (90 per cent) and SMEs acquired their ERP (87 per cent), with the profile of firms relatively homogenous across this category of ICT expenditure. Table 24 summarises the ERP construction/acquisition decision.

Firm type	Constructed or acquired ERP
SME 06	Acquired
SME 08	Acquired
SME 09	Acquired
SME 10	Acquired
SME 12	Acquired
SME 13	Acquired
SME 14	Constructed
SME 17	Acquired
Large 02	Constructed
Large 03	Acquired
Large 05	Acquired
Large 11	Acquired
Large 15	Acquired
Large 16	Acquired
Large 18	Acquired
Large 19	Acquired
Large 20	Acquired
Large 21	Acquired
Very Large 01	Acquired
Very Large 04	Acquired
Very Large 07	Acquired
Very Large 22	Acquired
Very Large 23	Acquired

Table 24: Construction or acquisition of ERP by firm

Only two firms constructed their own ERP. One of these was a large firm (large 02), and the other an SME (SME 14). Both firms were independent, non-family owned and characterised by a number of similarities:

- The IT department was comprised of one person, or did not exist.
- Small IT budgets.
- The lack of an ERP budget.
- No external consultants utilised.
- A CEO who did not believe that investment in larger ICT was warranted.
- A neutral or positive level of support by the CEO for the IT manager.

The remaining 21 firms all acquired their ERP, with the solutions selected by the firms presented earlier in section 5.1.4.

5.2.7 Manual or Electronic Data Transfer

The assessment of the data transfer mode between firms and their suppliers included productivity-enhancing information, such as design documentation; output data; specifications; metrics, and others. The majority of exchanges occurred on a manual basis between firms as depicted in table 25, with only one quarter of the sample utilising both an electronic and manual transfer option.

Manual/Electronic transfer of data	Manual	Electronic	Both
Very Large	60%	-	40%
Large	70%	-	30%
SME	88%	-	12%
Total Sample	74%	-	26%

Table 25: Transfer of information mode between the firm and supplier

Electronic options included electronic networks linking suppliers and customers, including extranets, virtual private networks (VPNs), EDI, email and fax. Manual data transfer options included the use of couriers and post to send information, and the sharing of information via face-to-face visits. The observed trend amongst the sample was for larger firms to adopt a greater use of both manual and electronic transfer options, with this diminishing as the firm size decreased. The results support research highlighting the increased use of electronic communication between suppliers and customers as the firm size increased.[48] Table 26 outlines the use results by firm type.

Firm type	Manual or Electronic data transfer mode
SME 06	Manual
SME 08	Manual
SME 09	Manual
SME 10	Manual
SME 12	Manual
SME 13	Both
SME 14	Manual
SME 17	Manual
Large 02	Manual
Large 03	Both
Large 05	Manual
Large 11	Manual
Large 15	Manual
Large 16	Manual
Large 18	Manual
Large 19	Both
Large 20	Manual
Large 21	Both
Very Large 01	Manual
Very Large 04	Manual
Very Large 07	Manual
Very Large 22	Both
Very Large 23	Both

Table 26: Transfer of information mode between the firm and supplier by firm

[48] Cassivi, 2007.

Very large firms

Two very large firms utilised a dual data transfer mode (very large 22, 23). These publicly listed firms were the largest and most complex of the sample, and characterised by diverse geographical operations with multiple supplier chains. The majority of the information transferred between the firms and their suppliers occurred via manual means. The firms contained large IT departments with over 30 staff in both cases and were well funded. In addition, both the CEO and IT manager embraced the use of electronic communication modes for supplier interaction. The principal reasons inhibiting the greater use of electronic information transfer were observed to be supplier-dependant and not on firm-side:

- Many large firms and SMEs supplying very large firms lacked the financial resources required to invest in sophisticated technology, such as CAD. This design standard was used by all of the very large firms, with designs often printed out and posted, or send via email as jpg or other picture formats. This did not allow for the manipulation and modification of designs, reducing the benefits of the technology.
- Smaller firms supplying very large firms often lacked the in-house staff, or skills amongst existing staff, to adequately integrate their ICT and achieve the benefits of seamless electronic information transfer.
- The culture of many smaller suppliers was not ICT-centric, resulting in a diminished ability to perceive the use of electronic transfer of information as a relevant exercise.

The remaining very large firms (very large 01, 04, 07) only undertook manual data transfer with their suppliers. All of these firms were characterised by a neutral or positive view of ICT by firm managers, and strong support of ICT by the CEO.

Large firms

Three firms used both a manual and electronic data transfer mode (large 03, 19, 21). All three firms were publicly listed and characterised by adequate financial resources to execute their ICT strategies. Only one CEO and other members of his management team held a negative view of ICT (large 19), which on occasions affected the IT manager implementing his chosen ICT strategy. This was due to the dual approval process he was required to follow with HQ and the CEO. Feedback from operations managers in these firms indicated that one of the key factors facilitating the use of electronic data transfer with suppliers was the selection of firms they knew that could accommodate this, or were willing to do so: "We always try and select firms that we know can handle some form of communication electronically in the first place" (operations manager, large firm).

Three of the remaining seven large firms did not utilise a dual mode of communication due to barriers existing within the firm (large 02, 15, 16) and with suppliers. In the case of one firm (large 02) this was principally due to a small IT department (1 person) and the resulting lack of skills and resources that the IT manager believed were required to pursue this option. He indicated an interest to enhance this capability further, subject to an enhanced budge being available. In the case of the second firm (large 15), the confrontational relationship between the IT manager and the CEO resulted in the latter negating the option of electronic integration with suppliers due to his belief that "I only spend what I have to." Although supportive of an electronic initiative, the IT manager did not believe that his small team (2 people) would be able to accommodate the work required, should his CEO support the effort. The third firm (large 16) did not engage in electronic integration with suppliers due to the recent acquisition by a public entity and the significant restructuring efforts being undertaken. These included redundancies being made and the scaling back of non-essential ICT and operational investment until the business was believed to be 'stable'. The four remaining large firms (large 05, 11, 18, 20) did not engage in a dual communication mode with suppliers. This was due to the inability, or non-compliance of suppliers to accommodate this option for the reasons defined at the outset of this section.

5.2.8 ICT Requirements Passed to Suppliers

Around one third of sample firms passed ICT criteria required to facilitate electronic information sharing to their suppliers. The degree to which this occurred was observed to increase with firm size and complexity reflecting the results from recent studies (Mullane et al, 2001). Table 27 depicts the proportion of firms passing these to suppliers.

ICT requirements passed to suppliers	**Yes**
Very Large	80%
Large	30%
SME	13%
Total Sample	35%

Table 27: ICT requirements passed to suppliers

Managers in very large firms displayed the highest willingness to provide the relevant information to suppliers, with a significant reduction in this approach occurring in large firms and SMEs. The latter displayed the smallest propensity to engage in requirements sharing with suppliers, with managers in some of these firms indicating that this occurred due to their inability to manage more complicated links with suppliers. Table 28 indicates the responses by firm-type.

Firm type	ICT requirements passed to suppliers
SME 06	No
SME 08	Yes
SME 09	No
SME 10	No
SME 12	No
SME 13	No
SME 14	No
SME 17	No
Large 02	No
Large 03	Yes
Large 05	No
Large 11	No
Large 15	No
Large 16	No
Large 18	No
Large 19	Yes
Large 20	No
Large 21	Yes
Very Large 01	Yes
Very Large 04	No
Very Large 07	Yes
Very Large 22	Yes
Very Large 23	Yes

Table 28: ICT requirements passed to suppliers by firm

Very large firms

Only one very large firm (very large 04) did not pass on ICT requirements to its suppliers. This was due to a decision by the IT manager to limit the time he was spending on such activities, as a result of time and resource constraints. The firm was publicly owned, with a positive relationship existing between the IT manager and his CEO. The remaining four very large firms passed on ICT requirements to their suppliers, but this resulted in their adoption in only two cases (very large 22, 23). As depicted in the previous section, these firms were the largest and most complex in the sample, and were located higher in the aerospace supply chain. This allowed them to exert a degree of influence over other large and very large firms supplying them, including the 'pushing' of compliance costs to those firms. The fear of contract loss, and/or the desire for contract renewal often resulted in capitulation to these requests. The remaining two very large firms (01, 07) passed on ICT requirements to suppliers, but this did not result in their adoption and subsequent electronic integration of solutions. Both firms possessed similarly sized IT departments (12-15 people), and positive internal relationships existed between key individuals in the management team. Many of the suppliers to these firms were SMEs, with the firms located at a lower level in the aerospace supply chain. Many SMEs did not accommodate these requests due to a lack of financial resources and organisational skills. Operations managers in these firms iterated that their SME suppliers often had such concerns:

> They worry that they will make all of this investment in time, resources and equipment to enable better electronic communication, and after their contract finishes, nothing more eventuates for them.

> Our suppliers don't believe that we will fully utilise the electronic transfer of information, leaving them with a bit of a lame duck investment.

This view was iterated by operations managers in SMEs supplying very large firms:

> They want the earth, but won't commit beyond a short production run. I am not taking the time to build something that is no longer relevant as soon as they ditch us for another supplier.

> If it wasn't that expensive, or require too much time, I would do it for them if, and I mean if, they gave me a guaranteed longer term order. I need security of commitment.

Large firms

Three large firms passed on ICT requirements to their suppliers (large 3, 19, 21). All three firms were publicly owned and were staffed by an IT department containing more than 8 people. In all three cases, the IT manager was the principal proponent for this strategy, despite the view of IT amongst managers being negative in one firm, in addition to being confrontational between the CEO and the IT manager (large 19). The remaining large firms did not pass on their ICT requirements to suppliers. This was due to some IT managers believing that they lacked the necessary resources to enable this to be executed (large 02, 05, 11, 15, 16, 17, 18). One firm's IT manager indicated that he believed his firm possessed the required resources (large 20), but he did not believe that many of his suppliers were able to accommodate such a request due to either limited funds or resources; "I can send them the information, but they won't do anything with it."

SMEs

Only one SME passed on ICT requirements to its suppliers (SME 08). The firm had an affiliation with a public entity, and although possessing a small IT department (3 people) the IT manager possessed an adequate budget that could be utilised to support suppliers: "I sometimes get our consultants to integrate us with suppliers who will be there for the longer haul with us." He was supported by a CEO who was not ICT-literate. The remaining SMEs did not pass on any requirements to their suppliers with the majority of IT managers not doing so due to inadequate resources (SME 09, 10, 13, 14, 17). All of these firms possessed 2 or less IT employees. The remaining two firms' IT managers (SME 06, 12) believed that their IT departments could accommodate this, with both firms employing 3 people. Both IT managers enjoyed positive relationships with their CEOs and believed they possessed adequate financial resources to allow them to engage external resources if required.

5.2.9 Size of IT Department

The largest IT departments were observed in very large firms, with a mean size of 42 employees, and a median of 25 employees. The mean for large firms and SMEs was around 5 and 2 employees respectively, and indicated in table 29.

Size of ICT department	Mean	Median	Mode
Very Large	42	25	n/a
Large	4.8	3	2
SME	2	2	3
Total Sample	12	3	2

Table 29: IT department size

The average IT department for the sample was 12 employees, with the median and mode of 3 and 2 employees respectively. The individual department size by firm-type is reviewed in the following sections.

Very large firms

Chart 14 depicts the size of the IT department for very large firms.

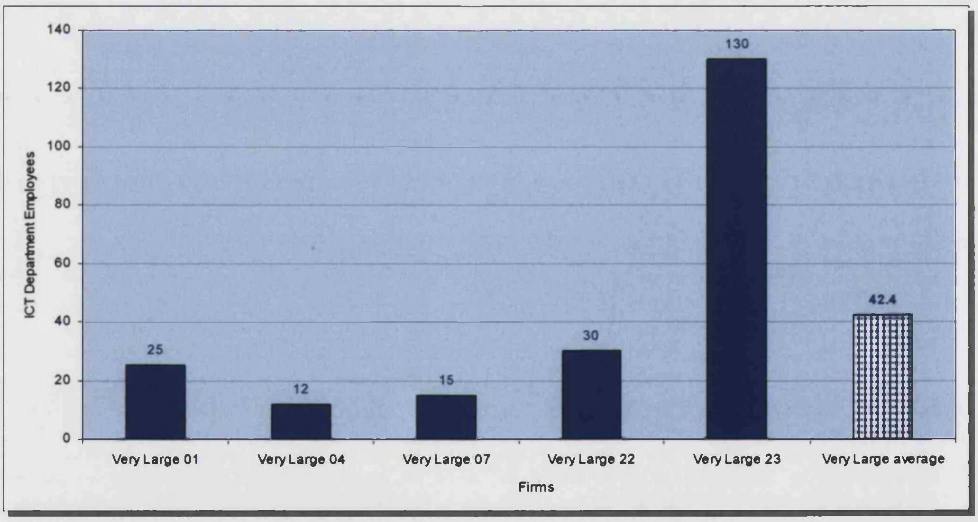


Chart 14: IT department size for very large firms

Four of the five very large firms (very large 01, 04, 07, 22) staffed IT departments with 30 or less people, with the remaining firm employing 130 IT staff (very large 23). All of these firms were publicly owned. Three of these firms operated significant international operations and were owned by parent companies that were characterised by complex aerospace businesses.

Large firms and SMEs

Large and SMEs depicted greater variability in the size of their IT departments with chart 15 presenting the results for these two firm types:

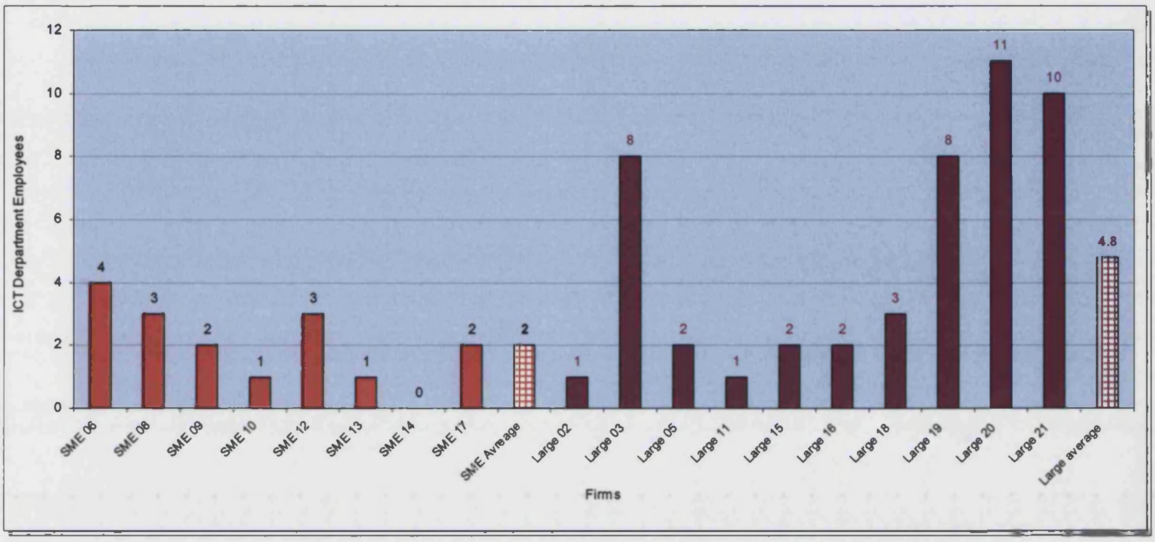


Chart 15: IT department size for SMEs and large firms

The smallest IT departments were found within SMEs, with an average size of 2 employees. In around half of the large firms, as the number of employees increased, the size of the IT department also increased (large 03, 18, 19, 20, 21). These firms employed over 500 people with the exception of one firm (large 18). This firm employed less than 500 people and was characterised by a very ICT-literate CEO who promoted the implementation of ICT via his IT manager, with whom who he enjoyed a positive relationship. The remaining large firms each employed more than 500 people (large 02, 05, 11, 15, 16). Three SMEs possessed an IT department with 3-4 employees (SME 06, 08, 12), with these firms employing an average of 160 people each. The remaining SMEs (SME 09, 10, 13, 14, 17) employed an average of 110 people each and had an IT department with 0-2 employees. These trends are congruent with recent research highlighting the increase in IT departments that often accompanies larger and more complicated business operations (MacGregor and Vrazalic, 2007). A number of variables influenced the size of the IT department:

- The complexity of the firm's operations: larger, more complex operations tended to generate greater requirements for information.
- Multiplicity of production processes: firms with a greater number of production lines and multiple concurrent operations generated a greater amount of data.
- Managerial requirements: larger firms often contained a greater number of managerial levels, with each defining its own requirements for information.

- CEO ICT literacy: ICT literate CEOs tended to require a greater degree of information from the business and were generally more supportive of an enhanced degree of IT expenditure.
- HQ requirements: Firms that belonged to other entities with HQ's were often required to regularly compile and send information covering the businesses financial and production performance.
- Pressure from customers: Firms that experienced significant pressure from customers to integrate their IT systems, or engage in e-commerce, often invested in their ICT and staff.

A number of factors did not appear to influence the firms' decision to adopt ICT:

- Competition: The majority of firm managers indicated that competition was not a primary factor influencing the adoption of ICT, with other factors exerting a greater influence on this decision (see above points).
- Government assistance: Firm managers were not swayed by Government initiatives to adopt ICT, or to train staff as a result of skills-upgrade initiatives.

The first of these two observations is counter to the majority of the literature and reflects cultural elements that are evident in a number of the aerospace firms, with managers appearing to not be influenced by what ICT practices competitors are engaged in.

5.2.10 Adequacy of Financial Resources

Eighty per cent of IT managers in very large and large firms believed they were provided with adequate financial resources permitting them to undertake their day-to-day tasks and to equip their firm with ICT. In contrast, around half of the IT managers in SMEs believed they were provided with adequate financial resources. These results equate to 70 per cent of sample managers believing they were provided with adequate resources in order to equip their firms with ICT. No information exists as to what constitutes 'adequate' financial resources across varying firm-types. If this existed it is likely to be specific to the individual firm. For these reasons, a definition of what constitutes 'adequate' financial resources was left to IT managers to convey. Table 30 summarises the IT managers' responses by firm.

Firm type	Adequate financial resources
SME 06	Yes
SME 08	Yes
SME 09	No
SME 10	No
SME 12	Yes
SME 13	No
SME 14	No
SME 17	Yes
Large 02	No
Large 03	Yes
Large 05	Yes
Large 11	Yes
Large 15	No
Large 16	Yes
Large 18	Yes
Large 19	Yes
Large 20	Yes
Large 21	Yes
Very Large 01	Yes
Very Large 04	No
Very Large 07	Yes
Very Large 22	Yes
Very Large 23	Yes

Table 30: Adequacy of ICT financial resources by firm type

Very large firms

Only one very large firm's manager (very large 04) believed that he was not provided with adequate financial resources. The firm was publicly owned and the least international and complex of all the very large firms, with the IT manager possessing the lowest annual budget of all very large firms. The principal reason for his dissatisfaction was the reduction in financial resources due to the CEOs re-prioritisation of the firm's expenditure. The relationship between the IT manager and the CEO was positive, with the senior management team also supportive of ICT use and adoption in the firm. The remaining firms' IT managers believed that they were provided with adequate financial resources required to execute their ICT strategies.

Large firms

Two large firms' IT managers (large 02, 15) did not believe that they were provided with adequate financial resources. One firm was independent and family owned (large 02), with a neutral relationship observed between the IT manager and the CEO. The firm utilised home-grown ERP, and possessed one of the lowest annual ICT budgets. Only essential replacement of ICT occurred, with no aspirational investments made as put forward by the IT manager. The second firm recently became owned by a publicly listed entity (large 15), and was characterised by a confrontational relationship between the CEO and the IT manager. The former did not view ICT investment positively and constrained the latter's efforts to upgrade ICT, including out-of-warranty items.

SMEs

Four SME IT managers indicated that they did not possess an adequate level of financial resources for ICT (SME 09, 10, 13, 14). All four of these firms were independent, with three being non-family-owned (SME 09, 14, 15), and one being family owned (SME 13). Two of these firms employed over 100 people each (SME 09, 10) with the remaining two employing less than 50 people each, and were amongst the smallest in the sample. This was also reflected in the IT managers in these firms possessing the smallest IT budgets. The remaining three firms' managers believed that their ICT was adequate to fulfil current requirements but did not 'stretch' to meet future demands that customers were placing upon them in particular for a greater level of electronic integration. Some were running PCs and Windows operating systems that were 5-7 years old and considerably out of warranty. The confrontational relationship between the IT manager in one firm and his CEO (SME 15) resulted in only ERP and departmental costs being funded, and no replacement of hardware.

5.2.11 IT manager Expenditure Sign-Off

IT managers in SMEs displayed the smallest authorisation for signing off ICT expenditure with a mean of around US$2,000. This was largely due to the smaller size of these firms. The informal culture and flatter organisational structure within these firms often resulted in a more casual approach to expenditure decisions. IT managers in around three quarters of SMEs reported that although they possessed a designated sign-off limit, this was often immaterial, due to the ability to make requests to their CEO 'face to face' and where accepted, for them to subsequently action this. Managers in large and very large firms displayed an average expenditure sign-off limit of around US$5,000 and almost US$12,000 respectively, as depicted in table 31.

ICT Manager expenditure sign-off	Mean	Median	Mode
Very Large	$11,780	$9,500	$19,000
Large	$5,510	$1,900	$1,900
SME	$2,138	$1,900	$1,900
Total Sample	$5,700	$1,900	$1,900

Table 31: Sign-off level of IT manager

The higher sign-off limit held by IT managers in many large and very large firms reflected higher ICT budgets, which in turn were justified internally by higher firm revenues, more complex operations, a managerial and HQ mandate for more information, and other factors. The mean sign-off limit for the sample was US$5,700, whilst the median and mode were almost US$2,000. Chart 16 depicts the expenditure sign-off limit for IT managers by firm.

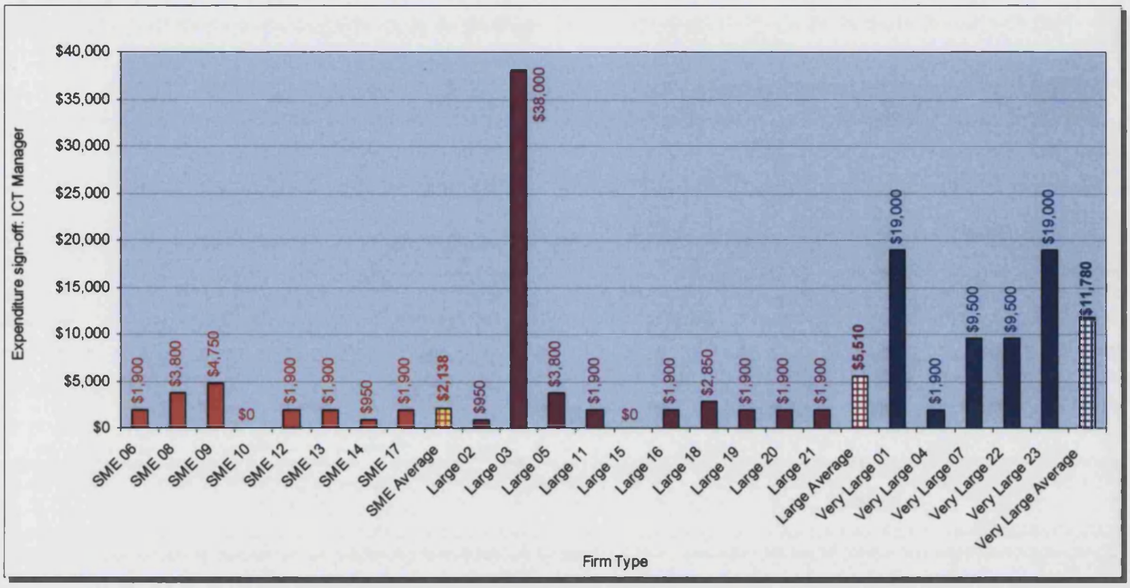


Chart 16: Sign-off authority of IT manager by firm

Two IT managers were not authorised to sign off any ICT expenditure, (SME 10, large 15). In the case of one firm, an independent non-family owned SME (SME 10), the IT department was comprised of one person, with a neutral relationship existing with his CEO. The firm leased its ERP from a low-cost provider and was characterised by the CEO not authorising any ICT expenditure beyond this, and intermittent PC replacement where faulty PCs were not able to be economically repaired. The second was a large firm (large 15) recently acquired by a public entity, with the CEO taking a negative view of ICT and prohibiting the replacement of ICT for the two person IT department. The confrontational relationship between the CEO and his IT manager was driven by the CEOs belief that “I have better things to do than waste money replacing perfectly good PCs or severs. If they still work, why replace them?” The remaining IT managers for SMEs had a sign-off between $950-4,750. The IT manager with the highest sign-off (SME 09) had the support of his CEO, but still did not believe that he had the required resources to execute his ICT vision.

The highest ICT sign-off authority for the sample was US$38,000 and was held by an IT manager in a large firm (large 03). This firm had recently been acquired by a public entity and a large scale IT and capital upgrade programme undertaken. As a result, the IT manager had negotiated a high sign-off authority in order to allow him to rapidly implement ICT changes within his budgetary remit. The IT managers in the remaining large firms possessed sign-off limits between US$950 and US$38,000. If the outlier of US$38,000 is excluded from large firms, the mean sign-off of US$5,510 reduces to US$1,900 for this firm-type, which is marginally below the SME mean of $2,138 as outlined in chart 16 on the previous page. Figure 15 below depicts the comparison between the factors influencing the sign-off limits of firm managers in SMEs and large firms.

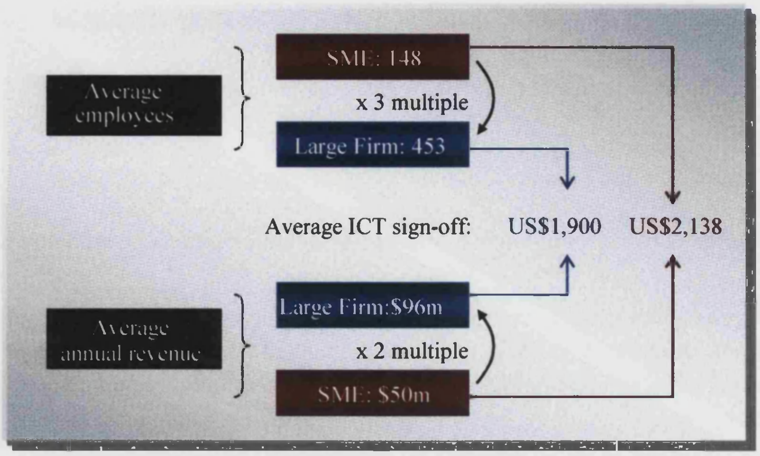


Figure 15: Comparison of average ICT sign-off: large firms vs. SMEs without large firm outlier

Although the IT managers in these two firm-types possessed similar ICT sign-off authority, a number of key firm characteristics differed:

- Average revenues for large firms were approximately twice the average for SMEs;
- Average employee numbers for large firms were three times greater than for SMEs.

IT managers for very large firms possessed the highest sign-off, with two indicating a limit of US$19,000 and two indicating a limit of US$9,500. The remaining firm's manager (very large 04) possessed a sign-off limit for ICT expenditure of US$1,900. This reflected the CEOs desire to control the ICT process including all expenditure. Although the IT manager and the CEO enjoyed a positive relationship, and a sizeable IT department (12) and budget, this did not translate to a higher sign-off limit. IT managers in very large firms indicated a number of reasons as to why they believed they possessed larger ICT sign-off than if they were in smaller sized firms:

> Our revenues and staffing levels are both significant, so we are not managing ICT for just 20-30 people. If the CEO doesn't want to be bothered every 5 minutes with a PC request, or for greater broadband capacity, he knows I need a healthy autonomy (IT manager, very large firm).
>
> We generate a ton of information from each automated production line we have. You multiply that out 50 times, and you suddenly have a huge data stream. That means hardware, software and support have to be there to manage this, and that also means purchases, repairs, and issues. If I had a one grand sign-off, my boss would get tired of seeing me (IT manager, very large firm).

5.2.12 ICT Expenditure

Annual ICT expenditure was reviewed based on a formula that included three major elements:

Annual ICT expenditure = [ERP component of ERP budget] + [ICT Hardware, Software, Services and Support] + [Departmental Costs]

ERP component: The majority of firms developed an ERP budget to cover the licensing, customisation, installation and maintenance of a solution with an annual cost incorporating these expenses. The majority of firms defined a 5 year ERP budget and amortised the expenditure annually to define the ERP expense.

ICT hardware, software, services and support: The firm's servers, PC, non-ERP services contracts, ICT services including broadband, telephony, and others, were included.

Departmental costs: The majority of expenditure was for employees, but also included a proportion for training, travel and related activities.

These three ICT expenditure categories are examined below, commencing with the firms' total ERP budget, from which annual ERP spending is derived.

5.2.12.1 ERP Budget

All firm managers whose firms implemented an ERP solution undertook some form of budgeting for their selected solutions, irrespective of firm size. The average planning horizon for this was 3 years. Table 32 presents the average total ERP budget for each firm type.

Total ERP budget	**Mean**	**Median**	**Mode**
Very Large	$15,200,000	$15,200,000	n/a
Large	$2,884,200	$1,330,000	n/a
SME	$1,182,188	$240,000	n/a/
Total Sample	$5,442,833	$1,900,000	n/a

Table 32: Total ERP budget (US$)

The mean ERP budget was the highest for very large firms, followed by large firms and SMEs. This trend was congruent with observations in other categories including ICT expenditure, IT department staffing, and the involvement of a HQ. Although the mean budget for SMEs was US$1.1M, the median was US$240k, indicating that a number of SMEs possessed large budgets considerably in excess of this. Chart 17 depicts the total ERP budget per firm.

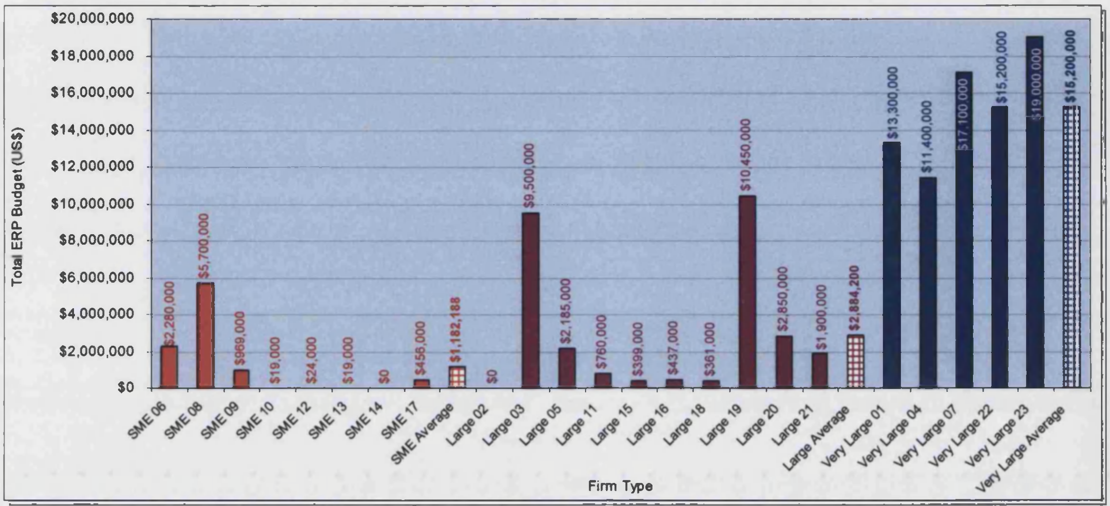


Chart 17: Total ERP budget by firm

Very large firms

The ERP budget range for this firm-type was US$11.4m-US$19.0m with a number of relatively homogenous factors contributing to its development and implementation within this firm type: all five firms selected large international ERP solutions, with 80 per cent implementing SAP and 20 per cent implementing JD Edwards (very large 01); all of these firms belonged to publicly listed entities with the decision on ERP made by HQ, and all firms were required to fund the majority, or all, of their ERP investment. The ERP budgets were believed by HQ to be "something the businesses are not allowed to have much of a say in, as this has group-wide implications." The firm's IT manager believed that "we get told what solution to implement, and after they (ERP consultants) have been out, we get told how much it will cost us."

Large firms

Significant variation in ERP budget existed between large firms. The mean of US$2.8m was skewed by two larger ERP budgets of US$10.4m (large 19) and US$9.5m (large 03), with this reducing to US$1.1m if these are excluded. Both firms were publicly owned and were required to accept SAP as a result of a group-wide rollout, with both substituting this solution for an existing one. The HQ within the parent companies of these firms dictated the selection of the ERP solution, with the firms responsible for funding this. Three further firms possessed ERP budgets in excess of US$1m: US$2.8m (large 20), US$2.1m (large 05), and US$1.9m (large 21). Only one firm wasn't publicly owned (large 20), and was one of the two independent primogeniture firms in the sample. The firm did not display many of the negative management attributes recent research has associated with this type of firm ownership (Bloom and Van Reenen, 2006). The firm obtained high management practices scores and was also consistently profitable. It operated a small number of manufacturing sites, and a small HQ where the CEO was located. The key ERP decisions were made by the CEO, as recommended by the IT manager. Of the publicly owned firms, one was characterised by a confrontational relationship between the CEO and the IT manager (large 05) but this did not appear to affect the ERP budget due to the firm's HQ defining the size of the this (although the firm was responsible for funding this).

Only one large firm did not define an ERP budget (large 02), with the firm using a MS Excel based solution. The firm was one of only two in the sample not utilising a commercial ERP solution, (with the other being an SME). This was driven by the significant losses the firm has been accruing in recent years, and the CEO reducing the IT department to one person. The remaining large firms' ERP budgets were between US$360k-US$760k with three of these being publicly owned (large 15, 16, 18) firms and one being independent and family owned (large 11). The largest ERP budget was for this firm (large 11; US$760k), which was on average twice the size of the other three firms. The CEO was very supportive of the IT manager, who was the only employee in the IT department, and followed his recommendations. This contrasted one of the three smaller-budget ERP firm (large 15; US$399k) where a confrontational relationship existed between the CEO and the IT manager, and in which the CEO expressed the open view that "IT is a waste of time and money." The ERP budget was defined by HQ with the firm paying for it, which further exacerbated the animosity the CEO held towards IT and his IT manager.

SMEs

ERP budgets for SMEs were polarised, with two firms having total expenditure in excess of US$1m (US$5.7m; SME 08, and US$2.3m; SME 06), whilst the remaining firms were grouped significantly below this. One of these firms had an affiliation with a publicly listed entity (SME 08), whilst the other (SME 06) was the sample's second independently owned primogeniture firm. This firm has consistently been profitable, and characterised by a positive relationship between the CEO and the IT manager. The firm has been undergoing a significant upgrade of its ERP to SAP across its five locations. The second firm (SME 08) also changed its ERP to SAP, with the budget reflecting the cost of implementing this. The IT manager was supported by the CEO, who took directions on ERP from the firm's HQ. One further SME possessed an ERP budget of almost US$1m (SME 09) and was independent non-family owned. The firm was undertaking further modification of its ERP solution, having selected and retained a comprehensive mid-market ERP solution (Vantage), with the CEO visibly supporting this and the role of ICT within the firm. One other firm possessed an ERP budget of US$456k, with the majority of this cost covering the upgrade to SAP. The firm was part-owned by a public entity, with the CEO upgrading the firm's ERP to be congruent with the parent company's ERP and was supportive of this process.

The four remaining SMEs possessed ERP budgets ranging from US$0k-$24k. The smallest firm in the sample (SME 14) was independent non-family owned and utilised an Excel based solution for its ERP, with the commercial manager also acting as the IT manager. Both he and the CEO were in agreement that the business could not afford a commercial ERP solution, and as a result, no ERP budget was defined, with the firm using MS Excel as a substitute. Of the remaining three firms, only one was owned by a public entity (SME 12). The firm employed 3 IT staff and had recently installed a mid-market ERP solution (AMAPS) with the IT manager's recommendations approved and supported by the CEO. This decision was made at the local level and funded by the business (US$24k). The second highest spending SME amongst the lower-end of ERP budgets (SME 10) was independent non-family owned and utilised a low-cost ERP solution (RentIT). The CEOs mandate to his IT manager was to "find something cheap but not nasty." The final firm (SME 13) was independent and family owned, and recently migrated from a home-grown solution using Excel to a low-end ERP (Welcome). The firm's small ERP budget (US$9k) was utilised to fund this, with the IT manager's recommendations accepted by the CEO, despite the confrontational relationship between the two, and the negative view of IT that the CEO promulgated within the firm.

5.2.12.2 Annual ERP Spend

Following the development of a total ERP budget, firms spent a proportion of this annually. This included the ERP license fee, customisation, and any other related external and consultancy work, but excluded any internal department costs, which were captured within the budget for the IT department. Table 33 summarises the mean, median and mode for the sample's annual ERP spending.

Annual ERP spend	**Mean**	**Median**	**Mode**
Very Large	$3,173,000	$3,325,000	n/a/
Large	$635,265	$266,000	n/a/
SME	$245,163	$50,350	n/a/
Total Sample	$1,151,379	$484,500	n/a

Table 33: Annual ERP spend

The trends in annual ERP expenditure reflected those observed in the preceding section, with larger firms generally spending the highest amounts with multiples of six over the expenditure of large firms, and over 12 times the multiple for SMEs. Chart 18 depicts the annual ERP expenditure by the sample firms.

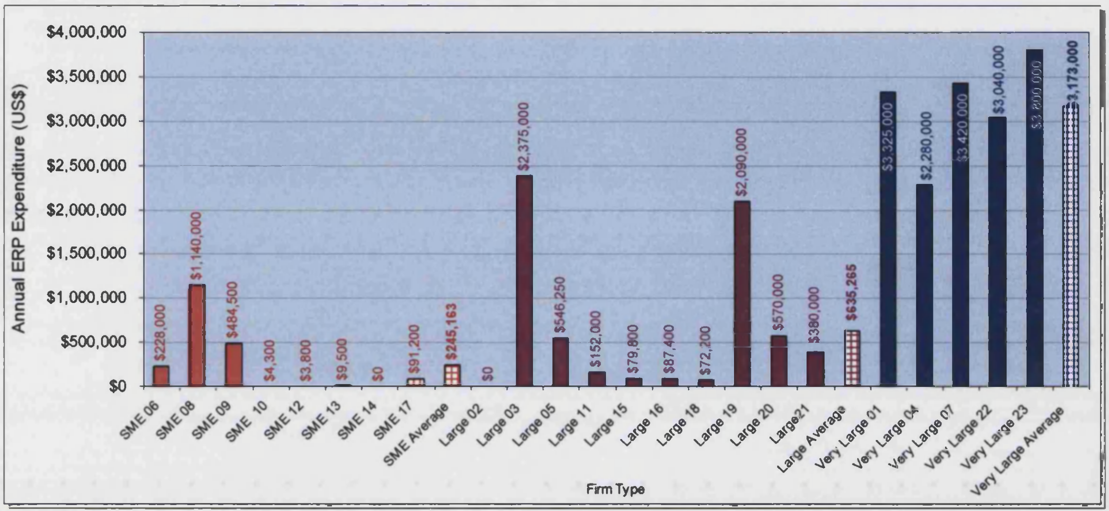


Chart 18: Annual ERP spend by firm

The annual ERP spending by very large firms varied between US$2.2m and US$3.8m. This contrasted the variation observed in large firms, of US$0m-US2.3m. SMEs also exhibited a large variation in annual ERP spending between firms (US$0m-US$1.1m), as depicted in the previous section.

5.2.12.3 Annual ICT Equipment, Services and Support Expenditure

The second major ICT expenditure category encompassed hardware, services and related support. The trend observed across the firms mirrored ERP expenditure, with the larger firms in the sample spending a greater annual amount on this category, as presented in table 34.

Annual ICT equipment, services and support expenditure	**Mean**	**Median**	**Mode**
Very Large	$4,655,000	$1,330,000	n/a/
Large	$141,930	$105,450	n/a/
SME	$58,738	$28,500	n/a/
Total Sample	$1,094,070	$95,000	n/a

Table 34: Annual ICT equipment, services and support expenditure

Large firms spent an average of two and a half times more on this category than SMEs, whilst very large firms outspent large firms and SMEs by a factor of around 30 and almost 80 respectively. The mean for the sample of US$1m was skewed by the large expenditure by very large firms.

Very large firms

The average expenditure on this category by very large firms was US$4.6m, as depicted in chart 19, with all of the firms in this category publicly listed.

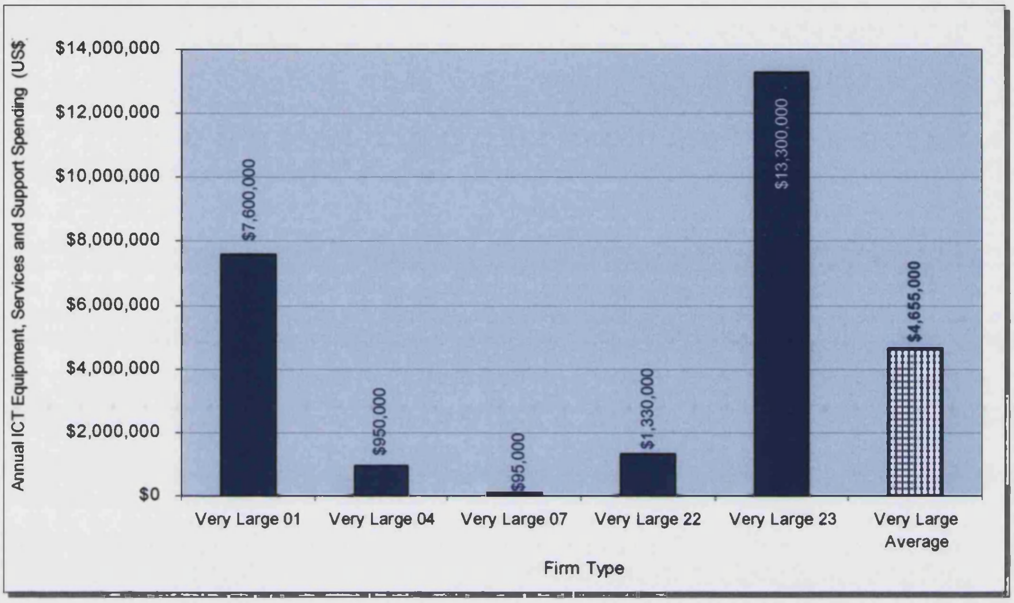


Chart 19: Annual ICT equipment, services and support expenditure – very large Firms

The largest spending firm (very large 23) outspent its nearest firm (very large 01) by a factor of almost two. The firm was one of the most international amongst this firm type, with the CEO believing that, "ICT is a key weapon for us. We spend big, but our business is big." The firm replaced PCs as soon as they were out of warranty (3 years) in areas defined as 'critical' (such as operations), but retained these longer in office and support functions and maintained a number of support contracts to ensure minimal down-time occurred. The next highest spending firm (very large 01) operated a number of international facilities, with its CEO also very supportive of ICT and expounding a high investment vision: "I can't expect my managers to provide me with real-time, up-to–the-minute information if I don't let them buy the kit and then maintain it." The firm also rotated PCs from the shop floor to less critical areas such as administration as soon as they were out of warranty, eventually discarding them when they became faulty, or were deemed to no longer be able to run new versions of Windows operating systems. The lowest spending firm (very large 07) spent a disproportionately small amount in this category (US$95k), in relation to its annual ICT budget (US$4.4m), and maintained one of the largest IT departments (15) with staff servicing IT in-house and extending the life of PCs and servers considerable longer than the warranty period (5-8 years out of warranty). Another firm (very large 22) spent US$1.3m on hardware, support and services. This firm also possessed a number of international operations and engaged in complex assembly and integration processes. A large IT department of ten employees supported this. PCs were utilised outside of the warranty period, with the average life of a computer being 7 years. The final firm (very large 04) mirrored this trend, with a large IT department of 12 managing the firm's PC and server longevity. This was the least international of the very large firms, but with the CEO planning for expansion overseas via acquisitions and greenfield modes: "We need to get our IT right here, and amongst the small number of overseas sites we currently own. This will give me comfort before we head out and do more deals abroad."

Large firms

One large firm spent over US$250k on this category (large 19), with the remaining firms all distributed below this amount, as depicted in chart 20.

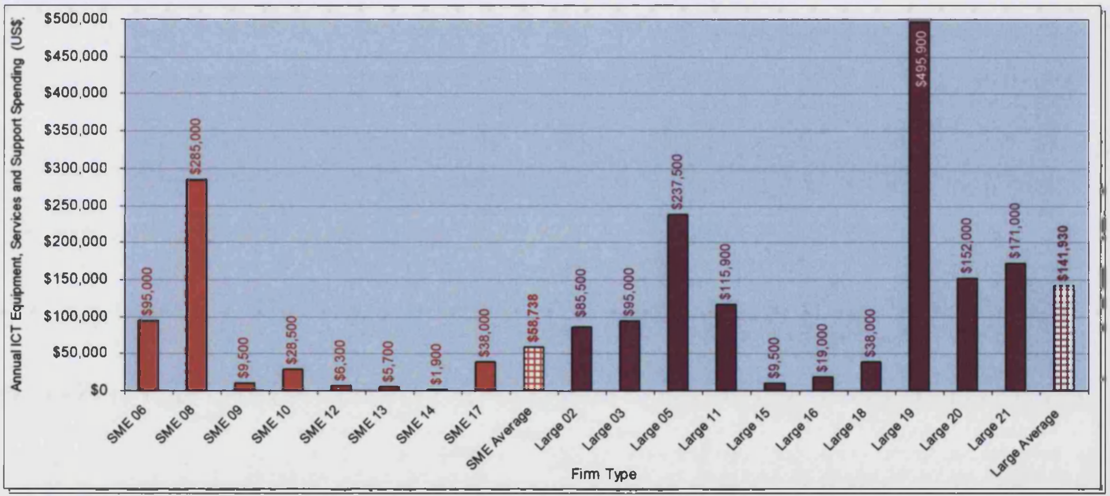


Chart 20: Annual ICT equipment, services and support expenditure- SMEs and large firms

This firm was publicly owned with a confrontational relationship existing between the CEO and the IT manager. The dual nature of the IT manager's ICT approval process (CEO and HQ approval required) often resulted in a lengthy request process, with expenditure normally eventually revised downwards, with the IT manager adopting a recurring strategy: "I take whatever HQ tell me I have to spend on IT, crank it up by a big whack and then present it to my boss. He then slashes it, and hopefully, it gets close to what I need. It often gets bounced around quite a bit though when he doesn't play the game, or when he is in usual form and hates everything to do with IT." The next highest spending firm (large 05; US$237k) was also characterised by a confrontational relationship between the CEO and the IT manager, with a small IT department of 2 maintained. The firm was also publicly owned but the IT function did not report to a HQ, with the IT manager and the CEO agreeing on the ICT strategy locally. Three other firms spent between US$100k-US$150k (large 20, 21, 11). One of these was a publicly listed firm (large 21), which spent US$171k on this category annually, with the CEO very supportive of ICT and the IT manager's efforts; "My IT manager is tasked with delivering robust systems that give me the information I need to run the business. I can't afford to skimp on my technology, and I don't."

Another firm was one of the two primogeniture businesses (large 20), with expenditure of US$152k p.a. and a CEO who was not ICT literate, but was very supportive of his IT manager: "IT is important to our business. It makes us share information faster and better, and we couldn't imagine operating without the IT we currently have." The third firm amongst these three (large 11) was independent, family-owned and spent US$115k p.a. on this category. The CEO tended to accept the majority of the decisions made by the IT manager and was supportive of the purchase of hardware and its support. A strong level of commitment for ICT existed across the firm, led by the CEO. Two further firms' expenditure was marginally below US$100k p.a. with one firm publicly owned (large 03) and one independent non-family owned (large 02). The first of these spent US$95k p.a. on this category, and employed a large IT department of 8.The CEO believed that ICT was "at the core of what we do," and was generally supportive. The business was in the midst of considerable structural changes being made, but the ICT function was not affected as a result. The three remaining large firms (large 15, 16, 18) spent US$9.5k-US$38k on this category and were all publicly owned. One of these (large 15) was characterised by a confrontational relationship between the IT manager and the CEO, with the latter maintaining an openly hostile view of IT: "I want the bare minimum IT and that's it." This was reflected in the US$9.5k p.a. spend in this category, which was to cover essential maintenance on servers. One of the remaining two firms (large 16) was in the midst of a significant restructuring operation with all expenditure curtailed including ICT (US$19k). The CEO did not foresee this as a long term scenario: "Once we stop the losses and streamline the business, we will focus on ICT and what we need to buy to replace the antiquated systems here." The remaining large firm (large 18) spent US$38k on this category with the CEO displaying very strong IT knowledge and support for technology. The firm was recently acquired by a publicly listed entity, and was also undergoing structural changes. The IT manager envisaged that he would be able to increase the current level of spending in 12-18 months: "Our CEO is all for a renewal of ICT, but until we get the business on track, it's a lower priority."

SMEs

Expenditure on ICT equipment, services and support was polarised for this firm-type, with two firms spending over US$100k, whilst the remainder spent under US$40k. The largest spending firm's CEO (SME 08; $US285k) was committed to ICT and believed that "it is an essential part of our business." A similar commitment was witnessed in the CEO of the second highest spending firm (SME06; US$95k), which was a primogeniture company. The IT manager and the CEO enjoyed a particularly strong and positive relationship, with the CEO supportive of his recommendations: "There is little that I am not allowed to do. It helps that we are profitable, and that my CEO let's me spend the money to keep us current on ICT." Two firms spent approximately one third of this amount, with one (SME 17) spending US$38k p.a. with the IT manager permitted to develop strategies that he believed were optimal for the business: "I am able to push through things that will help the business, versus those that are just essential. It's not really a 'push-through' as much as a discussion and a nod." The second firm spending near this figure (SME 10; US$28k) was characterised by a neutral relationship between the CEO and his IT manager, but this did not impede requests for the latter to continue replacing hardware as required. He faced pressure to maintain useable PCs as long as possible, which he accomplished with the aid of a local support firm.

The final four firms in this firm-type spent below US$10k p.a., on this category. One firm (SME 09) was independent non-family owned, and spent US$9.5k. The IT manager was strongly supported by the CEO: "He is pretty reasonable. When I need to change a PC, he knows it's because it's a last resort. We will hold our PCs as long as possible, with some of our accounts team using Windows 98 still." Another firm (SME 12) was owned by a larger entity, and spent US$6.3k on this category. The firm's IT manager and CEO had a positive relationship, supported by an IT team of three. This enabled the IT manager to extend the use of IT using his own staff, with parts purchased externally. Only server support was contracted to third parties. The third firm (SME 13) was independent family-owned and spent US$5.7k on this category. The IT manager was solely responsible for IT within the firm, and reflected the strategy adopted by other SME IT managers in this group: "We stretch out the use of our PCs as long as possible. I still have an old 486 clunker that runs Windows, Excel and connects to the web. I have more problems with the newer PCs than some of these old time boxes." The majority of the firm's annual cost in this category was for server support contracts. The final firm (SME 14) was the smallest firm in the sample in terms of both size and revenue and was independent non-family owned. The annual expenditure for this category was US$1.9k which was congruent with the negligible spending this firm undertook in ICT. The firm's commercial manager (who acted as the IT manager) and the CEO did not believe the firm's profits, or the scale of its operation, justified ICT spending beyond the current level: "We are small business and our IT reflects that. No fancy equipment. Just a cheap server and PCs we plan to keep around for a while."

5.2.12.4 Annual IT Department Costs

This category was comprised of the firms' IT department costs, with staffing representing 90-95 per cent of total costs, with the remainder contributed by training and smaller incidental costs not captured elsewhere such as travel and entertainment. Table 35 summarises these costs for the three firm-types:

Annual ICT Department costs	Mean	Median	Mode
Very Large	$6,002,480	$1,330,000	n/a
Large	$272,650	$185,250	n/a
SME	$94,763	$86,450	n/a
Total Sample	$1,456,391	$159,600	n/a/

Table 35: Annual IT department costs

The largest average IT department costs were for very large firms, with a mean of US$6m. This was 22 times greater than the large firm average (US$272k), and 63 times greater than the SMEs average (US$93k).

Very large firms

Four of the five very large firms had annual IT department costs between $638k-US$1.5m, with one (very large 23) spending US$25m. If this firm is excluded, the mean for this firm-type is US$1.1m. The firm was one of the most internationalised in the sample and embraced a strong technology ethos which filtered down from the CEO, who was IT literate. The firm operated complex production and assembly businesses and was located at the apex of the aerospace supply chain and operated related aerospace businesses. Technology, including ICT and other production assets, was integral to the company' operations with the IT manager chartered to maintain 99.99 per cent reliability: "We can never go down. This is a mission critical business that relies on ICT. Without it working properly, we're screwed." This was reflected by an IT department staffed by employees with a broad range of skills including, programming, networking, hardware, and others. These managed the firm's entire ICT network, with some situated in international locations. The firm was required to work closely with a HQ to define its ICT expenditure, with the latter only intervening if the firm's ICT was outside of a defined tolerance level that had been established. Chart 21 depicts the annual IT department costs.

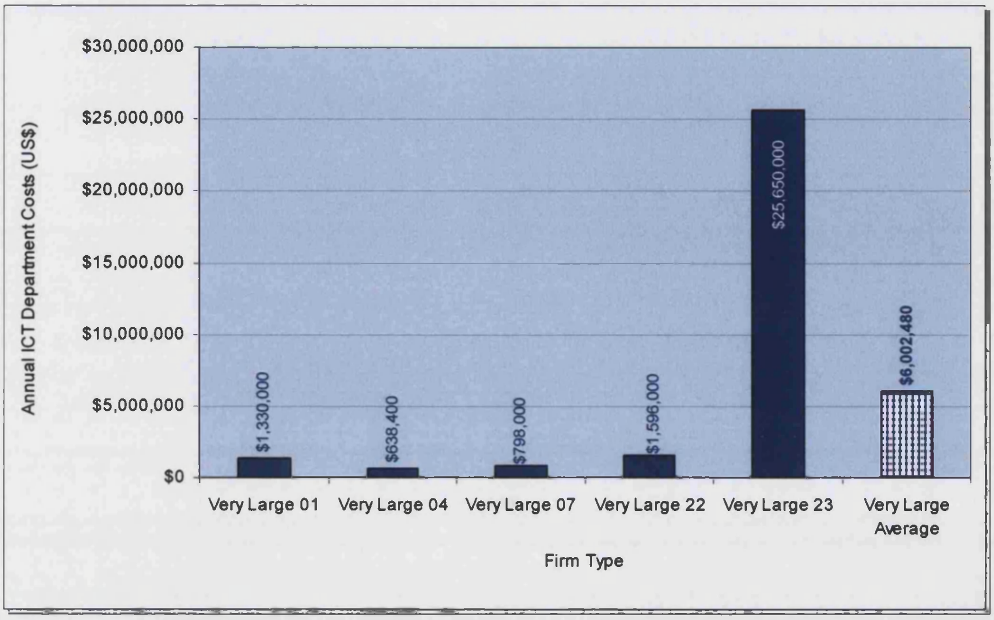


Chart 21: Annual IT department costs – very large firms

Two of the remaining four firms also operated large complex operations with significant international elements. One of these (very large 22) staffed its IT department with employees possessing networking and hardware skills. It spent the second highest amount amongst this firm-type (US$1.5m) with the IT manager originating from a heavy engineering background: "They don't realise how much IT drives their business, but thankfully for them, they won't find out if I have my way and keep things ticking over. That's why we spend a lot on IT, but my teams need to cover a lot of ground and systems." The second firm (very large 01) operated multiple international sites that catered to different market segments. The CEO mandated that he have access to information from these in real-time, which drove the IT manager to maintain a permanent IT department staffed by both programmers, IT hardware and networking specialists resulting in a US$1.3m annual departmental spend. The two final firms in this group were predominantly UK based with limited overseas facilities. One firm (very large 04) had one of the most IT literate CEOs who supported the maintenance of an in-house IT team: "If I don't have the people here, giving me and my managers what we need to run the business, I have nobody but myself to blame if things go wrong with our IT." The firm planned to increase its current annual US$638k IT department cost to over US$1m within 2 years. The final firm (very large 07) managed a predominantly UK business, but was required to share information with overseas related businesses and a HQ. The firm's IT department costs (US$798k) were primarily driven by the need to maintain networking staff and server specialists, with the IT manager planning to employ further specialists in order to develop a number of bespoke programmes to track some aspects of the production process.

Large firm and SMEs

Four large firms spent more than the highest spending SME on their IT department, as depicted in chart 22. A number of SMEs outspent large firms on their IT department, reflecting an overlap between some firms across these two firm-types.

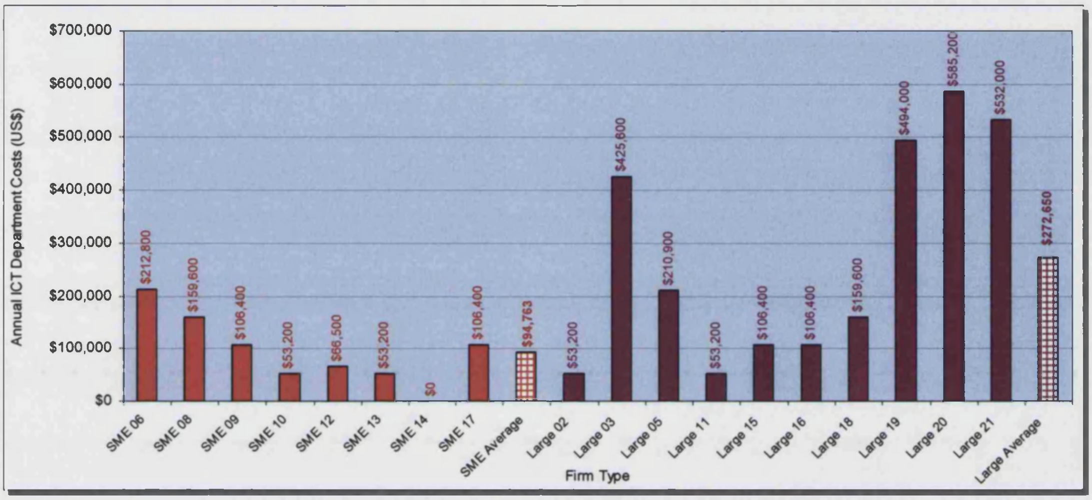


Chart 22: Annual IT department costs – SMEs and large firms

Large firms

Four large firms spent over US$400k p.a. on their IT departments. One was a primogeniture firm, with an IT department expense of US$585k (very large 20). The firm operated a number of overseas locations which were supported by the IT staff in the UK, as well as through 11employees based there. The CEO and IT manager collaborate on defining the IT budget and headcount. The next highest spending firm (large 21; US$545k) was part of a publicly listed company with the CEO having to seek approval for changes to headcount and spending. He has maintained the IT department at a constant level and has recently been pushing for an increase in the budget to manage with enhanced information requirements from HQ. The third firm in this group (large 19) spent US$494k on its IT department and was part of a publicly listed group. The IT department cost is a key area of contention for the CEO, with the approval of HQ required for any IT spending. This is further complicated by the IT manager being required to adhere to a HQ mandate for IT and subsequently seeking the approval of the CEO for this. He faces continued pressure to scale down the IT department: "Our CEO doesn't seem to get it. If I scale all of this back, he won't be able to get half of the information he wants, or, have someone jump when he has a problem. I am actually glad for once that the central office exists, and I never thought I would ever say that." The final firm spending over US$400k on its IT department (large 03) and was publicly owned. The firm had a practice of employing very experienced IT staff with the result that some were older and able to undertake a range of tasks. This was supported by the CEO, with the IT manager driving this strategy: "I want good solid all rounders who can go from designing a LAN to installing it." Four further firms spent over US$100k on their IT departments. One firm (large 05) was publicly listed and spent US$210k on its IT department. The firm's CEO and IT manager had a confrontational relationship, with HQ required to review any final budgets and plans for the business, including for ICT. Recognition existed by HQ that the IT manager's request for IT funding was generally acceptable, with pressure subsequently exerted on the CEO to comply by HQ staff. The IT manager leveraged this deliberately: "My boss hates spending on IT at the best of times, but he is smart enough to know that he has to. I make sure this will happen by having long conversations with HQ and constantly sending them information. That's the only way I can maximise the chance of getting what we need." Another large firm (large 18) spent US$159k on its IT department. The firm was owned by a public entity that was undergoing significant structural changes. This had not curtailed expenditure on ICT due to the CEO and IT manager convincing HQ of the benefits that maintaining this investment would bring in the medium and longer term. The CEO was IT literate, with collaboration with the IT manager assisting to secure investment in the department from HQ: "It became clear to head office that if they cut back the department, they would not receive the kind of information they wanted."

Two firms spent around US$100k on their IT department. Both were publicly owned with one firm (large 15) characterised by a confrontational relationship between the CEO and the IT manager. The latter was able to maintain the staffing of the IT department due to HQ insisting that this occurred, with the CEO accepting that he was not able to alter this: "I have been left with two IT guys which I can't change. They know we can't get more staff, or buy anything, so they are like PC repairers to me more than anything else." The second firm spending this figure (large 16) also reported its ICT expenditure to a HQ, but was supported locally by the CEO. He maintained the current level of 2 employees in the department and did not foresee this increasing in the future: "Our guys do a good job keeping the firm's hardware going for as long as possible as well as making sure the shop floor hardware is giving me data on our production." The final two large firms (large 02, 11) also spent a similar amount on their IT department (US$53k). Both firms were independent non-family owned and the IT department of both was comprised of a single employee - the IT manager. In both firms, a neutral relationship existed between the CEO and the IT manager with the principal tasks undertaken by the latter being similar and encompassing the extension of PCs beyond their warranty period, establishing networks (both local and wide area) and advising the CEO of future requirements.

SMEs

The highest spending firm (SME 06) spent over US$200k on its IT department. This firm was a primogeniture one with an IT department that was greater than over half of those found in large firms. This reflected the CEOs commitment to the function: "Our business needs accurate information as rapidly as possible. Without this, we can't make the corrections we need to and any element that we are off by a minute amount costs us." The next highest spending firm (SME 08; US$159k) was part of a public entity, with the CEO and the IT manager working closely on the requirements of the IT department. The IT manager had expanded his department from one additional employee to two in the last 18 months in order to undertake greater degree of support in-house: "We are not a huge firm, so having 3 people involved in IT is a big cost. Our CEO has listened to my rationale over time and has seen the benefits versus the costs. We can now repair some of our hardware here as well as expand and maintain our own LAN." Another firm (SME 09) was independent family-owned, with the CEO maintaining a small core IT department comprised of an IT manager and an experienced network engineer. The CEOs rationale for the continued cost of over US$100k p.a. for the department was, "to have a first point of contact internally for all IT issues, without needing to pay for expensive work every time we need to route cables, add new printers, fix PCs." A second firm also spent a similar amount on its IT department (SME 17) and was part of a larger public entity. The business was in a state of change with the CEO striking a balance between maintaining ICT and replacing or increasing the pool of IT in the business. The IT manager believed that the CEOs outlook was positive and resulted in continued funding for the function: "If we need things, we usually get them. I won't even bother putting up items that I know are 'nice to have' because we are a smaller company and need to maximise what we have- if it ain't broke, we don't usually try and repair it."

One firm (SME 13) was independent family-owned and spent over US$50k p.a. on its IT department, with the IT manager being the only departmental employee. His relationship with the CEO was confrontational, but this did not usually result in impediments to his task being carried out successfully, or to the required ICT investment being made. The IT manager's main tasks were the maintenance of PCs beyond their warranty and the establishment and support of LANs: "I am a jack-of-all trades around here which is due to my 25 years in the industry. Our CEO knows he needs some internal support, so the more he gets for his buck the better he feels." Another firm (SME 10) spent a similar sum on its IT department, which was staffed by the IT manager only. The firm was independent non-family owned with the IT manager's time primarily spent focusing on the support of the production process with the use of a low-cost unbranded ERP solution leased from a local supplier: "Sometimes I wonder why I am employed, but I think that's because we need our PCs maintained and the ERP to be monitored. It's not a top-end solution so I spend most of my time fixing computers, printers and problems with the network." Another firm (SME 12) employed a senior IT manager and 2 junior members, spending almost US$70k annually on its IT department. The firm had a supportive CEO and utilised a cheaper low-cost ERP. The main function of the junior employees was to maintain the PCs and local network, with the IT manager undertaking a broader role including the monitoring of the firm's production technology: "I tend to keep a close eye on how the guys on the shop floor are working with production data to make sure we get the right inputs, otherwise we have no idea how we are really doing." The final firm (SME 14) was the smallest in the sample and did not utilise a dedicated IT department. The commercial manager undertook the function where required, but the absence of an ERP solution and the firm's very small size, his tasks were PC-oriented. Any repairs or issues he could not undertake were 'shopped around' to the cheapest supplier: "There is no IT department. I sometimes dabble with a PC to see why it's not working. Beyond that, we make it someone else's problem to fix it."

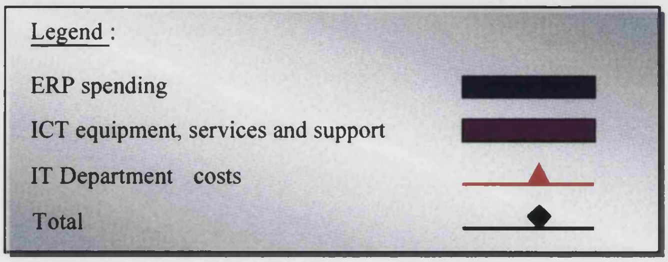
5.2.12.5 Total ICT Spending

The previous sections defined the major categories comprising the firms' ICT spending, which included an ERP component; an ICT hardware, software, services and support component, and department costs. This section consolidates these three expenditure categories to define total annual ICT spending with table 36 presenting the mean, median and mode for each firm-type.

Total Annual ICT Spending	Mean	Median	Mode
Very Large	$ 13,830,480	$ 5,966,000	n/a/
Large	$ 1,049,845	$ 657,875	n/a/
SME	$ 398,525	$ 160,550	n/a/
Total Sample	$ 3,601,698	$ 600,400	n/a/

Table 36: Total annual ICT spending

Very large firms displayed the highest mean, which was on average 13 times greater than the mean for large firms, and 34 times greater than SMEs' mean. In contrast, large firms had two and a half times greater annual ICT costs than SMEs. The mean for the sample was US$3.6m, which was significantly skewed by the larger ICT expenditure across all three categories by very large firms. Total ICT spending is presented by firm-type in the three charts on the following pages which depict the three major ICT expenditure categories utilised, and the total of these.



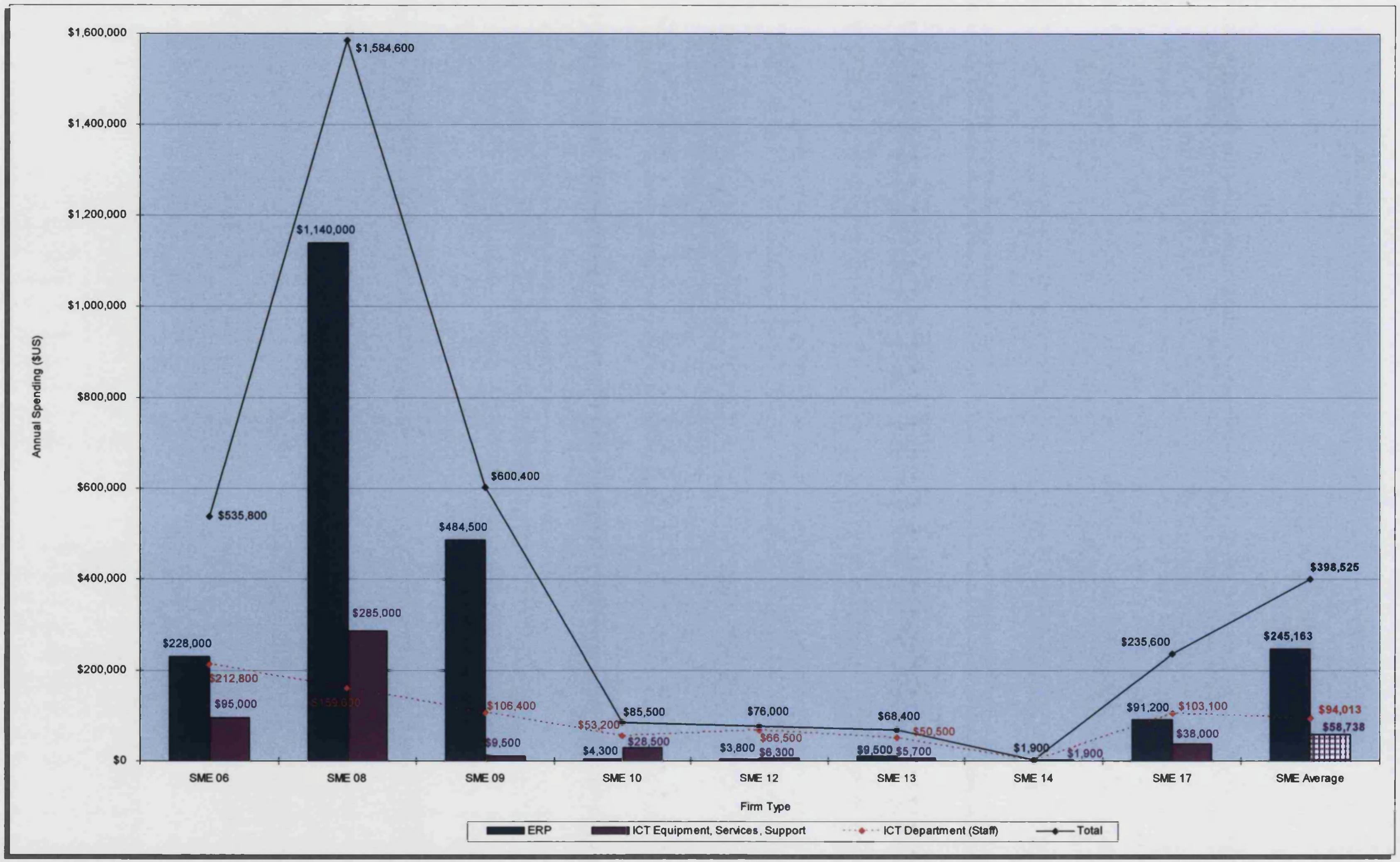


Chart 23: Total annual ICT expenditure for SMEs

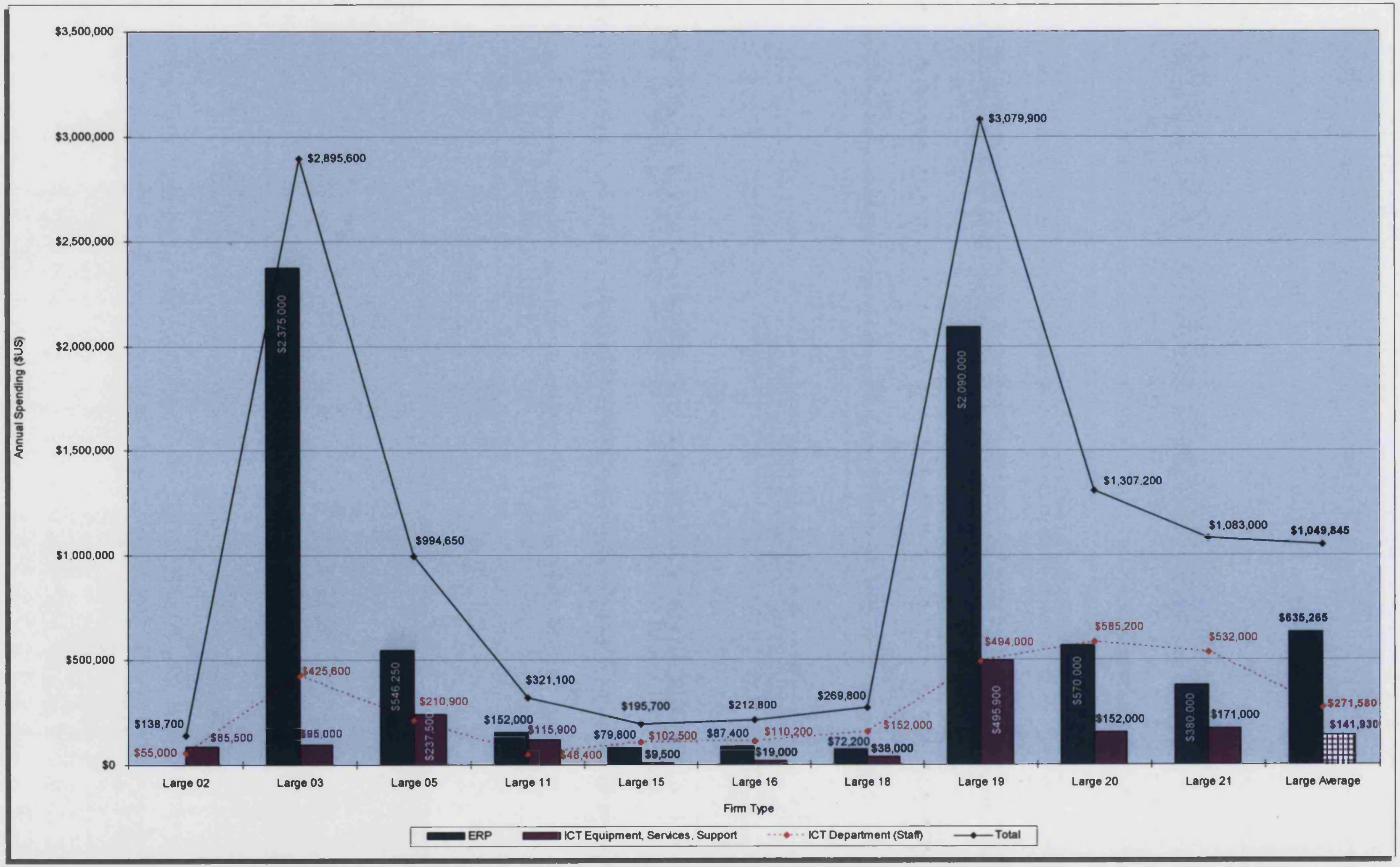


Chart 24: Total annual ICT expenditure for large firms

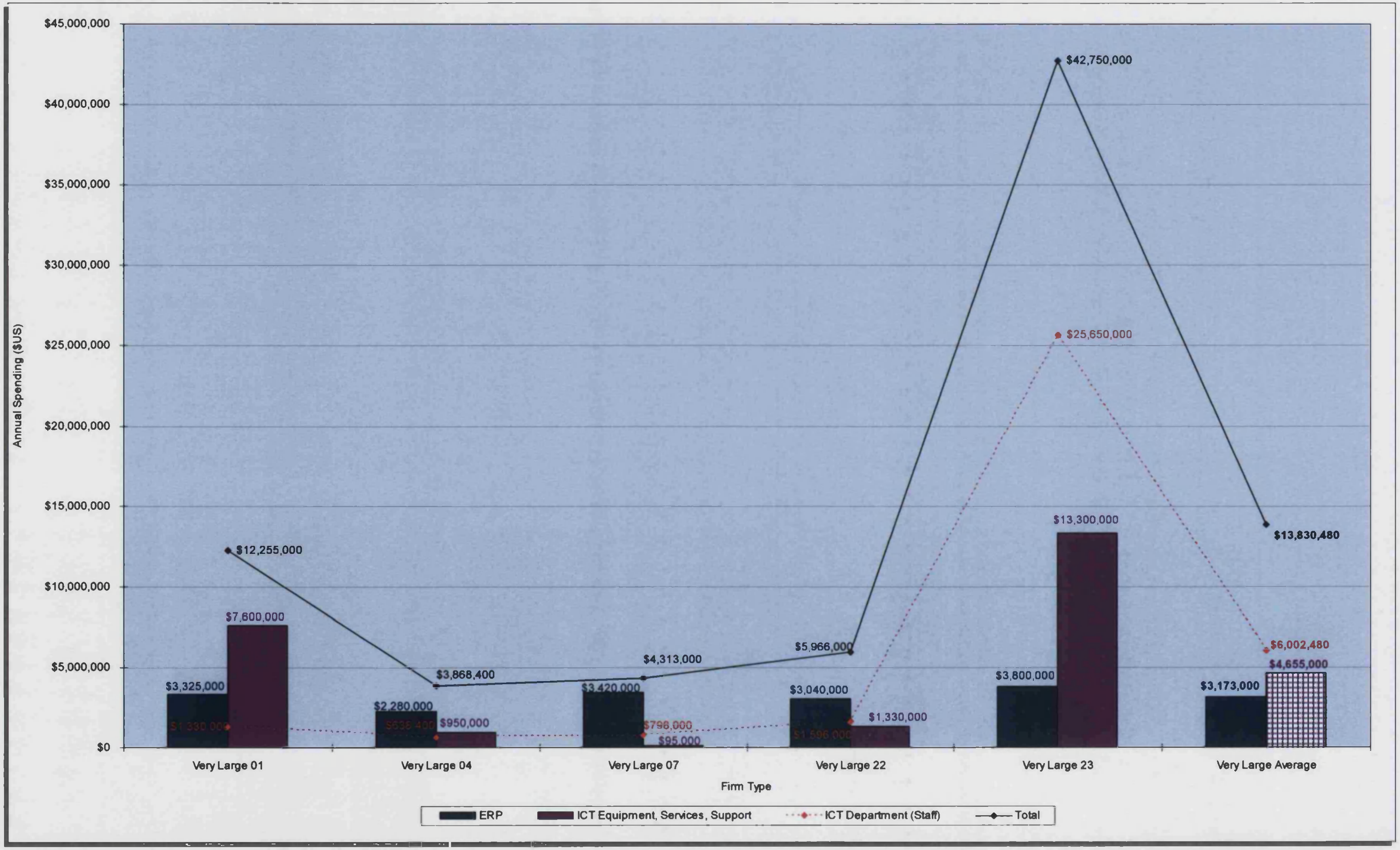


Chart 25: Total annual ICT expenditure for very large firms

5.2.12.6 Annual ICT Expenditure by Spending Bands

Utilising the data presented in these charts, the firms' annual expenditure on the three major ICT categories was segmented into six spending bands: US$0-$100k; US$101k-$500k; US$501k-US$1m; US$1m-$2m, US$2m-5m and >US$5m. This permits the comparison of expenditure levels both by the band of spending and by firm-type within each. Chart 26 summarises the total annual spending for the sample by expenditure bands, before the data are segmented by expenditure band for the three main expenditure categories.

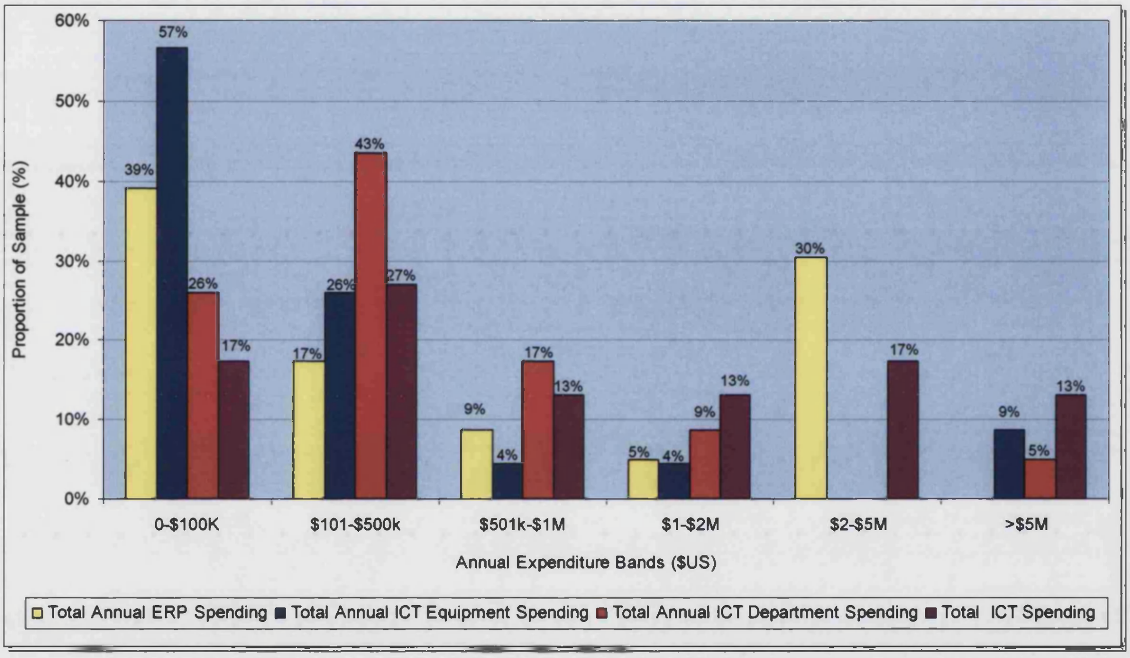


Chart 26: Total annual ICT expenditure by spending bands

Around one fifth of the sample's total annual ICT expenditure was between US$0-$100k, with this band also accounting for over half of all annual equipment spending. It also represented the highest proportion of ERP spending. The next expenditure band (US$101k-$500k) accounted for the highest proportion of the sample's total annual ICT spending and department costs, whilst accounting for the second highest ICT equipment spending. Total annual ICT spending was evenly distributed across the next four expenditure bands. Expenditure levels above US$1m p.a. only occurred for large and very large firms. The data for chart 26 above reflect the absolute spending by firms on ICT. In order to compare this further, spending on ICT as a proportion of revenues has been utilised, as depicted in chart 27. The individual percentage figures have been masked in order to preserve the anonymity of firms, with a range of 'high' to 'low' utilised. The data do not support either of the conflicting hypotheses observed in the literature: (i) smaller firms spend a greater proportion of their revenues on ICT than larger firms (Harris and Katz, 1991), and; (ii) smaller firms spend a lower proportion of their revenues on ICT than larger firms (Heart et al, 2001).

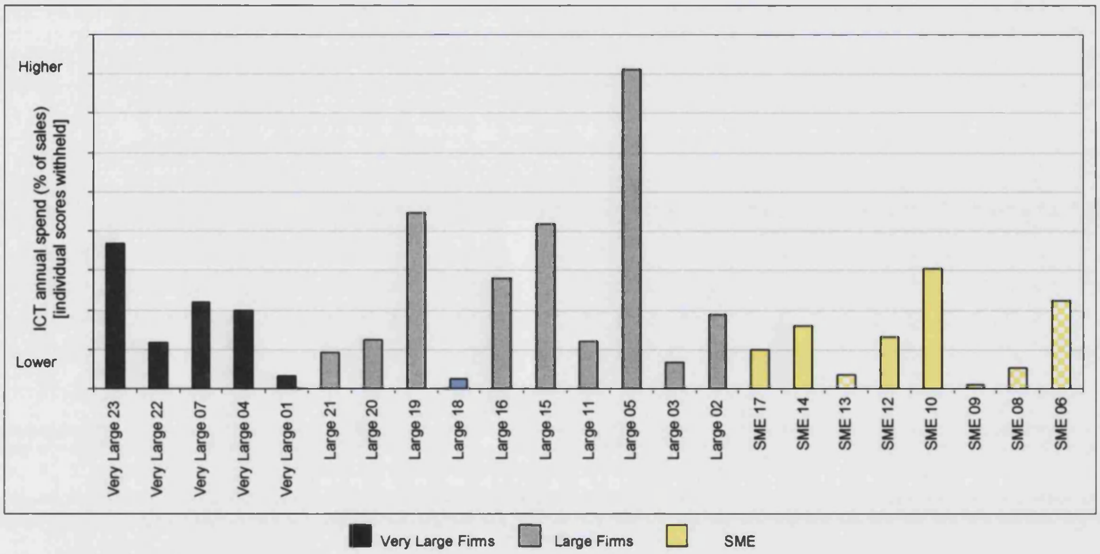


Chart 27: Total annual ICT expenditure as a proportion of sales by firm type

Regression analysis confirmed an insignificant relationship between these variables, with a p value of 0.2473, which is greater than the significance value of 0.05 (see Appendix F). In addition, a low correlation coefficient of 0.251 was obtained, which does not support the existence of a linear relationship between the variables of revenues and ICT investment. This is displayed clearer when the above chart is depicted in descending order.

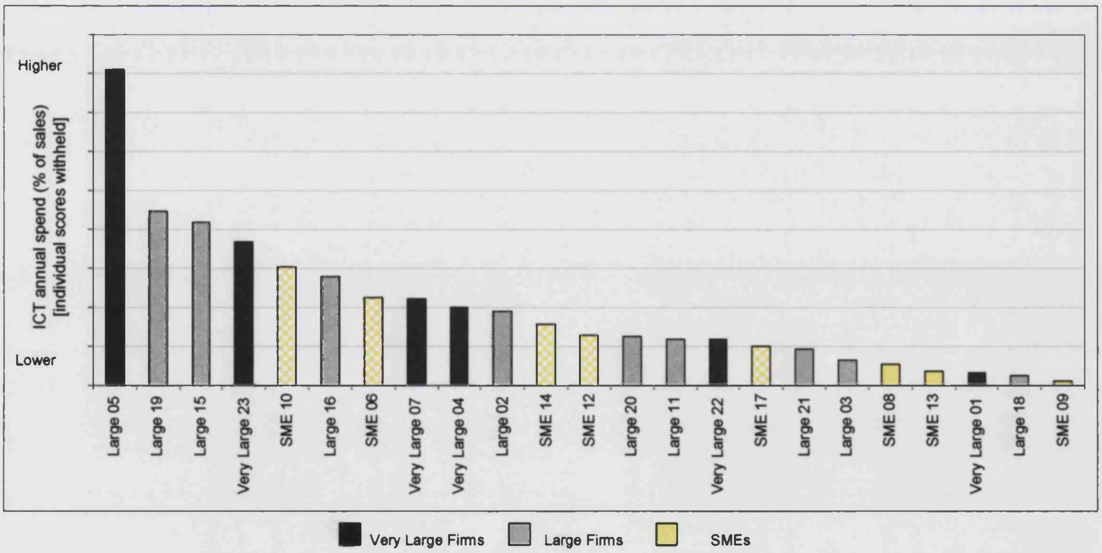


Chart 28: Total annual ICT expenditure as a proportion of sales by firm type (descending order)

This chart displays the mixed results, with no firm type clearly dominating: firms from all three firm-types are presented throughout the spectrum of ICT spending.

5.2.13 Identification of ICT Competencies and Training

Around 40 per cent of firms identified ICT competencies formally, with the remaining firms almost evenly divided between those undertaking the informal identification of ICT competencies and those not undertaking any form of assessment. The formal identification process was in all cases part of a formal appraisal process, with no firms undertaking an assessment of ICT skills outside of this review mode. Where the identification of ICT competency occurred, this was accompanied with the identification of training needs. In the absence of a readily adoptable definition as to what constitutes formal and informal modes of ICT competencies and training, the following have been developed and were utilised in discussions with firm managers:

> *Formal*: Occurred as part of a documented process, which was integrated with a required staff appraisal/personal development review.
>
> *Informal*: Did not occur as part of a documented process, taking place through conversations, day-to-day observations, and other modes of communication.

SMEs undertook the lowest level of formal ICT competency and training identification with around one quarter engaging in this. This increased to almost one third of large firms and occurred in the majority of very large firms, as depicted in table 37.

ICT competency and training identification	Formal	Informal	None
Very Large	80%	20%	-
Large	30%	40%	30%
SME	25%	25%	50%
Total Sample	39%	30%	31%

Table 37: Identifying ICT competency and training

Half of all SMEs and around one third of large firms did not undertake any form of ICT competency identification. In contrast, all very large firms undertook some form of formal or informal assessment.

Firm level results are presented in table 38, which highlights that a divergent approach between ICT competency and training identification occurred in only two firms (SME 14, 17). One firm (SME 14) was the smallest of the sample with the commercial manager also managing the IT function. A limited informal assessment of ICT competency occurred, which was comprised of knowledge gained on ICT requirements through daily discussions with staff. This was not followed up with any formal or informal training requirements investigation, with the commercial manager nominating any training he believed was required, although this occurred very infrequently. The second firm (SME 17) was also an SME, in which no formal ICT competency identification occurred but some informal ICT training assessment occurred. The firm did not engage in any formal staff appraisals, with the HR and IT manager holding infrequent discussions on ICT training, and which employees might be the recipients of this.

Firm type	ICT competency identification*	ICT Training needs identification*
SME 06	Formal	
SME 08	Formal	
SME 09	None	
SME 10	None	
SME 12	Informal	
SME 13	None	
SME 14	Informal	None
SME 17	None	Informal
Large 02	None	
Large 03	Formal	
Large 05	Formal	
Large 11	Informal	
Large 15	Informal	
Large 16	None	
Large 18	None	
Large 19	Informal	
Large 20	Informal	
Large 21	Formal	
Very Large 01	Formal	
Very Large 04	Informal	
Very Large 07	Formal	
Very Large 22	Formal	
Very Large 23	Formal	

Table 38: ICT competency and training needs identification by firm

All other firms utilised the same mode for identifying ICT training and competency requirements e.g. a formal mode utilised in the identification of one resulted in a formal mode being utilised in the identification of the other. Limited literature exists exploring these themes, identifying the need for an enhancement of ICT skills, but not exploring the internal processes utilised to identify and develop these (Duan et al, 2002).

The only very large firm utilising an informal identification process (very large 04) has grown rapidly through acquisitions, with senior managers indicating that they have not been able to implement their planned changes to the firm due to its current 'state of flux'. This has resulted in ICT skills and training being classified as 'non essential', along with formal performance appraisals. All of the large firms undertaking the formal identification of skills were publicly listed, with formal appraisals utilised to assess employees' skills and competencies, including for ICT. Of the three firms not undertaking any form of identification of ICT skills or training needs, one was independent and family owned (large 02), with the remaining two publicly listed (large 16, 18). Both of these firms were recently acquired by publicly listed entities and had been unprofitable and lacking investment. Newly installed managers from the parent company did not believe that the identification of ICT skills and competencies was a priority, with both firms also bereft of an established formal appraisal process. The remaining four firms undertook some form of informal identification of ICT skills and training needs (large 11, 15, 19, 20). Two of these firms were publicly listed (large 15, 19) with one of these not undertaking any formal appraisal process (large 15), but with the IT manager active in identifying employees he believed required ICT training as a result of skills deficiencies: "I know most of the employees so I tend to keep an eye on those in key roles that I think need more IT training." The second firm (large 19) undertook a formal performance review of all employees who were not on an hourly rate (shop floor staff in general), but only an informal identification of ICT occurred: this was not part of the formal process, due to the HR manager not believing that this was required. The IT manager was proactive in assessing what competencies existed in the firm and directly targeting employees he believed required further training: "What can I do? The CEO and HR manager don't think we need to make it part of people's job review, so I do it on my own and make arrangements where I have to."

Four SMEs did not undertake any form of ICT skills or training identification (SME 09, 10, 13, 17). Two firms were independent non-family owned (SME 09, 10), and one was independent family-owned (SME 13). Although the managers of both firms held positive views of ICT and were supportive of the IT manager, the identification of these skills and training was not believed to be justified based on the companies' size and available resources. Only one had an affiliation with a public company (SME 17), with both entities bereft of a formal appraisal process or any other identification mode for ICT skills and training. No plans existed to alter this, with managers believing that the businesses priorities did not include the formal or informal assessment of ICT skills and training requirements. Two firms undertook the formal assessment of ICT (SME 06, 08). One of these was an independent privately owned primogeniture firm (SME 06), with the CEO believing that, "we need to understand what our IT skills are so that we can continue to retain competent people in-house." The second firm was partly owned by a publicly listed entity, and altered its assessment mode to mirror the latter's, introducing formal appraisals that included an IT skills and competency component. The firm's IT manager was 'passively' supportive of this: "If you can't beat them, join them." The final two SMEs (SME 12, 14) engaged in the informal assessment of ICT skills and training. One firm was owned by a publicly listed entity (SME 12), with the parent's management contemplating taking the group private. The firm did not engage in the formal appraisal of employees with skills and training identification dependent on managers gathering such information as they undertook their daily routine. The final SME (SME 14) was independent family owned, with the CEO opposed to the introduction of any formal appraisal processes: "I just don't believe they accomplish anything. You end up scoring people and agreeing on things that you never end up doing. 'Just get on with it' is my motto. Besides, we are a tiny firm and I know everybody." The firm's commercial manager also acted as its IT manager and informally identified ICT skills and requirements through his day-to-day tasks. The results obtained by Levy and Powell (2000) did not appear to be evident in the sample: SMEs were able to successfully use more sophisticated applications such as ERP that were predominantly designed to fit with the organisational characteristics of larger firms. This eventuated for two key reasons: (i) large scale ERP solutions such as SAP were being 'cut down' and made available as cheaper packages (e.g. *mySAP*), and, (ii) these solutions were offered with enhanced training options.

5.2.14 Priority of ICT Skills

Discussions with IT managers utilised a three point scale to categorise the perceived priority of ICT in the firm: *high, moderate,* and *low.* These categories were not defined for managers, bur relied on their perception. Table 39 summarises the results, with around 40 per cent of sample firms placing a high emphasis on ICT skills. Around one quarter placed a moderate emphasis on ICT skills, with one third placing a low emphasis on these skills.

Priority of ICT skills	High	Moderate	Low
Very Large	80%	-	20%
Large	30%	30%	40%
SME	13%	37%	50%
Total Sample	39%	26%	35%

Table 39: Priority of ICT skills

Eighty per cent of very large firm staff placed a high priority on ICT skills, reflecting a significant difference with large firms and SMEs. This supports recent research positing that the adoption of technology such as ICT increases the demand for skilled labour and causes firms to place a higher priority on ICT skills (Autor et al, 1998). Giuri et al (2008) assessed the demand for ICT skills in the context of organisational development, positing that: "Users and producers need a long time to experiment with these new technologies and to adapt their organizations to new systems of production. The supply of skills required by the new technologies takes time to materialise," (p33). Firms that placed a higher emphasis on the priority of ICT skills reflected these results, with managers often making organisational adjustments to accommodate including providing time off for training and promoting employees who had undergone ICT training into additional roles and/or responsibilities. This was particularly evident amongst very large firms, which possessed an appropriate structure, budget and staffing levels. This was not always the case for large firms and SMEs.

Around one quarter of managers in large firms and SMEs placed a moderate emphasis on ICT skills, with no very large firm managers responding positively to this category. Managers in these firms (large and SMEs) indicated that a moderate view meant that their firms were as likely to enhance the status of ICT skills as to downgrade them to a lower priority. In contrast, around two thirds of managers indicated that their firm viewed ICT skills a low priority with this opinion particularly evident amongst SMEs and large firms; over half of all small firm managers believed that this was the case, followed by a marginally lower number of large firm managers. Only one very large firm's employees (very large 04) did not believe that their firm assigned a high priority to ICT skills, as depicted in table 40 below. The firm was continuing to acquire and integrate new companies, with ICT skills deemed to be a low priority. The firm's IT manager was under increased pressure to rationalise ICT and define a coherent architecture for the group: "The upgrading of ICT skills is not something we do formally or place a high priority on. I can't be on top of all of the IT networks in our companies, let alone worry about how well people use IT."

Firm type	Priority of ICT skills
SME 06	Moderate
SME 08	Moderate
SME 09	Low
SME 10	Low
SME 12	High
SME 13	Low
SME 14	Low
SME 17	Moderate
Large 02	Low
Large 03	High
Large 05	Moderate
Large 11	Low
Large 15	Low
Large 16	Moderate
Large 18	High
Large 19	High
Large 20	Moderate
Large 21	High
Very Large 01	High
Very Large 04	Low
Very Large 07	High
Very Large 22	High
Very Large 23	High

Table 40: Priority of ICT skills

All of the large firms placing a high priority on ICT skills (large 03, 18, 19, 21) were publicly owned. These four firms were characterised by larger IT departments staffed by an average of seven employees. Three other large firms' managers indicated that their firm placed a lower priority on ICT skills (large 02, 11,15), with one of these firms being independent non-family owned (large 02). Another was independent family owned (large 11) with a further one being publicly owned (large 15). All of these firms employed two or fewer IT employees. Three further firms placed a moderate priority on ICT skills (SME 05, 16, 20). Only one of these wasn't publicly owned (large 20), and was a primogeniture firm with 11 ICT employees, with the IT manager relatively informal in his approach. The remaining two firms (large 05, 16) employed two IT people.

Half of the IT managers in SMEs believed that the priority of ICT skills was low in their firm (SME 09, 10, 13 14). Three of these firms were independent non-family owned (SME 09, 10, 14), and included the smallest firm of the sample (SME 14). The IT function was undertaken by the commercial manager, who did not believe that the development of ICT skills was relevant or an affordable option for his firm's size or strategy: "I am also the IT guy, and that's saying something. We are too small to worry about our IT skills. All we care about is making it month to month with a full order book." The remaining two firms possessed IT departments staffed by 1-2 employees with these firms employing between 100-250 people. Only one SME placed a high priority on ICT skills (SME 12). This firm had ties to a publicly listed company with the IT manager being a strong advocate of ICT skills: "I have two staff members and always strive to keep their skills current. We think that a high level of ICT literacy translates to a better company." The managers of the remaining three firms (SME 06, 08, 17) believed that their firm placed a moderate priority on ICT skills, and employed an average of 3 IT people. Two of these firms did not undertake any degree of ICT training or skills identification (SME 06, 08). The final firm (SME 17) engaged in the informal identification of ICT skills and placed a moderate value on them. This was largely driven by the CEO and operations manager who both believed that: "It's more important to have people being able to use a piece of shop floor equipment than a computer." The results across firm types indicate that some organisational environments were more supportive of ICT skills and their priority, but it is acknowledged that the process for qualifying this further is not easy. This is congruent with Giuri et al's (2008) evidence, who state that "the interactions among technical change, skills, and organisational change are complex and difficult to measure," (p35).

5.2.15 ICT Skills Expectation Amongst Support Staff

Research by Caldeira and Ward (2002) on ICT satisfaction was drawn upon in order to explore managerial perceptions on the required level of ICT competence by organisational support staff entering the firm. This area has not been adequately explored in the literature but is directly relevant to this study due to the possible effect that ICT skills can have on both individual and firm-level productivity (ibid). Discussions occurred with managers on whether they believed that support staff in functions such as administration, finance, HR, operations, and other non-operational areas should already possess ICT skills before being recruited by the firm, or whether this could occur after they were recruited through additional training encompassing:

- Word processing;
- Spreadsheets;
- Power point/presentation software;
- Use of Microsoft Windows;
- Internet use;
- Accounting/Payroll software;
- Telephony (including PABX)
- ERP

All managers in the sample believed that a rudimentary level of ICT skills was a pre-requisite before an employee could be considered capable of undertaking support functions. The view of managers harmonised across the sample, with the belief that support staff should not be trained on basic ICT skills by the firm:

> We are not a big firm and can't afford to hire support people to train them up on how to use a computer to type letters or to fill in spreadsheets (Production manager, SME).
>
> If people want training on Windows, Excel, or Word, they should do a course and go on work experience. We can't subsidise that however and will only hire people that can hit the ground running (HR manager, large firm).

5.2.16 ICT Training Expenditure

IT managers were asked to define if their IT training budgets were high, medium or low. This reflects the approach utilised in other areas in this section, and has also been facilitated by the lack of relevant benchmarks being available due to the heterogeneous nature of the relevant considerations, including firm size, ownership, financial strength, employees, and many others. Table 41 summarises the sample results.

ICT training expenditure	High	Moderate	Low
Very Large	80%	-	20%
Large	60%	20%	20%
SME	13%	38%	50%
Total Sample	43%	22%	35%

Table 41: ICT training expenditure

Around 40 percent of firm managers believed that their ICT training budgets were high and capable of delivering their department's plans. This figure halved for manages who believed that their budgets were moderate, and permitted them to achieve many, but not all of their training aspirations, and contrasted managers who believed that their training budgets were low, and would not permit them to adequately undertake planned training. As the firms increased in size and complexity, IT managers tended to display a greater satisfaction with the size of their ICT training expenditure. In contrast, half of the managers in SMEs believed that their ICT training expenditure was low, with less than half this figure believing this to be the case in the other firm types. Table 42 depicts the results for ICT training expenditure, juxtaposed against firm ownership with family owned/managed firms highlighted.

Firm type	ICT training expenditure	Firm Ownership
SME 06	**Moderate**	**Independent: Primogeniture**
SME 08	Moderate	Public
SME 09	Low	Independent: Non-Family
SME 10	Low	Independent: Non-Family
SME 12	High	Public
SME 13	**Low**	**Independent: Family**
SME 14	Low	Independent: Non-Family
SME 17	Moderate	Public
Large 02	Low	Independent: Non-Family
Large 03	High	Public
Large 05	Moderate	Public
Large 11	**High**	**Independent: Family**
Large 15	Low	Public
Large 16	Low	Public
Large 18	High	Public
Large 19	High	Public
Large 20	**Moderate**	**Independent: Primogeniture**
Large 21	High	Public
Very Large 01	High	Public
Very Large 04	Low	Public
Very Large 07	High	Public
Very Large 22	High	Public
Very Large 23	High	Public

Table 42: ICT training expenditure by firm

The firm's ownership structure has been posited to influence its technology spending, including training and support (Abor and Biekpe, 2007). Only one very large firm's IT manager believed that his ICT training expenditure was low (very large 04). This firm has continuously acquired smaller, and often, troubled businesses, integrating them into a group. Although the firm has approved the rollout of ERP across all of the operating businesses, the replacement of IT has been postponed across the group until the CEO believes that the firm has been adequately 'stabilised'. This has also resulted in a diminished budget on ICT training, despite the firm's IT department of 12. A lack of formal appraisal system did not permit the more cogent identification of training needs and the subsequent quantification of this.

Two independent family owned firms were included in the sample, (large 11, 13), with the IT manager in one (large 11) indicating that his ICT training expenditure was high, whilst the IT manager in the second (SME 13) indicated that his ICT training expenditure was moderate. The IT manager did not believe that his moderate level of training expenditure was problematic in allowing him to meet his objectives: "I manage ten staff in the IT department and can afford to spend a moderate amount training them. We don't go any great to excess, more 'middle of the road', and although I could probably use more training money, if the trade off is getting good ERP and IT and less on training, I will go for this any time." One primogeniture firm in the sample employed 4 IT staff (SME 06), with the IT manager believing that his IT training expenditure was moderate: "We don't go over the top, but I get by training people as I need to. Our CEO won't refuse me if I absolutely had to train people, but it doesn't really get to that point." This firm was characterised by a confrontational relationship between the IT manager and the CEO, with the former depicting his ICT training budget as low: "We are only a small business, and I am lucky if I can stay current on IT let alone pay for staff to attend training. I end up having to train people myself half of the time."

The sample size is not large enough to accurately assess if family owned/managed firms undertake lower ICT expenditure than non-family owned/managed firms. Only four family owned firms were represented, with IT managers reflecting all three responses to ICT training expenditure (high, medium and low). In contrast, the IT managers of the four independent non-family owned firms all indicated a lower expenditure on ICT training. Three of these firms were SMEs (SME 09, 10, 14) and one was a large firm (large 02). The reasons cited for these responses by the IT managers varied:

> We've got a decent IT budget, and a couple of staff, but I just can't justify spending much on IT training (IT manager, SME).
>
> There's only me, and we are not a huge company. I will sometimes send someone on a course, but our CEO is not a fan of 'dead money' being spent on IT training (IT manager, SME).
>
> We are very lean. I am the only IT person, and even though we have over three hundred people, they are mostly on the shop floor. The office staff have to be self-sufficient so I tend to go on the odd Microsoft course (IT manager, large firm).

Amongst the remaining large firms (large 15, 16), two IT managers cited low ICT training expenditure priorities for similar reasons: their firms placed a greater priority on rationalising operational problems, with the emphasis in ICT-related issues reduced as a result. These firms each employed 2 IT individuals. Three remaining IT managers in publicly listed companies cited high ICT training expenditure (large 03, 18, 19). All of these firms possessed larger IT departments (8, 3, 8 people respectively) with IT managers sharing the belief that ICT training should be diffused to the broader base of employees. Two firms (large 18, 19) identified ICT training needs through formal staff appraisals.

5.2.17 Tenure of CEO and IT manager

The relationship between the CEO and the IT manager is a key one influencing many aspects of ICT (Feeny et al, 1992). Research has posited that the tenure of the CEO influences management practices such as R&D investment, which in turn influences the level of related technology investment such as ICT (ibid). The tenure of both the CEO and the IT manager were assessed, in addition to the relationship between the two (see the following section).

CEO tenure	Mean	Median	Mode
Very Large	10.4	12	18
Large	11.4	6	17
SME	10.6	6	n/a
Total Sample	10.9	7	1

Table 43: Tenure of CEO (years)

ICT Manager tenure	Mean	Median	Mode
Very Large	10.3	6	5
Large	10.1	10	10
SME	12.4	12	15
Total Sample	10.6	10	5

Table 44: Tenure of IT manager (years)

The average tenure of both the CEO and the IT Manger was similar. This was relatively consistent across firm types, although greater variation occurred within firm-types. Chart 29 depicts the firm level results for both roles, highlighting the considerable variation occurring within firm-types.

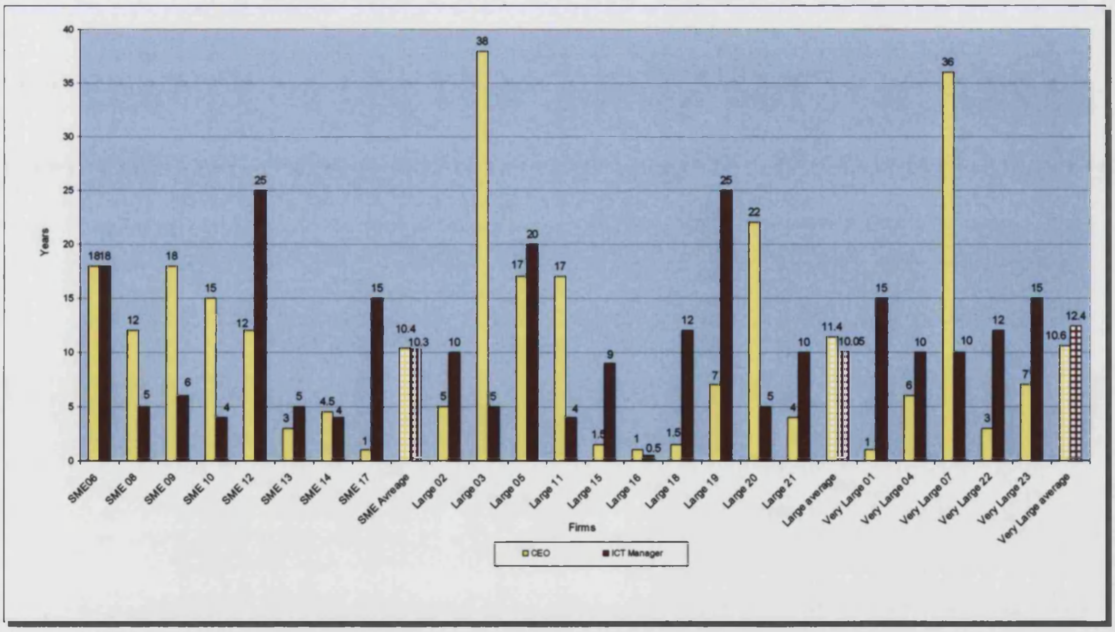


Chart 29: Comparison of tenure for the CEO and IT manager

Very large firms

The average tenure for CEOs at very large firms was around 12 years, which was approximately 20 per cent longer than the tenure for IT managers in these firms. These results were skewed by the single firm in which the CEOs tenure considerably exceeded the IT manager's tenure (very large

07), with the former having been at the firm for 36 years. If this result is removed, the average CEO and IT manager tenure is around 4 and 13 years respectively. In the firms where the IT manager's tenure exceeded the CEOs tenure (very large 01, 04, 22, 23), the former had been employed within the business for their entire career, commencing in entry level roles in the IT department. In the remaining firm (very large 07), the IT manager was a mid-career professional who joined the firm from another aerospace company in a similar role.

Large firms

The average tenure for CEOs amongst this firm-type was around 10 years and 12 years for IT managers. The results were fragmented, with six firms displaying longer tenure for IT managers than their CEOs (large 02, 05, 15, 18, 19, 21). In the remaining four firms (large 03, 11, 16, 20), the CEO displayed a longer tenure than the IT manager. The longest tenure in the entire sample was for the CEO of one large firm (large 03, 38 years), with the individual having been at the publicly listed Company through numerous acquisitions: "I am tired of the buy and sell game here. I have seen a lot of changes both in manufacturing and in our technology, and the pace is getting faster." Only one firm displayed a long tenure for both the CEO and IT manager (large 05), at 17 and 20 years respectively, despite a confrontational relationship existing between the two. This was also a publicly listed entity. The CEOs of three large firms (large 15, 16, 17) had recently commenced employment with those firms (tenure of 1.5, 1, 1.5 years respectively). In the case of one of these publicly listed firms (large 16), the CEO had recently appointed the IT manager: "I brought someone in I knew and trusted for our IT. The place is in a mess, and even though I can't get to spending much on IT yet, someone can start looking at it." This firm-type (large 19) displayed the equal longest tenure of any IT manager (along with one small firm, SME 12), who had been employed at the firm all of his career: "We have been bought, sold, bought, sold, and I sometimes forget who we work for. The fad is for us to now change hands between public companies."

The CEO of the primogeniture firm (large 20) had been at the firm for 22 years, and had recently hired a new external IT manager to manage the IT department with 10 employees: "We needed to get additional skills in-house since we run a large IT team." In the only independent non-family owned firm in this firm type (large 02), the IT manager had been employed for 10 years, which was twice as long as the CEOs tenure. The IT manager was the sole technology employee and worked closely with the CEO, with whom he had a neutral relationship: "Our CEO usually has bigger things on his plate than the upgrading of our PCs, but he still has time to hear me out." The only independent family owned firm's (large 11) CEO had been employed for 17 years, with the IT manager having worked at the firm less than a quarter of that period. The CEO was originally an external hire and not related to any family members: "I came in thinking I would do 3-4 years, but soon it will be 20. I don't think I will be moving anytime soon."

SMEs

The average tenure of CEOs and IT managers was similar amongst SMEs, at around 10 years for both. In half of the SMEs, the CEO had been at the firm longer than the IT manager (SME 08, 09, 19, 14). Only one of these firms was part of a publicly listed entity (SME 08), with the remaining three firms being independent non-family owned. The longest serving CEOs had been at their firm for 18 years (SME 06, 09). One of these firms was a primogeniture one (SME 06), with the CEO taking over from his father. In the second firm, the CEO commenced in a commercial role before becoming the CEO ten years later. In around 40 per cent of SMEs, the IT manager had been employed longer than the CEO (SME 12, 13, 17). In one of these firms, (SME 12), the IT manager had worked in the business his entire working career (25 years), commencing in an operational role before starting the IT department 15 years previously. He planned to continue in the role until his retirement. The IT manager of the second firm in this group (SME 13) had been employed at the firm for 5 years, which was 2 years longer than the CEO. His confrontational relationship with the CEO was currently causing him to reconsider his tenure at the firm: "He was better when I started, and although he lets me do my job, he sometimes becomes a real pain." In the remaining firm (SME 17), the IT manager had been at the firm for 15 years, with the CEO only recently commencing: "I have seen them (CEOs) come and go, so we will see how long this guy hangs around. Most don't tend to be as IT savvy as they think they are."

5.2.18 Relationship between the CEO and IT manager

The relationship between the CEO and the IT manager can influence the utilisation of ICT (Feeny et al, 1992) and its success:

> IT successes generally reflect an effective relationship between business managers and IS managers, with this dialogue needed most right at the top (Keen, 1991; p214).

The relationship between the sample firms' CEOs and IT managers was classified using a three-tiered taxonomy developed for this study:

> *Positive*: The CEO supports the IT manager across his activities with little if any irritation or hostility observed or reported. This relationship is reflective of strong positive ties at the professional and/or personal level. The CEO is often a champion for the IT manager, conveying his intentions to others in the firm.

Neutral: The CEO permits the IT manager to undertake his duties without being either supportive or inhibitory. Occasional overt support might occur, or conversely, occasional irritation. The CEO does not continuously act as a champion for the IT manager, although on occasion, he may do so.

Confrontational: The CEO and the IT manager exhibit openly hostile or antagonistic behaviour. The CEO will not overtly support the IT manager and will often impede his requests. The IT manager may undertake his job satisfactorily, despite this occurring.

IT managers were asked to categorise their relationship with their CEO using the above as a guide. Additional observations were made, but the limited nature of the window of observation was not believed to be as relevant in assessing this as feedback from IT managers. Table 45 summarises the classification of the relationship between the CEO and the IT manager.

Relationship between CEO and ICT Manager	Positive	Neutral	Confrontational
Very Large	100%	-	-
Large	50%	20%	30%
SME	74%	13%	13%
Total Sample	70%	13%	17%

Table 45: Relationship between CEO and the IT manager

A positive relationship existed between the CEO and IT manager in all very large firms. This occurred in around half of the large firms, whilst SMEs displayed a positive relationship in almost three quarters of cases. Large firms also displayed the highest proportion of confrontational relationships, with around one third of CEO-IT manager relationships falling into this category. SMEs displayed the second highest number of positive relationships, and a small number of neutral and confrontational ones. A number of observations were made with respect to these results:

- A larger number of individuals reported to the CEOs of very large firms, with limited time often provided to individuals requesting a meeting. This often resulted in the IT manager utilising written requests, primarily via email, limiting the ability to personally interact beyond shorter meetings. This in turn reduced the chance of a negative relationship developing.

- The more formal organisational structure of very large firms, including performance reviews for staff, often resulted in individuals taking greater efforts to ensure a confrontational relationship did not eventuate, as this could affect their annual appraisal, and in turn, their bonus, advancement, or other eventualities.

- In many large firms, and in the majority of SMES, a smaller firm resulted in fewer individuals reporting to the CEO, with greater contact occurring with his direct reports during the normal course of a working day.
- Many large firms, and almost all SMEs, did not utilise an annual formal appraisal system. This often resulted in both the CEO and direct reports being less inhibited in engaging in confrontational behaviour. The principal ramifications of this included the termination of employment, or the curtailing of salary increases. Many of the senior individuals reporting to the CEO in these firms held roles that were only one level below him, with no realistic advancement prospects beyond their current senior roles, and in the majority of cases, did not receive any bonus.
- The CEOs in the majority of large firms and all SMEs were closely involved in the recruitment decisions for both their immediate reports and for other key members of staff. This process provided would often reinforce positive relationships with the CEO.
- The smaller size of some large firms and SMEs resulted in greater interaction between the CEO and his direct reports, as well as other staff. This contrasted very large firms and provided greater potential for relationships to become strained or to reinforce positive ones.

The results by firms are presented in table 46.

Firm type	Relationship between MD and ICT Manager
SME 06	Positive
SME 08	Positive
SME 09	Positive
SME 10	Neutral
SME 12	Positive
SME 13	Confrontiational
SME 14	Positive
SME 17	Positive
Large 02	Neutral
Large 03	Positive
Large 05	Confrontiational
Large 11	Neutral
Large 15	Confrontiational
Large 16	Positive
Large 18	Positive
Large 19	Confrontiational
Large 20	Positive
Large 21	Positive
Very Large 01	Positive
Very Large 04	Positive
Very Large 07	Positive
Very Large 22	Positive
Very Large 23	Positive

Table 46: CEO-IT manager relationship status

Very large firms

The observed relationship between the CEOs of very large firms and their IT managers were all positive. In addition to a number of the observations outlined earlier in this section, a number of specific observations emerged for this firm-type:

- The majority of CEOs had worked in various functional areas during their career, resulting in greater exposure to ICT and other technologies, and a stronger affinity with the roles and challenges the IT manager faced as a result.
- This firm-type reflected larger and more complex organisations, all operating multiple sites, with an enhanced requirement for information and a closer collaboration with the IT manager.
- A high degree of formal planning was undertaken by very large firms, which also involved collaboration with the IT manager.
- The 'mission-critical' nature of very large firms' operations required an ongoing dependence on IT and consistent interaction between the CEO and the IT manager.

Where the relationship between the CEO and IT manager was at risk of becoming confrontational, or had already become confrontational, either individual could utilise formal options to attempt to ameliorate this, including mediation from the HR department. In some cases, this did not progress to this point, due to the 'self-checking' nature of the assessment and reward structure existing in these firms, in particular, the risk of a reduced score in formal appraisals. This often precipitated; the modification of behaviour before this occurred in order to mitigate the chance of a smaller bonus; diminished promotion prospects; 'sideways' move to another role, and others.

Large firms

Three of the four confrontational relationships in the sample were observed within this firm-type (large 05, 15, 19). A neutral relationship was observed in one firm (large 02), with the remaining half of large firms (large 03, 16, 18, 20, 21) displaying a positive relationship between the CEO and the IT manager. All of the firms displaying a confrontational relationship were publicly owned (large 05). One firm in this group (large 15) had recently recruited a new CEO from a heavy engineering sector who was charged with turning the operation around. This resulted in frequent clashes with the IT manager on a wide range of issues: "The CEO doesn't understand that he can't get the information he wants, or the measurement of indicators, without investing in more IT and throwing out the old stuff. He is trying to use the latter to do the former, and it just doesn't work. This is a daily ritual as he doesn't want to spend a dime until he gets some results. What's he going to measure them with though?" The last large firm displaying a confrontational relationship between the CEO and IT manager (large 19) had the equally longest serving IT manager in the sample (25 years) and was required to obtain approval for ICT spending from both HQ and the CEO, with the latter required to fund this. The CEO and IT manager viewed this as an unacceptable scenario, but one which they was required to work with.

Two firms displayed a neutral relationship between the CEO and IT manager (large 02, 11). One of these firms (large 02) was independent non-family owned, in which the CEO minimised IT investment in the business with the IT manager not 'pushing' a preferred ICT position: "I have learnt to adapt. I no longer press for things I want as I have never gotten them." The second firm (large 11) displayed a neutral CEO-IT manager relationship was independent family-owned, with the IT manager content in his role and his relationship with the CEO: "It's just his nature. He is kind of middle-of-the-road with everybody, and rarely do you see him angry or too excited. The owners trust him and he has been here a while, so I keep it on an even plane with him and end up with most things I need."

The remaining large firms displayed positive relationships between the CEO and IT manager (large 03, 16, 18, 20, 21). One of these was a primogeniture firm (large 20), with the remaining firms being publicly listed. This firm's CEO had worked at the firm for his entire career, taking over from his father 22 years ago. His IT manager was recruited 5 years ago from outside of the aerospace industry, and managed a team of 10. The CEO was very supportive of the IT manager and believed that ICT is a key element of his business operations: "We may have our disagreements about IT at times, but we always discuss issues and finish any meetings on the right note. He does a very good job and always gets my nod if something is necessary for us to do." Of the remaining four firms, the CEO of one (large 03) displayed a very low knowledge of ICT, and a resulting high dependency on the IT manager. Another firm (large 16) had recently installed a new CEO to turn around the newly acquired business 12 months earlier, and who recruited his own IT manager. The IT manager was constrained in what he could replace during this early stage of the change process, but this did not inhibit the maintenance of a positive relationship with the CEO: "I knew what I was getting into, and frankly it's a mess. But my job is to take stock and come up with the necessary changes, so I report on that, and make do with what we have at the moment. He listens to what I say to him, and we are buying time to get results and start investing in IT again." Another firm (large 18) had one of the most positive observed relationships between the CEO and IT manager of any firm in the sample, and was also undergoing significant structural changes. The IT manager had been at the firm for 12 years, with the CEO arriving in the past year: "This place needs a lot of work, and if I can't make that happen, the parent will shut it down. My IT guy is phenomenal and I look to him to help me mould the business, particularly with the requirement to have accurate production and cost information." The last large firm (large 21) with a positive relationship between the CEO and IT manager was part of a large international group. The CEO was active in working with the IT manager on IT issues and supported his initiatives for the business: "Our head office is a pain with the information they require, with my IT guy taking care it. He only comes to me when he absolutely needs to, and in between, keeps me posted on what is going on."

SMEs

Only one SME displayed a confrontational relationship between the CEO and the IT manager (SME 13). The firm was independent family-owned with the IT manager employed for 5 years. He was hired by the owners, despite the CEO expressing a preference to bring in his own IT manager. This created a level of ongoing conflict, which although not necessarily inhibiting the ability of the IT manager to execute his tasks, often caused an overt level of disagreement: "Our CEO would have loved to hire people that he already knew, but that would have meant sacking all of us. Given we are making money, that's was pretty hard to justify." One SME displayed a neutral relationship (SME 10), with the firm being independent non-family owned. The firm's CEO was approaching retirement, and was amongst the least ICT-literate of any firm boss in the sample: "IT is a necessary evil isn't it? I don't like spending money there, but I have no choice."

The remaining six SMEs displayed positive relationships between the CEO and IT manager (SME 06, 08, 09, 12, 14, 17). One of these firms, (SME 06) was the second primogeniture firm in the study, with the CEO taking over from his father. The IT manager has been employed for the same period of time, and was initially recruited into an operational role. He moved into the ICT role a short time after joining, when the need was recognised by the CEO of an enhancement to the IT department: "It's coincidental that the CEO and I have been here for the same period of time. We get along very well and he is a big fan of IT integration in the business. That's why we have four people in the IT department." Another firm (SME 08) was associated with a publicly listed entity, with the IT manager supported in his functions: "I have been allowed to grow to three people because our CEO believes that we should be as self-sufficient as possible. He actively encourages others in the business to come to us with things they want from IT, so he is definitely supportive." One firm was independent non-family owned (SME 09), with the CEO recently approving for the IT manager to add another person to his department and actively supporting his IT manager: "If he needs things, I sign them off. We have a good rapport, and he will ask me if it's necessary. He knows not to hassle me if it's trivial, which is why he can sign off a couple of grand on his own." Another firm (SME 12) had the equal longest serving IT manager at 25 years, whilst the CEO was with the firm for approximately half of that time. The positive relationship between the two was reinforced with the increase over time of the IT department to three people: "Our CEO has come a long way in his understanding of what ICT can do. Credit to him that he has been willing to listen and act on what I provide him." One of the smallest firms in the sample (SME 14) was independent non-family owned, and also displayed one of the strongest relationships between the CEO and IT manager. The role of the latter was performed by the commercial manager, due to the firm's small size and minimal ICT investment: "My boss and I get along very well. We have both been here about 5 years and work well together. He lets me get on with buying new PCs when we need them and repairing others when they break." The final firm (SME 17) had a newly recruited CEO working alongside an IT manager who had been at the business for 15 years. The firm had recently been acquired by a publicly listed entity, but was allowed to be run as an independent business as before. The IT manager was visibly supported by the CEO: "I believe that good IT is a cornerstone of accurate information being available, so I am keen to ensure that my IT manager has the tools he needs to give me business stats when I need them."

5.2.19 Management and User View of ICT

The perception of ICT within the firm can influence its use and management:

> " Keeping themselves credible and trustworthy is a major concern for ICT professionals as well as IT companies/departments" (Holm et al, 2002; p333).

Managers and some employees were asked for their view of ICT, with the number canvassed for each varying, depending on the firm's size, the type of plant visited, and other factors. In all cases, the majority view was used for the final perception of ICT. Table 47 summarises the results of the investigation into the perception of ICT, segmented by management and users.

Perception of ICT	Positive	Neutral	Negative
Very Large			
Management	80%	20%	-
Users	80%	20%	-
Large			
Management	60%	20%	20%
Users	80%	20%	-
SME			
Management	50%	38%	12%
Users	63%	25%	12%
Total Sample			
Management	61%	26%	13%
Users	74%	22%	4%

Table 47: Management and user view of ICT

The majority of managers and ICT users in the sample had a positive perception of ICT in the firm, followed by around one quarter who held a neutral view. A minority held a negative view, with this being particularly small amongst users. Both managers and users held the same perception of ICT in very large firms, with 80 per cent of managers and 20 per cent of users holding a positive and neutral view respectively. Although the same number of users held a positive view in large firms, a slightly lower number of managers held this view. Around half of SME managers held a positive view, and two thirds of users. Table 48 presents the firm level results.

Firm type	User perception of ICT	Management perception of ICT
SME 06	Positive	Positive
SME 08	Positive	Positive
SME 09	Neutral	Negative
SME 10	Neutral	Neutral
SME 12	Positive	Positive
SME 13	Negative	Neutral
SME 14	Positive	Neutral
SME 17	Positive	Positive
Large 02	Neutral	Neutral
Large 03	Positive	Positive
Large 05	Positive	Positive
Large 11	Positive	Neutral
Large 15	Neutral	Negative
Large 16	Positive	Positive
Large 18	Positive	Positive
Large 19	Positive	Negative
Large 20	Positive	Positive
Large 21	Positive	Positive
Very Large 01	Positive	Positive
Very Large 04	Neutral	Neutral
Very Large 07	Positive	Positive
Very Large 22	Positive	Positive
Very Large 23	Positive	Positive

Table 48: Management and user perception of ICT

Only one firm (very large 04) showed a neutral score amongst managers and users. The firm was run by a very ICT literate CEO and was significantly acquisitive of smaller troubled aerospace companies that were being integrated. This resulted in significant cultural and operational upheaval with the closure of some product lines and plants, resulting in job losses. An ICT 'freeze' was in place, with managers and many employees viewing any ICT spending as 'unnecessary' during this period. This resulted in a neutral view, with the CEO believing that staff would alter their perception once the businesses improved their trading position: "Right now, they view our IT guys with a little suspicion and don't understand why we are putting in expensive ERP when their colleagues are getting sacked."

The managers and users of only one large firm (large 02) both held a neutral view of ICT, reflecting the CEOs view that "its money best spent elsewhere." The firm was independent non-family owned, with this view just stopping short of being promulgated in a negative manner, with staff and managers neither too supportive nor derogatory of ICT. The firm was the only large business without a commercial ERP solution, using Microsoft Excel to track production. One firm's (large 11) users had a positive view of ICT, whilst its managers had a neutral view. The firm was independent family-owned with the CEO leading the neutral perception of ICT: "I know we need to have good IT to let me get data when I need it, but I can't get too excited that it does more for me than spit out spreadsheets." Users of the firm's ICT were more enthusiastic about its capabilities, with the IT manager actively circulating within the firm to bolster support for its use. Only two firms displayed a negative perception of ICT amongst managers and a differing perception amongst users (large 15, 19). In one publicly owned firm (large 15), managers had a negative view of ICT, whilst users had a neutral view. The divergence was caused by the negative view the CEO expressed for ICT and the curtailing of the majority of all related expenses. The other managers emulated this behaviour, but were balanced by users who did not share this view. This was largely due to their perception that 'the good guys' were the IT manager and his single employee, who were trying to obtain better ICT for them to use, but were 'hampered' by the senior managers: "It sucks. We have some average PCs and servers that sometimes go down, and instead of fixing them like the IT manager wants, our supervisors tells us to make do." In the second firm (large 19), managers held a negative view of ICT whilst users held a positive view. The firm's CEO and his other senior operational managers were openly antagonistic of the IT manager in large part due to the approval process he was required to follow: HQ defined his ICT requirements annually, with this requiring approval by his CEO, due to the latter funding all technology spending within his business. The CEO did not trust the IT manager's requirements, reinforcing the negative view of ICT: "I will make him squirm before I approve anything. I know corporate drive most of it, so they stack up his list, he adds to it, and then I have to pay for it." The IT manager's long tenure of 25 years (equal longest in the sample) provided him with considerable experience in managing both the process and a number of CEOs over time: "I've seen them come and go, but I am still here." Users in the firm were supportive of the IT manager with many appreciating the hardware, software and training he was able to organise; "He has a tough job being sandwiched, but he always somehow comes through. He's a tough nut and if it wasn't for him, we would still be using 1970's PCs."

The managers and users in half of the SMEs expressed a positive view of ICT (SME 06, 08, 12, 17). One firm's (SME 10) managers and users displayed a neutral view of ICT, with the firm being independent non-family owned. The firm leased a non-branded low-cost ERP solution, with minimal other ICT spending. Managers and users found this to be 'adequate', although the latter expressed a desire to obtain more PCs and a more up to date ERP. One firm's users (large 13) had a negative view of ICT, whilst managers had a neutral view. The firm was independent family owned, with the CEO and the majority of his managers believing that the firms ICT was adequate in facilitating the required tasks. In contrast the IT manager and other users believed that the ICT was significantly inadequate, and that the mid-tier ERP solution in place was not properly tailored to the business to maximise its potential. The continued confrontational relationship between the IT manager and the CEO compounded this division as did the IT managers initiatives at monitoring ICT benefits (see following section). In the final SME in this group (SME 14), users had a positive perception of ICT, whilst managers had a neutral view. This independent non-family owned firm was one of the smallest in the sample. Both the CEO and the IT manager expressed a desire to invest in more ICT, but were reluctant to do so due to the limited funding available to them. Users did not believe that their current ICT prohibited them in undertaking production, and were supportive of their managers: "We think the stuff we have is fine. It lets us get the information we need. For such a small place, we don't need more, although our bosses would like to have more."

5.2.20 Benefits Monitoring of ICT

Seventy per cent of the sample firms did not undertake any monitoring of ICT benefits following its installation. The results varied considerably between firm types, with the majority of very large firms undertaking some type of benefits monitoring, in contrast to large firms and SMEs, which revealed lower benefits monitoring, as depicted in table 49.

Monitor benefits of ICT	% of Sample
Very Large	80%
Large	20%
SME	13%
Total Sample	30%

Table 49: ICT benefits monitoring

Only one SME (SME 13) undertook any form of benefits monitoring. The firm was independent family-owned, with a confrontational relationship existing between the CEO and the IT manager, and a negative and neutral view of ICT existing amongst users and managers respectively. The negative view of ICT amongst users was in part contributed to by the IT manager's initiatives to monitor the benefits of the ERP and general PC access on the shop floor. This required staff to maintain a log of their access including its purpose, duration, and other information, which many saw as an attempt to monitor their activities. The belief existed by both managers and users that not enough effort was made to communicate to users the purpose of the monitoring, resulting in the negative perception regarding managerial intentions. Table 50 depicts the results for all firms.

Firm type	Monitor benefits of ICT
SME 06	No
SME 08	No
SME 09	No
SME 10	No
SME 12	No
SME 13	Yes
SME 14	No
SME 17	No
Large 02	No
Large 03	Yes
Large 05	Yes
Large 11	No
Large 15	No
Large 16	No
Large 18	No
Large 19	No
Large 20	No
Large 21	No
Very Large 01	Yes
Very Large 04	No
Very Large 07	Yes
Very Large 22	Yes
Very Large 23	Yes

Table 50: ICT benefits monitoring by firm

The remaining SMEs did not undertake any monitoring of their ICT to asses benefits. Only two large firms undertook any form of benefits monitoring (large 03, 05). Both firms were publicly listed, with one displaying a confrontational relationship between the CEO and the IT manager (large 05). The firm's IT manager and operations director implemented a monitoring system as part of the migration to a new expensive ERP. This required the capturing of information by users on when they accessed the solution; the duration of access; areas accessed, and their views. This was viewed favourably by both managers and users, with managers communicating the intentions of the monitoring clearly to all staff as well as taking part in the project themselves. In the case of the other publicly listed large firm (large 03), no monitoring occurred for IT hardware, but this did occur for a new ERP solution. The company's IT manager drove the programme to assess the use of the new solution, with users required to keep an Excel spreadsheet they were provided with that captured information relating to their usage motives, information sought, length of time utilised, and others. Following the completion of the 3 month period, further monitoring of the ERP occurred through information gathered directly from the ERP, and not from users. In addition, bi-annual questionnaires were distributed to all employees to gauge their use of ICT within the firm, with the results providing an indication of the perceived benefits.

Only one very large firm did not engage in any ICT benefits monitoring (very large 04). The firm was the least developed amongst this firm-type in terms of processes and operations, and was growing primarily through the acquisition of smaller businesses. These were generally SMEs with underperforming operations. The CEO and IT manager did not believe that their managers had the time to undertake the monitoring of ICT, and could not foresee that this would alter in the near future. The remaining very large firms undertook varying degrees of ICT monitoring. One firm (very large 01) had a formal annual feedback process requesting staff to complete a questionnaire on their ICT use in order to assess where the optimal benefits were occurring and to adjust the mix of ICT if required. The CEO and IT manager did not believe that the firm's dispersed, varied and complex operations permitted further follow-up of ICT. Another very large firm (very large 07) also measured ICT benefits through a survey distributed electronically every two years to all staff. No other benefits monitoring occurred. A more formal approach was undertaken by another very large firm (very large 23). The firm's operations were complex and geographically dispersed, with the IT manager possessing the largest IT department (130) and budget (US$42m) in the sample. The firm followed up the release of all new IT hardware with a questionnaire to employees, and all new ICT projects and ERP were designed with benefits measurement in mind, with follow-up questionnaires and visits by ICT staff to capture information and report back to the CEO and other senior managers. The data were also passed to the firm's HQ, which monitored ICT usage and benefits. Another large firm (large 21) was also one of the largest and most complex aerospace companies in the sample. The only monitoring of benefits that occurred was for enterprise level programmes, which was limited to ERP. Users were asked to complete surveys after the introduction of the initial ERP, and at 2 year intervals thereafter. These were collated and sent to the company's HQ as well as being used by local managers.

5.3 ICT Satisfaction

5.3.1 Measuring Satisfaction

The difficulties in objectively assessing the success of ICT have been addressed by a number of researchers.[49] The literature review has identified the level of ICT success as depicted by the firm's staff, as being the most meaningful measure of its effectiveness, when compared to other variables.[50] This study adheres to this proposition, in preference over another widely used measure, *computer utilisation*[51] The use of the this is believed to be too narrow in adequately capturing the often ubiquitous reach of ICT however within the firm, including in ERP, MRP, payroll, accounting, EDI,

[49] Caldeira and Ward, 2001.
[50] Thong, 1996.
[51] Delone and McLean, 1992.

CAD, website use, and others, which increasingly underpin or enhance activities, but which may be under-represented by a focus on the level of PC utilisation. Delone and McLean (1996) state; "User satisfaction of user information satisfaction is probably the most widely used single measure of IS success" (p69). This study 'peels the layers' of the firm to qualitatively and quantitatively explore the underlying elements defining ICT adoption and use, including the level of satisfaction. The methodological simplicity of an approach assessing end-user satisfaction based on "what is liked" affords a transparent view of how ICT is perceived with minimal ambiguity. Measuring computer utilisation does not necessarily accomplish this aim, with usage not always a relevant proxy for satisfaction.

ICT satisfaction was discussed with firm managers across three themes, drawing on a number of relevant studies:[52]

(i) The degree of satisfaction with the information generated and accessed by ICT in order to permit managers to undertake their work..

(ii) The degree to which problems were encountered in the adoption and use of ICT, and how satisfactorily these were resolved.

(iii) If ICT was believed to contribute to the firm's performance.

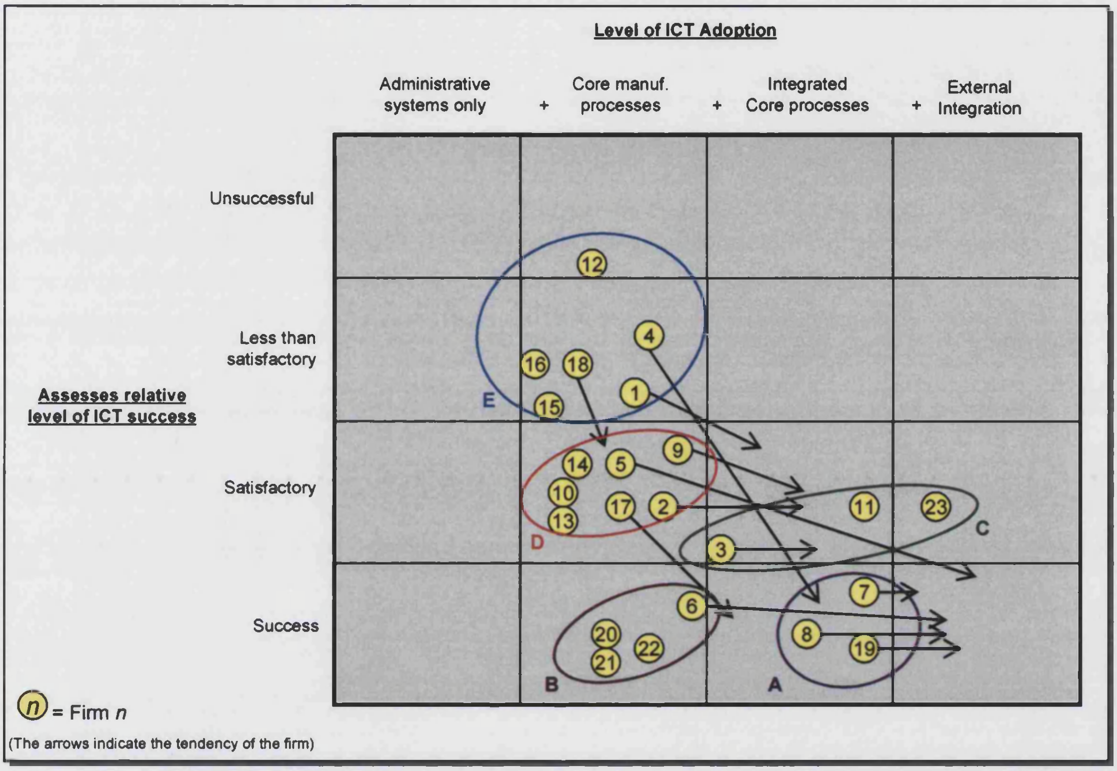
Figure 16 draws on Caldeira and Ward (2002) to map the managers' perception of the degree of ICT success against its adoption and use. Four levels of ICT success were defined on the y-axis, with a score of 1 to 4 assigned to the manager's response on their depiction of ICT as "Unsuccessful", "Less than Satisfactory", "Satisfactory", and "Success" respectively. Four levels of ICT adoption were defined on the x-axis, commencing with the narrowest use of ICT for administrative purposes and broadening this to ICT being used to integrate core manufacturing processes with the firm's processes, and external parties.

5.3.2 Results

Results for ICT satisfaction were grouped into five clusters, from A to E. Cluster A contained three firms whose managers believed their ICT was a success. They did not believe that more appropriate ICT could have been adopted, or that any problems existed with the choice of ICT. These managers believed that their firm had achieved significant business benefits through the use of the selected ICT, and that technology had unified their core processes. None of the firms exhibited integration with external suppliers or customers, although they all aspired to do so. Two of these firms were trialling on-site access to their inventory by their major supplier with a PC installed and integrated

[52] Caldeira and Ward, 2001.

into their ERP. If both of these proved successful by the end of 2007, they could lead to a permanent arrangement and a greater degree of external integration with suppliers.



Source: Caldeira (2002)

Figure 16: ICT Success and adoption

Four firms comprised cluster B with managers indicating the same high level of success with their ICT as the managers in cluster A. All of the managers were satisfied with their firm's use of ICT and believed that no problems existed in their choice or use of ICT. The firms in this cluster displayed a lower level of ICT integration than those in cluster A with their core manufacturing processes integrated by the use of ICT but not their administrative processes. Managers in one firm in this cluster aspired to migrate to higher levels of ICT integration, and had developed plans and a budget to integrate their core systems with ICT as well as major external suppliers.

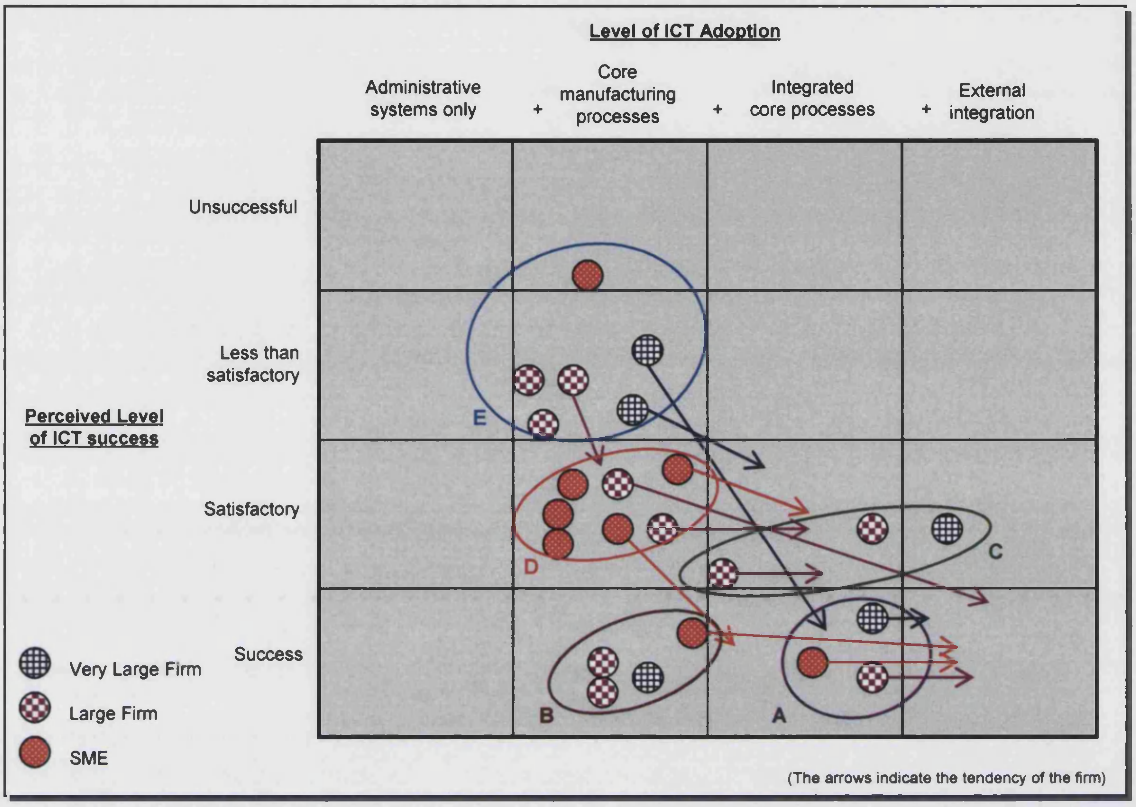
Cluster C was comprised of three firms whose managers displayed lower levels of ICT success than those in cluster A and B, rating ICT use as 'satisfactory'. Managers in these firms were satisfied with their overall use and adoption of ICT but believed that room for further improvement existed and that some ongoing problems with ICT 'had not been ironed out yet'. This included the inadequacy of the ERP solution to provide a required level of production data. All of the managers believed that specific business benefits had been yielded by the use of ICT. Two of the three firms in this cluster had their core processes integrated by the use of ICT, with the third firm having integrated its ICT with a number of its major suppliers and customers. The lower level of satisfaction cited by managers within this firm reflected 'teething problems' still being experienced with external integration.

The managers of the seven firms in cluster D also depicted their ICT as 'satisfactory', with this the largest of the five clusters. The level of ICT adoption was lower than cluster C, with only core manufacturing systems integrated. The managers provided mixed feedback as to why their satisfaction with ICT was not greater including: shortfalls in the features of ERP; wrong data being provided; a lack of required data; the slow update of information, and a lack of buy-in from some employees. In all cases in this cluster, managers believed that business benefits had been achieved by the integration of their core manufacturing processes. Two of the firms were in the process of integrating their core processes by the use of ICT within the next 12 months and believed this would result in a "satisfactory" outcome, due to the anticipation of teething problems.

The final observed cluster, E, contained six firms, with managers reporting a less than satisfactory opinion of ICT, with one manager reporting that the ICT was unsuccessful in accomplishing its defined aims. All firms reported some level of underlying ICT problems, with managers in three of these not believing that any short term rectification was possible and that the level of ICT satisfaction would not change in the future as a result. These managers were not expecting to alter their present level of ICT satisfaction or its level of integration. Managers in these firms believed that ICT was making minimal, or no contribution, to business performance. Of the remaining three firms in the cluster, two were planning to integrate their core processes within the next 24 months, with one believing that this would result in a successful outcome. The second firm's managers were more cautious, believing this would result in a satisfactory outcome and not a 'success' immediately. The third firm's managers believed that changes being made to ICT would result in their ICT approval becoming 'satisfactory', based on the delivery track record of the IT department. No changes were going to be made in the level of ICT integration, which encompassed core manufacturing systems.

5.3.3 Results by Firm Type

Around ninety per cent of SMEs had their core manufacturing systems integrated by ICT. Of these firms, around one quarter of the managers deemed their current ICT as being successful, whilst approximately one in ten deemed it to be unsuccessful. Figure 17 denotes the satisfaction level and degree of ICT adoption by firm type.



Source: Caldeira (2002)

Figure 17: ICT success and adoption firm-type

Managers who were less than satisfied with their ICT held this opinion primarily due to an inability to extract the required information from their ERP. In contrast, the firm managers defining their ICT as being a 'success' were satisfied with the information being extracted, and were in the process of integrating their ERP further across their core processes and with some external suppliers and customers. These firms currently utilised SAP. The remaining SMEs were satisfied with their ICT, with firm managers in two firms planning to use ICT to integrate their core processes in the future.

Firm Type	Success	Satisfactory	Less than satisfactory	Unsuccessful	Administrative systems only	Core manufacturing processes	Integrated core processes	External integration
Very Large Firm*	40%	20%	40%	0%	0%	60%	20%	20%
Large Firm*	30%	40%	30%	0%	0%	70%	30%	0%
SME*	25%	63%	0%	12%	0%	88%	12%	0%
All Firms^^	30%	44%	22%	4%	0%	74%	22%	4%

* Figures reflect the results within each firm type (e.g."40% of very large firms")
^^ Reflects the total results for all firms (i.e. "30% of all firms")

Table 51: Satisfaction levels with ICT and adoption by firm type

Table 52 summarises the interplay between the satisfaction of ICT and its integration.

Satisfaction with ICT	Firms	% of total sample	% of firm type
Believe that future level of satisfaction won't change	**18**	**78%**	
Very Large	3		60%
Large	8		80%
SME	7		88%
Believe that future level of satisfaction will change one level	**4**	**18%**	
Very Large	1		20%
Large	2		20%
SME	1		12%
Believe that future level of satisfaction will change two levels	**1**	**4%**	
Very Large	1		20%
Large	-		-
SME	-		-
Integration of ICT	**Firms**	**% of total sample**	**% of firm type**
Believe that future level of ICT integration won't change	**13**	**57%**	
Very Large	3		60%
Large	6		60%
SME	4		50%
Believe that future level of ICT integration will change one level	**8**	**35%**	
Very Large	2		40%
Large	3		30%
SME	3		38%
Believe that future level of ICT integration will change two levels	**2**	**8%**	
Very Large	-		-
Large	1		10%
SME	1		12%
Both ICT satisfaction and integration	**Firms**	**% of total sample**	**% of firm type**
Believe that future levels of ICT satisfaction and integration won't change	**13**	**57%**	
Very Large	3		60%
Large	5		50%
SME	5		63%
Believe that future levels of ICT satisfaction and integration will change one level	**8**	**35%**	
Very Large	1		20%
Large	5		50%
SME	2		25%
Believe that future levels of ICT satisfaction and integration will change two levels	**2**	**8%**	
Very Large	1		20%
Large	-		-
SME	1		12%

Table 52: Summary of ICT satisfaction and level of integration

Around four fifths of the firm's managers believed that the current level of satisfaction with ICT wasn't likely to change in the future. In the majority of these cases, the reason cited was the perceived limitation of the IT department to migrate the level of satisfaction beyond the current one. The remaining minority of respondents cited the technology itself as the primary reason that ICT satisfaction was not likely to improve, including the lack of capability to execute what was required, the requirement to make further investment, and others. Only one manager believed that the level of ICT success was likely to increase by two levels, from 'less than satisfactory' to 'success'. This was due to a group-wide rollout of SAP, replacing disparate legacy systems inherited within acquired firms. One fifth of the firms expected to improve their level of ICT satisfaction by one level from their current position. Almost two thirds of firm managers reported no plans to alter the current level of ICT integration, with around forty per cent planning to increase this by one level, and fewer than one in ten were planning to increase this by two levels.

6. Location Results

6.1 Overview

The firm's location decision represents one of the three principal themes explored in this study, and is the milieu in which managerial practices and ICT investigations are nested. This study assesses aerospace clusters the UK, with the majority established for a considerable period of time, and reflecting the same evolutionary path observed in many other developed countries (Beaudry, 2001). The intersection of these themes has not been explored in the literature however, but is believed to be topical and relevant for a wide audience that includes policy makers and other researchers. The promotion of agglomeration as a key benefit for participants continues to occur in the literature and in industry[53] but little firm-level investigation has been undertaken to assess if the posited benefits are valid in the 21st Century where digital connectivity is ubiquitous in many nations, and the tyranny of distance might not apply. This section explores clustering from *the firm's perspective,* including the motivation for firm managers to engage in clustering activities, and results in a contribution being made to the debate on the perceived benefits of co-location. By including the role of ICT in this investigation, the duality of clustering is explored at firm-level in one of the first such studies. The role of spatial clustering is first explored, establishing the terms of reference from which virtual clustering is subsequently investigated as depicted in figure 18.

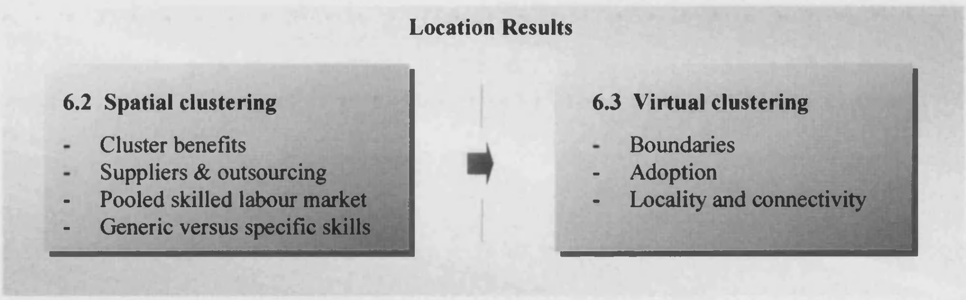


Figure 18: Structure of Location data analysis

6.2 Spatial Clustering

This study does not attempt to validate the existence of aerospace clusters in the UK. A significant amount of information exists verifying their presence and locations, assimilated by both regional industry bodies,[54] the national industry body (SBAC) and Government efforts (House of Commons, 2005).[55] Research specifically addressing UK aerospace clusters posits that benefits accrue to

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53 Keeble and Wilkinson, 1999; Porter, 1998.

54 This includes *Midlands Aerospace Alliance, Northwest Aerospace Alliance, Farnborough Aerospace Consortium, West of England Aerospace Forum, Aerospace Wales,* and *Northern Defence Industries.*

55 Beaudry, 2001; Mair and Field, 2002.

participants through: "Regional- and local-scale co-operative and competitive links between firms, and between firms and institutions, that improve competitiveness and wealth creation [with] links that are aided by geographical proximity," (Mair and Field, 2002).[56] This section explores whether geographical aerospace clusters obtain such benefits through discussions with managers in the sample firms, drawn from a cross section of UK aerospace clusters. The parameters utilised to assist this reflected the multidimensional nature of clusters and the lack of consensus on what constitutes a cluster, including its boundaries and measurement methods.[57] In assessing the degree to which firm managers believed that their firm may be physically clustered, respondents were asked to consider both a geographical and functional dimension. In undertaking this, the major issue highlighted by Martin (2002; p16) was considered:

> The key weakness is that there is nothing inherent in the concept itself to indicate its spatial range or limits, or whether and in what ways different clustering processes operate at different geographical scales. We are not suggesting that the cluster concept should refer to a particular pre-specified geographical size or scale; but to use the term to refer to any spatial scale is stretching the concept to the limits of credulity.

Some definitions describe a cluster as spanning a region, or even a country, with the geographic scope of the sources of advantage determining the nature of the regional cluster (Porter, 1990). Following a pilot study of small and large aerospace firms, three factors emerged for consideration when presenting the notion of clusters to firm managers:

- First, it was evident that managers were able to convey their firm's location with respect to whether it was located in a cluster.
- Second, notional boundaries existed as to how far their cluster extended which did not require considerable elaboration or definition.
- Third, the ability to engage in some form of personal contact was as an option that existed for firms located in a physical cluster, with this diminished for virtual clustered firms.

These factors confirmed that a similar approach could be utilised in the exploration of virtual and physical clusters. The pilot study revealed that defining the cluster boundaries for the study's participants (such as in terms of distances) resulted in them experiencing greater difficulty in conceptualising or reconciling its borders with their perceptions, with greater success evident when the border of the cluster was left to managers to define. Table 53 presents the guidelines defined for this study in order to assess the degree to which clustering activities occurred:

[56] Research commissioned by two of the major regional aerospace industry bodies: West of England Aerospace Forum (WEAF) and South West Regional Development Agency (South West RDA).
[57] Martin and Sunley, 2003.

No physical clustering activities: No activities occur.

Low level of physical clustering activities: Very infrequent or minimal activities occur with clustered firms.

Medium level of physical clustering activities: Activities occur on a more frequent basis, although these might be interspersed by infrequent periods. They are not excessive and are not likely to form part of the firm's established pattern of communication.

High level of physical clustering activities: Activities occur as part of the firm's regular routine with a high degree of repetition and commitment in terms of human and technical resources. The activities may form part of the firm's ingrained mode of operation, or be frequent aspects of its communication with other participants.

Table 53: physical clustering activities

The initial question posed to managers was, "Is your firm located in a geographic cluster?" This question sought to confirm the belief that all of the firms belonged to a geographical cluster, based on secondary research, and to explore any alternative response in greater detail. All managers responded affirmatively to the question however, without the need to embark on the second of these. Table 54 summarises the results for the degree to which managers indicated that their firm engaged in activities within their cluster.

Firm Type	Degree of *spatial* clustering
SME	
Low	25%
Medium	-
High	-
None	75%
Large Firm	
Low	20%
Medium	20%
High	-
None	60%
Very Large Firm	
Low	20%
Medium	-
High	-
None	80%
TOTAL	
Low	22%
Medium	8%
High	-
None	70%

Table 54: Level of clustered activities

These results are also presented in chart 30 to allow for a visual comparison by firm-type.

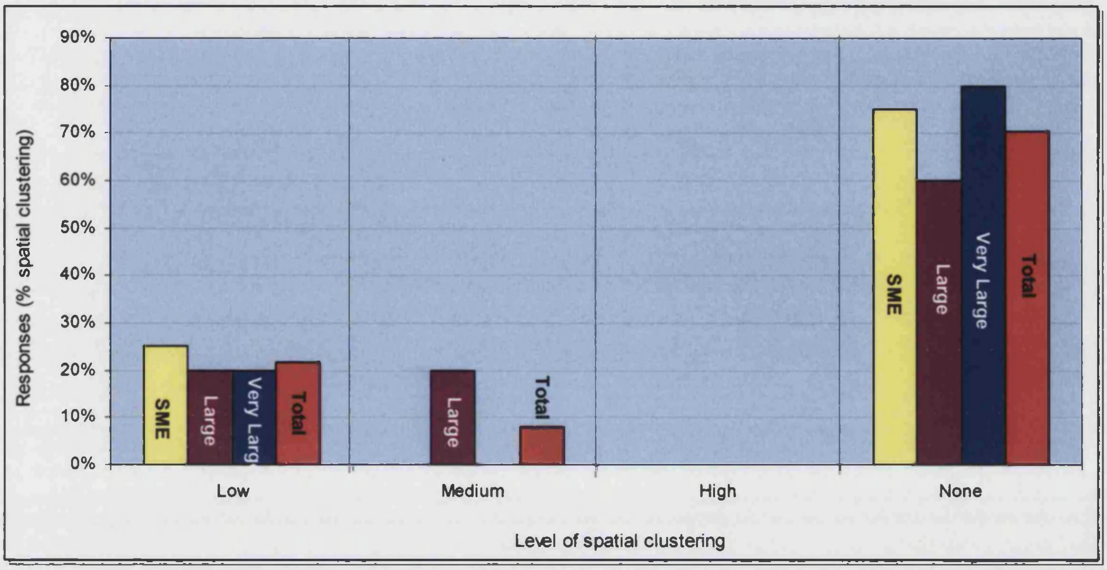

Chart 30: Level of spatial clustering by firm-type

SMEs

One quarter of SMEs engaged in a low degree of cluster activities. These results are contrary to the findings in some of the literature promoting the benefits of clustering for SMEs.[58] The principal intra-cluster interactions engaged in by this these firms were related to the execution of orders. No instances of knowledge transfer with universities occurred, although around one quarter of SMEs had at some point over the past five years been offered assistance with enhancing their lean manufacturing practices through participation in programmes developed by primes and regional industry bodies. This was perceived as a positive initiative and welcomed by the majority of firm managers.

Large and very large firms

Large firms engaged in the highest level of intra-cluster activities of the three firm types, with one fifth indicating a low level of cluster activities, and a further one fifth indicating a medium level of cluster activity. Around one fifth of very large firms also engaged in a low level of intra-cluster activities, with no other level of activity undertaken by this firm-type. Upstream activities by these firms occurred with a limited number of customers, reflecting the polarised nature of the aerospace supply-chain and the position of many of these firms at its apex. Managers across all three firm types indicated that these levels were not likely to decrease in the near future, with four principal

[58] Caldeira and Ward, 2002.

reasons cited: (1) low transport costs (which have been reducing over time); (2) increased competition from low-cost offshore suppliers; (3) reduced communication costs facilitating the greater use of ICT for virtual connectivity, and; (4) downward price pressure from customers. Seven of the sample firms had responded to these factors by establishing their own offshore operations, with this group including one SME, two large firms and four very large firms.

Some companies operated multiple plants, with this applicable for all large and very large firms, and for some SMEs. Only a minority of firms operated multiple plants in the same cluster, with the majority of firms operating plants in different clusters. This resulted in a consistent perspective of physical clustering across sample firm managers, which was not augmented by views that accounted for multiple plants within the same cluster. In the minority of very large firms that operated plants in close proximity to each other, firm managers cited some benefits which included the delivery of office supplies, ease of face-to-face meetings, the ability to share some support staff, and others. In the firms reviewed, the plants were located less then 5 miles from each other and were perceived to be more of 'one large dispersed plant' than a collection of a number of smaller plants. This did not facilitate the sharing of more skilled operational staff however, or for savings to be made from suppliers for factor inputs due to the plants manufacturing different products and employing individuals skilled in the operation of specific equipment. This resulted in a natural limitation being imposed on the study with respect to how managers perceived physical proximity in the context of multiple plants, with this further reduced by the intra-firm perspective of the study and its methodologies. These factors also diminished the assessment of network relationships.

6.2.1 Cluster Benefits

The perceived benefits of spatial cluster participation were measured utilising 11 categories drawn from Yamawaki (2002), with table 55 depicting these and the results for the sample. This is one of the few studies that explores the benefits that firms may extract from cluster participation, and encompasses a cross-section of areas that includes procurement, competition, access to customers and suppliers, and others. Managers were permitted to make multiple responses, due to more than one factor often being relevant. The responses indicate that two thirds of the sample firm managers did not believe that any benefits accrued to their firm from its location in a cluster. Three categories did not elicit any response from managers: business alliances, the sharing of information and competition. Respondents indicated that their businesses were relatively specialised and the forming of alliances did not offer any additional benefits. If international orders were sought, these were developed through the firm's own endeavours and not through alliances facilitated by Government agencies, which manager's indicated were 'too slow', 'too bureaucratic', or 'not targeting the required markets'. In addition, the presence of competitors in the cluster was not perceived to confer any benefits to the firm with the view prevalent that "It doesn't matter if competitors are located here or not. It doesn't change the way we operate" (operations manager, SME). In the majority of cases, managers and employees believed that the firm's competitive position was driven by the practices of the firm and not its participation in a cluster. This is congruent with research by Yamawaki (2002; p138):

> While clusters may provide firms that belong to them with common cluster-specific and region-specific advantages, such advantages may be offset by firm-specific disadvantages... clustering does not necessarily guarantee that all the firms benefit equally from it, but each firm's firm-specific resource and capability instead may play a more important role in shaping the firm's viability in the industry.

The diffusion of technology was perceived to be a cluster benefit for a minority of firms, with this result confined to SMEs. These majority of these firms indicated that their large customers sometimes assisted with advice on the use and selection manufacturing technology and ICT, but that no intellectual property was provided in the exchange of such information.

Firm Type	Ease of procurement	Access to labour market	Availability of skilled workers and engineers	Specialisation/ division of labour	Access to supplier/ subcontractor	Access to customer base	Competitive environment	Diffusion of technology and technological cooperation	Opportunity for business alliance	Access to market information	Regional policy	No advantage
SME*	25%	25%	13%	-	38%	25%	-	13%	-	-	13%	63%
Large*	10%	10%	10%	10%	10%	30%	-	-	-	-	-	70%
Very Large*	20%	40%	20%	20%	20%	20%	-	-	-	-	20%	60%
Total^^	17%	22%	13%	9%	22%	26%	-	4%	-	-	9%	65%

* Figures reflect the results within each firm type
^^ Reflects the total results for all firms
Source: Yamawaki (2002)

Table 55: Cluster benefits for participants

Around one tenth of the sample indicated that regional policy was a cluster benefit, with this confined to large and very large firms, which tended to engage in a greater degree of Government liaison, often employing a dedicated resource to undertake this. Around one fifth to one quarter of managers indicated that access to customers, suppliers and subcontractors, labour markets and procurement were cluster benefits. These proportions indicate that the majority of firm managers did not perceive these to be major benefits of cluster participation. The majority of firm managers believed that the benefits of localisation had diminished over time by 'the chasing of low costs'. This was depicted as 'a two-edged sword' by firm managers who believed that they were increasingly competing against low-cost producers nationally and internationally, but in turn, they themselves were demanding this parity from their suppliers. These results are congruent with research positing that in an increasingly globalised milieu, a growing number of clustered firms are engaging with suppliers and customers outside of their geographical domain (Di Maria, 2003).

Following initial indications that the benefits of cluster participation may be lower today than in previous years, managers were explicitly asked the question, "How do you compare the benefits of clusters today than in the past?" This question was only asked at the end of discussions following the capturing of other information and was deliberately phrased in this manner to minimise it being leading. Almost all managers responded that they believed clusters had greater benefits in the past. No manager indicated that this still occurred today, and only a very small number of managers indicated that some benefits still accrued to their firm from clustering. Additional research could be undertaken to assess spillovers and address this question, utilising a large database such as Amadeus. This could review the labour productivity of plants located close to each other in aerospace clusters and provide a reference point from which to review the findings of this study that being located in a cluster is less important today than it was previously. This exercise is outside the scope of this study but represents one further avenue of follow-on work.

6.2.2 Relationship with Suppliers

The distribution of a firm's suppliers represents a further proxy for the prevalence of agglomeration.[59] Chart 31 depicts the proportion of the sample firms' suppliers within their cluster.

[59] Liao and Hong, 2007.

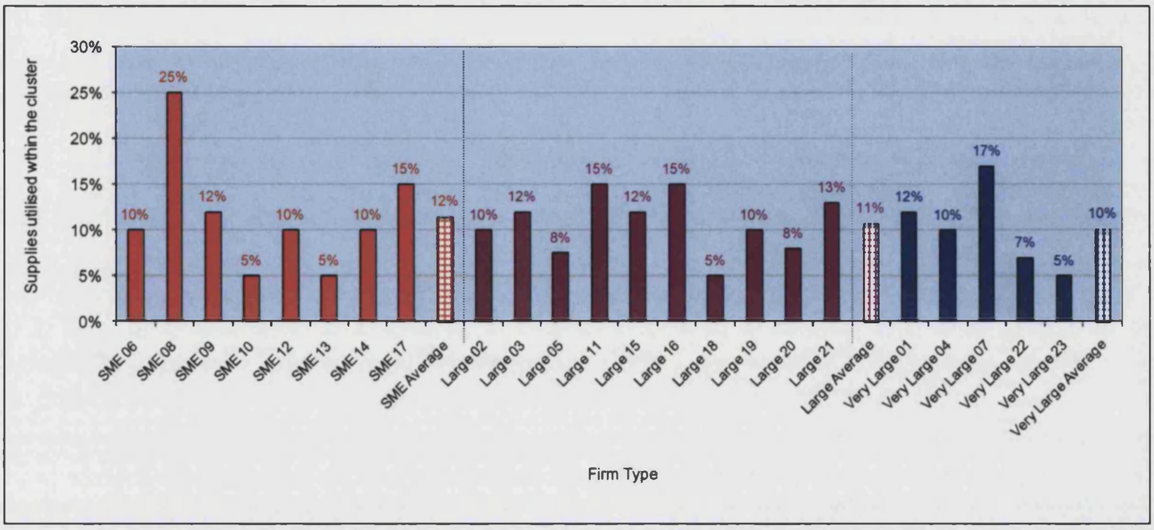

Chart 31: Sourcing of supplies within the cluster

The variability of the data across firm types illustrates the lack of a firm-specific pattern. The mean, median and mode for the entire sample were 11 per cent, 10 per cent and 10 per cent respectively. These figures were relatively consistent across the three firm types as depicted in table 56, with the majority of firms sourcing raw materials outside of their cluster.

	SME	Large Firms	Very Large Firms	Entire Sample
Mean	12%	11%	10%	11%
Median	10%	11%	10%	10%
Mode	10%	10%	n/a	10%

Table 56: Mean median and mode for the sourcing of supplies within the cluster

The majority of firm managers reported a reduction in the proportion of raw materials their firms have sourced from suppliers located within their clusters since the late 1990's, with the principal reasons cited including:

- More competitive prices offered by firms located outside of the cluster.
- A decrease in logistical costs within the UK.
- A decrease in the number of suppliers located within the cluster.
- A greater number of low-cost international suppliers.
- The establishment of production facilities in low-cost countries.

These findings are contrary to literature citing the benefits of clusters (Folta et al, 2006).

6.2.3 Outsourcing

Outsourcing represents an additional proxy for agglomeration (Teng and Jaramillo, 2005). Chart 32 depicts the proportion of the firms' production that is outsourced, and the amount of this that is outsourced *within* the cluster.

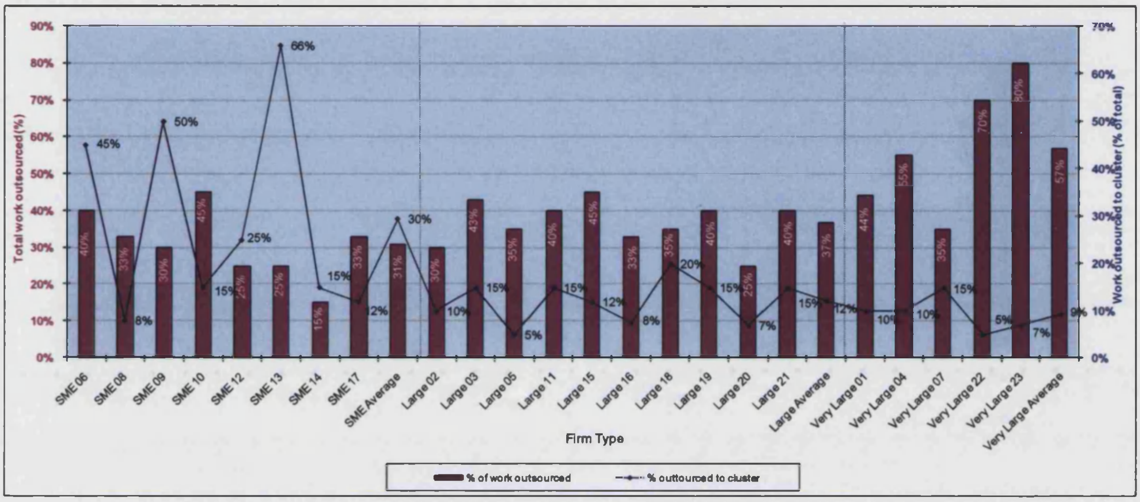

Chart 32: Total outsourcing by firms and the proportion undertaken within their cluster

The data indicate an interesting pattern, with SMEs outsourcing the lowest proportion of their production amongst the three firm types, but the highest amount outsourced within their cluster. This relationship reversed as the firm size increased, with the largest firms outsourcing the highest proportion of their production, almost twice the proportion as smaller firms, but outsourcing the lowest amount within their cluster, as depicted in table 57.

Total outsourced	SME	Large Firms	Very Large Firms	Entire Sample
Mean	31%	37%	57%	39%
Median	32%	38%	55%	35%
Mode	33%	40%	n/a	40%
Outsourced to cluster	**SME**	**Large Firms**	**Very Large Firms**	**Entire Sample**
Mean	30%	12%	9%	18%
Median	20%	14%	10%	15%
Mode	15%	15%	10%	15%

Table 57: Mean, median and mode for outsourcing activities

A number of factors contribute to the variations in outsourcing levels between the types of firms, with Figure 1 earlier in this dissertation depicting the structure of the aerospace supplier tiers:

- Very large firms included tier one firms and were amongst the largest and most influential in the UK aerospace sector, which often assembled the final products.

- SMEs were most often contracted by tier two and three firms, which were contracted by other upstream firms (tier one and primes), or in some cases, peer firms. The SMEs' products tended to be less complex with a greater proportion produced by these firms.
- The majority of SMEs possessed lower financial resources than large and very large firms. Wherever possible, a greater proportion of production was undertaken 'in house' in order to maximise both the control over the product and the return generated from it.
- Many SMEs did not possess the resources and infrastructure required to manage a large proportion of work being outsourced.

These variations in the outsourcing pattern between firm types can be partly accounted for by a number of factors:

- SMEs producing relatively more commoditised products faced a higher elasticity of demand and in some occasions selected intra-cluster firms to sub-contract production to in order to minimise costs where these were lower than those of out-of-cluster firms.
- Large and very large firms often employed business development staff that negotiated sub-contracted production with firms both in and out-of-cluster in order to accommodate cost pressure from their customers.
- Large and very large firms were able to displace some production-related compliance costs to the firms undertaking their outsourcing, resulting in a lowering of some of their costs.[60]

These are congruent with research highlighting the efficiency considerations driving the outsourcing decisions of firms (ibid).

6.2.4 Pooled Skilled Labour Market

Cluster literature frequently cites the creation of a pooled market of skilled workers as a key attribute of agglomeration benefiting both local firms and employees.[61] This study has revealed results contrary to this, with only around one in ten managers believing that this is a benefit of cluster participation, and ranking this attribute second to last amongst cluster attraction factors. The mode utilised to develop skilled workers varied between firms, with Yamawaki's (2002) four-category depiction utilised to explore how firm managers developed their skilled workers.

[60] Some costs, such as monitoring and inspection, are reduced as a result, as these firms bring the product to their customer for review. This results in further cost reductions through the reduction of time spent by staff on related tasks.
[61] Baptista, 1996.

Firm Type	On-the-job training	Inter-firm cooperation in skill formation	Recruit from outside of the cluster	Recruit from other firms in the cluster
SME	63%		13%	25%
Large	70%	10%	20%	30%
Very Large	80%		20%	20%
Total	70%	4%	17%	26%

(Multiple responses permitted)
Source: Yamawaki (2002)

Table 58: The development of the firms' skilled workers

Around one quarter of firms obtained their specialised labour from within their cluster. Managers cited varying reasons for pursuing this strategy: "it was the closest place to look"; "we try and find people who are working at a competitor"; "people can't be expected to travel far"; "why would people uproot across the country to come to another manufacturer?"; "it's easier and faster for us and workers". The overwhelming majority of managers cited that they would have embarked on exactly the same skills acquisition strategy if their firm was not located within an aerospace cluster, with this result not supporting the view that cluster-specific skills development strategies are often utilised by spatially concentrated firms.

Many firm managers expressed difficulty in sourcing skilled personnel within their cluster due to a limited number of competitors or the absence of other firms using the same equipment and similar processes. This reduced the ability of firms to recruit a worker who possessed directly comparable skills and often resulted in a hiring policy of 'as close as possible'. The expectation that some codifiable knowledge could be attracted was not always fulfilled, due to knowledge in the manufacturing sector and aerospace often being tacit. This reflects the findings that skills are not always transferable beyond the context in which they are embedded, where they are specific to organisational and geographic locations:

> Companies value access to a labour pool that is familiar with the operations of their businesses and able to apply their skills in the particular work environment of the cluster. To be sure, "commodity skills" that are easily transferable are wanted by all employers. But the "leveraged skills" that are industry specific are scarcer (Rosenfeld, 2002; p24).

In order to obtain the required skills, around one fifth of sample firms recruited people from outside of their cluster, with this often occurring from surrounding geographic regions, nationally or even internationally. SMEs undertook a lower level of out-of-cluster recruiting than large and very large firms, due to a lack of financial and organisational resources. Large and very large firms occasionally migrated skilled personnel between geographic regions and countries, engaging in around 50 per cent more out-of-cluster recruitment of skilled personnel than SMEs. On-the-job training was the principal mode of skills acquisition, with almost three quarters of firms engaging in this. This was congruent with research positing that, (i) cluster access to a labour market and the availability of skilled workers are considered less important sources of advantage and; (ii) general training in clusters is lower in significance and prevalence than on-the-job training (Yamawaki, 2002). Recent research by Rosenfeld (2002; p24) commissioned by the European Union on skills development in clusters is further supported by this study's results:

> Even more specialised, firm-specific "proprietary skills" are learned on the job and enable companies to build internal intelligence; such skills also foster knowledge spillover as people change jobs.

6.2.5 Generic versus Specific Skills

Table 59 depicts the firms' preferences between generic and specific skills, with only one in ten managers believing that generic skills were ideal for undertaking key operational tasks.

Category	General skills	Specific skills
Management	35%	65%
Operational	9%	91%
Technical/IT	61%	39%
Administrative	96%	4%

Table 59: Generic vs. specific skills preference

Around 90 per cent of all respondents believed that specific skills were required for operational workers with this view prevalent within many of the firms and throughout the organisational spectrum. Where managers recruited operational staff with more generic skills: (i) this occurred in the absence of the availability of the required specific skills, and, (ii) workers were trained on-the-job as rapidly as possible. In contrast, specific skills were perceived to be less important for managerial functions, with two thirds of managers believing that good generic skills should be the priority, with a number of reasons offered for this: "good managers can be used across industries"; "managers direct and lead, and don't need to know everything about the production process"; "good managerial skills are about knowing a bit about a lot". The use of generic skills transferred from outside of aerospace was reflected in the recruitment of almost one fifth of managers and senior operational staff from the automotive sector. This represented the largest source of employees outside of aerospace, with the belief that generic skills could be transferred between the two:

> I don't know the first thing about an aeroplane. What I do know is how to manage the production of components in a lean manner and on time. Whether this is for a car or a plane is immaterial. It's all pretty much the same (VP, very large firm-former car manufacturing operations director).

Three principal factors contributed to the transfer of these skills: (1) the similarity in production processes, including an emphasis on lean manufacturing; (2) the existence of hierarchical relationships between a prime contractor, tier-one suppliers, tier-two suppliers and other firms, which are predominantly SMEs; (3) extensive subcontracting between manufacturers and suppliers.

Almost two thirds of managers believed that the recruitment of generic technical/IT skills was acceptable. Only a very small minority believed that administrative employees needed to possess specific skills, attributing this to the nature of the work they undertook. The majority of managers believed however that these employees should be proficient in the use of administrative and related software upon their arrival. The recruitment of generic skills for administrative roles was deemed to be acceptable by the majority of managers, who did not class word processing, spreadsheets, accounting, personnel and related software as a specialised skill. In somewhat of a conflicting view however, managers were reticent to provide training for newly hired administrative employees, with consensus existing that "they should know how to use the software as part of their job". This view was particularly ingrained with respect to word processing and basic spreadsheet skills.

6.3 Virtual Clustering

6.3.1 Defining the Boundaries

Virtual clustering has been gaining increased attention as communicative technologies become more ubiquitous, cheaper and protected by enhanced security, with the OECD (2002a; p5) highlighting this and defining a virtual cluster as:

> ...a network of clustering firms grouping together various entities from different countries or regions targeting similar markets or sharing the same technological challenges.....Collaboration can be established even if actors are separated by great geographic distances by means of electronic communication.

The use of this term reflects some of the ambiguity encountered in physical clustering.

> For those promoting the formation of clusters, they are nothing more than:
>
> > a group of businesses or organisations that can benefit by doing things together.
>
> For those whose business is regional economic development, an industry cluster is:
>
> > a regional concentration of competing, complementary and interdependent firms that create the wealth of regions through exports for whom membership within the group is an important element of each member firm's individual competitiveness. (Johnston 2003; p8).

This study's investigative perspective for virtual clusters is congruent with Zadek et al (2006), who posit that clusters can be geographically dispersed, and include a virtual and geographic domain. This encompasses the role that ICT can play in facilitating the development of clusters through the creation of virtual communities in which participants are geographically dispersed (ibid). Within this type of cluster, entities take part via ICT, which emulates physical participation in an attempt to strengthen the value of the cluster as a whole (ibid). In exploring the firm-level utilisation of ICT and its role in any virtual clustering, Romano et al's definition was adopted (2001; p1):

> A virtual cluster is conceived as an e-business community, made up of customers, suppliers, distributors and commerce providers sharing digital and knowledge networks for collaboration and competition.

This definition is also reflected by Molina and Flores (1999; p 2):

> A Virtual Industry Cluster is an aggregation of companies from diverse industries, with well defined and focused competences, with the purpose of gaining access to new markets and business opportunities by leveraging their resources.

These definitions are extrapolated by other researchers who emphasise both the social and commercial impact of virtual clustering:

> Electronic communities also represent a relatively neglected social unit of analysis, yet their influence is likely to grow as more participants get connected to mediating technologies. In addition to communities of local residents, professional communities offer an interesting look at work that spans particular organizations and geographic boundaries (Vlachopoulou and Manthou, 2003; p127).

6.3.2 Degree of Adoption

Firm managers were asked to categorise their firm's virtual activities utilising one of four descriptions. These included the broad use of ICT encompassing the provision of connectivity with other firms for coordination of work efforts; collaboration; facilitating electronic transactions and communication; providing and obtaining information from partners, customers and suppliers, and other collaborative activities (Steinfield, 2002). Four levels of activity were defined for this study for firm managers to select from, as depicted in table 60.

No virtual clustering: No activities occur.
Low level of virtual clustering: Very infrequent or minimal activities. [1-10 times per month].
Medium level of virtual clustering: Activities occur on a more frequent basis, although these might be interspersed by infrequent periods. They are not excessive and are not likely to form part of the firm's established pattern of communication. [11 -20 times per month].
High level of virtual clustering: Activities occur as part of the firm's regular routine with a high degree of repetition and commitment in terms of human and technical resources. The activities may form part of the firm's ingrained mode of operation, or be frequent aspects of its communication with other participants. [>20 times per month].

Table 60: Virtual clustering levels

We can acknowledge that these parameters do not represent 'an exact science' and could be broader or narrower. In the absence of any established benchmarks and following pilot testing, they are believed to be acceptable in exploring the role of virtual clustering within aerospace firms and whether it has an enabling role to play in complementing or substituting other modes of communication and transacting. This investigation follows the research path defined by others investigating whether ICT is "the basic enabling infrastructure to support virtual organisations in business clusters encompassing; the internet, groupware, workflow-systems, videoconferencing, ERP, and document management systems" (Weiss, 2002; p4). Despite the interplay between a firm's virtual and spatial orientation possibly influencing its structure and strategy, it is the role of proximity that is most frequently cited as being 'crucial' in encouraging knowledge sharing, reducing transaction costs, improved access to specialized inputs, and stimulating innovation (Steinfield, 2002). The facilitative role of ICT is not prevalent in the literature, with agglomeration regarded as the primary means by which firms transact:

> Our argument is that geography still matters. First, distance still presents barriers, especially for smaller firms that have fewer resources to cover various forms of transaction costs. The majority of goods and services still rely upon some form of physical movement, which implies both distributional costs and a need to negotiate logistical and distribution support (Holmefjord et al, 2002; p9).

Limited research has assessed the interplay between virtual and spatial clustering. Steinfeld (2002) reflects the principal view that "clusters capitalise on proximity, including providing access to a concentration of skilled workers, rather than relying on electronic networks and automation to achieve transactional and informational advantages." The role of ICT in the development and maintenance of local industrial clusters has not received a great deal of attention with this recognised by some researchers, with Steinfeld (ibid; p5) positing that "despite the wealth of industrial cluster studies, relatively little research has specifically examined the role of information and communications infrastructure in influencing cluster success". The literature overwhelmingly focuses on *physical clustering*, with the general premise existing that this has brought benefits to key industries such as Silicon Valley (Bresnahan and Saxenian, 2001), pharmaceuticals (Caby et al, 1998) and biotechnology (Cooke, 2001). The exploration of virtual clustering and the possible influence this might have on firm strategy, operations and performance has not been adequately researched. This study sets out to re-dress this balance. Table 61 summarises responses by firm managers on the degree to which their firm engaged in virtual clustering.

Firm Type	Degree of *virtual* clustering
SME	
Low	38%
Medium	-
High	-
None	62%
Large Firm	
Low	-
Medium	40%
High	20%
None	40%
Very Large Firm	
Low	40%
Medium	20%
High	20%
None	20%
TOTAL	
Low	22%
Medium	22%
High	13%
None	43%

Table 61: Virtual clustering of firms

Almost half of all firms did not engage in any degree of virtual clustering. Managers between firm types indicated minor differences in the reasons why this had not occurred, with *cost* not cited as the principal reason, contrasting literature highlighting this as a barrier for smaller firms (Nikolaeva, 2006). The principal barriers to the adoption of virtual clustering varied marginally between the types of firm:

- *Large and very large firms*: An absence of virtual clustering in a number of firms was due to two principal reasons:

  (1) A lack of pressure from major suppliers (where the firm was not a prime);

  (2) A lack of strategic direction that incorporated or defined a requirement for virtual clustering.

  Results from the sample firms are congruent with literature that highlights the role that customers play in defining the virtual linkages and capability of suppliers and how leadership and strategy affect virtual clustering (Marshall et al, 2000).

- *SMEs*: These were not as homogenous in their outlook to virtual clustering as large and very large firms, with a greater variability observed in strategy, purchasing, recruitment and other operational elements, often reflecting the personality of the firm's owner. The three principal reasons for not adopting virtual clustering were:

- A lack of demand from customers;
- Firm owners and managers did not wish to pursue this;
- A lack of skills to develop and implement appropriate solutions.

These results were consistent with literature assessing the role of smaller firm owners in the adoption of virtual solutions and the absence of customer demand in facilitating connectivity (Stockdale and Standing, 2006), and a deficiency in appropriately skilled personnel (ibid).

The differences between the firms' responses are summarised in chart 33.

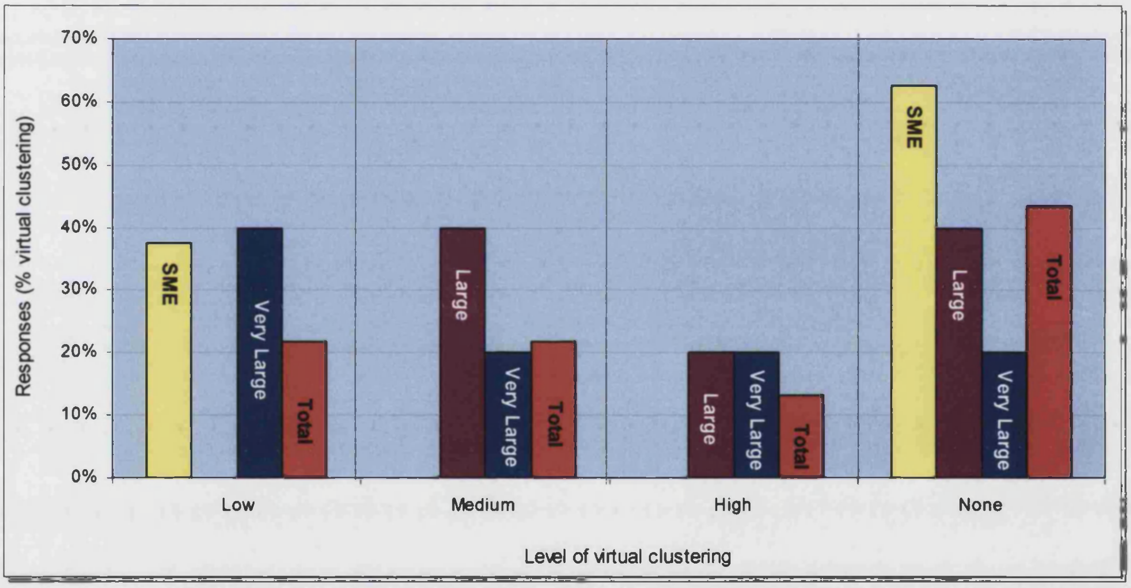

Chart 33: Firm degree of virtual clustering

Around 40 per cent of SMEs and very large firm managers indicated that they were involved in low levels of virtual clustering, with no SME engaged in other levels. In contrast, around 40 per cent of large firms were involved in a medium level of clustering, with around half of this number involved in a high level of clustering. This firm type was characterised by firms operating close to primes and other tier 1 aerospace companies, and located at a higher upstream position in the supply chain. Customers were predominantly well funded and experienced companies that often mandated that their suppliers engage in virtual clustering. These firms 'took the brunt' of virtual connectivity directives from their customers and did not necessarily pass these on to their subcontractors:

> We really don't have a choice. If we don't connect our ordering systems, they will find someone who will (Operations manager, large firm).

> We often get the short end of the stick. We have to comply with their technology requests, but we don't necessarily pass these on to all of our sub-contracts. We just can't. Especially if they are small SMEs who produce bits and pieces for us. We are like the 'meat in the sandwich' in a way then (IT manager, large firm).

Very large firms were the only firm type to be represented across low, medium and high levels of virtual connectivity. The majority engaged in low levels, with the remaining number divided between medium and high levels of connectivity. Only one fifth of very large firms did not adopt virtual clustering, with twice as many large firms not adopting it, and over three times as many SMEs not adopting it.

The overall results revealed that over one fifth of firms engaged in low and medium levels of virtual clustering, whilst around one in ten firms engaged in high levels. In contrast, around forty per cent of the sample did not engage in virtual clustering at all. Feedback from this group indicated that if a customer required the firm to adopt some form of virtual connectivity, this would be accommodated, provided that the cost of such an initiative was not commercially prohibitive. In the absence of this, firm managers indicated that their firms were not provided with the requirement to engage in virtual clustering. In some cases, particularly amongst large and very large firms, virtual clustering-enabling ICT investments were made even if they resulted in a narrowing of the profits for an individual contract, in the belief that this could lead to follow-on business from that customer, or if it allowed the firm to leverage the investment to develop business from other customers. The findings were congruent with literature depicting the power that customers can exercise over their supplier's adoption of technology (Mehrtens et al. 2001).

6.3.3 Virtual Connectivity and Locality

The results from the sample support conclusions that the communication revolution enables firms to build new links with customers and suppliers irrespective of their location (MacGregor and Vrazalic, 2005). They were not congruent with research that hypothesised that "experiences with actual information and communication technologies (ICT) use in general, and the internet in particular, show that geography still matter" (Holmejford et al, 2002; p1). The results indicated that the model for clustering in aerospace has evolved, with virtual clustering perceived by some firm managers as a transacting and communication mode in its own right, whilst others saw it is an extension of their physical operations, permitting them to interact with customers and suppliers in an alternative manner. The overwhelming majority of sample firms engaging in virtual clustering did so with customers and partners both within and outside of their physical cluster with no defined criteria for engagement evident: virtual clustering was undertaken when benefits were believed to accrue to the firm, or where customers and/or suppliers mandated that it occurred. This was not dependent on the physical separation between the firms involved. Where firms were located within the same geographic cluster, or were outside of this but still within close proximity to each other, meetings would often occur if required, with this option being less feasible if the firm was located further. The majority of managers indicated that the criteria for engaging in virtual connectivity with customers and suppliers were not however dependent on proximity. These are congruent with other results in this study indicating that managers most often selected suppliers for reasons that were agnostic of location and included price, specialisation, and quality.

In around one quarter of firms, virtual communication was utilised in the establishment of relationships with new trading partners, without any initial face-to-face contact occurring. This often happened later, if customers requested a meeting, or if a visit to the business was required prior to the awarding of any contracts. This requirement was often lower if firms were ISO 9001 accredited. These results were consistent with recent research on the role of ICT as a facilitator of virtual clustering (Steinfield, 2006; p3):

> ...the advent of high capacity, global ICT networks enables increased outsourcing and encourages firms to replace local trading partners with distant ones that might offer lower costs and higher quality. At the extreme, the replacement of in-cluster trading relationships with distant ones might ultimately diminish the benefits that come from being in a cluster. This suggests that greater use of electronic commerce may damage clusters by weakening trading relationships among members and reducing local cooperation.

There was no evidence that trading relationships with outside-of-cluster firms damaged the sample firms' local relationships or reduced local relationships. General feedback from managers across firm types indicated that:

- The aerospace sector had evolved over time, with physical location less important in securing orders for their firms.
- The sector had become internationalised, with low-cost overseas producers representing one of the major threats to the awarding of work to local firms.
- Advances in ICT made it possible to virtually link up operations within an organisation (such as via an extranet), or between suppliers and customers.
- A greater comfort on engaging in secure communications existed.

The benefits of virtual clustering for smaller firms has largely been overlooked in the literature (Steinfield, 2006). This is acute in the case of manufacturing, with limited studies exploring any potential benefits of virtual clustering amongst firms engaged in such activities (Chiarvesio, 2004; p1511):

> Electronic networks could allow SMEs to overcome advantages mainly based on physical proximity and extend their business networks through the search for new customers in the on line markets. From this perspective, evolutionary trends of clusters can be influenced by network technologies, also with important implications in the way manufacturing processes and information flows are organized between the local and the international context. In fact, from our standpoint, ICT do not only reduce barriers to global transactions (ecommerce, lower transaction costs), but also open new opportunities in terms of how innovation and knowledge management processes develop.

A similar conclusion has been reached by other researchers, who view the benefits that a firm gains from virtual clustering as being complementary to those it may be able to gain from its physical location (Steinfield, 2005; p1):

> In many cases it is better for firms to view e-commerce as situated within a particular social and geographic context, enabling services that complement a firm's physical location, work in concert with other modes of interaction and exchange, and emphasize pre-existing exchange partners.

Many traditional geographic clusters are adopting a greater use of ICT in order to virtually enhance their competitive position and productivity such as French biotechnology (Lemarie et al, 2001) and aerospace in Europe (Galasso, 2006). This study's aerospace firms supported these conclusions, with firm's displaying an evolution in their adoption of ICT in order to facilitate virtual connectivity. With firms dispersed in geographical clusters throughout the UK, the role of location warrants further investigation, including the potential influence on defining a firm's attributes and factors of production encompassing its pattern trade, the acquisition of skills, and others.

7. Management Practices Results

This section presents the firms' management practices results. The CEP-McKinsey tool is utilised to obtain scores for 18 practices grouped into four areas, which comprises the initial section of this chapter. This includes the segmentation of the data both at a micro level (by firm) and at a higher level (by firm-type and practice). The results are utilised to assess if any relationship exists between the quality of managerial practices and firm performance, with the inclusion of some ICT elements also explored in the middle section of this chapter. The chapter concludes with the inclusion of results from additional firm level indicators which could potentially affect both managerial practices and ICT use, with some statistical analysis undertaken on these. Figure 19 summarises the structure of this chapter, segmented into the three major areas:

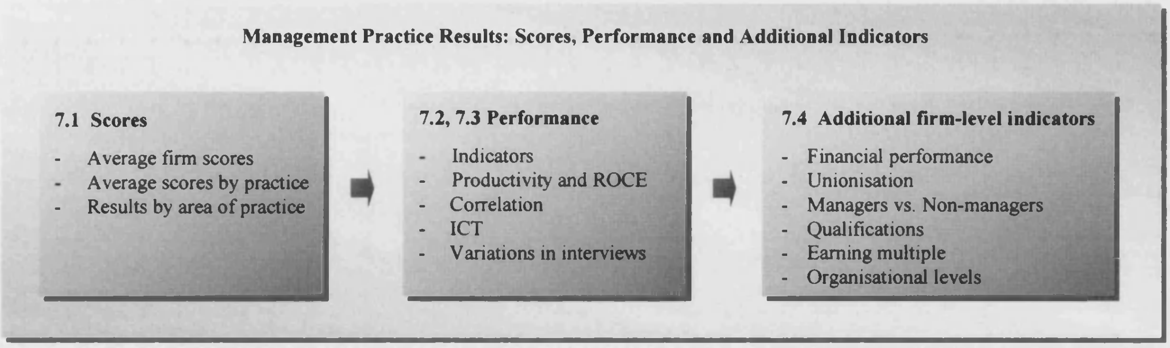

Figure 19: Structure of Management Practices data analysis

The following sections present the results for the management practices investigation, which dovetail into the assessment of the hypotheses in chapter 8.

7.1 Management Practices Scores

7.1.1 Overview

The management practices surveys were administered to a production manager at a distance via telephone initially, and replicated during site visits. Due to the nature of the 18 practices, and the experience of the author in administering these during the CEP's 5,000 telephone interviews in 2006-07, the follow-up interviews were conducted through conversation and scored using a notepad. In addition, wherever possible, two other individuals were interviewed. This consisted of the CEO or a comparable person, and a supervisor, or another equivalent person, and a shop floor worker. Where this was not possible, the production manager was interviewed along with a shop floor person. Each question was scored on a scale of 1 to 5, with 5 representing the best attainable managerial practices, and 1 the poorest. Each question also contained a number of sub-questions that acted as a guide to maximising the accuracy of the investigation. In adhering to the survey tool's methodology, the initial selection of firms and interviews were undertaken double blind: subjects were not aware that they were being scored at any stage, and the author was not aware of the firm's financial performance during the selection process. Despite not obtaining financial data before site visits, managers often discussed their firm's financial position during this exercise, with the information noted. The structure of this section encompasses three areas of results.

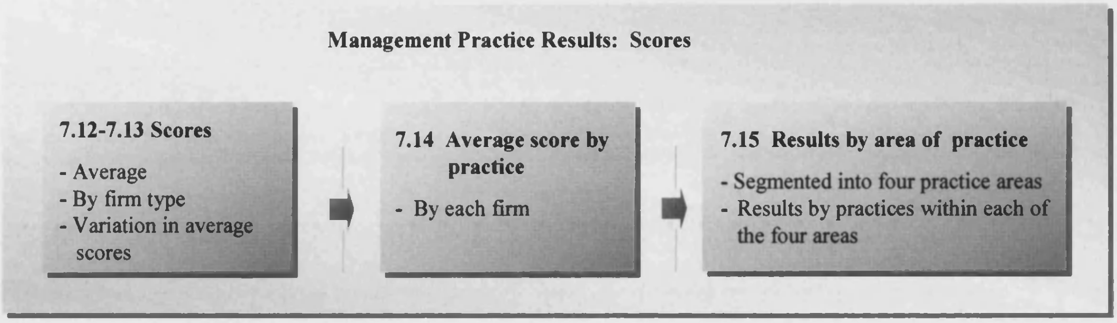

Figure 20: Structure of Management Practices data analysis for scores

The results for each of these three areas are presented in this section.

7.1.2 Scores

Following the interviews, the scores for each firm were averaged, in order to provide a single score for comparative purpose. The range of scores displayed a stepped change by firm-type:

- **SMEs** displayed the lowest average firm scores with a range of 2.93-3.67 and an average of 3.34 across this firm-type.
- **Large** firms displayed an average firm score range of 2.37-4.19 an average of 3.57 across this firm-type
- **Very large** firms displayed an average score range of 3.39-4.20 with an average across this firm-type of 3.84.

These scores are congruent with the trend observed in CEP-McKinsey results of 5,000 manufacturing firms and highlighted by researchers involved in the work (Bloom and Van Reenen, 2006). Chart 34 depicts the average score per firm segmented by firm-type, and contrasted to both the firm-type average and the sample average, with the latter being 3.55.

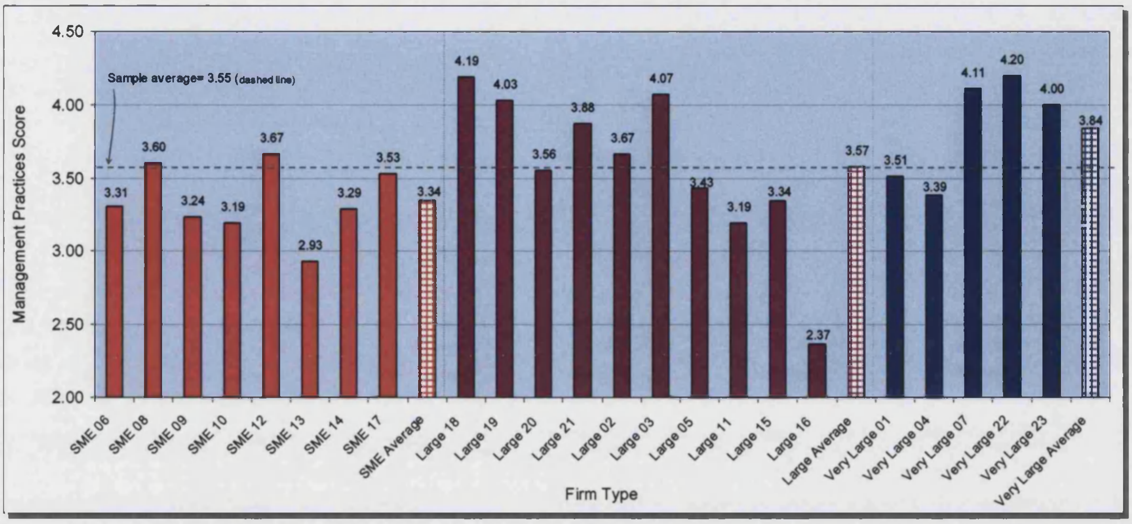

Chart 34: Average management practices score per firm

The graph summarises a number of observations:

- The average management practices score for each firm-type increased as the firm size increased from an SMEs (3.34) to large firms (3.57) and very large firms (3.84).
- Variations in the management practices scores amongst firms occurred within all three firm-types.
- No firm obtained a score lower than 2.0, or greater than 4.20.
- Forty per cent of large firms and 60 per cent of very large firms obtained management practices scores greater than the highest scoring SME.

Despite the increase in management practices scores as firm-type increased from SMEs to very large firms, no significant correlation was found to exist between these two variables, with two proxies used for firm size: *revenues* and *employees*. Tables 62 and 63 depict the results respectively with the correlation coefficient for both variables almost identical.

	Revenue	Management Practices Score
Revenue	1	
Management Practices Score	0.279834334	1

Table 62: Correlation between management practices scores and revenues

	Employees	Management Practices Score
Employees	1	
Management Practices Score	0.285749845	1

Table 63: Correlation between management practices scores and employees

Regression analysis also indicated that no degree of significance existed in the relationship between managerial practices scores and employees, or revenues.[62] This reinforced the requirement to undertake further firm-level exploration of why average management practices scores differ not only between firm-types, but between firms within the same firm-type. This occurred through a variety of modes, including interviews, observations, primary and secondary data and the detailed exploration of ICT use, with the interplay between ICT and managerial practices little explored in facilitating the productive use of a firm's assets. The following sub-sections provide an assessment of the management practices scores. Following this, chapter 8 explores the assimilated results with the study's other principal themes of ICT and location.

7.1.3 Variation in Average Firm Scores

Firms within the same firm-type displayed variations in their average management practices score. Table 64 summarises the variation in the firm's average management practices score against the firm-type and sample average.

Firm Type	Below Firm-Type Average	Below Sample Average	Above Firm-Type Average	Above Sample Average
Very Large Firms	40%	40%	60%	60%
Large Firms	50%	40%	50%	60%
SME	63%	75%	37%	25%

Table 64: Variation in average management practices scores by firm-type

Three quarters of SMEs obtained an average management practices score below the sample average, whilst almost two thirds obtained a score below the SME average. Forty per cent of large firms were below the sample average, whilst 50 per cent were below the firm type average. In contrast, 40 per cent of very large firms were below the firm type and sample average. The scores validate the skewed nature of the results depicted in the previous section, with smaller firms obtaining lower average scores which were located further from the sample mean, with the latter influenced by the

[62] P values 0.1959 and 0.1861 were obtained for managerial practices versus revenues and versus employees respectively (see Appendix M, [A] and [B] respectively) which were greater than the significance level of 0.05 resulting in acceptance of the hypothesis that no relationship existed between managerial practices scores and either of these variables.

higher average scores obtained by very large firms, and reflected by the smaller variance of these from the sample mean. An assessment of the variation in management practices scores obtained by the firms for the 18 practices against both the firm-type and sample average provides a deeper understanding of the firm managers' actions in key areas of the firm. These are segmented by firm-type.

SMEs

Chart 35 depicts the variation in the average management practices scores of SMEs against the firm-type and sample average. Three SMEs obtained an average firm score that was greater than the firm-type average, whilst only two of these firms' score exceeded the sample average.

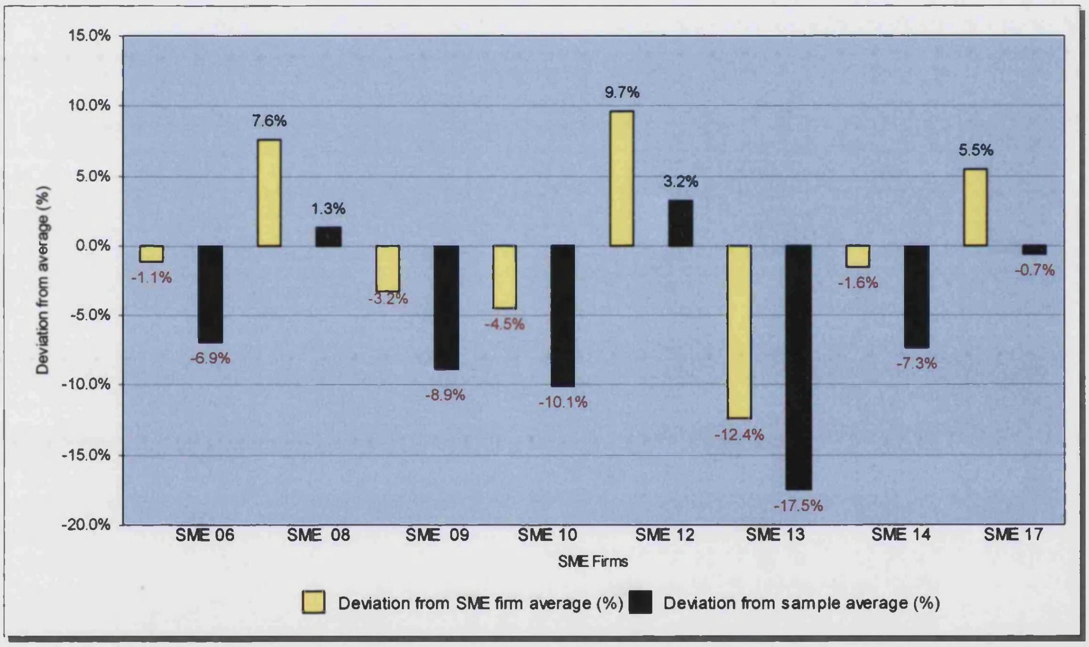

Chart 35: SME management practices score deviation from firm-type and sample averages

Of the six firms indicating any negative deviation in scores, five displayed this in the same direction against both firm-type and sample average, with one firm displaying a positive deviation against the firm-type average but a negative deviation against the sample average. As depicted in section 3.2.2.1.3, the 18 practices can be broadly divided into four major areas of firm activity encompassing *the lean manufacturing process; performance management; target setting and planning,* and *talent management.* The deviation in SME scores reflected a number of general trends:

- SMEs tended to score lower for an entire area of activity, in contrast to obtaining a variation in scores for practices within an area.

- Around 60 per cent of SMEs obtained negative deviations as a result of lower scores gained in their shop floor areas encompassing lean, performance management and target setting.
- The area of talent management revealed a mixed response, with around half of the firms obtaining positive deviations against both the firm-type and sample averages and half obtaining negative deviations. This indicated that SMEs were 'in the middle' in their approach to talent management.

Table 65 depicts the deviation in the results by firm against both averages.

	SME 06		SME 08		SME 09		SME 10		SME 12		SME 13		SME 14		SME 17	
Management Practices Categories	+/- from SME Average	+/- from Sample Average	+/- from SME Average	+/- from Sample Average	+/- from SME Average	+/- from Sample Average	+/- from SME Average	+/- from Sample Average	+/- from SME Average	+/- from Sample Average	+/- from SME Average	+/- from Sample Average	+/- from SME Average	+/- from Sample Average	+/- from SME Average	+/- from Sample Average
1. Introduction of lean	0.0%	1.7%	14.3%	16.2%	-14.3%	-12.8%	0.0%	1.7%	7.1%	9.0%	-7.1%	-5.6%	-14.3%	-12.8%	14.3%	16.2%
2. Rationale for lean	-0.9%	-5.1%	-0.9%	-5.1%	6.2%	1.6%	-0.9%	-5.1%	6.2%	1.6%	6.2%	1.6%	-29.2%	-32.2%	13.3%	8.4%
3. Process documentation	8.7%	-0.3%	1.0%	-7.4%	8.7%	-0.3%	8.7%	-0.3%	-14.6%	-21.7%	-37.9%	-43.0%	8.7%	-0.3%	16.5%	6.8%
4. Performance tracking	-13.7%	-23.6%	9.8%	-2.8%	2.0%	-9.7%	-21.6%	-30.6%	25.5%	11.1%	-13.7%	-23.6%	2.0%	-9.7%	9.8%	-2.8%
5. Review of performance	-7.7%	-13.7%	15.4%	7.9%	7.7%	0.7%	0.0%	-6.5%	7.7%	0.7%	-23.1%	-28.1%	-15.4%	-20.9%	15.4%	7.9%
6. Performance dialogue	8.1%	0.7%	0.9%	-6.0%	15.3%	7.4%	-13.5%	-19.4%	15.3%	7.4%	-13.5%	-19.4%	0.9%	-6.0%	-13.5%	-19.4%
7. Consequence management	-17.8%	-22.6%	4.7%	-1.5%	-10.3%	-15.5%	-10.3%	-15.5%	34.6%	26.7%	-25.2%	-29.6%	4.7%	-1.5%	19.6%	12.6%
8. Type of targets	-3.0%	-12.1%	21.2%	9.9%	5.1%	-4.8%	-11.1%	-19.4%	29.3%	17.2%	-27.3%	-34.1%	-3.0%	-12.1%	-11.1%	-19.4%
9. Interconnection of targets	-6.8%	-16.7%	24.3%	11.1%	-6.8%	-16.7%	-6.8%	-16.7%	24.3%	11.1%	-30.1%	-37.5%	1.0%	-9.7%	1.0%	-9.7%
10. Time horizon	-4.0%	-15.3%	4.0%	-8.2%	4.0%	-8.2%	-4.0%	-15.3%	20.0%	5.9%	-28.0%	-36.5%	-4.0%	-15.3%	12.0%	-1.2%
11. Goals are stretching	5.3%	-1.9%	19.3%	11.1%	-1.8%	-8.5%	-15.8%	-21.5%	12.3%	4.6%	-22.8%	-28.1%	12.3%	4.6%	-8.8%	-15.0%
12. Clarity of goals	3.4%	2.8%	-3.4%	-4.1%	-10.3%	-10.9%	10.3%	9.7%	3.4%	2.8%	3.4%	2.8%	-10.3%	-10.9%	3.4%	2.8%
13. Installing a talent mind set	-19.3%	-17.5%	10.1%	12.5%	-4.6%	-2.5%	2.8%	5.0%	-4.6%	-2.5%	10.1%	12.5%	10.1%	12.5%	-4.6%	-2.5%
14. Building high performance culture	-18.5%	-22.4%	11.1%	5.8%	-18.5%	-22.4%	11.1%	5.8%	3.7%	-1.3%	11.1%	5.8%	3.7%	-1.3%	-3.7%	-8.3%
15. Making room for talent	-7.7%	-13.4%	15.4%	8.2%	-15.4%	-20.6%	-7.7%	-13.4%	7.7%	1.0%	7.7%	1.0%	0.0%	-6.2%	0.0%	-6.2%
16. Developing talent	25.5%	15.8%	2.0%	-5.9%	-13.7%	-20.4%	-13.7%	-20.4%	-5.9%	-13.2%	-5.9%	-13.2%	2.0%	-5.9%	9.8%	1.3%
17. Creating a distinctive proposition	10.3%	2.7%	3.4%	-3.7%	-3.4%	-10.1%	-10.3%	-16.5%	10.3%	2.7%	-31.0%	-35.8%	3.4%	-3.7%	17.2%	9.2%
18. Retaining talent	16.5%	16.5%	-14.6%	-14.6%	-6.8%	-6.8%	1.0%	0.9%	-6.8%	-6.8%	1.0%	0.9%	1.0%	0.9%	8.7%	8.7%
Average deviation per firm	-1.1%	-6.9%	7.6%	1.3%	-3.2%	-8.9%	-4.5%	-9.9%	9.7%	3.2%	-12.4%	-17.5%	-1.6%	-7.3%	5.5%	-0.6%

Table 65: Deviation of average management practices score for SMEs against firm-type and sample average

The four SMEs obtaining the largest negative deviation from the *sample average* (ranging from -6.9 to -17.5 per cent) displayed similar scoring profiles:

- Performance management, target setting and planning displayed some of the largest deviations.
- The setting of targets and the interconnection of those targets drew particularly low scores from SMEs, as did establishing the time horizon for targets and the breakdown of targets into achievable results.
- Some SMEs displayed a more advanced ability to identifying, developing and retaining talent than other firms.
- Variation existed in the approach to lean by the SMEs. Firms obtaining higher scores in their lean practice and rationale for adopting lean did not necessarily obtain higher overall management practices scores. Despite these areas often being depicted as key to the improvement of manufacturing firm performance, the results indicate that better management practices are required in multiple areas to maximise the overall management practices scores and firm performance.

One of the firms with the lowest average managerial practices score (SME 13) (a negative 17 per cent deviation against the sample average), was an independent family owned firm founded by the owner and still run by the same individual. The firm obtained some of the largest negative deviations in the performance and target setting areas of all firms, ranging from minus 19.4 per cent to minus 37.5 per cent. It also obtained the highest negative deviation in the lean area of any firm in the sample, with its process documentation yielding a minus 43 per cent deviation. The firm was marginally profitable, but indicated that relatively small reductions in production volume could alter this. The firm was also one of four firms in the sample in which a confrontational relationship existed between the CEO and the IT manager, and the only firm to display a negative view of ICT by staff. It also displayed the second lowest level ICT spending of the sample (US$68k p.a.).

These results lend some support to recent research indicating that family owned firms are often amongst the worst performing ones where only family members are in managerial control of its activities (Bloom and Van Reenen, 2006), although this effect is cited as being less detrimental to firm performance than *primogeniture* firms, where the firm's head is the first born son of the family-owners (ibid). Only one SME (SME 06) was primogeniture with this firm displaying the second lowest negative deviation amongst SMEs with respect to the sample average, and a marginally negative deviation against deviation this firm-type. This firm displayed strong profitability, revenues, significant investment in ICT (US$0.5m p.a.) and an average management practices score that deviated less than 10 per cent less against the sample average. These indicate that this firm is not performing poorly, with the result polar to some research on the performance of primogeniture firms (ibid). One possible factor contributing to this result could be competition (Bloom et al 2005), with additional research undertaken at the CEP indicating that a long tail of poorly performing firms with bad management practices (including primogeniture firms) exists when lower levels of competition are prevalent (ibid). The aerospace sector is characterised by a high degree of competition within the UK and increasingly from firms located in low-cost and emerging economies, with this factor possibly explaining the higher managerial practices scores and firm performance observed in the two primogeniture firms.

Of the four remaining SMEs with negative deviations, three were independent non-family owned, with the head of these firms being one of the owners in the majority of cases. The fourth firm (SME 17) was owned by a larger public firm with a professional manager employed. This firm displayed a positive deviation against firm-type average of around five per cent and a marginally negative deviation with respect to the sample average. The firm was in the process of implementing a major change programme to overhaul its operations that included the recruitment of new managers; the implementation of new production processes; target setting and monitoring; staff retention, and other areas which encompassed areas that the firm scored less than the sample average. The firm was making significant losses (>US$3M p.a.), and contrasted the three independent non-family owned firms displaying a negative deviation, which were all profitable. One was a very small firm with fewer than 40 employees that was marginally profitable, which also spent the lowest amount in the sample on ICT (US$1,900 p.a.). Another of these firms displayed ICT spending that was in the upper quarter of the sample (US$600k), whilst the other firm was the fourth lowest spending one on ICT (US$85k p.a.).

All SMEs had obtained ISO9001 certification, but the majority of firm managers indicated that this did not result in significant changes to the way their firms were run, or how the production process was undertaken. ISO9001 certification resulted in these firms implementing enhanced documentation, administration, product tracking, and other related elements required to obtain this certification. The principal reason firm managers gave in undertaking ISO9001 was a requirement by customers:

> ISO is a pain to get because it is time consuming, involves a lot of staff being tied up to document simple things like how you buy a pen, or send a rivet to a customer, but it doesn't make you manufacture better or run your shop floor tighter (Production manager, SME).

> We have a simple reason for going through ISO: we couldn't get a contract with any reasonable customer without it. We wouldn't bother otherwise (Production manager, SME).

Large firms

Forty per cent of the large firms obtained a negative deviation in their average management practices scores against both the firm-type and sample average. This ranged from a deviation of minus four per cent and around minus three per cent respectively, to almost minus 34 per cent against both, as depicted in chart 36. Only one large firm's (large 20) average management practices score obtained the average for both the firm-type average and sample average. A further five firms displayed a positive deviation of their average management practices score against both the firm-type and sample average, with this ranging from around two per cent for the former to around 17 per cent for the latter.

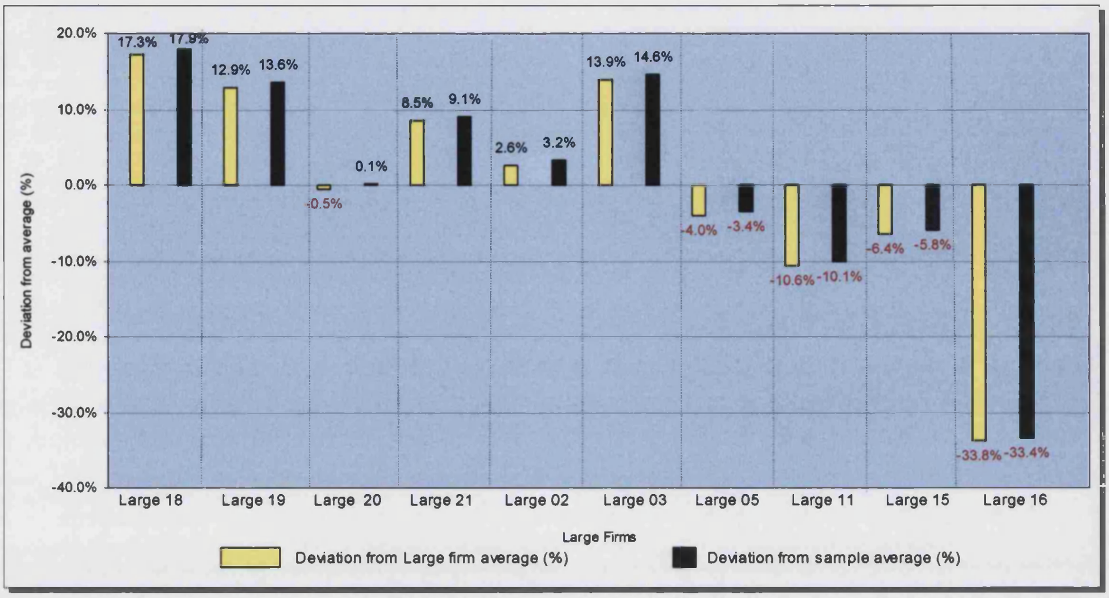

Chart 36: Large firm management practices score deviation from firm-type and sample averages

The firm-level results for the deviations are depicted in Table 66, divided into two sections below.

Large Firms: 1-5	Large 18		Large 19		Large 20		Large 21		Large 02	
Management Practices Categories	+/- from Large Average	+/- from Sample Average	+/- from Large Average	+/- from Sample Average	+/- from Large Average	+/- from Sample Average	+/- from Large Average	+/- from Sample Average	+/- from Large Average	+/- from Sample Average
1. Introduction of lean	17.3%	22.0%	22.9%	27.9%	-2.2%	1.7%	-9.2%	-5.6%	4.7%	9.0%
2. Rationale for lean	-0.4%	-2.4%	21.7%	19.3%	-3.2%	-5.1%	-17.0%	-18.7%	3.7%	1.6%
3. Process documentation	23.3%	31.0%	23.3%	31.0%	-12.9%	-7.4%	0.5%	6.8%	0.5%	6.8%
4. Performance tracking	22.3%	27.8%	22.3%	27.8%	-0.3%	4.2%	-13.6%	-9.7%	-0.3%	4.2%
5. Review of performance	18.6%	20.8%	18.6%	20.8%	-8.2%	-6.5%	5.9%	7.9%	5.9%	7.9%
6. Performance dialogue	27.8%	28.9%	6.5%	7.4%	-0.1%	0.7%	26.5%	27.6%	-13.4%	-12.7%
7. Consequence management	16.0%	18.2%	-0.6%	1.3%	-3.3%	-1.5%	3.6%	5.6%	3.6%	5.6%
8. Type of targets	17.6%	23.1%	23.2%	28.9%	5.0%	9.9%	19.0%	24.5%	-16.0%	-12.1%
9. Interconnection of targets	19.3%	16.7%	19.3%	16.7%	13.6%	11.1%	20.7%	18.1%	-14.8%	-16.7%
10. Time horizon	11.9%	13.0%	17.5%	18.6%	4.9%	5.9%	4.9%	5.9%	4.9%	5.9%
11. Goals are stretching	11.0%	9.8%	5.7%	4.6%	-0.9%	-1.9%	25.5%	24.2%	-7.5%	-8.5%
12. Clarity of goals	18.5%	15.1%	1.6%	-1.3%	-8.3%	-10.9%	26.9%	23.4%	5.8%	2.8%
13. Installing a talent mind set	-0.3%	-4.0%	12.1%	8.0%	16.8%	12.5%	16.8%	12.5%	16.8%	12.5%
14. Building high performance culture	8.3%	7.2%	-3.1%	-4.1%	-7.4%	-8.3%	14.0%	12.8%	14.0%	12.8%
15. Making room for talent	25.2%	27.0%	25.2%	27.0%	6.7%	8.2%	13.8%	15.4%	6.7%	8.2%
16. Developing talent	37.9%	39.0%	9.2%	10.0%	-6.6%	-5.9%	22.1%	23.0%	0.6%	1.3%
17. Creating a distinctive proposition	21.1%	18.1%	10.5%	7.9%	5.3%	2.7%	-7.9%	-10.1%	11.8%	9.2%
18. Retaining talent	12.7%	11.8%	-6.1%	-6.8%	-6.1%	-6.8%	1.7%	0.9%	25.2%	24.2%
Average deviation per firm	17.3%	17.9%	12.9%	13.6%	-0.5%	0.1%	8.5%	9.1%	2.6%	3.2%

Large Firms: 6-10	Large 03		Large 05		Large 11		Large 15		Large 16	
Management Practices Categories	+/- from Large Average	+/- from Sample Average	+/- from Large Average	+/- from Sample Average	+/- from Large Average	+/- from Sample Average	+/- from Large Average	+/- from Sample Average	+/- from Large Average	+/- from Sample Average
1. Introduction of lean	32.7%	38.0%	4.7%	9.0%	-16.2%	-12.8%	-10.6%	-7.0%	-44.1%	-41.9%
2. Rationale for lean	31.4%	28.8%	3.7%	1.6%	-17.0%	-18.7%	-5.9%	-7.8%	-17.0%	-18.7%
3. Process documentation	7.2%	13.9%	0.5%	6.8%	7.2%	13.9%	-14.2%	-8.9%	-35.7%	-31.6%
4. Performance tracking	26.3%	31.9%	-13.6%	-9.7%	13.0%	18.1%	-9.6%	-5.6%	-46.8%	-44.4%
5. Review of performance	27.1%	29.5%	5.9%	7.9%	-15.3%	-13.7%	-15.3%	-13.7%	-43.5%	-42.5%
6. Performance dialogue	13.2%	14.1%	6.5%	7.4%	-26.8%	-26.2%	-9.5%	-8.7%	-30.8%	-30.2%
7. Consequence management	3.6%	5.6%	-3.3%	-1.5%	3.6%	5.6%	5.0%	7.0%	-28.2%	-26.8%
8. Type of targets	5.0%	9.9%	-9.0%	-4.8%	-2.0%	2.5%	-4.8%	-0.4%	-38.4%	-35.5%
9. Interconnection of targets	6.5%	4.2%	-14.8%	-16.7%	-14.8%	-16.7%	-3.4%	-5.6%	-31.8%	-33.3%
10. Time horizon	11.9%	13.0%	-23.1%	-22.3%	-23.1%	-22.3%	6.3%	7.3%	-16.1%	-15.3%
11. Goals are stretching	12.3%	11.1%	5.7%	4.6%	-20.7%	-21.5%	0.4%	-0.6%	-31.3%	-32.0%
12. Clarity of goals	34.0%	30.2%	-15.4%	-17.8%	-15.4%	-17.8%	-4.1%	-6.8%	-43.6%	-45.2%
13. Installing a talent mind set	1.2%	-2.5%	-6.5%	-10.0%	-6.5%	-10.0%	-6.5%	-10.0%	-43.9%	-46.0%
14. Building high performance culture	21.1%	19.9%	14.0%	12.8%	-14.5%	-15.4%	-8.8%	-9.7%	-37.3%	-38.0%
15. Making room for talent	-7.5%	-6.2%	-14.7%	-13.4%	-14.7%	-13.4%	-14.7%	-13.4%	-26.0%	-25.0%
16. Developing talent	7.8%	8.6%	-13.8%	-13.2%	-6.6%	-5.9%	-13.8%	-13.2%	-36.8%	-36.3%
17. Creating a distinctive proposition	-1.3%	-3.7%	-1.3%	-3.7%	-1.3%	-3.7%	0.0%	-2.4%	-36.8%	-38.4%
18. Retaining talent	17.4%	16.5%	1.7%	0.9%	-21.8%	-22.3%	-6.1%	-6.8%	-18.6%	-19.2%
Average deviation per firm	13.9%	14.6%	-4.0%	-3.4%	-10.6%	-10.1%	-6.4%	-5.8%	-33.8%	-33.4%

Table 66: Deviation of average management practices score for large firms

A number of general observations can be made about the deviation of the average management practices scores for large firms:

- No pattern emerged amongst the firms' deviation in the four activity areas covered.
- No firm was bereft of any negative deviation in the 18 practices, indicating that each had some area that could be improved upon.
- In contrast to better performing SMEs (those with a large positive average deviation), better performing large firms displayed fewer negative deviations amongst the 18 practices covered.
- Three of the four large firms with negative deviations against both the firm-type and sample averages obtained results that did not exceed minus 11 per cent, with the fourth firm obtaining larger deviations of minus around 34 per cent and minus 33 per cent respectively.
- This firm-type contained the only firm in the sample to obtain large negative deviations in all 18 practices (large 16), with the smallest negative deviations (the best result) for the firm being around minus 6 per cent and minus 15 per cent against the firm-type and sample average respectively. Both of these deviations occurred against the same practice: the time horizon utilised for planning. The same firm obtained the highest number of significantly larger negative deviations of any sample firm, with 5 practices yielding a negative deviation of over minus 40 per cent, with a further 8 practices yielding a negative deviation between minus 30 per cent and minus 39 per cent. This firm had recently been acquired by a publicly listed company and was undergoing significant change across all elements if its operations. The results reflected the poorer management practices that "had gotten the firm into a mess in the first place" (Production manager, large 16).

Seven of the large firms were publicly listed, or owned by publicly listed entities. The remaining three firms were divided between independent non-family ownership, independent family ownership, and independent primogeniture ownership. The primogeniture firm's (large 20) management practices score was same as both the firm type and sample average, showing that this firm obtained a score congruent with the sample average.[63] The promotion of the first born founder's son appears to have been a successful one, with the firm profitable and spending a high annual amount on ICT that was fourth highest amongst this firm-type (US$1.5m). The firm displayed lower scores (negative deviations) in its approach to lean and performance measurement when compared to other large firms, displaying the potential to improve these and increase the

[63] Negligible deviations occurred from both of these, resulting in the applicability of this statement against the average management practices score of 3.56 for the firm-type and 3.55 for the sample.

average managerial practices score still further. A number of key managers expressed confidence in the CEOs ability:

> The business has grown even stronger since his father left it to him, which is the best testament to how good a job he has done (Operations director).

> We spend a lot of money on technology, including ICT, and that's down to our CEO believing that it is important to our business (IT manager).

The success of this heir-controlled firm is at odds with the literature highlighting the underperformance of such firms including recent research by Bloom (2006; p1):

> While family ownership seems to improve management practices modestly, family management by the children of founders is typically less good. When the CEO is selected by 'primogeniture' - that is, selecting the eldest son – the management practices of the firm tend to be extremely bad.

The small sample size of two primogeniture firms does not permit a thorough study of this firm class. The average to higher average managerial practices scores and profitability of both of these firms does not support the view that "the relationship between family successions and firm performance is extremely strong and economically large: family CEOs cause an average decline in firm profitability on assets of at least four percentage points" (Bennedsen et al, 2007; p9). As iterated earlier in this section, this may be due to the increased level of competition found in the aerospace sector with this factor posited to contribute towards improving managerial practices scores (Bloom and Van Reenen, 2007): "It has often been speculated that the productivity-enhancing effects of competition work through improving average management practices, and our study provides support for this view" (p1,355).

The independent family owned large firm (large 11) obtained an average management practices score of 3.19, which resulted in score deviations of around minus 10 per cent against both the firm-type and firm sample average. The firm's founder is also its CEO, with the business consistently profitable, and with a large annual ICT spend supported by the CEO that is the sixth highest of all large firms (US$0.32m). This firm was undertaking a significant review of its operations with the CEO and IT manager synchronised in their view of the businesses weaknesses and its strengths. Although the firm obtained lower scores for many of the 18 practices, this reflected structural changes being made. The CEO had a particularly strong grasp of the firm's operations and was very active in a business development function, which has resulted in sales of over US$50m p.a., and a consistent profitability.

The independent non-family owned firm (large 02) obtained an average management practices score of 3.67, which resulted in a positive deviation against the firm-type and sample average of around 3 per cent respectively. The firm had been acquired by an overseas owner in the late 1990's but had experienced a contraction in its business in the UK in early-mid 2000, resulting in some site closures. It has experienced significant losses in the past few years and has restructured its operations, and was profitable before this time. The positive deviation in its management scores against both the firm-type and sample average indicates that its management has implemented practices that are ahead of many peer firms in the sample. The firm's annual spending on ICT was the lowest of all large firms (US$137k) and believed by managers to be both adequate in maintaining required ICT and at the maximum level that current budgetary constraints permit. The firms CEO and operations director maintain a close working relationship:

> I need to be involved in what is happening to the firm very closely. We are working through a restructuring plan that has little room for error (CEO).
>
> We have been going through a lot of pain, but the business has very strong sales and can gain back its profitability once we complete our restructuring. The main focus right now is shifting production to our well performing sites for which we are taking a big hit to the bottom line (Operations director).

Of the remaining seven publicly listed large firms, four displayed positive deviations in their average management practices scores. Three of these firms displayed double digit results against both firm type and sample averages (Firms large 18, large 19, large 03). The CEO and the IT manager in one of these firms (large 19) displayed one of the four confrontational relationships observed in the sample, but this did not translate into diminished ICT expenditure, which was the highest amongst this firm type (US$3m p.a.). Over two thirds of this expenditure was driven by a group-wide mandate to upgrade ERP to SAP which was expected to continue for a further two years. In the absence of this, the expenditure was still significant and despite the nature of the relationship between the CEO and the IT manager, the former was not blocking technology investment. The firm was profitable, and its average management score of 4.03 made it the fifth highest scoring business. The IT manager was able to utilise some ERP funds from a centrally assigned pool which provided him with a higher degree of confidence: "HQ dictates a lot of my ICT expenditure, particularly for ERP. Once we complete the spending of the current centrally assigned ERP budget for SAP, all my dealings with the CEO will be based on approving ICT that he pays for. I eventually get a lot of my ICT, but not before a few arguments."

The best performing large firm (large 18) obtained an average management practices score of 4.19, which was also the second highest of the entire sample, but only by 0.01. This resulted in positive deviations from both the firm-type and sample average of around 17 per cent and only two negative deviations among the 18 practices; the rationale for the adoption of lean and the instillation of an ethos for the development of the firm's talent. The firm was run by a lean 'zealot' who had implemented a number of production methods to instruct employees at all levels on the benefits of lean. The IT manager and the CEO enjoyed a positive working relationship, with the former able to spend the fourth highest annual ICT budget within this firm type (US$269k). The firm was profitable and in the process of a review of its operations with a number of operational improvement targets being set by the CEO.

The third publicly owned large firm (large 03) displayed double digit positive deviation against both averages obtained an average management practice score of 4.07. This was the second highest of this firm type and fourth highest of the entire sample, yielding positive deviations of around 14 per cent against both the firm-type and sample average, and three negative deviations amongst the 18 practices that were all confined to the talent management area. This firm also displayed the highest scores in the lean area of all the sample firms, with positive deviations in three out of four practices of between 26 and 38 per cent. The firm belonged to a publicly listed international group that was undertaking significant structural changes to its UK operations. Despite significant revenues (>US$100m p.a.) this has resulted in losses being incurred in the last year. This is forecast to reverse for the subsequent year once restructuring costs are absorbed by the business in the current year. The CEO and the IT manager have a good working relationship which is more formal, reflecting the corporate culture of the parent company. The firm's annual ICT spending is the second highest of all large firms (US$2.8m) with a migration to SAP over the near term accounting for 8 per cent of this figure. The firm's operations director believed that the main challenge in improving management practices was cooperation with the firm's unions.

The fourth large publicly owned firm (large 21) displayed positive deviations in its management practices score of 3.88 against both firm-type and sample average depicted single digit results at around nine per cent. The firm obtained four negative deviations amongst the 18 practices, with three of these occurring within the lean area and one occurring in the talent management area. The firm was owned by a parent company operating internationally and was profitable. A good relationship existed between the CEO and the IT manager, with the firm responsible for the third highest annual ICT spend amongst this firm-type (US$1m). The firm's management was mandated by the parent company to upgrade its ERP to SAP with around half of the costs being met by the firm's head office.

Four large firms displayed negative deviations in their average management practices score against both the firm-type and sample average (large 05, 11, 15 and 16). One of these firms was independent and family owned (large 11), with the remaining three firms publicly owned. Two of the firms experienced double digit negative deviations against both the firm-type and sample average (large 11, 16) whilst two experienced single digit deviations (large 05, 15). One of these firms (large 16) experienced the largest negative deviations amongst all firms in the sample, at around minus 33 per cent against both the firm-type and sample average respectively. The firm was publicly listed, with the CEO and IT manager displaying a positive relationship, and general support for ICT spending and the role of technology in the business. Annual ICT expenditure was the seventh highest amongst large firms (US$212k) and funded by the business. The firm had been experiencing continuous losses during the past three years with the current year's losses higher due to exceptional items that included restructuring costs. The firm had been acquired by a listed parent company with a new management team which was in the midst of making significant structural changes to the business.

The two firms (large 05, 15) displaying single digit negative deviations in their average management score against both the firm-type and sample average obtained similar scores and deviations: around 3.4 and minus 4 to minus 6 percent. Both firms were publicly owned with one firm (large 05) displaying one of the four confrontational relationships in the sample between the CEO and the IT manager. The annual ICT budget was the 5th highest of large firms (US$994k) with half of this accounted for by an ERP upgrade programme over the next 3 years. The view of the IT manager depicted a level of resistance when attempting to secure ICT: "Sometimes I don't get all of my ICT, and I often have to go through a lot of pain and hoops. This means I sometimes have to drop things, with the decision to deny something not always based on rational grounds." The firm has been making small losses during the past two years with the identification by the management team of a number of areas for improvement, particularly in the area of target setting and planning: "We think that many of our lean processes are okay, and have spent a lot of time improving these. We still have a way to go, but think that our planning process could be improved along with the way we source supplies" (operations director). These observations were reflected in the lower scores obtained for these areas by the firm.

The second large firm (large 15) with single-digit negative deviations for the average management practices score against firm-type and sample average, displayed lower scores (negative deviations) in all but three of the 18 practices. The positive deviations (above both firm and sample average) were confined to the performance and tracking area. The firm was publicly owned by a parent company and was profitable. The firm was one of the other sample firms displaying a confrontational relationship between the CEO and the IT manager with this being the most noticeable all sample firms. The firm's annual ICT expenditure was the second lowest of all large firms (US$197k), with almost half of this accounted for by new ERP mandated by the parent company. The firm displayed the lowest annual ICT equipment expenditure of all large firms (US$9k) with the IT manager not permitted to replace hardware, including servers and PCs despite continued problems with many of these.

Very large firms

All of the very large firms were publicly owned. Three obtained higher average management practices scores (positive deviations) against both the firm-type and sample average, whilst two obtained lower scores (negative deviations) as depicted in chart 37.

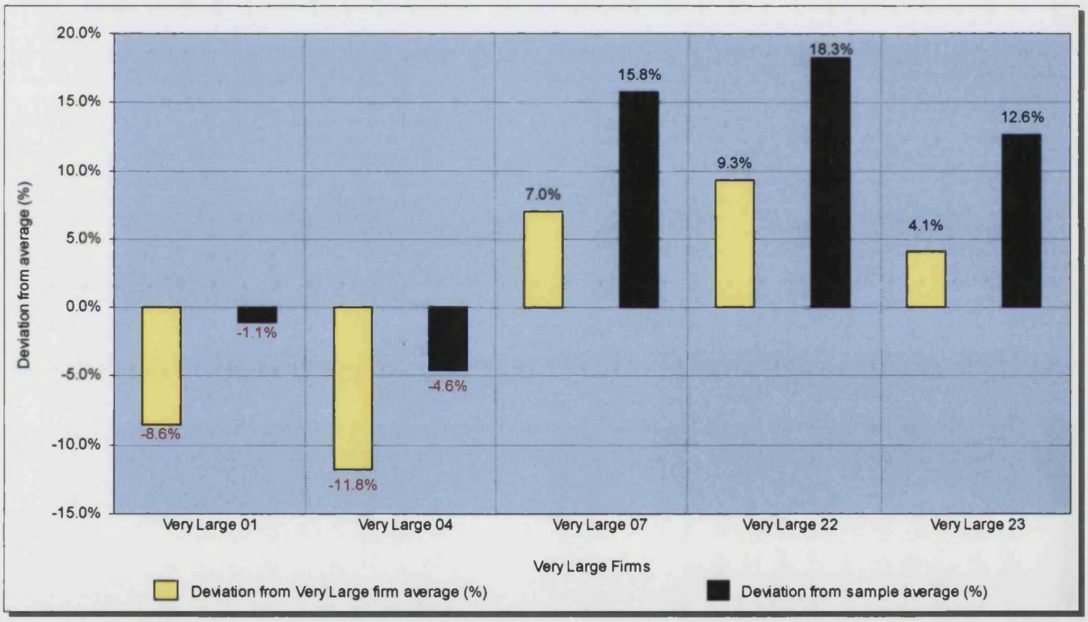

Chart 37: Very large firm management practices score deviation from firm-type and sample averages

The positive deviations for these firms against the sample average were similar to the positive deviations observed for the better performing large firms and significantly greater than for comparable SMEs. The negative deviations were significantly smaller than those observed for similar large firms, and marginally smaller than those observed for SMEs. The largest number of poorer scoring firms against the sample average was amongst large firms. Table 67 depicts the firms' deviations across the 18 management practices.

	Vary Large 01		Very Large 04		Very Large 07		Very Large 22		Very Large 23	
Management Practices Categories	+/- from Very Large Average	+/- from Sample Average	+/- from Very Large Average	+/- from Sample Average	+/- from Very Large Average	+/- from Sample Average	+/- from Very Large Average	+/- from Sample Average	+/- from Very Large Average	+/- from Sample Average
1. Introduction of lean	-2.3%	-12.8%	-34.9%	-41.9%	22.1%	9.0%	17.3%	4.6%	-2.3%	-12.8%
2. Rationale for lean	-8.3%	1.6%	-26.7%	-18.7%	10.0%	22.0%	2.7%	13.8%	22.2%	35.5%
3. Process documentation	5.9%	6.8%	-43.5%	-43.0%	34.2%	35.3%	18.6%	19.6%	-15.3%	-14.6%
4. Performance tracking	-11.2%	-2.8%	1.5%	11.1%	1.5%	11.1%	6.6%	16.7%	1.5%	11.1%
5. Review of performance	-19.1%	-13.7%	-19.1%	-13.7%	1.1%	7.9%	29.4%	38.1%	7.8%	15.1%
6. Performance dialogue	-1.7%	7.4%	-1.7%	7.4%	-7.9%	0.7%	13.0%	23.5%	-1.7%	7.4%
7. Consequence management	-20.0%	-15.5%	6.7%	12.6%	0.0%	5.6%	6.7%	12.6%	6.7%	12.6%
8. Type of targets	-16.9%	-12.1%	-16.9%	-12.1%	17.7%	24.5%	5.3%	11.3%	10.8%	17.2%
9. Interconnection of targets	-19.9%	-2.8%	-8.5%	11.1%	8.7%	31.9%	5.3%	27.8%	14.4%	38.9%
10. Time horizon	-9.4%	5.9%	-3.4%	13.0%	-9.4%	5.9%	1.4%	18.6%	20.8%	41.2%
11. Goals are stretching	-7.4%	4.6%	-7.4%	4.6%	-7.4%	4.6%	6.5%	20.3%	15.7%	30.8%
12. Clarity of goals	2.8%	9.7%	2.8%	9.7%	9.3%	16.5%	8.0%	15.1%	-22.9%	-17.8%
13. Installing a talent mind set	-13.3%	-10.0%	-13.3%	-10.0%	30.1%	35.0%	9.8%	14.0%	-13.3%	-10.0%
14. Building high performance culture	-3.6%	5.8%	-22.9%	-15.4%	15.7%	26.9%	8.0%	18.5%	2.8%	12.8%
15. Making room for talent	1.1%	8.2%	-19.1%	-13.4%	7.8%	15.4%	2.4%	9.7%	7.8%	15.4%
16. Developing talent	-21.7%	-13.2%	4.4%	15.8%	-2.1%	8.6%	14.9%	27.4%	4.4%	15.8%
17. Creating a distinctive proposition	-11.3%	2.7%	-11.3%	2.7%	5.3%	22.0%	6.4%	23.3%	10.9%	28.4%
18. Retaining talent	7.0%	8.7%	-8.3%	-6.8%	-0.6%	0.9%	10.1%	11.8%	-8.3%	-6.8%
Average deviation per firm	-8.6%	-1.1%	-11.8%	-4.6%	7.0%	15.8%	9.3%	18.3%	4.1%	12.6%

Table 67: Deviation of average management practices score for very large firms

A number of general observations were made about these management practices scores:

- No pattern emerged in the deviations for very large firms, mirroring the results for large firms and SMEs.
- Some larger deviations for individual practices were similar to the higher deviations observed in large firms. These included large positive deviations (35per cent) and large negative deviations (minus 43per cent) amongst the very large firms.
- Only one firm displayed positive deviations in all areas, with this firm also being the only one to obtain this result in the entire sample (very large 22).
- Forty per cent of very large firms displayed a negative deviation against either the firm-type or sample average management practices score, in contrast to half of large firms and three quarters of SMEs.

One firm (very large 22) obtained positive deviations in all 18 practices and the highest average management practices score (4.20) of all sample firms. This firm was part of an international public group and was currently unprofitable. This was due to significant investment in capital expenditure in ‘growth areas’ and the reduction of its cost base in other areas, which was causing losses at present. This was expected to improve within 2 years. A very good relationship existed between the CEO and his IT manager, with the firm spending the third highest annual amount on ICT of all very large firms (US$5.9m), with around half of this spent on ERP. The CEO had been recruited from a long career in heavy engineering on the strength of his lean and process improvement experience:

> I haven't got a clue about planes. I really don't care about learning about them either. What matters to me is how the various parts are manufactured and assembled. That's what I know best- making things on time and within a budget. And for that to work properly, you need technology. More specifically, what to do with technology. I think we do that pretty well (CEO, very large 22).

The next highest scoring very large firm (large 07) displayed positive deviations against the firm-type and sample average of 7.0 per cent and almost 16 per cent respectively. Its average management practices score (4.11) was above all but one large firm, and all SMEs. The firm was part of an international public company and was strongly profitable. The relationship between the CEO and the IT manager was positive, with no impediments to ICT expenditure. The annual ICT expenditure was the fourth highest within this firm-type (US$4.3m) with over three quarters spent on ERP. The firm managers were actively involved in ICT decisions and supported the IT manager's efforts.

The third highest scoring firm (very large 23) displayed positive deviations in its management practices score (4.0) of 4 per cent 12 per cent against the firm-type and sample average respectively. The firm was publicly owned and consistently profitable, with the CEO and the IT manager enjoying a close working relationship. This firm was also undertaking a restructuring programme that was expected to yield a reduction in some fixed costs. This was expected to have a minor reduction in annual ICT expenditure with the firm's current level of spending the highest in the entire sample ($42m), with ERP (SAP) accounting for a minority of this, due to its installation in a previous year and the annual recurring cost comprised of maintenance and minor modifications. The relationship between the CEO and the IT manager was positive and extended to the latter being involved in planning sessions and operational reviews: "The management team is very open to ideas and our CEO is extremely inclusive. He sees ICT as a key enabler in the business and this is supported throughout the lower ranks."

Of the two firms displaying negative deviations, one (very large 04) obtained lower management practices scores against both the firm-type and the sample average (minus 12 per cent and minus 5 per cent respectively). The firms average management practices score (3.51) was greater than that obtained by 40 per cent and around two thirds of large firms and SMEs respectively. The publicly listed firm had multiple sites and was acquisitive in the market, with a strategy of purchasing and integrating businesses. The firm was consistently profitable and run by a hands-on CEO who espoused the integration of ICT as a core business tool: " I expect to be able to get information instantly in order to make decisions. My managers can't be disturbed every minute to provide me with this, which is why technology is so important." The firm's annual expenditure in ICT was the lowest of this firm-type (US$3.8m), with ERP accounting for over half of this as the group embarked on a 3 year conversion of all its subsidiaries ERP to SAP.

The second very large firm (very large 01) displayed deviations of around minus 9 per cent in its average management practices score (3.51) against the firm type average, but was almost neutral against the sample average. The firm obtained the highest number of negative deviations in the performance tracking and reporting area of the questionnaire against the firm-type average (almost 80 per cent), and almost two thirds against the sample average. The firm was publicly listed and part of a large international group, and consistently profitable. The CEO and the IT manager enjoy a positive working relationship, with the CEO very supportive of the use of technology throughout the business. The annual ICT expenditure was the second highest of this firm-type (US$12.5m), with ERP accounting for around one quarter of this. The role of ICT was believed by the CEO to be an important element of his business: "Our business is about manufacturing to order for customers. We deal with a lot of sub-contractors and a small number of major customers. Our next big push is to integrate closer with our contractors so that we can see what they are doing better and really be just-in-time."

7.1.4 Average Scores by Management Practice

The CEP-McKinsey management practices tool defines 18 practices covering four areas. The average results for the sample firms are presented in table 68.

Management Practices Categories	Very Large Firm Average	Large Firm Average	SME Average
1. Introduction of lean	3.07	3.58	3.50
2. Rationale for lean	4.09	3.62	3.53
3. Process documentation	3.54	3.73	3.22
4. Performance tracking	3.94	3.76	3.19
5. Review of performance	3.71	3.54	3.25
6. Performance dialogue	4.07	3.76	3.47
7. Consequence management	3.75	3.62	3.34
8. Type of targets	3.61	3.57	3.09
9. Interconnection of targets	4.37	3.52	3.22
10. Time horizon	4.14	3.58	3.13
11. Goals are stretching	4.32	3.79	3.56
12. Clarity of goals	3.89	3.55	3.63
13. Installing a talent mind set	3.46	3.21	3.41
14. Building high performance culture	3.89	3.51	3.38
15. Making room for talent	3.71	3.52	3.25
16. Developing talent	3.83	3.48	3.19
17. Creating distinctive proposition.	4.51	3.80	3.63
18. Retaining talent	3.27	3.20	3.22
Average score per firm type	3.84	3.57	3.34

Table 68: Average management practices score for each question

The table highlights the increasing average score as the firm size increased, but this was not found to be a statistically significant relationship, as depicted in section 7.1.2. The variability in scores between the various categories is also depicted. The management practices of SMEs are of particular interest to this study, due to the dominance of this firm type in the sector and the large differences that often exist with larger firms in terms of resources, training, the formality of practices, and other factors. Many SMEs have also been found to rely on obsolete technology, labour intensive and traditional management practices:

> Formal planning is uncommon in SMEs leading to outdated management practices and autocratic management that may limit the ability to take advantage of knowledge from customers. SMEs' management structure is flatter less complex structures. Furthermore the 'communication line is often shorter and direct, thus allowing a faster discourse on knowledge management issues within the organisation (Levy and Powell, 2005; p246).

Despite the prevalence of these factors in some SMEs in this study, they often obtained higher management practices scores than many larger firms. The prevalence of factors such as a flatter structure and more formal planning, did not translate into firms obtaining higher scores for their managerial practices. Chart 38 on the following page depicts the results of the management practices scores depicted in table 68, permitting a comparison of the variations within a firm-type and between firm types.

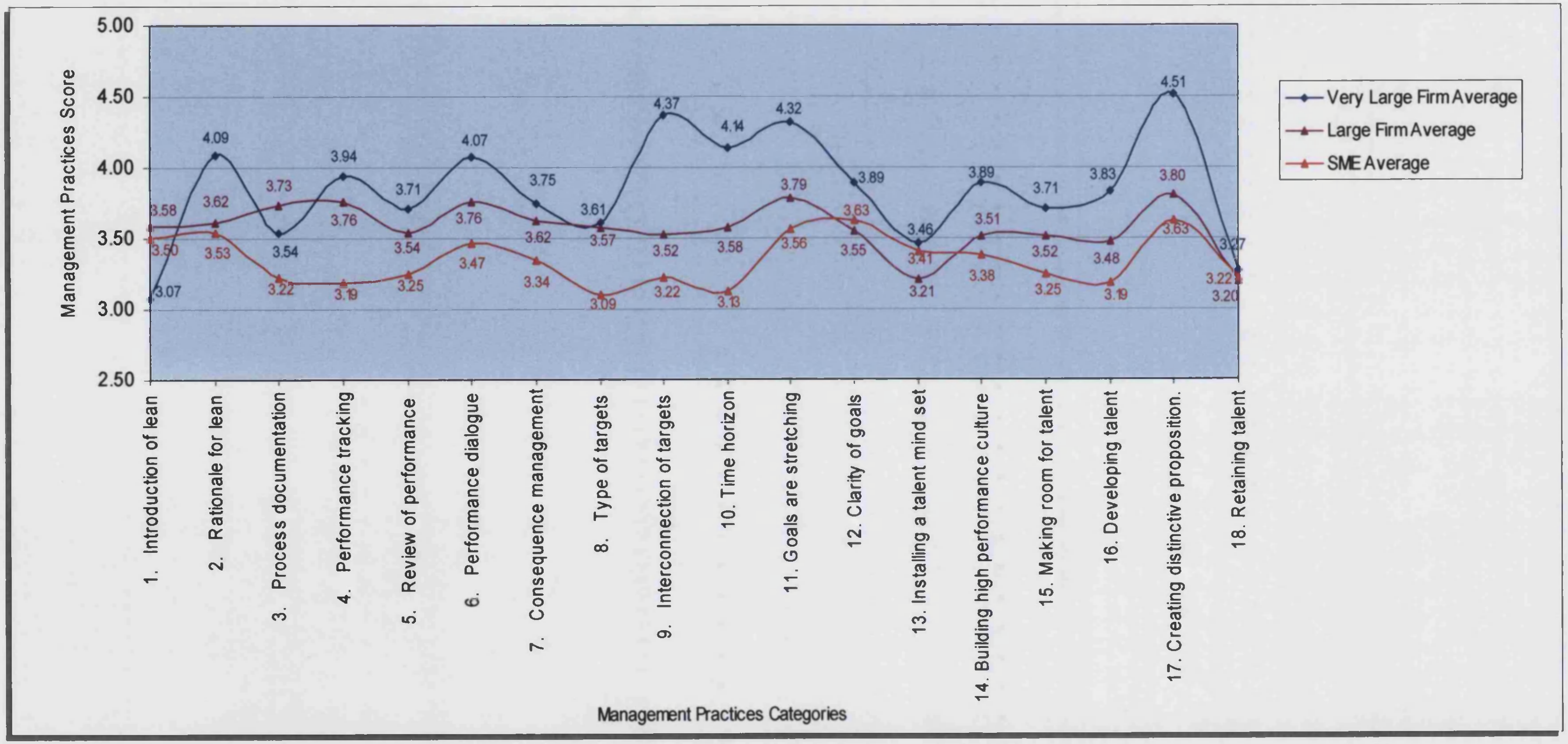

Chart 38: Average management practices score per question

7.1.5 Results by Grouped Area of Practice

The CEP-McKinsey tool segmented the 18 management practices into four areas previously highlighted: *operations*, *monitoring*, *targets*, and *incentives*. This section presents the results by firm-type for these areas, including a number of the drivers contributing to these. This establishes a number of the background influences occurring in the firm, including those affecting ICT use.

7.1.5.1 Operations

1. Introduction of lean: This practice reflected the degree to which lean was adopted by the firms. Very large firms obtained the lowest average score (3.07), which was marginally lower than the score for large firms and SMEs, with these two firm-types obtaining similar scores (around 3.50). This was one of only two practices where very large firms did not obtain the highest score.[64] The midpoint score of 3 for this category reflected the CEP-McKinsey definition: "Some aspects of modern manufacturing have been introduced, through informal and/or isolated change programmes". Responses from firm managers highlighted some variation in lean practice adoption, but a similar position overall:

   > We are still evolving our lean processes. Although they are adequate, we want them to be better and more structured (Production manager, very large firm).

   > We would rather adopt the parts of lean that are suited to our business and do these well, than spend a great deal of time and money on other areas (Manufacturing manager, large firm).

   > I use lean more to correct problems. We don't break into teams to fix problems. I just go to where the problem seems to be happening and grab that guy to fix it (Manufacturing manager, SME).

   No clear pattern for lean adoption emerged. This reflected the fragmented nature of lean adoption across the sample, and the aerospace sector as a whole.

2. Rationale for introducing modern manufacturing: SMEs and large firms obtained average management practices scores of 3.53 and 3.62 respectively, which was aligned with the midpoint score of 3, reflecting the CEP-McKinsey definition of; "Modern manufacturing techniques were introduced to reduce costs". Many managers within both of these firm-types iterated similar views: "It's all about costs, costs, costs. We get screwed on prices thanks to cheaper imports, so we can't really raise these. We use lean to make sure that we manufacture

[64] Category 3 was the second one where this occurred.

to a price" (Manufacturing manager, SME). In contrast, very large firms obtained a high average score (4.09) which reflected modern manufacturing techniques being introduced to enable them to meet business objectives, including costs. Observations confirmed these results, reflecting the culture evident in many very large and some large firms: "It's not just about saving money. Unless you embrace modern production techniques, whether you call that lean or not, you can't change the culture of the workforce" (Product unit manager, very large firm). A number of key observations were made about this practice:

- The directive to embrace advanced production techniques was often 'pushed down' from a central corporate function.
- Dedicated and experienced lean practitioners were often hired by these firms to introduce lean and manage implementation programmes.
- Very large firms often required a greater level of reporting and information that included enhanced metrics gained from production data extracted as a result of lean initiatives.
- Businesses acquired by very large firms were often required to embrace wider elements of lean in order to be congruent with 'higher standards' already present in the acquiring firm.

3. <u>Process problem documentation</u>: All three firm types scored between the midpoint of 3.00, and 4.00, with large firms scoring the highest (3.73), followed by very large firms (3.54), and SMEs (3.22). This was the second practice for which very large firms did not obtain the highest score. A score close to the midpoint indicated, "Improvements made in one week workshops involving all staff, to improve performance in their area of the plant". Observations with SMEs indicated that the majority of these firms did not deviate significantly from this level of process improvement, whilst larger firms had introduced functions that reflected a more formal, structured and more frequent approach, reflecting the higher score of 5; "Exposing problems was integral to individuals' responsibilities and resolution occurs as a part of normal business processes rather than by extraordinary processes/teams." The results for very large firms were somewhat inconsistent with the higher scores obtained in section 2, but these were reconciled through observations:

    - Some very large firms were overhauling their operations due to recognition by managers that some shop floor practices were not congruent with the broader lean tenets they had implemented.

- Some large firms were smaller in terms of revenue, staff and complexity than very large firms, but still displayed strong managerial practices in lean. This resulted in greater visibility of shop floor practices than some very large firms that possessed a larger workforce, within which some poorer-performing staff could 'hide' with greater ease.
- Some very large firms were more heavily unionised, resulting in resistance by the labour force to the adoption of additional or revised working elements without an adjustment to their workforce agreements.

Many SME shop floor employees lacked the accountability that was witnessed in some of their counterparts in larger firms;

> We don't take problem resolution to extremes by making it a core part of workers day-to-day efforts. If a problem comes up, anybody can flag it, and anybody can fix it (Team leader, SME).

> If we do find a fault, we usually put someone on it to fix. If it's bigger than a one man job, we might get a few people together but it's not the norm and we don't have teams on standby. We can't afford that (Supervisor, SME).

7.1.5.2 Monitoring

4. Performance tracking: The extent to which the three firm-types tracked their performance diverged, with very large firms scoring 3.94. This was almost midway to the highest score of 5, with some firms reflecting the CEP-McKinsey definition of: "Performance is continuously tracked and communicated, both formally and informally, to all staff using a range of visual management tools." Others reflected the midpoint measure of 3.00: "Most key performance indicators are tracked formally. Tracking is overseen by senior management." Large firms obtained a marginally lower score of 3.76, whilst SMEs obtained the lowest score of 3.19. These were close to the mid-point score of 3.0. Managers across firm types held contrasting views on key performance indicators (KPIs):

> We have boards all over the place with all of the KPI's on them. At any minute, staff can come over and see how their particular line is going (Team leader, very large firm).

> We have a 'war room' where every conceivable KPI is up, split up by the section of the business it represents. On the shop floor, we have display boards where each new shift can see the last shift's performance and we can track these (Plant manager, large Firm).

> We don't display any performance metrics. Who would put those together? I get the production figures on what's been manufactured, what's in inventory, what's been

ordered, and that kind of stuff, but we don't put up any figures on the wall (Production manager, SME).

The absence of performance tracking at shop floor level was most evident amongst SMEs.

5. Performance review: Very large firms obtained the highest score for the review of their performance (3.71) which was reflected in the midpoint score of 3 and the CEP-McKinsey definition of: "Performance is reviewed periodically with successes and failures identified. Results are communicated to senior management. No clear follow-up plan is adopted." Although some very large firms scored higher than the other firm-types, the lack of communication in conveying performance metrics to all staff constrained scores from being higher. Large firms displayed the next highest scores (3.54), with SMEs scoring the lowest (3.25). No firm-type obtained higher scores that would indicate: "Performance is continually reviewed, based on indicators tracked. All aspects are followed up to ensure continuous improvements. Results are communicated to all staff". This management practice was a particular area of weakness for many smaller firms, with managers and other employees on the shop floor acknowledging the lack of performance reviews.

   They are not big on us reviewing what we have done so that we can learn from it and correct future problems. 'Too busy' is what they say to us each time, 'Just get on with manufacturing' (Team leader, large firm).

   Our boss wants to see the details for orders. That's what he cares about. Anything more he leaves to us on the shop floor (Shop floor worker, SME).

6. Performance dialogue: Very large firms displayed a consistency in conveying performance data to employees, obtaining an average score of 4.07. This was marginally closer to the highest score possible than the midpoint for this category, which reflected the CEP-McKinsey definition of: "Regular review/performance conversations focus on problem solving and addressing root causes. Purpose, agenda and follow-up steps are clear to all. Meetings are opportunities for constructive feedback and coaching". Large firms obtained the second highest result (3.76), followed by SMEs (3.47). Reviews did not frequently occur in smaller firms. Despite the availability of information at meetings, many review conversations were often cursory and did not address issues or root causes, reflecting the mid-point score of 3.00 for this category and the CEP-McKinsey definition of: "Review conversations are held with the appropriate data and information present. Objectives are clear to all participating and a clear agenda is present. Conversations do not, as a matter of course, drive to root causes of problems." The average score for this firm type reflected better communication initiatives present in many larger SMEs, balancing those SMEs that did not display any formal

communication, agenda or the provision of information in communications: "Our meetings are a bit of a joke. When we have them, our team leader can't be arsed to do anything. He always asks if we have any problems, which we don't reveal even if we did. Then we break up" (Shop floor worker, SME).

7. Consequence management: Very large and large firms displayed similar average scores in their tolerance of poor-performing areas of the business (3.75 and 3.62 respectively). These scores were closer to the midpoint of 3, which indicates that firms tolerate a period of poor performance before corrective action is taken. SMEs scored 3.34, reflecting the tolerance of underperforming areas for a period of time before corrective action was taken. The average scores did not indicate that any particular firm type engaged in the retraining of areas of weakness, or moving individuals to where their skills were appropriate. Although this occurred in some individual firms across all three firm types, it did not occur frequently enough to affect the average scores across these. This represents one of the weakest practices witnessed amongst all firm-types.

7.1.5.3 Targets

8. Type of targets: Very large and large firms obtained similar average scores (3.61 and 3.57 respectively). SMEs obtaining the lowest score for this firm-type amongst all of the 18 practices (3.09). The midpoint score of 3.00 reflects firms who incorporated both financial and non-financial targets into senior management's appraisals, with these not enforced throughout the organisation. All firms were closer aligned to this midpoint than the best practices score of 5.00, which reflects goals being a balance of financial and non-financial targets that managers view as inspiring: "All of us at this level have some bonus component. I don't really get excited about my targets though because we rarely hit them" (Manufacturing manager, very large firm). Many SME and large firm managers did not receive any financial targets. Although the average core for SMEs in particular was on the midpoint, many managers were primarily set operational targets, reflecting the lowest score of 1.00: "I don't set any financial goals for the managers. They only get given units to produce" (CEO, SME).

9. Target interconnection: This practice yielded the largest divergence between the scores of SMEs and very large firms (1.15). SMEs' average score of 3.22 reflected goals being based on shareholder value, but not clearly communicated to individuals. This was also evident for many large firms, which obtained a score of 3.52. In contrast, very large firms obtained the second highest score of the 18 practices (4.37), which reflected corporate goals focusing on shareholder value, and increasing in specificity as they cascade through the business until they

define individual performance expectations. Very large firms obtained a cluster of the highest scores for the practices within this area, reflecting a particular strength in 'targets' for this firm-type. Observations further enhanced an understanding of the divergence in the scores between the three firm-types:

- Very large firms adhered to central corporate planning guidelines, with a greater emphasis on reporting, and shorter term performance.
- Formal planning practices were often managed by a dedicated corporate team.
- Public ownership amongst larger firms resulted in greater reporting requirements, including for both financial and non-financial information.
- Smaller firms most often lacked the necessary skills and resources for a 'bottom up' approach to target setting and planning.
- A lack of a division of labour existed amongst smaller firms, with the firm's head often also acting in other functions such as generating sales, with less time devoted to detailed target setting.
- The culture between larger and smaller firms was different, with the former being more formal, bureaucratic, and less adaptive to change, whilst the latter were more entrepreneurial, responsive, and adaptive.

Many managers in very large firms believed that specificity of targets was positive and reinforced a corporate ethos:

> It is important for everybody to know what they need to contribute to make us a success. We make sure that even the guys on the shop floor know what they have to produce through the boards up above their flow lines (Manufacturing manager, very large firm).
>
> I have never seen any financial information or financial targets. My boss tells me how many parts we need to produce each period, and I get on with it. I wouldn't know the first thing about our company performance (Plant manager, SME).

10. <u>Target time horizon</u>: This practice yielded second lowest score for SMEs (3.13) with this practice also displaying the second highest divergence between this firm-type and very large firms (1.02). Very large firms obtained a score of 4.14, which reflected best practices of long term goals being translated into specific short term targets in order for these to become a 'staircase' to reach longer term goals. This observation was consistent within this firm-type and reflected the cultural and structural factors present in these firms as highlighted in the previous section (Section 9). Firm managers were required to report according to various time-

horizons: "We are required to produce a five year, three year and one year plan. These are corporate requirements which we can't change and which come around all too often each year" (COO, very large firm). Both large firms and SMEs were closer aligned to the midpoint score of 3.00 which reflected the existence of short and long term goals that were not necessarily linked to each other. The lower SME score reflected a number of firms whose managers were focused exclusively on short term goals.

> We don't plan beyond a twelve month horizon, with this consisting of sales targets and other leads being put into a spreadsheet (CEO, SME).
>
> Sure we do planning: 'What time should we go to lunch'? (Operations manager, SME)

11. <u>Goals are stretching</u>: This practice yielded the second lowest score for SMEs (3.13) and also represented the second highest divergence in the score between this firm-type and very large firms (1.02). Very large firms obtained a score of 4.14, which reflected long term goals being translated into specific short term targets in order for these to become a 'staircase' to reach longer term goals. This observation was consistent within this firm-type and reflected the cultural and structural factors present in these firms. Firm managers expressed the requirement to report based on time periods often defined by HQ or their CEO or Finance Manager:

> We are required to produce a five year, three year and one year plan. These are corporate requirements which we can't change and which come around all too often each year (COO, very large firms).
>
> My boss wants a 3 year plan, with one year in detail (Operations manager, SME).

12. <u>Clarity of goals</u>: Very large firms obtained the highest scores (3.89) followed by SMEs (3.63) and large firms (3.55), with this practice reflecting managers' ability to define targets and convey them throughout the organisation. This practice also displays a high degree of compression between the threes cores, which converge around the average management practices score for the sample of 3.55. The midpoint average score of the firms reflected: "Performance measures that are well defined and communicated; performance is public in all levels but comparisons are discouraged." The majority of managers in the sample conveyed similar views on the clarity of their firm's goals, irrespective of firm size (reflected by the lower variance between the three average scores). The initiatives implemented by many very large firm managers to communicate goals throughout the organisation were also reflected by

smaller firms. In the case of SMEs, the lower number of employees often resulted in the CEO and operations manager liaising with fewer people, and conveying information to them regularly directly.

7.1.5.4 Incentives

13. <u>Instilling a talent mind set:</u> The final five practices are centred on the use of human capital and the reward structure. This commences with the efforts managers make to communicate that having top talent in the organisation is a key way for the firm to succeed, including being measured and held accountable for hiring and retaining talent. SMEs performed better than large firms, with an average score of 3.41 and 3.21 respectively, whilst very large firms performed marginally better, with an average score of 3.46. No firm manager indicated that he/she was measured or held accountable on the strength of the talent pool in the organisation. This particular aspect of talent was one of the poorest scoring ones, with few managers indicating that they actively promoted a view of talent in the organisation. The principal factor resulting in SMEs scoring higher than large firms was the smaller size of these firms, with some smaller firms facilitating closer contact between the senior management team and other employees. This often led to discussions during which employees were sometimes informed of their value the firm, although this did not appear to occur on a frequent basis.

14. <u>Building a high performance culture:</u> Very large firms obtained a score of 3.89, which was higher than large firms (3.51) and SMEs (3.38). This practice focused on how the firms appraised their employees and utilised a bonus system. The differences in scores among the three firms reflected the more formalised environments of large firms which included formal appraisals and bonuses for many employees. This was the case for many large firms, and for a smaller proportion of SMEs. Smaller SMEs in particular showed a lack of a performance-driven culture, which was reflected in their lower average score: "Nobody gets a bonus. The bonus is having a job" (CEO SME). This practice was also the most targeted one for improvement by very large firm managers: "We don't reward lower levels well enough. They get an hourly wage and that's it" (Production manager, very large firm).

15. <u>Making room for talent:</u> This practice reflected firms removing underperformers from their roles, with very few firm managers indicating that they moved poor performers out of the company or their current roles as soon as weakness was identified. This would have achieved the highest score for this category. In contrast, the majority of firms were marginally above the midpoint which reflected people being left in their current role for a period of up to a few years before being moved on. Very large firms scored 3.71, with large firms scoring 3.52, and

SMEs scoring 3.25. This practice also proved to be one of the most contentious one amongst managers, with some indicating that poor performers were often 'hidden' from them. This occurred when other employees did not inform their supervisor of poorer performing individuals whose work effort was not immediately apparent. This was generally confined to firms exhibiting three criteria: (i) larger size (including larger SMEs); (ii) team participation in activities; (iii) a lack of performance measures. Where performance measures existed, teams were more hesitant to 'hide' poorer performers, with firm managers indicating that employees did not like to 'carry freeloaders, as they were helping to reward non-workers. This did not appear to be the case for firms without performance incentives, with employees often forming becoming 'comrades' to protect each other's jobs.

> I know that some of my supers are hiding deadwood. I don't have the time or patience to sit there and find out who they are (Plant manager, very large firm).
>
> You hope that some of the others turn on the guy not doing his job. Sometimes they do, sometimes they don't (Manufacturing manager, large firm).

In many SMEs, particularly smaller ones without unionisation, underperforming individual were often dismissed once it was evident that they could not adequately perform their job. A diminished focus on re-training or redeployment was directly due to limited budgets or a lack of alternative positions respectively, amongst a smaller workforce.

> If someone can't do their job, it's pretty obvious quickly. It's not like we can't see them. I will work out why they can't, and if it's not because they have some personal problem, or we haven't shown them right, they need to go (Manufacturing manager, SME).

16. <u>Developing talent:</u> This practice yielded one of the lowest scores for SMEs (3.19). This contrasted very large firms, which scored higher (3.83) and large firms, which scored in between these two firm-types (3.48). All firms indicated that individuals were promoted based on their performance, with very large firms approaching a score of 4.00 which was mid-way to the highest available score of 5.00, which reflects the active development and promotion of top performers. No firm manager indicated that people were promoted solely on the basis of tenure: "Being here for a long time doesn't mean you get a promotion" (Operations manager, SME). The promotion of talent in larger firms often occurred through more formal processes including appraisals, whilst smaller firms rarely engaged in formal appraisals. Many small firm managers indicated that the promotion prospects for employees were often limited, due to the smaller size of these firms and flatter organisational structure, in which they could not always promote higher performers further, or due to cost pressure, offer the more financial incentives such as a higher salary, bonus etc.

17. Creating a distinctive proposition: All firms obtained higher scores for this practices with very large and large firms obtaining their highest average score of all practices (4.51 and 3.80 respectively), and SMEs obtaining their equal highest score (3.63). Very large firms' score reflected the development of a unique value proposition to encourage talent to join their organisation above their competitors. The other two firm-types were almost equidistant between the average score of 3.00, reflecting a value proposition that was comparable to a competitor's. Firm managers in smaller firms were able to articulate a value proposition for their firm without any problems.

18. Retaining talent: This practice revealed the closest grouping of average management practices scores, with very large firms, large firms and SMEs obtaining 3.27, 3.20 and 3.22 respectively. All firm managers' scores were skewed to the midpoint, which reflected that "they usually work hard to keep top talent". No firm manager obtained the highest score, which would have indicated that "they did whatever it takes to retain talent". There existed a uniformity of responses across firm types for this practices, with many managers stating: "once a person has decided to leave, there's not much we can do to keep them. They have already made their mind up to go." Many managers indicated that this practice was unlikely to improve in the future due to this belief being widely held, and not likely to alter.

7.2 Performance and Management Practices

Performance predictors continue to evolve, with an increased recognition of the need to define a useable and applied approach, with Wilcox and Bourne (2003) stating: "Surely the purpose of a performance measurement system is to be able to steer the organisation in line with the overall strategy. To do this requires a radical review of the way data are collected, interpreted and presented," (p812). The CEP-McKinsey methodology is arguably such a departure. This study extends its use further by incorporating it within a wider-reaching framework that combines traditional survey tools with more in-depth case study interview techniques. Empirical testing of the tool with over 5,000 firms has demonstrated that higher scores are strongly correlated with superior firm performance, as measured by three performance indicators: *productivity, return on capital employed* and *sales growth.*[65] This section presents the results for the first two of these performance indicators as depicted in figure 21.

[65] Bloom and Van Reenen, 2006.

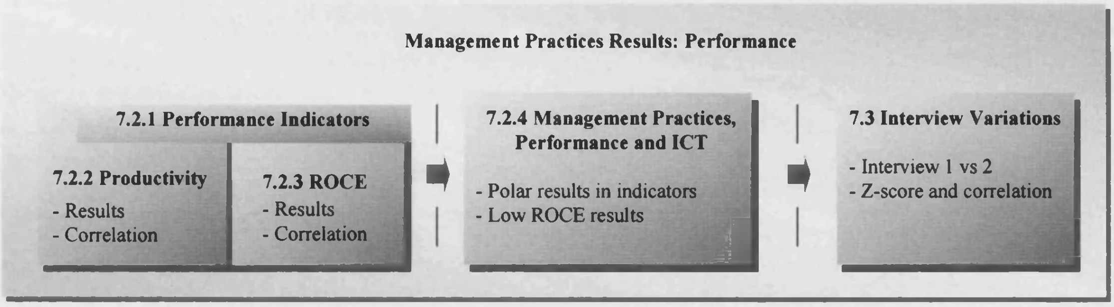

Figure 21: Structure of management practices performance sections

Incomplete data did not permit sales growth to be reported, but we do not believed to hinder the results obtained or the conclusions reached.

7.2.1 Performance Indicators

Two performance indicators were utilised for the sample firms reflecting two of the three indicators inherent in the CEP-McKinsey methodology: *labour productivity* and *return on capital employed (ROCE).* Labour productivity was defined as sales per employee per annum, whilst ROCE was calculated by dividing net profit by capital employed. Both of these definitions were utilised by the CEP-McKinsey methodology and reflect these as widely accepted performance definitions. The third performance indicator utilised by the CEP-McKinsey methodology was *sales growth.* This was not adopted, due to incomplete data. Following the calculation of annual labour productivity and ROCE, the degree to which these two indicators were correlated with managerial practices was assessed, reflecting the CEP-McKinsey methodology (Bloom and Van Reenen, 2006; p11): "There is scope for legitimate disagreement over whether all of these measures really constitute 'good practice'. Therefore, an important way to examine the externality validity of the measures is to examine whether they are correlated with data on firm performance constructed from company accounts and the stock market."[66] This approach facilitates the quantification of the firms' management practices and provides an empirical backdrop for the qualitative assessment of technology, intra-firm relationships, activities and other aspects of the organisational milieu that have the potential to affect performance.

7.2.2 Labour Productivity

Sales per employee per annum (labour productivity) is the first of two performance indicators assessed. A further impetus for the use of this indicator was the readily available data required to calculate it (sales and employees) across all of the sample firms. Additional productivity indicators

[66] The volatility of the stock price can make a relative comparison difficult, but this issue is prevalent in all firm-comparisons using such an indicator. This is not believed to inhibit this comparative study.

could have been used that were directly relevant to the production environment of the sector including defect rates, downtime, absenteeism, product line over-runs, and others. This option was reviewed and not utilised due alternative variables not being available for the majority of firms which would have resulted in a significantly reduced sample. The use of annual labour productivity was the only measure where data were readily available externally from other sources, such as the Amadeus database, which ensured that all firms could be included in the sample. Other data would also not have been forthcoming from managers in many of the firms. Data for the sample are presented in two charts. Chart 39 reflects labour productivity in descending order, expressed as annual sales per employee per annum in millions ($US) for the most recently available data for each firm. The sample average was US$0.217m, with around 40 per cent achieving productivity greater than this figure, comprised of one SME, five large firms and three very large firms.

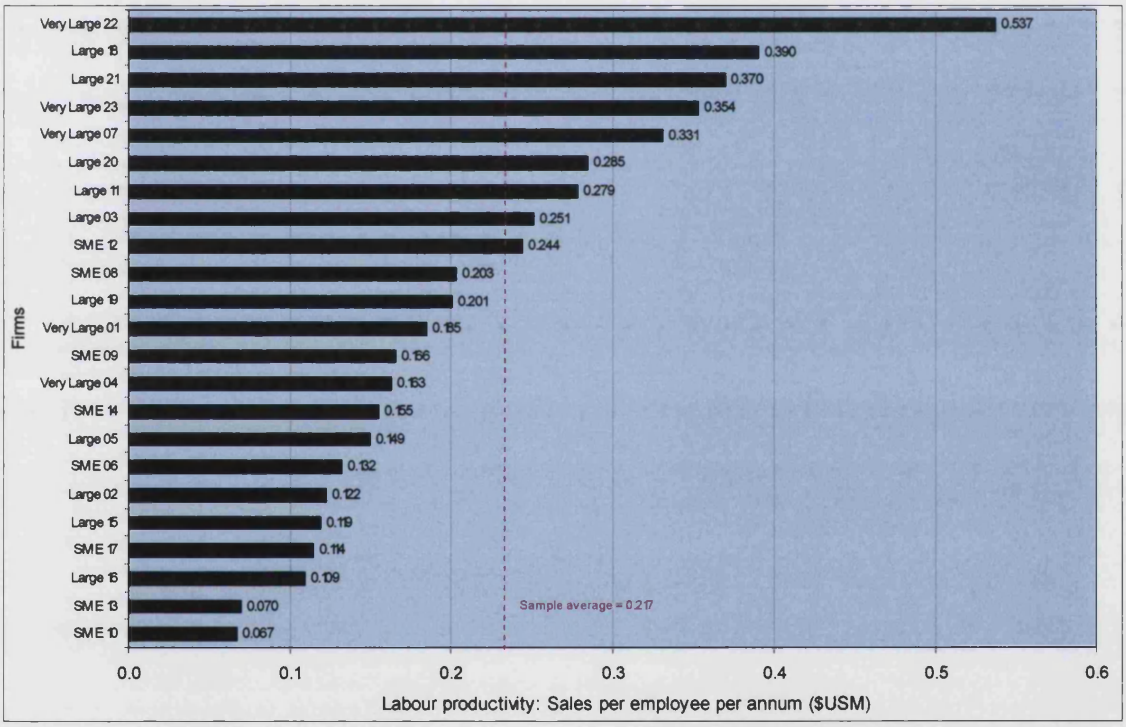

Chart 39: Labour productivity distributed from highest to lowest

Chart 40 presents a distribution of the firm's labour productivity per annum by firm-type, and the average labour productivity for each.

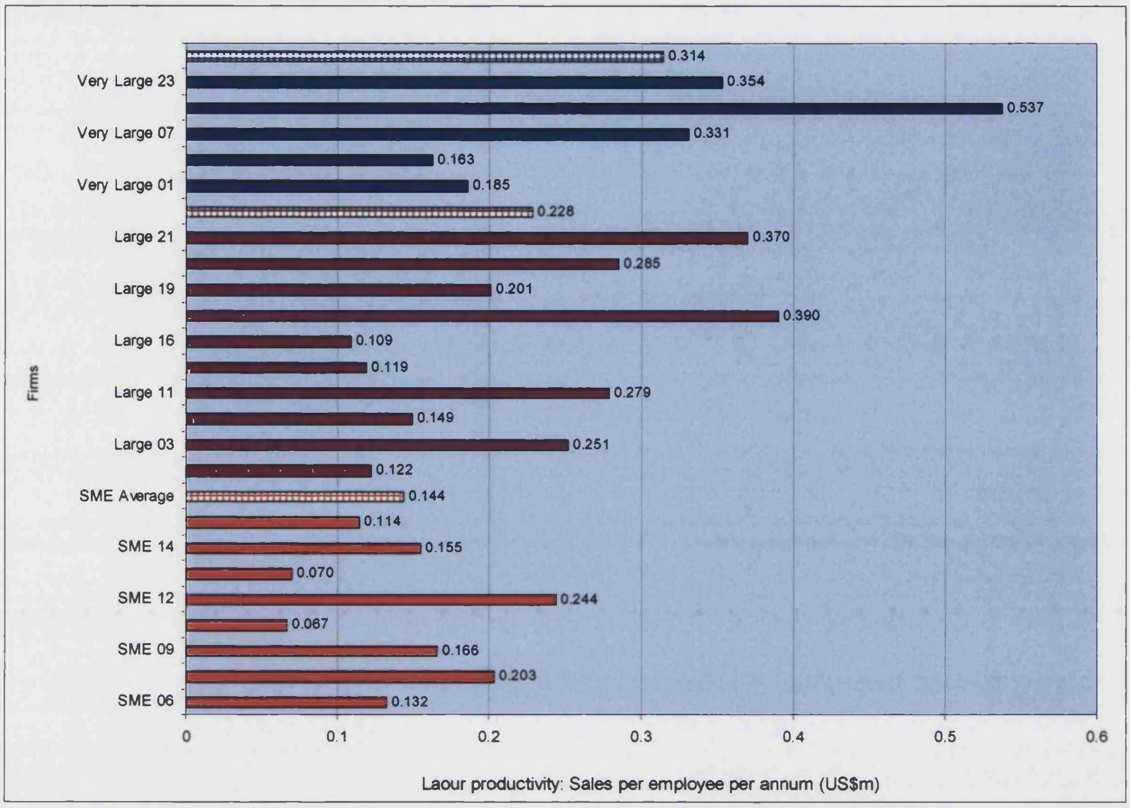

Chart 40: Labour productivity by firm-type

Average labour productivity increased with firm size, with SMEs, large firms and very large firms obtaining average sales per employee per annum of US$0.144m, US$0.228m and US$0.314m respectively. In contrast to a lack of correlation between management practices and firm size, management practices were found to be strongly correlated with labour productivity as depicted in the next section. Table 69 depicts the mean median and mode for each firm type.

Labour Productivity	SME	Large	Very Large
Mean	0.144	0.228	0.314
Median	0.144	0.226	0.331
Mode	n/a	n/a	n/a

Table 69: Labour productivity mean, median and mode (US$m)

7.2.2.1 Labour Productivity and Managerial Practices

The distribution of the firms' annual labour productivity against management practices scores is presented in chart 41. Two groupings for firm types emerge, with SMEs clustered in the middle of the chart and grouped along a sloping line right-to-left. The results are boxed within a management practices score range of 2.8-3.5, and a corresponding labour productivity range of $US0.05m-

$US0.25m per worker per annum. Large firms are scattered marginally wider than SMEs, with one visible outlier evident in the lower left quadrant of the chart. Very large firms are confined to the top of the chart (upper right quadrant), with a smaller number of firms located lower and to the left.

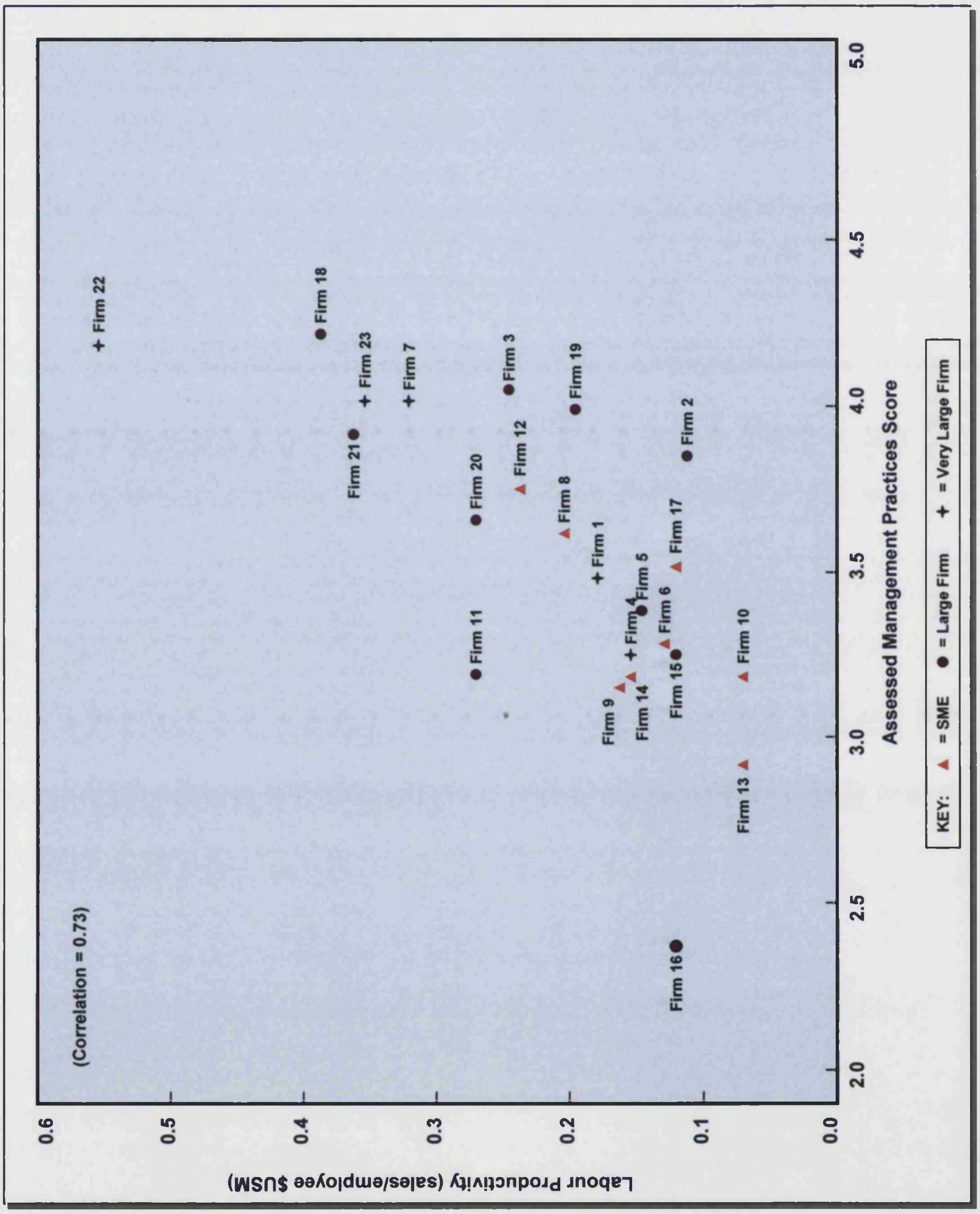

Chart 41: Productivity versus management practices scores

When the data points in the previous chart are transposed to a chart with a dual y-axis that includes management practices scores on one axis and productivity on the other, the relative movement between these variables can be observed more readily as in chart 42 below. This chart does not add new data to chart 41, but is a bridge with the correlation analysis in the subsequent section, reflecting the mirroring of productivity and management practices scores, with the degree to which this occurs addressed through correlation in the following section.

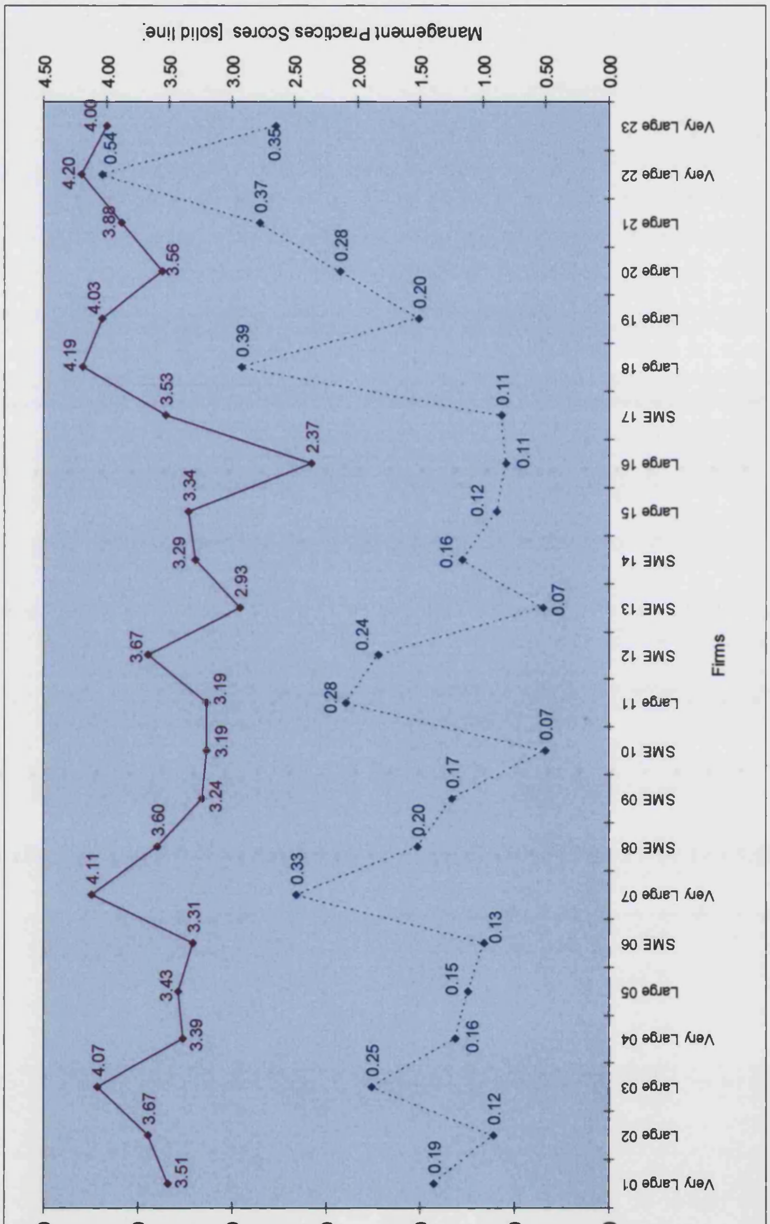

Chart 42: Productivity versus management practices scores- dual y axis

7.2.2.2 Correlation between Labour Productivity and Managerial Practices

Correlation analysis was undertaken on annual labour productivity versus management practices. Correlation measures and interprets the strength of a linear or nonlinear (e.g., exponential, polynomial, and logistic) relationship between two continuous variables whilst not making any priori assumption as to the relationship between variables: it is not concerned with the relationship between variables, but provides an estimate of the degree of association between the variables and the direction of that association. A general definition of the term is:

> Correlation does not mean causation. One cannot draw cause and effect conclusions based on correlation. There are two reasons why we cannot make causal statements:
>
> (1) We don't know the direction of the cause - Does X cause Y or does Y cause X?
>
> (2) A third variable "Z" may be involved that is responsible for the covariance between X and Y" (Stockburger, 2008).

Bloom and Van Reenen (2006; p24) reinforce this in the large-scale survey of managerial practices in manufacturing, in which they discovered a significant level of correlation between productivity and management practices scores: "The coefficients in the production function estimates are of quantitative as well as statistical significance...although we cannot clearly attribute causality to the management scores on productivity".

The sample data reveal a high degree of positive correlation between productivity and management practices scores, with a regression coefficient of 0.7296, as depicted in table 70. This indicates that the correlation coefficient is significantly different from zero and that a linear relationship exists between the two variables of management practices and labour productivity.

	Productivity (sales/employee)	Management Practices Score
Productivity (sales/employee)	1	
Management Practices Score	0.729675	1

Table 70: Correlation of management practices with productivity (sales per employee)

The interpretation of a correlation coefficient does not occur in a consistent manner in the literature and depends on the author, the context and purpose. Drawing on Franzblau's (1958) typology in particular, the obtained correlation coefficient ($r=0.72$) indicates a 'marked degree of correlation' between management practices scores and firm productivity, when $0.60 < r < 0.80$, even without the use of regression analysis. This indicates that in the sample, higher management practices scores are associated with firms that obtained higher labour productivity, and that lower scores were associated with firms that obtained lower labour productivity. Although this does not imply causality, it is congruent with the results from the CEP-McKinsey studies across a total of 5,000 firms internationally that reflected a very strong relationship between performance indicators and management practices scores: "The results of the latest study demonstrate once again that our management practice scoring methodology is a robust metric, closely correlated to a range of corporate performance metrics including labour productivity, sales growth and return on capital employed" (Bloom et al, 2007; p5). Regression analysis in this study supports this result, yielding a p value, which is considerably lower than the 0.05 significance level (see Appendix D). This is a significant result, and permits the rejection of the hypothesis that no relationship exists between managerial practices and productivity.

The significant correlation result obtained in this study indicates that for the sample, management practices scores could be used as a predicator of performance, but they cannot be assumed to be the cause of performance: other variables could be influencing the covariance between these two. The exploration of other variables and factors at firm level, both from a remote and in-firm vantage point, including the possible mediating role of ICT, provides a rich cache of information and observations that can assist to bridging the current lacuna at the intersection of management practices, ICT use and firm-performance. The facilitating use of ICT was highlighted by the Productivity Commission's investigation into ICT use and productivity in Australia (2004; p59), which reached the conclusion that:

> The speed with which information can be sourced and analysed is one of the most important outcomes from advances in ICT, and the one that has had the biggest impact on firm performance.

Chart 43 presents the results from the correlation analysis, with a line of best fit plotted. The higher correlation coefficient is reflected in the closer coupling of the observed productivity figures for the firms (y values) around the line of best fit, with a smaller variance in the distance between these points and the line.

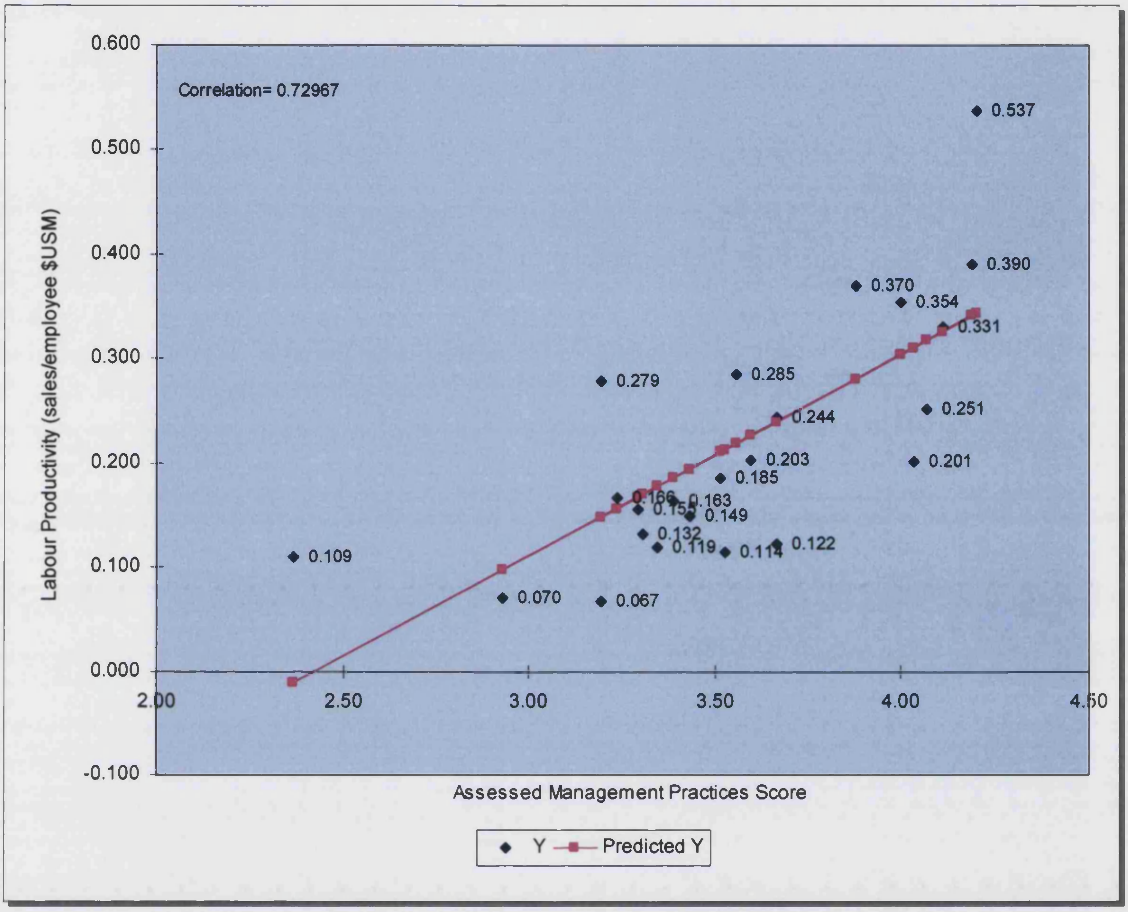

Chart 43: Line of best fit for correlation - management practices versus productivity

7.2.3 Return on Capital Employed (ROCE)

The second key performance indicator assessed was return on capital employed (ROCE). This reflects the rate of return earned by shareholders from their investment, indicating the efficiency and profitability of a company's capital investments. It is a widely used profitability measure to benchmark firm performance and is one of the most reliable measures of corporate performance, calculated by dividing operating profit by capital employed:[67]

$$\text{ROCE} = \frac{\text{Profit before Interest and Taxation}}{\text{Capital Employed}}$$

Capital employed on the denominator represents the value of the assets contributing to a company's ability to generate revenue and is commonly defined as:

Capital Employed = Total Assets − Current Liabilities
[where Total Assets = Non Current Assets + Current Assets]

ROCE utilises the non-labour assets of the firm which include ICT and other technology resources that have been explored in greater detail in the first sections of this study. One other commonly utilised alternative to ROCE was also assessed prior to the commencement of this section of the study: the *rate of return* approach. This requires the regression of productivity growth against lagged ICT/sales. The limited data do not support the use of this approach however, which is particularly applicable where ICT capital depreciates very rapidly (Griliches 1998) Additional data would make this alternative rate of return calculation feasible and a viable alternative to ROCE. Both productivity and ROCE are 'static' depictions of the firm's operation, reflecting the final effects of managerial practices on the utilisation of fixed assets and a labour pool. They do not however answer "how" and "why" questions. Enyi (2005; p3) highlighted some of the limitations inherent in the use of firm-level indicators to reflect performance: "Performance indication can only be meaningful to the user if it bears a true reflection of the relationship that it was intended to test. This is the reason why a critical review of the existing financial analysis and interpretational tools (particularly ratios which measures management efficiency and effectiveness in the use of available resources) has to be made". Through a number of hypotheses, and information that 'peels the surface' of the organisation and ICT, this study addresses such concerns and makes a contribution in the process.

[67] Bertrand and Schoar, 2003; Bloom and Van Reenen, 2006.

Chart 44 presents the ROCE results for the sample. The ROCE average was almost 13 per cent, with all but three firms obtaining a positive ROCE. The highest performing ROCE was 44 per cent, whilst the lowest was almost minus 30 per cent. Just over half of the firms obtained an ROCE greater than the sample average, indicating that the sample was not polarised.

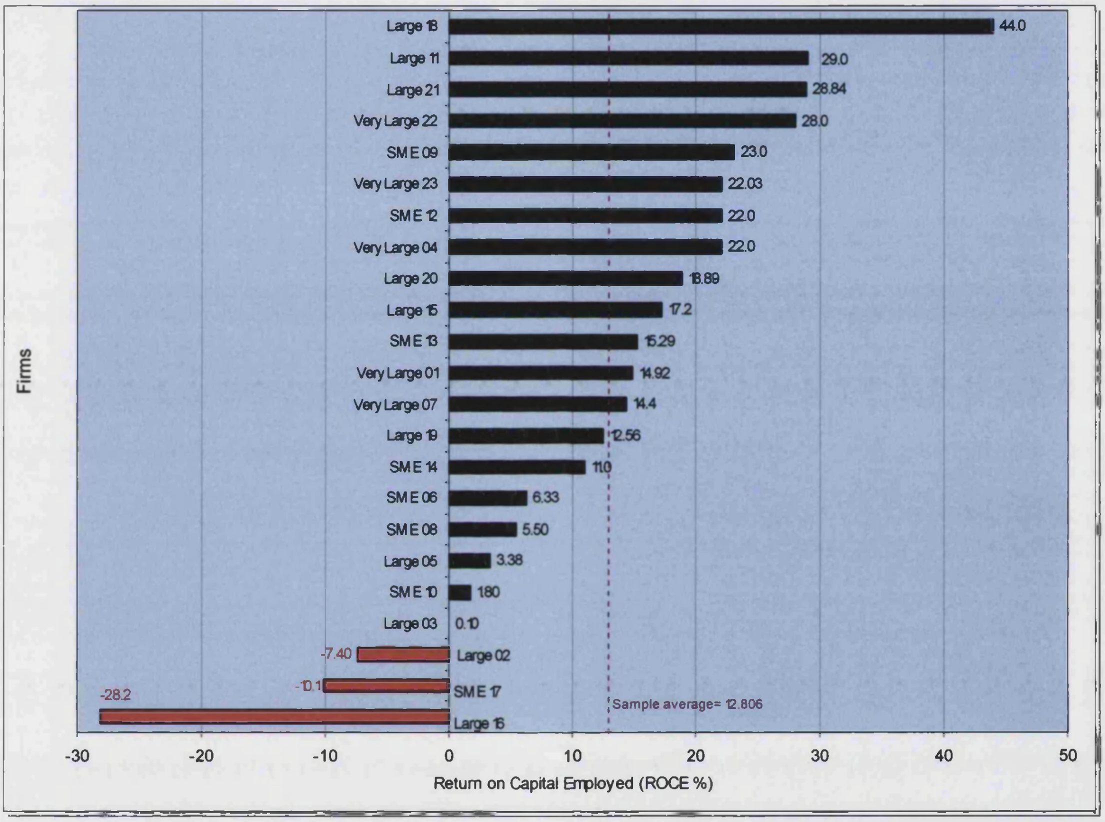

Chart 44: ROCE distributed from highest to lowest (%)

Large and very large firms comprised the largest proportion of firms obtaining above-sample average ROCE, with each firm-type accounting for around 40 per cent of the sample, followed by SMEs. All very large firms had an ROCE above the sample average, whilst 40 per cent of large firms and one third of SMEs obtained an ROCE lower than this. Three firms obtained a negative ROCE, with a two further firms obtaining a marginally positive ROCE. Chart 45 segments the ROCE by firm type, illustrating the variability within each, and between the three. Only very large firms obtained a firm-type ROCE average which exceeded the sample ROCE average of around 12 per cent. The ROCE average for large firms and SMEs was lower than this, with 10 firms from both of these two firm-types obtaining an ROCE lower than this, equally divided between large firms and SMEs. A further 8 firms obtained an ROCE higher than this, comprised of large firms and 3 SMEs. The data indicate that a higher ROCE could be associated with an increase in firm size, but this is not supported by further statistical analysis as depicted following Chart 45.

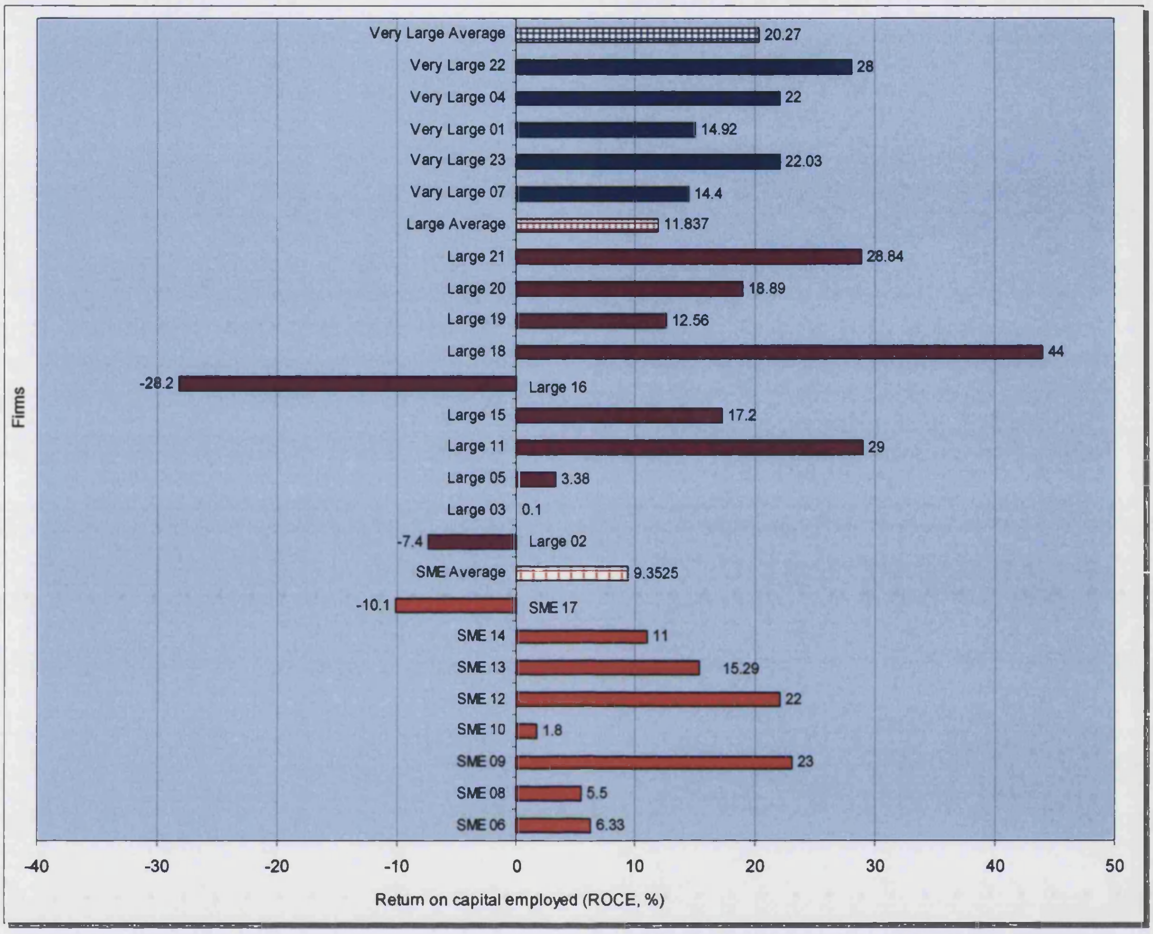

Chart 45: ROCE by firm-type (%).

Very large firms displayed a mean ROCE of 22 per cent, which was almost twice the mean ROCE for large firms and two and a half times the mean ROCE for SMEs, as depicted in table 71.

ROCE (%)	SME	Large	Very Large
Mean	9.35	11.84	20.27
Median	8.67	14.88	22.00
Mode	n/a	n/a/	n/a/

Table 71: ROCE mean, median and mode (%).

The correlation relationship and regression results between ROCE and employees and revenue were not statistically significant as displayed in Tables 72 and 73.[68]

[68] P values of 0.5589 and 0.3980 were obtained in a regression of ROCE against employees and revenue respectively, which were greater than the significance value of 0.05, leading to an insignificant result (see Appendix A and B for the results respectively).

	ROCE	Employees
ROCE	1	
Employees	0.128523589	1

Table 72: Correlation between ROCE and employees

	ROCE	Revenue
ROCE	1	
Revenue	0.186485137	1

Table 73: Correlation between ROCE and revenue

Within firm types, differing degrees of variation occurred between the upper and lower bound ROCE as depicted in table 74.

Variation in ROCE	%
Very Large firm	13.60
Large firm	72.20
SME	33.10

Table 74: Variation in ROCE within firm-type (highest minus lowest amount (%))

Very large firms displayed the lowest variation in ROCE, with an almost 14 per cent difference between the highest and lowest ROCE within this firm-type. Large firms displayed the highest variation, with 72 per cent separating the lowest and best performing firms' ROCE. SMEs obtained a difference of 33 per cent between the highest and lowest ROCE in this firm type. The differences in variation in ROCE cannot be attributed to:

- Homogeneity within firm-types: All three firm-types contained firms engaged in a cross section of aerospace activities with no concentration of similar firms within a firm-type.
- Regional differences: The firms within each firm-type were drawn from across UK regions with no single region dominating a firm-type.

7.2.3.1 ROCE and Managerial Practices

The distribution of firms' ROCE is presented in chart 46, which depicts the return on capital employed against management practices scores.

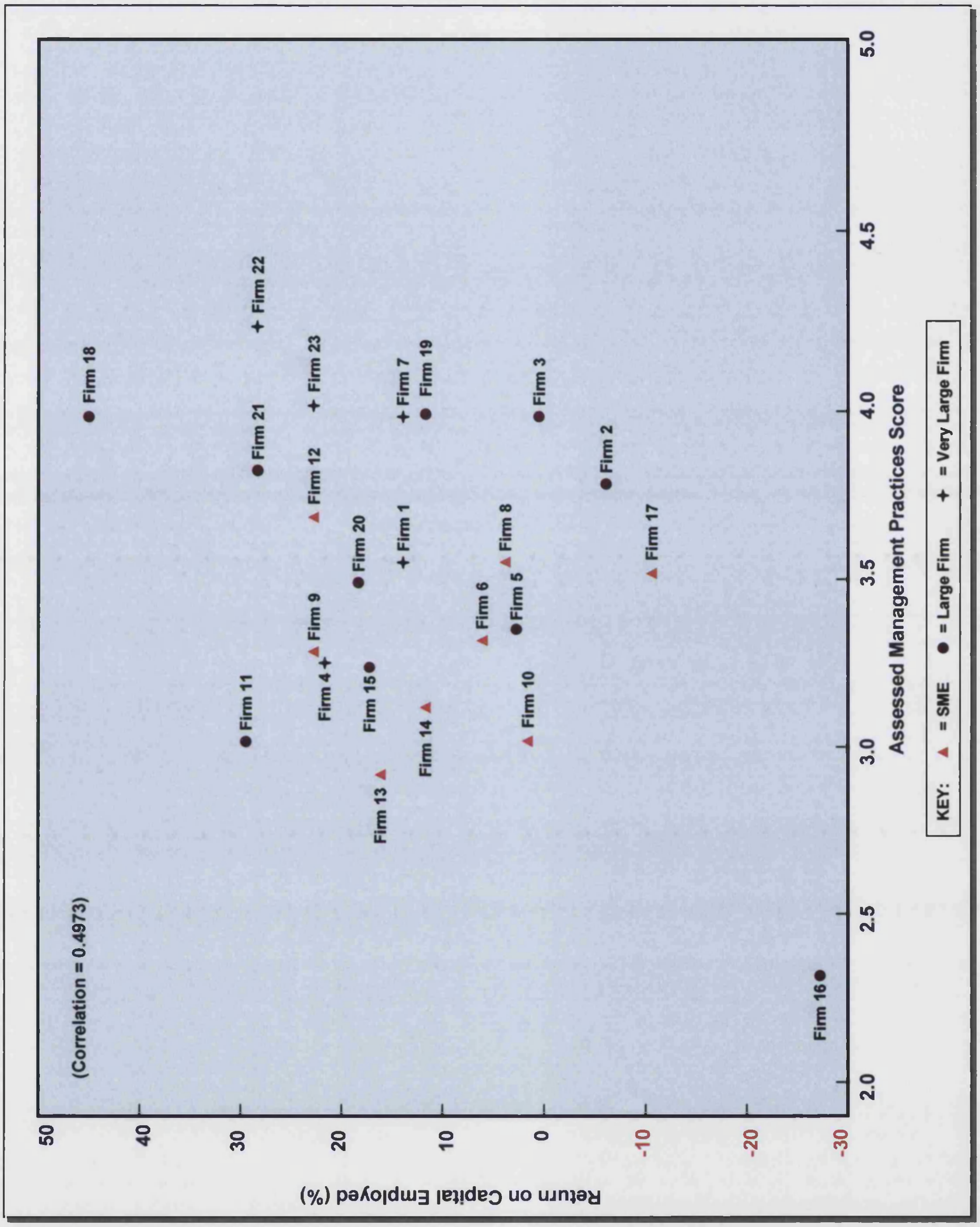

Chart 46: ROCE versus management practices scores

When the data are transposed to a chart with dual y axes, as in chart 47 on the following page, the relative movement between managerial practices sectors and ROCE can be observed more easily. Correlation analysis in the following section explores any relationship between these variables.

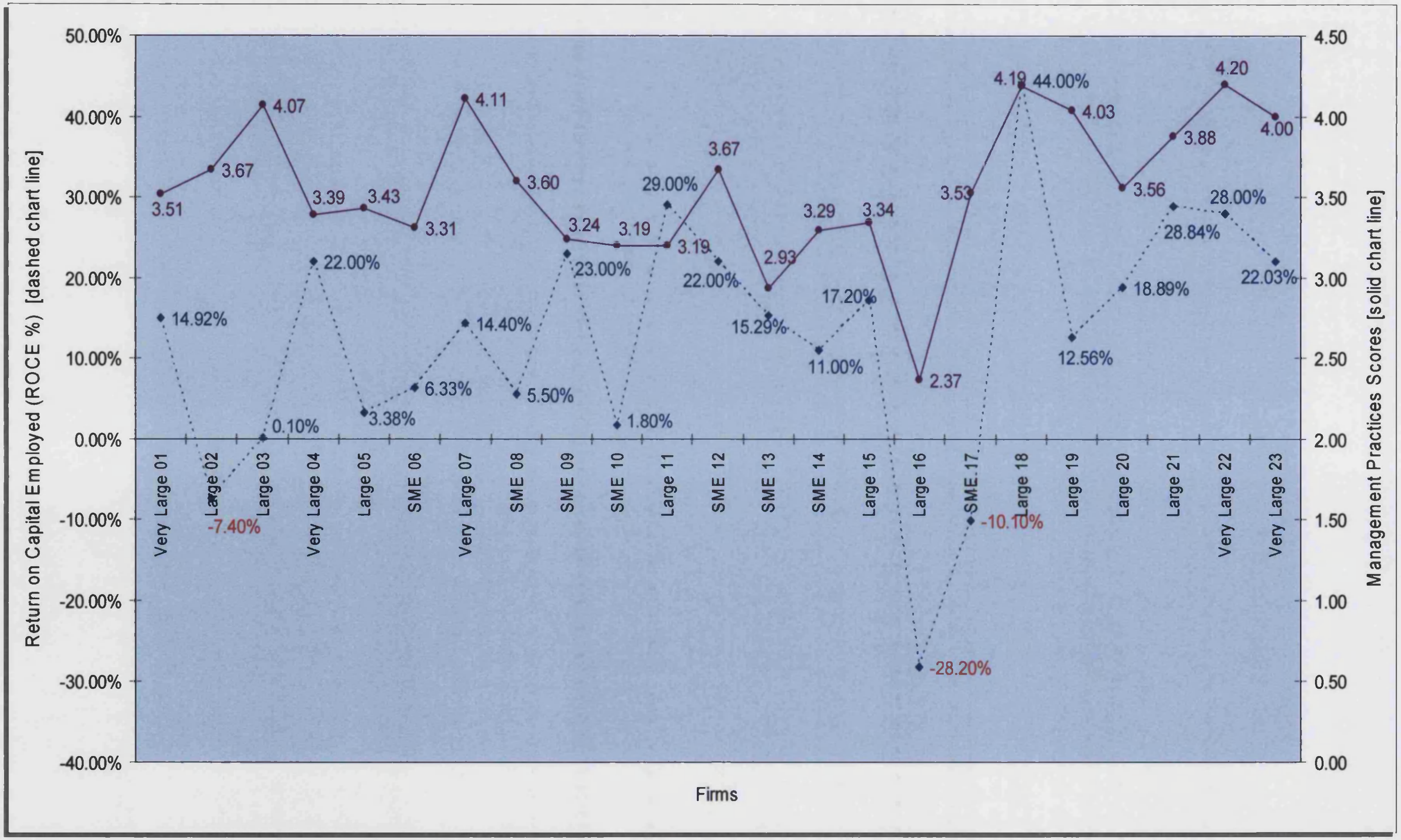

Chart 47: ROCE versus management practices scores- dual y axis

7.2.3.2 Correlation between ROCE and Management Practices

The sample data for the 23 firms yielded a correlation between ROCE and the management practices scores, of 0.49732 as depicted in table 75.

	ROCE	Management Practices Score
ROCE	1	
Management Practices Score	0.497392	1

Table 75: Correlation of management practices with ROCE

Using Franzblau's (1958) typology, this yields a moderate linear level of correlation with the correlation coefficient being between 0.40-0.60 ($0.40 < r < 0.60$), and the conclusion that some degree of linear relationship exists between the two variables of management practices and ROCE. Some researchers posit that a more relevant approach to correlation is a 'rule of thumb', with correlations less than 0.30 indicating little if any relationship between the variables (Hinkle et al, 1988), but results above this reveal some relationship level which increases in line with the score increase. Correlation does not infer that changes in one variable are the direct result of another variable. The fluctuation in a variable might be due to chance, or due to the effect of other variables that were not adequately considered, or which have changed over time. Regression yielded a p-value of 0.01574 which is less than the 0.05 level of significance (see Appendix D) and a significant result. This permits the rejection of the hypothesis that no relationship exists between managerial practices and ROCE.

The capital employed in calculating ROCE includes the firm's ICT, plant and equipment, other technology and assets that comprise fixed assets. A lower correlation between ROCE and managerial practices, coupled with a higher correlation between productivity and managerial practices, indicates that scope exists for firms to further improve the use of their assets and/or the quality of practices, which in turn may result in an increase in ROCE. Bloom et al (2005) reviewed the returns to IT capital stocks for a panel of 11,000 firms in the US and the UK, utilising one of the largest micro-based samples in the world and discovering that, "the significant impact of IT on productivity, [can] account for almost all of the higher productivity of US multinationals" (p4). Although the results obtained in this study for the correlation between ROCE and managerial practices do not explicitly infer causality, emerging evidence indicates that firm-level factors resulting in the more productive management of the firm's ICT may result in an enhanced ROCE and productivity (Bloom et al, 2005; p5):

> ...at least some of the differential performance of productivity between the US and the EU since the mid 1990s is due to the internal organization of US firms... there is evidence for significant differences in the "organizational capital" of US firms relative to British and other European firms, even when these US firms operate in Europe.

A recent major study by the Productivity Commission (2004) in Australia highlighted the interplay between managerial practices and ICT:

> Management information systems have facilitated process innovation through improvements in planning, work process monitoring, product quality, input supply management, and customer service. In some cases, the improvements to management systems have been instrumental in bringing about significant cultural or organisational change.

Other studies posit that the use of ICT, and ultimately the return on capital employed, could be improved as a result of increased organisational effectiveness:

> .... IT as a rapidly changing technology requires effective management practices (as well as organizational devolution) to be fully exploited. Because the capabilities of IT are constantly improving exploiting this will require ongoing change within the firm which well managed firms are much more likely t be able to cope with this uncertainty. This implies that better managed firms will be able to obtain higher returns from new IT technologies (Bloom et al, 2005; p19).

A further recent large-scale country investigation into ICT use and productivity obtained results that supported these studies, highlighting the interlinked nature between the use of information technology, managerial practices, and the structure of the firm:

> Management information systems have facilitated process innovation through improvements in planning, work process monitoring, product quality, input supply management, and customer service. In some cases, the improvements to management systems have been instrumental in bringing about significant cultural or organisational change (Productivity Commission, 2004; p58).

Firm-level organisational elements are increasingly being acknowledged as influencers of the return on capital, and the use of ICT, which ultimately affect performance (Murphy, 2002). This study represents one of the first research efforts to amalgamate these threads.

The lower correlation coefficient obtained between ROCE and management practices than between management practices and labour productivity is reflected in chart 48, with the ROCE results (y-values) located further from the line of best fit than in chart 43 for labour productivity. Around two thirds of firms are located in the area bordered between management practices scores of 3.00 to 3.30 on the x-axis, and ROCE of minus 10.0 to plus 30.0 per cent on the y-axis.

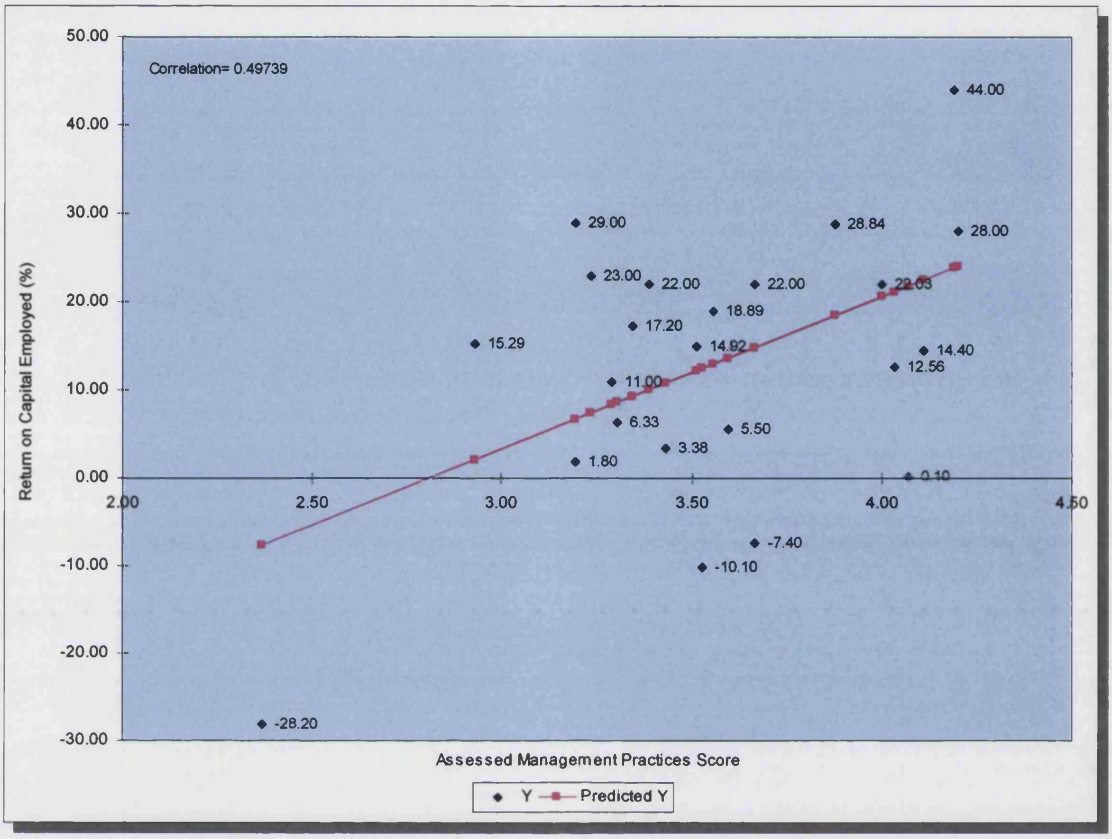

Chart 48: Line of best fit for correlation. management practices versus ROCE

ROCE displayed a lower correlation with management practices than productivity. Despite higher managerial practices scores, some firms obtained lower, or negative ROCE. In other cases, it appeared that firms could have obtained a higher ROCE than they were currently obtaining, with many obtaining high managerial practices scores. Firm level investigation revealed a number of factors that contributed to these results:

- A number of firms were poorly performing with losses, low orders, ineffective, or minimal ICT, and possessing organisational elements that lacked effect, and had recently been acquired by other firms. In many cases, these had installed their own management teams to ‘turn around’ these businesses, which were assessed as part of the study, and had obtained higher scores. Insufficient time had elapsed between the new management team commencing and for better practices to take effect.

- Some firms that obtained a lower ROCE and lower managerial practices scores were in the process of installing additional managers recruited from outside of the business, either from a head office, or recruited externally, in order to improve performance. These firms were in a ‘state of flux’ with many existing managers unsure of their roles and employment status, and indicating that their focus was not on improving the business during this process.

7.2.4 Management Practices, Productivity, ROCE and ICT

Chart 49 displays ROCE, productivity and managerial practices results. Three firms obtained polar results between productivity and ROCE and mixed management practices results, whilst a further two firms obtained an ROCE of less than five per cent. These five firms are highlighted below:

Polar ROCE and Productivity Results

SME 17: This firm had recently been acquired by a publicly listed entity and displayed negative ROCE, strong productivity, and management practices score that reflected the sample average. This firm was in the process of being turned around by a new management team. Labour productivity was one of the lowest five in the sample, and its negative ROCE was the second lowest. Continued improvements to management practices were occurring, as new managers were being hired to replace incumbents, or, to undertake newly defined roles. ICT was utilised throughout the firm, which was further enhanced through the upgrade to SAP from a less sophisticated commercial option.

Large 02: The firm was independent non-family owned, with productivity amongst the lowest five firms and with its negative ROCE the third lowest in the sample. The average management practices score was marginally above the sample average, with shareholders attempting to amalgamate recent acquisitions that had increased the firm's cost base considerably, but with revenues correspondingly lower. No commercially available ERP solution existed, but ICT was utilised throughout the firm through enhanced PC use and some production data being available through a 'home-grown' solution.

Large 16: This firm displayed the largest negative ROCE of the sample and productivity that was amongst the five lowest firms. The firm also obtained the lowest average managerial practices score of the sample. This firm had recently been acquired by a publicly listed company, with the majority of the previous senior management team replaced and a significant change programme initiated. The majority of the management practices in place were still the existing ones however, due to these being recent initiatives. The firm's use of ICT was limited, with PCs and information access on the shop floor level poor. Lower-cost ERP was utilised, although funds had been allocated for an upgrade to SAP over the next two years.

Large 03: This firm displayed high productivity, a negligible ROCE (just above zero), and the fourth highest average managerial practices score. The firm had been acquired by a large international publicly listed company and had been undergoing considerable structural change, including making write-downs and implementing redundancies. This resulted in losses, which were forecast to be turned to profits within the following two years. ICT was integral to the firm's operation, and was reflected in sustained higher budgets and a dedicated IT department.

ROCE of Less than Five Per Cent.

SME 10: This firm was independent non-family owned and obtained the second lowest ROCE (marginally above zero), and the lowest productivity. It also obtained the third equally lowest management practices score, and was not undergoing any structural change, with the results reflecting its day-to-day operations. The firm leased one of the lowest cost and simplest commercially available ERP solutions, and spent one of the lowest annual amounts on ICT.

Large 05: This firm was publicly listed, obtaining the third lowest positive ROCE and an average level of productivity. The firm also obtained an average management practices score that was marginally below the sample average. Lower-cost ERP was replaced a major commercial solution, with ICT prevalent throughout the firm. Recent structural changes had resulted in strong gross profits being reduced to small net losses, which the management team was confident of reversing once a transformation programme was complete.

The remaining firms obtained an ROCE greater than five per cent and are not reviewed in greater detail. Chart 49 depicts the relationship among the three variables of ROCE, productivity and managerial practices.

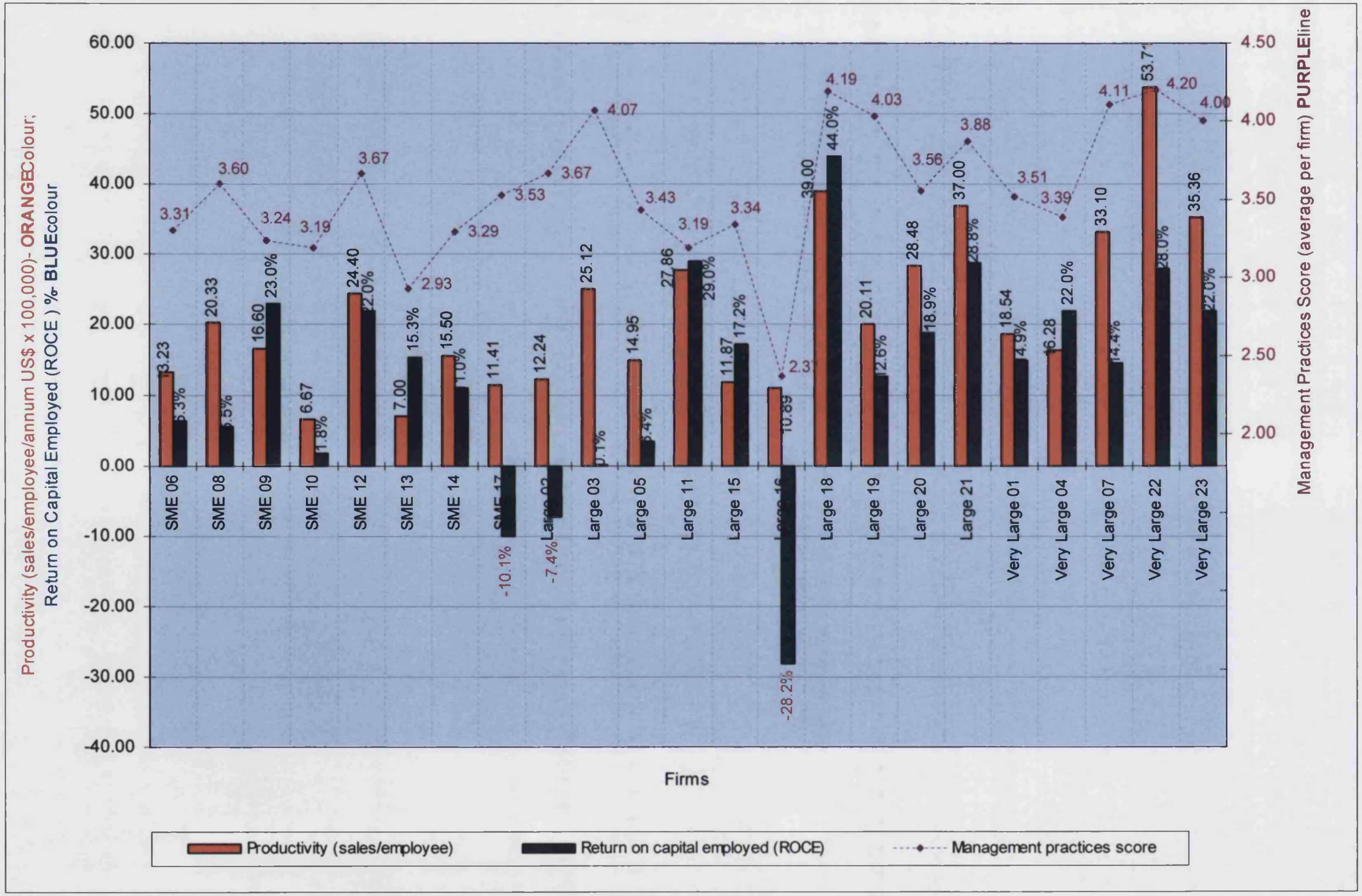

Chart 49: ROCE versus management practices and productivity

7.2.5 Complementarities between ICT and Management

This study's results indicate that a significant positive correlation exists between management practices and productivity. The hypotheses in section 8 also reveal that a statistically significant relationship exists between ICT and productivity. The final extension of this is the assessment of the possible complementarity between management practices and ICT as highlighted by recent research by Bloom et al (2005) with a number of outcomes posited and depicted in table 76 below.

	ICT High	ICT Low
Good Management	1. Very high productivity	2. Low productivity (maybe worse than cell 4 below)
Bad Management	3. Low productivity	4. Low productivity

Table 76: Complementarity between ICT and Management

The table illustrates the complementary relationship that can exist between these variables. In cell 1, good management and high ICT use can result in very high productivity. Where good management is accompanied by low ICT use, this can result in low productivity, as depicted in cell 2. Where bad management is accompanied by high ICT use, this can result in low productivity use, as depicted by cell 3, with the same result potentially ensuing where ICT use is also low, as depicted in cell 4. Good managerial practices and high ICT use should be complementary, resulting in high productivity. In order to test for complementarity, a regression of the interaction between ICT and management was undertaken. This study has discovered that management practices have a significant and positive correlation with firm performance amongst the sample (section 7.2.2.2), with ICT also shown to be significantly positively correlated with performance (see hypothesis H1c in section III, part 8).

In testing the relationship between ICT and management, a standard production function was utilised ('Cobb Douglas function'). This followed Bloom et al's (2005) approach that minimises division bias ensuing from a measurement error when testing a number of variables together, including sales over labour ("labour productivity") and ICT expenditure over sales. This would otherwise generate a negative correlation mechanically and an inaccurate result. Formally, a Cobb-Douglas production function in employment and ICT capital is defined as,

$$\ln Y = a + \alpha \ln L + \beta \ln C$$

where Y = output (proxied by sales), L = workers, C = ICT capital and a is a constant term (Hicks neutral efficiency). Cobb Douglas firstly takes the logarithm of the variables to be tested, to reduce the skewness of the data before undertaking the linear regression. This is reflected by the letter "l" being placed before the outputs (e.g. *lsales* to reflect the logarithm of productivity).

Before testing for complementarity, an initial equation was constructed that included the influence of key variables on each other encompassing; productivity (*lemp*), capital investment as defined by tangible fixed assets (*lacap*), ICT investment (*lict*) and management (*management*). These established the variables within which management would be multiplied against ICT in order to test for complementarity. Before this was undertaken, the initial equation was run and reviewed, as presented in table 77.

```
Number of obs =       21
                                                    F(  4,     16) =  139.23
                                                    Prob > F       =  0.0000
                                                    R-squared      =  0.9385
                                                    Root MSE       =  .59247
```

lsales	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lemp	.699033	.2108898	3.31	0.004	.2519666	1.146099
lacap	.2964804	.1062023	2.79	0.013	.0713416	.5216192
lict	.2189594	.1252342	1.75	0.100	-.0465252	.484444
management	.3815957	.2369712	1.61	0.127	-.1207607	.8839521
_cons	5.27734	.7101674	7.43	0.000	3.771852	6.782828

Table 77: Cobb Douglas- Results for productivity, capital, ICT and management

The results indicate a significant result for ICT at the 10 per cent level of significance (0.100 above) and for management at the 12.7 per cent (0.127) level of significance. Two outliers were removed from the sample, yielding a total of 21 observations. Although these results were not as strong as others in this study, this is believed to be due to the sample size being too small to test multiple variables. This scenario contrast the statistical assessment of the isolated variable of ICT on productivity, undertaken in section 8 of this study, which was found to be very significant at the 1 per cent level. Following the establishment of the above multiple variables in the production function, the interplay between ICT and management was introduced in order to test for complementarity. This is depicted as *m_lict* in table 78.

```
Number of obs =        21
                                                   F(  5,     15) =  120.30
                                                   Prob > F       =  0.0000
                                                   R-squared      =  0.9435
                                                   Root MSE       =  .58644
```

lsales	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lemp	.6708449	.1989581	3.37	0.004	.2467757	1.094914
lacap	.3786329	.1597541	2.37	0.032	.0381251	.7191407
lict	.986268	.8094147	1.22	0.242	-.7389587	2.711495
management	3.146347	3.040324	1.03	0.317	-3.33395	9.626644
m_lict	-.2238897	.2474561	-0.90	0.380	-.7513299	.3035505
_cons	-5.224422	11.73073	-0.45	0.662	-30.22788	19.77903

Table 78: Cobb Douglas- Results for ICT versus management for complementarity

The above results indicate that the introduction of the additional variable of ICT versus management (m_lict) has reduced the significance for each of these two variables. ICT is now significant at the 24.2 per cent level (0.242), which has reduced in significance from the 10 per cent level in table 77, and management now significant at the 31.7 per cent level (0.317), which has reduced in significance from the 12.7 per cent level (0.127) in table 77. No complementarity was found between ICT and management reflected by a negative coefficient for the m_lict term of -0.223. This is not believed to negate the presence of complementarity however, with the result most likely due to the small number of observations in the production function. The expansion of the sample size could remedy this if this study was enlarged. A further check on the results was undertaken through the regression of ICT and management against productivity, which yielded a strong positive relationship with a correlation coefficient of 0.84, as depicted in chart 50.

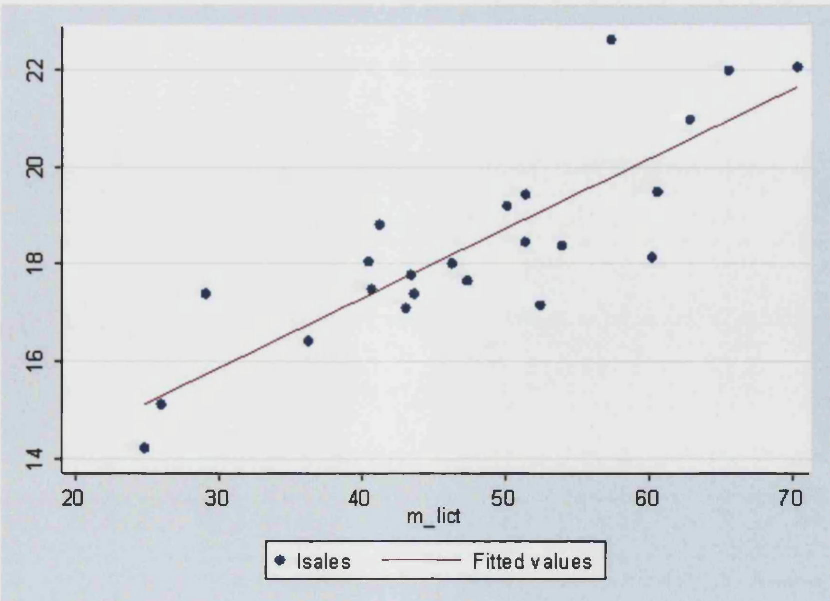

Chart 50: Relationship between management and ICT versus productivity

This significant positive result did not translate into a positive result for complementarity once the variables were combined into the production function, confirming the belief that the observed lack of complementarity is likely to be the result of a small number of observations in the production function. This result does not alter despite the removal of outliers and a close review of all other data points.

7.3 Interview Variations

A further level of analysis on managerial practices scores was the degree of similarity between scores obtained in more than one interview. The management practices interview scores are plotted against the average additional face-to-face interview scores for each firm in chart 50.

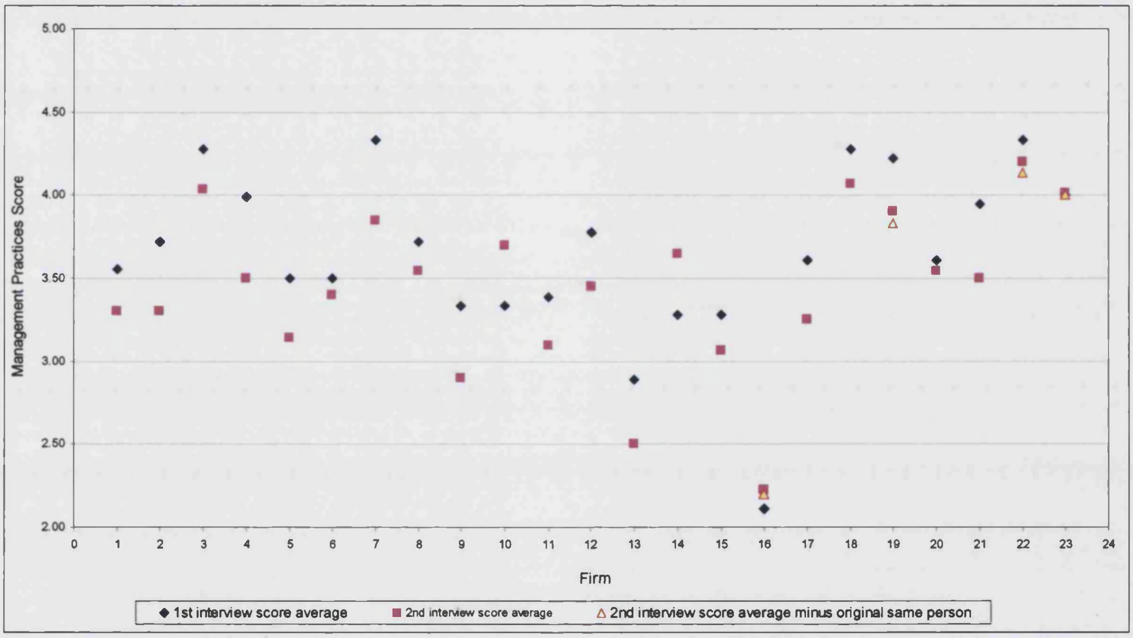

Chart 51: Average management practices scores by firm- interview one vs. interview two

The chart depicts average scores plotted for the first at a distance interviews (blue) against the average scores of the second in-situ interviews (purple). The number of people interviewed in situ varied from 1 to 4, depending on the size of the firm, access obtained, and the priorities of the business at the time. In 4 firms (16, 19, 22, 23), the same person initially interviewed via telephone was re-interviewed in person with the results incorporated into the second interview average in the chart. This result was also removed in order to assess the difference in average scores without its influence, presented in the chart as a yellow/red diamond. The close proximity of these scores with those originally obtained from the same person, indicates that their responses were consistent. The scores were generally also similar to those of the other individuals interviewed, indicating congruence with these data points. Regression analysis with and without this result was undertaken in order to test the significance of both sets of results, with the results presented in table 79.

	Interview 1	Interview 2 (without same person)
Interview 1	1	
Interview 2 (without same person)	0.888038	1

	Interview 1	Interview 2 (with same person)
Interview 1	1	
Interview 2 (with same person)	0.888631	1

Table 79: Correlation analysis- interview one and two (with and without original interviewee in 2nd interview)

Regression analysis revealed a high degree of correlation for both results. The inclusion of the 4 original interview subjects for the second interviews resulted in a significant correlation coefficient of 0.8934. When these were removed, a marginally lower coefficient was obtained of 0.8912. Both scores indicate a strong positive relationship and that scores replicated at firm level reflected those obtained during the remote interview and vice versa, which was confirmed with a p-value less than the 5 per cent significance level. This permitted the rejection of the hypothesis that the two scores are significantly different (see (A) in Appendix E). An adjusted R square of 0.78 was obtained in both scenarios, indicating that 78 per cent of the results in one interview can be determined by those in the other.

A z-test was conducted on the two samples (interview one vs. interview two) in the form of a critical two-tailed test at the 95 per cent confidence interval to assess if the null hypothesis could be supported that the two populations are similar, as measured by their means. If this occurred, it would further support the methodology, by indicating that at-a-distance interviews were an accurate representation of the results that could be expected from interviews conducted in the firm. A z-score of 0.6853 was obtained (see [B] in Appendix E) which was significantly greater than 0.05, indicating that the null hypotheses could be accepted: the two groups were similar. The z-score was also lower than the z-critical two-tailed score (1.9599), which is a further statistical indicator that the null hypothesis can be accepted. These assessment modes confirmed the robustness and applicability of the management practices tool in quantifying the actions of managers.

7.4 Additional Firm Level Indicators

Results from six other firm-level indicators were collected, which were integral elements of the CEP-McKinsey methodology and provide a further 'peeling of the organisational layers' to reveal other possible influences on firm performance and use of ICT (Bloom et al, 2007). A number of these have also been identified as being relevant in the assessment of managerial practices on productivity:

(1) Financial Performance
(2) The level of unionisation.
(3) The number of managers/non-managers.
(4) The level of degree qualified managers and non-managers.
(5) The earnings multiple between the CEO and the shop floor.
(6) The number of organisational levels between the CEO and the shop floor.

Data were collected for each of these and are depicted below.

7.4.1 Financial Performance

The financial performance of each firm was assessed over the past three years, with the net profit/loss position of each presented in table 80.

Firm type	2006	2005	2004
SME 06	Profitable	Profitable	Profitable
SME 08	Loss	Profitable	Profitable
SME 09	Profitable	Profitable	Profitable
SME 10	Profitable	Profitable	Profitable
SME 12	Profitable	Profitable	Loss
SME 13	Profitable	Profitable	Profitable
SME 14	Profitable	Profitable	Loss
SME 17	Loss	Loss	Loss
Large 02	Loss	Loss	Loss
Large 03	Loss	Loss	Profitable
Large 05	Loss	Loss	Profitable
Large 11	Profitable	Profitable	Profitable
Large 15	Profitable	Profitable	Profitable
Large 16	Loss	Loss	Loss
Large 18	Profitable	Loss	Loss
Large 19	Profitable	Profitable	Profitable
Large 20	Profitable	Profitable	Profitable
Large 21	Profitable	Profitable	Profitable
Very Large 01	Profitable	Profitable	Profitable
Very Large 04	Profitable	Profitable	Loss
Very Large 07	Profitable	Loss	Profitable
Very Large 22	Loss	Loss	Loss
Very Large 23	Profitable	Profitable	Profitable

Table 80: Net profit/loss position by firm

The data reflect the evolving, consistent or intermittent profitability of firms. Four firms displayed losses for each of the three periods (SME 17; large 02, 16; very large 22), whilst some displayed losses in a single period (around a fifth of the sample), or two of the three periods (just over 10 per cent of the sample). Fifty per cent of SMEs and large firms displayed profitability in all periods, compared to around a fifth of very large firms. Large and very large firms displayed the equal highest proportion of loss making periods with losses occurring in 40 per cent of the available periods,[69] contrasting SMEs which displayed losses in around one quarter of the available periods.

Losses in All Periods

Of the four firms displaying losses for all of periods, one was an SME (SME 17). The firm was majority owned by a listed entity which had been funding its losses. The firm's shareholders believed that it possesses strategic value and the potential for improved performance through restructuring. During 2007, the firm's cost of sales and administration expense increased by 25 per cent, but prices rose by less than half of this. The operations director believed that ICT was being proactively managed after the recent move to SAP: "We are finally making some progress with our ICT, but we need better use of it by managers as they currently don't access the data they ask me about all of the time." Two other large firms displayed a similar pattern (large 02, 16), with the cost of sales rapidly approaching the value of the firm's turnover for the review period in one of these (large 02), resulting in losses once other costs were factored in. The firm was independent non-family owned with the shareholders attempting to amalgamate recent acquisitions that had increased their administration expenses by a factor of four during the most recent period, resulting in increased losses, with the CEO focusing his attention on a number of key areas; "I need to get a better handle on our cost and production base, and I am not sure I am getting that with our home-grown attempt at an ERP system. I may need to bite the bullet and get a decent one." The other large firm (large 16) was owned by a publicly listed entity and was undergoing significant restructuring, resulting in some exceptional costs for this which contributed to losses. The CEO was focusing on areas of the business that he believed would reverse the company's losses: "I can make cuts here and there, and leave ICT for later. As far as I am concerned, it's not a priority at the moment." The remaining firm exhibiting losses across all four periods (very large 22), was one of the largest in the sample and employed extensive ICT. The firm was exhibiting fluctuations in its cost base at the same time that its managers were attempting to correct delays from occurring, with the CEO experiencing a high degree of frustration: "I am trying to cope with a thousand fires, delays, rising costs, fixed-price contracts and data that is sometimes old before I even get it. I need to get stability in the business before I can look at it closer."

[69] 12/30 periods for large firms and 6/15 periods for very large firms.

Losses in Two Periods

Three firms displayed losses for two successive periods, with all of these being large firms (large 03, 05, 18) and publicly listed. One firm (large 03) was continuing to make structural changes, with the IT manager pushing a greater use of technology to the line managers and supervisors: "We are winning good contracts, but we still haven't gotten our costs and use of information under control." Another firm (large 05) was attempting to adjust its product mix and suppliers in order to reverse its losses, with the IT manager not believing that the CEO had done enough to support ICT being used in the firm: "I can't help thinking that better support will get people using it more, and importantly, asking for better IT and kit that's really relevant to their job. We tend to scratch the surface with what we have at present." The final firm (large 18) had recently been acquired and a new CEO installed who was a lean 'zealot' and was attempting to reduce the cost of materials, whilst not being able to raise prices due to fixed price contracts. He was also reviewing the use of ICT: "If we can't make things work, they will close us down. I have a passion for lean, but I am not sure if my cost data is correct, because I can't trust all of my IT."

Single-Period Loss or Profit in all Periods

The remaining firms displayed a loss in one period, or profits across all periods. Of the five firms displaying a loss in one period, three were SMEs and two were very large firms. Two of the SMEs were publicly owned (SME 08, 12), with one (SME 14) being independent family owned. The latter of these was one of the smallest firms in the sample with the business hovering between marginal profitability and marginal losses. Another of the two firms (SME 08) has been consistently profitable, with a recent shrinkage in sales experienced. The firm's IT manager was satisfied with the degree of ICT investment and use: "The issue isn't that we spend on IT, but what we do with it. We haven't fully grasped what the data can tell us and the transition to SAP has been much harder than we ever thought-not to mention expensive." The last of these three firms (large 12) had improved its performance in the past two years, with the earliest period showing losses. The firm was one of the lower spenders on ICT and ERP, but had recruited 3 IT people, with the CEO believing this would result in self-sufficiency: "I can't see why we can't do what we want with them. It's 3 bodies to do our IT." Of the two very large firms displaying a single period loss, one (very large 04) was continuing its strategy of acquiring SMEs. Despite considerable issues in the amalgamation of these, the firm's loss was confined to the earliest period, with consistently growing profits ensuing since. The IT manager believed that IT would play an increasing role in this: "We have stopped a lot of investment in the companies we have bought until we bed in SAP and ditch the Mickey Mouse crap we found. Once we do that, we will focus on upgrading the IT with an enterprise view and economies of scale buying." The final firm (very large 07) had experienced a loss in the middle review period, but had turned this into a profit. The firm had a strong focus on ICT, with the IT manager controlling one of the larger departments (15 people): "We are trying hard to get our costs down and implement lean across the organisation at an even higher level. We have been an SAP house for a while but we certainly haven't really tapped the use of ICT as well as we should."

7.4.2 The Level of Unionisation

Booth's (2002; p200) extensive study of the impact of unionisation on productivity highlighted a number of issues:

> US evidence suggests that unions do not on average significantly increase productivity and that unions decrease productivity growth. The British evidence as to the impact of unions on productivity is mixed. Unions appear in general to have had a negative impact on the level of productivity.

This has been supported by other researchers who have undertaken specific studies in a manufacturing environment (Bemmels, 1987; p241-250):

> The evidence suggests that unions reduce the effectiveness of some managerial practices undertaken to increase productivity , and that a poor labor-management relations climate also reduces productivity.....the evidence indicates that unions alter the effectiveness of managerial practices.

Recent research by Metcalf (2002; p45) summarises a growing perspective which posits that the effect of unionisation on managerial practices, and vice versa, is dependent on the country as much as it is on firm-level factors:

> The evidence indicates that, in the USA, workplaces with both high performance work systems and union recognition have higher labour productivity than other workplaces....In the UK previous negative links between unions and labour productivity have been eroded by greater competition and more emphasis on "partnership" in industrial relations but there is a lingering negative effect of multi-unionism, just as there is in Australia.

The conclusion that the management-union cooperation yields superior outcomes to adversarial relations has been gaining wider acceptance, and is congruent with early studies that assessed the managerial response to unionisation (ibid). These studies posited that changes in management practices and procedures often occurred to accommodate and respond to unionisation including adopting more formal modes of organisational control, including utilising a more professional approach to labour relations (ibid). These included more production target setting and the processes for both the monitoring and review of performance. Recent research has yielded inconclusive results in this area, indicating the difficulty inherent in assessing the impact of a unionised workforce on other areas of the firm: “This (research) leaves at least half of the union impact unexplained…” (Bemmels, 1987; p251). Haskel (2005) states: “The relation between unions and business productivity remains contentious” (p2). A significant factor contributing to this lacuna is the use of industry level data, and the lack of the relevant firm-level data as depicted by Haskel (2005; p3): “One well-acknowledged problem is that micro data on business level productivity and unionism is very hard to come by.” The observations and data from this study bridge some of this gap in the literature, but also indicate inconclusive results with respect to unionisation levels and ICT use and the effect of management practices. Table 81 presents the results for the level of unionisation by firm, reflecting the proportion of the workforce belonging to a union, including the average for each firm-type.

Firm Type	Unionisation
SME 06	80%
SME 08	90%
SME 09	75%
SME 10	70%
SME 12	70%
SME 13	0%
SME 14	0%
SME 17	50%
SME Average	54%
Large 02	90%
Large 03	90%
Large 05	90%
Large 11	20%
Large 15	60%
Large 16	50%
Large 18	90%
Large 19	85%
Large 20	80%
Large 21	90%
Large Average	75%
Very Large 01	50%
Very Large 04	90%
Very Large 07	0%
Very Large 22	90%
Very Large 23	95%
Very Large Average	65%

Table 81: Unionisation level by firm

The average level of unionisation was highest for large firms, with three quarters of employees belonging to a union. Very large firms displayed the next highest level of unionisation, with an average of two thirds of employees belonging to a union. SMEs displayed the lowest average level of unionisation, with around half of employees belonging to a union. Chart 52 displays the data.

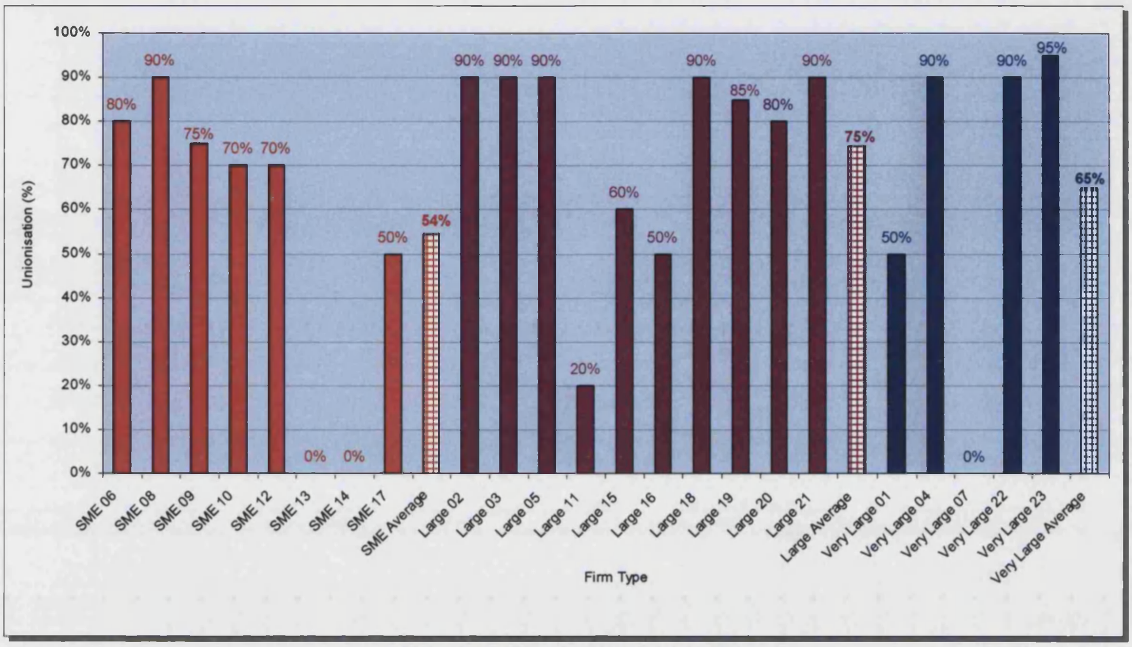

Chart 52: Unionisation level by firm

This study does not undertake a detailed exploration of unionisation at the firm level, but we can learn about some in the context of managerial practices and ICT use. A number of observations were made on the unionisation in the sample:

- Firm size did not determine the level of unionisation: variations existed in the level of unionisation across all firm types.
- Where the firm was not a publicly owned entity, the CEOs and/or owners preferences determined the level of unionisation.
- Where firms were unionised, this always encompassed shop floor employees in the first instance. Employees in other functional areas did not necessarily belong to a union.
- Of the three firms indicating the absence of any level of unionisation, two were independent SMEs (one was family owned, and one was non-family owned), and one was a publicly listed very large firm.

Discussions with firm managers across functions (IT, operations, finance) and shop floor employees, coupled with observations, proved inconclusive in assessing the effect of unionisation on ICT use. The utilisation of ICT, its proliferation, training and investment, and other ICT related elements, were randomly distributed throughout the sample, with some firms engaged in ICT-intensive activities displaying high levels of unionisation, and vice versa. Unionised employees displayed the same variation in their approach to ICT as non-unionised employees, with firm managers not favouring one environment (unionised versus non-unionised) over the other with respect to ICT investment and use.

7.4.3 Managers versus Non-Managers

The number of managers in the firm can influence the flow and nature of information both upwards and downwards (Meier, and Hicklin, 2007). The level of managers versus non-managers was explored in the firms, with table 82 summarising the results by firm. The largest variation in the average number of managers occurred in SMEs with a low of five per cent and a high of 25 per cent observed, with this firm-type also possessing the highest average number of managers, at 15 per cent. Large firms displayed the next highest average number of firm managers at just over 10 per cent. Very large firms displayed the lowest average number of managers at eight per cent, and possessed the same variation as large firms, with a low of five per cent and a high of 15 per cent of managers.

Firm Type	Manager	Non Manager
SME 06	5%	95%
SME 08	20%	80%
SME 09	15%	85%
SME 10	10%	90%
SME 12	10%	90%
SME 13	20%	80%
SME 14	25%	75%
SME 17	15%	85%
SME Average	15%	85%
Large 02	5%	95%
Large 03	15%	85%
Large 05	15%	85%
Large 11	5%	95%
Large 15	10%	90%
Large 16	15%	85%
Large 18	8%	92%
Large 19	15%	85%
Large 20	10%	90%
Large 21	15%	85%
Large Average	11%	89%
Very Large 01	5%	95%
Very Large 04	5%	95%
Very Large 07	10%	90%
Very Large 22	15%	85%
Very Large 23	5%	95%
Very Large Average	8%	92%

Table 82: Managers vs. non managers by firm

Chart 53 permits a clearer side-by-side comparison of the data.

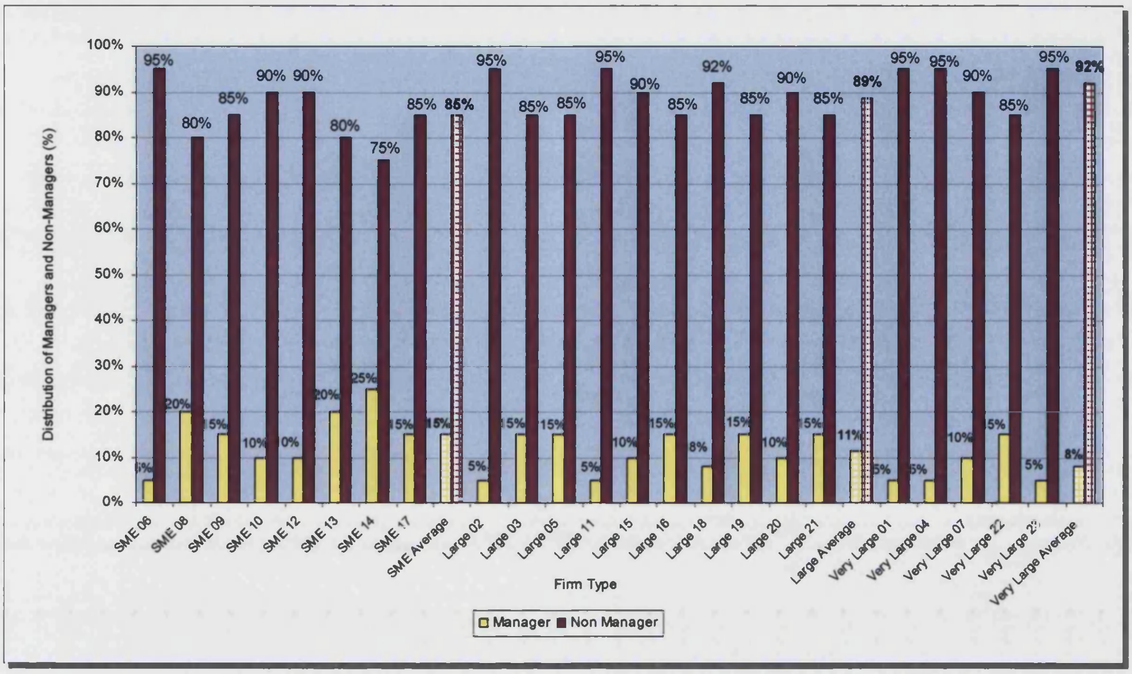

Chart 53: Managers vs. non managers by firm

Three very large firms displayed some of the lowest number of managers (5 per cent; very large 01, 04, 23). These were contrasting firms. One was one of the largest and most complex in the sample (very large 23), and adhered closely to a corporate defined organisational structure, with the number of shop floor workers established following analysis by a corporate strategy function. This approach was also reflected by another of these three firms (very large 01), which also contained multiple international operating businesses. The final of these three firms (very large 04) had rapidly evolved into a very large firm through acquisitions, with the CEO enforcing a policy of 'minimal administration': "We are lean and have to be when you are a low-cost producer in a very competitive business. That goes for how many managers we employ. The fewer the better." One firm (very large 22) also operated complex multiple international sites but had one of the most bureaucratic organisational frameworks and a higher proportion of middle managers than the other very large firms. This resulted in a higher number of managers (15 per cent) which was in part due to the nature of its ownership structure. The remaining firm (very large 07) was in the process of reviewing its managerial level, which included 10 per cent of its workforce being classed as managers, with a view to reducing this to around eight per cent over a three year period in order to compete more effectively on price to its customers.

Large firms displayed the same variation in the proportion of the workforce employed as managers as very large firms (5 to 15 per cent). Five firms had a management ratio of 15 per cent (large 03, 05, 16, 19, 21). All of these firms were publicly owned with their CEOs and operations directors generally adhering to a head office requirement on management ratios. Two other firms displayed a managerial ratio of 10 per cent with one of these publicly owned (large 15), and the other being an independent primogeniture firm (large 20). The CEO of the publicly owned firm was required to ensure that his management ratio was congruent with other firms in the group, irrespective if his business was of a similar nature to the others: “They don’t understand that we might not need the same managers as another part of the group, or, that I might actually need more managers due to the nature of a particular production process.” The CEO of the primogeniture firm adopted a managerial ratio that ‘felt comfortable’ and that he believed helped him to manage the firm. Three firms employed less than 10 per cent of their workforce as managers (large 02, 11, 18). Two firms were independent, with one of these being family owned (large 11) and exhibiting one of the lowest managerial levels of the sample at five per cent, with the CEO espousing a ‘cost minimisation’ ethos: “I want to know everything going on, and I hate paying too many middle-men to tell me.” The other independent firm (large 02) also exhibited one of the lowest ratio of managers (five per cent), with the CEO holding a similar view: “I need to know what’s going on, so I don’t have a lot of managers. The ones I have use IT pretty well, and tend to email everything.”

The largest intra firm-type variation in managerial rations occurred in SMEs, which displayed a ratio of managers from 5-25 per cent, with an average of fifteen per cent. Three firms had managerial ratios equal to or greater than 20 per cent all employees (SME 08, 13, 14). One of these firms (SME 08) was recently acquired by a publicly listed entity (SME 08) but was permitted to operate without interference by the parent, or by the requirement to adhere to other corporate parameters. Its CEO was content with the current level of (minimal interference) by HQ in the running of his business: “We run smaller teams that need to be supervised tightly, so we employ a larger number at a managerial level.” Another firm in this group (SME 13) also had a managerial ratio of 20 per cent and was independent family-owned. The firm’s owners had promoted a greater number of employees to managers over time as part of their retention programme. The third firm (SME 14) was independent non-family owned and displayed the highest level of managers in the sample at 25 per cent, despite being one of the two smallest firms in the sample. The number of managers reflected the smaller workforce and the larger number of employees the CEO promoted over time to a supervisory (managerial) level. Only one SME displayed a managerial level less than 10 per cent (SME 06). This was the primogeniture firm, with five per cent of employees classed as managers. The CEO and the operations director operated on a ‘lean as possible’ principle, which was reflected in their view of managers: “We only promote as few as required, and encourage our managers to run as large a team as is practical, safe and productive.” Four firms’ managerial level was between 10-15 per cent (SME 09, 10, 12, 17). Two of these firms were independent non-family owned (SME 09, 10), with the CEOs displaying a desire to keep their managerial level as low as possible in the belief that at the present time, this could not be reduced. The remaining two firms had an affiliation with a publicly listed company, with one firm (SME 12) making efforts to reduce its ratio of managers to around 10 per cent from a current figure of 15 per cent. This was being driven by the CEOs belief that the ratio was 'too high'. A corrective policy had been implemented of not promoting employees to some managerial positions once current managers had left the company. The final firm (SME 17) displayed a managerial ratio of 15 per cent and had also been publicly acquired in the last 24 months. The firm was required to adhere to some head office protocols, but the CEO was generally permitted to run the business at his discretion.

The ratio of managers to non-managers appeared to have some effect on ICT use within the firm. Firms with a greater proportion of managers with degrees appeared to generate more frequent requests for information, with this encompassing a broader base of data. The use of ICT also appeared to be influenced by the extent to which managers were measured and rewarded: those employed on more defined performance based remuneration tended to request information more regularly in the form of reports, production figures, stock levels, and other indicators that formed part of their key performance indicators. Often, this information was subsequently passed on to their managers, and/or CEO. This requirement often drove the demand for accurate, up-to-date production data, which was mediated by ERP, and resulted in a greater proliferation of PCs on the shop floor and other areas. This also often resulted in the use of additional ICT to track, monitor and communicate the information including email, mobile phones, fax and others. Figure 22 depicts the ratio of managers in the firm as an influencing factor in ICT use as discovered by this study.

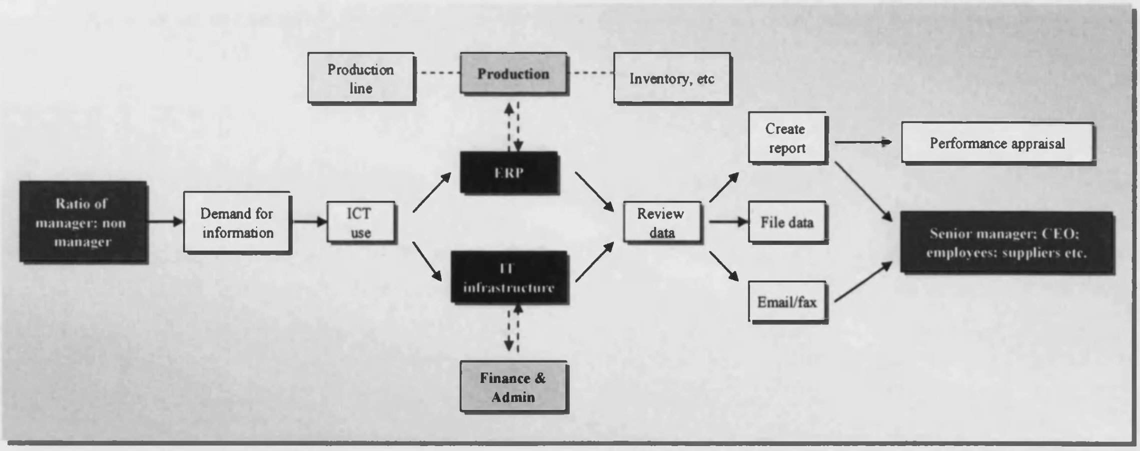

Figure 22: The managerial ratio as a determinant of ICT utilisation

The majority of non-managerial employees did not utilise ICT to the same degree as their managers, with a number of factors influencing this including the number of PCs on the shop floor; the level of ICT training; the visibility of performance data, and others.

7.4.4 Degree Qualified Managers and Non-Managers.

The research on the effects of managerial on firm performance is relatively inconclusive. This study confirms that managerial tasks are often multifaceted, and involve the negotiation of tasks between individuals with varying degrees of education and training, both formal and informal. The proportion of degree education amongst managers and non managers in the sample was obtained, in order to assess the conclusions of earlier research findings that the link between managerial training and firm performance is relatively weak (Westhead and Storey, 1996). Table 83 depicts the proportion of degree qualified managers and non managers in the sample.

Firm Type	Degrees: Managers	Degrees: Non Managers
SME 06	90%	10%
SME 08	60%	10%
SME 09	80%	10%
SME 10	15%	2%
SME 12	50%	45%
SME 13	25%	10%
SME 14	5%	10%
SME 17	50%	10%
SME Average	47%	13%
Large 02	50%	5%
Large 03	50%	10%
Large 05	33%	25%
Large 11	60%	5%
Large 15	10%	10%
Large 16	80%	10%
Large 18	30%	5%
Large 19	3%	5%
Large 20	30%	5%
Large 21	5%	5%
Large Average	35%	9%
Very Large 01	95%	60%
Very Large 04	60%	10%
Very Large 07	80%	50%
Very Large 22	70%	20%
Very Large 23	80%	70%
Very Large Average	77%	42%

Table 83: Degrees for managers and non managers by firm

The highest proportion of degree qualifications occurred in very large firms, with an average of 75 per cent and 40 per cent of managers and non-managers possessing a degree respectively. This was followed by SMEs, with an average of almost half of manages and just over 10 per cent of non managers holding degrees respectively. In contrast, around one third of managers and almost 10 per cent of non managers respectively held a degree in large firms. Chart 54 depicts these results, with the chart indicting the considerable variation within SMEs and large firms in particular. Very large firms displayed the lowest variation in degree qualified managers and employees, with the highest and lowest figures obtained for managers of 95 and 60 per cent respectively. A high average proportion of non managers also possessed degrees was mirrored to some level by the high number of non managers possessing a degree (42 per cent), but displayed a wider variance, with a low and a high of 10 and 70 per cent observed respectively. With the exception of one firm amongst this firm-type (very large 04), the remaining firms were strongly engineering focused and design-driven, with a requirement for a strong formal technical level of competence amongst managers and non managers. This often extended to the shop floor, with many new graduates commencing in this area as part of their initial firm rotation.

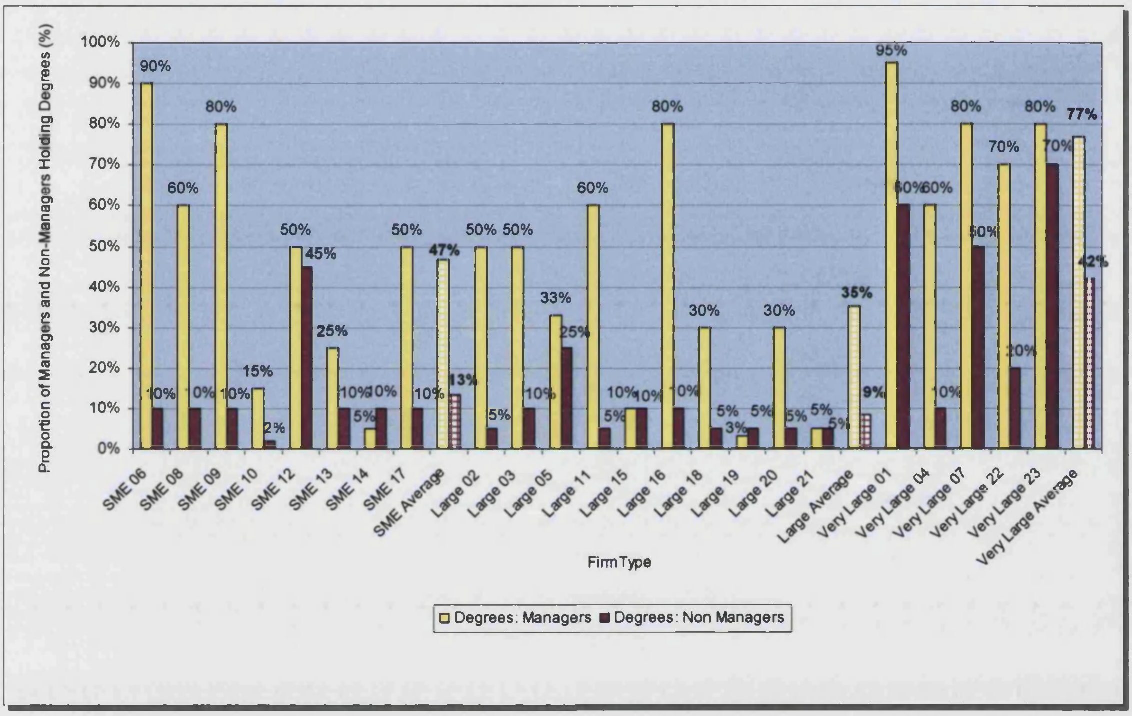

Chart 54: Degrees for managers and non managers by firm

One firm (very large 04) had grown through the acquisition of primarily financially troubled businesses, and relied to a large degree on existing managers and staff to turn these businesses around. This business did not possess a number of the attributes that were prevalent in the majority of very large firms. A number of observations were made with respect to this firm-type (very large):

- Entry into managerial positions for very large firms was generally only open to university graduates, with the majority recruited from engineering disciplines.
- Many managers in these firms obtained additional post graduate qualifications as a result of management trainee schemes, particularly engineers transitioning into management.
- Formal appraisal programmes were in place in a number of firms, which identified areas for further educational development, in addition to mandating this occurred before promotions could occur in some instances.

- Non-managerial employees were afforded the same opportunities, with high-performers often identified through the appraisal process and permitted to undertake graduate degrees, sponsored by the firms.

Managers in large firms displayed the lowest level of graduate education, with an average of one third holding such a qualification. The penetration of degrees amongst managers has been posited to be affected by a number of factors including: the firm's history; the nature of its production; the complexity of its operations; the background of its CEO; if it belonged to a publicly listed entity; the number of employees, and other factors (Bertrand and Schoar, 1999). Some of these factors appeared to be prevalent amongst the sample and are highlighted where they were discovered.

One large firm (SME 19) displayed the lowest level of managerial qualifications, with only three per cent of its managers possessing a degree qualification, and this firm forming part of a publicly listed entity. The firm contained a large proportion of managers who had been with the firm for their career and had reached managerial levels as a result of their performance. The firm was acquired in the past five years, with the new corporate office implementing more formal career planning in order to double this figure within four years. One other large firm (large 21) showed similar results, with a lower number of managers holding degrees (5 per cent). The business of both of these firms involved manufacturing parts, and the firm's owners not believing that managers' lower degree qualifications inhibited their work performance. Ten per cent of another firm's managers (large 15) possessed graduate qualifications, with this firm's history encompassing contract manufacturing and the promotion of employees from the shop floor. This has curtailed the number of graduate qualified managers with this not likely to alter significantly due to the acquisitive nature of the firm's parent, and the poor performing firms being acquired with the intention of turning them around. The remaining large firms displayed between 30-80 per cent degree qualified managers, with non-manager graduate qualifications not rising above one quarter of employees, and with the average almost reaching 10 per cent.

SMEs displayed the second highest level of degree qualified managers, with an average of almost half of all managers possessing a graduate qualification. The lowest number of managers with a degree was five per cent (SME 14), with this firm being one of the two smallest firms, and independent non-family owned. The firm undertook relatively uncomplicated tooling of metal and plastic components, with the qualified employees confined to the finance manager, the commercial manager and a small number of other production employees. The second lowest level of degree qualifications was 15 per cent, from another independent non-family owned firm (SME 10). The firm manufactured components from drawings supplied to it, with the CEO not believing that the firm required managers to be degree qualified. One other firm displayed a figure below 50 per cent

(SME 13), which was independent family-owned. The firm's CEO believed that the current mix of 1 in 4 managers being degree qualified was sufficient, placing a higher importance on 'on the job training': "I need some guys to be qualified, like my finance guy, a few engineers, and that's about it. I am even less fussed about the shop floor guys. I am amazed if we have any over there." The remaining SMEs displayed a level of 50 per cent or greater. The primogeniture firm (SME 06) had the second highest number of managers with degrees at 90 per cent, with the CEO an advocate of only hiring degree qualified managers, or, allowing high potential managers without degrees to obtain this on a part-time basis. Eighty per cent of another independent non-family owned firm's (SME 09) managers had completed degrees, with the CEO believing that a strong engineering skill base was required: "I hire guys with degrees, because that is the only way I can make sure that I have a common platform of technical skills. There is little ambiguity when you have two or three guys with an engineering degree. Otherwise, you have to try and work out what standard they are at." One firm (SME 12) had managers and non-managers with almost the same level of degree qualifications (approximately half). The firm had an affiliation with a publicly listed entity, but these levels were prevalent before this occurred due to the belief by the CEO that the business specialised area of designing and manufacturing of high tolerance components in aircraft required qualified engineers and technologists. Ten per cent of non-managers in three quarters of all SMEs possessed degrees, with this proportion due in large part to the less sophisticated nature of the business in these firms.

Firms employing a higher proportion of managers possessing a degree were not necessarily higher performing firms. The results were inconclusive, with some profitable firms receiving higher managerial practices scores and employing a higher proportion of managers without tertiary qualifications. In contrast, some poorly performing firms employed a higher proportion of managers with a degree. Correlation analysis confirmed the observations, with an insignificant correlation coefficient of 0.00689 existing between profitability and the degree of formal education (see [A] Appendix G). Regression analysis yielded a p value of 0.7515, which was greater than the 0.05 significance level, resulting in an insignificant result and the acceptance of the hypothesis that no relationship existed between the degree of formal education in the firm and its profitability. A higher correlation coefficient of 0.34932 was obtained between non-managers possessing degrees and profitability, indicating that although this was greater than for managers, it was still not significant (see [B] Appendix G). Regression analysis yielded a p value of 0.1022, which was greater than the 0.05 significance level. This resulted in an insignificant result and acceptance of the hypothesis that no relationship existed between the formal education status of non-managers and profitability. Observations and interviews revealed that the individual's qualifications were not determinants of their use of ICT. A number of factors determined the extent to which ICT was utilised, including an individual's role within the firm and the extent to which ICT was available.

7.4.5 Earnings Multiple between the CEO and a Shop Floor Worker

The multiple of CEO compensation over other employees' compensation provides an indicator of the reward culture at the firm. An average multiple of 5.5 was observed between the CEO and shop floor earnings across the sample. Table 84 displays the results for the individual firms.

Firm Type	Earnings multiple: CEO to Shopfloor
SME 06	6.0
SME 08	8.0
SME 09	10.0
SME 10	3.5
SME 12	3.5
SME 13	2.0
SME 14	3.0
SME 17	4.0
SME Average	5.0
Large 02	15.0
Large 03	5.0
Large 05	4.0
Large 11	2.0
Large 15	6.0
Large 16	4.5
Large 18	8.0
Large 19	4.0
Large 20	7.0
Large 21	5.0
Large Average	5.6
Very Large 01	8.0
Very Large 04	12.0
Very Large 07	8.0
Very Large 22	8.0
Very Large 23	2.5
Very Large Average	6.0

Table 84: Earnings multiple between CEO and shop floor

Only one very large firm's CEO (very large 23) received a lower earnings multiple (2.5) when compared to others in this firm type, with this firm a complex international publicly listed entity. The compensation structure reflected the opposing demands often made by multiple major shareholders and the historical evolution of the firm. This included curtailing the CEOs remuneration, with minimal opportunity to amend this in the future, unless a change of major shareholders occurred. Three of the remaining very large firms' CEOs received eight times their shop floor employees earning (very large 01, 07, 22). These firms all operated large complex international businesses. The final firm's CEO (very large 04) received the greatest earnings multiple, with this firm being the smallest of the group in terms of revenue and employees, and having grown through the acquisition of troubled smaller SME and some large firms. The CEO was largely rewarded on his achieving revenue growth targets: “We need to get better performance from the businesses, but that’s the next step. My remuneration is tied to a number of targets, including the firm’s top line growth at this stage.” Chart 55 depicts the CEOs earnings multiple across the three firm-types.

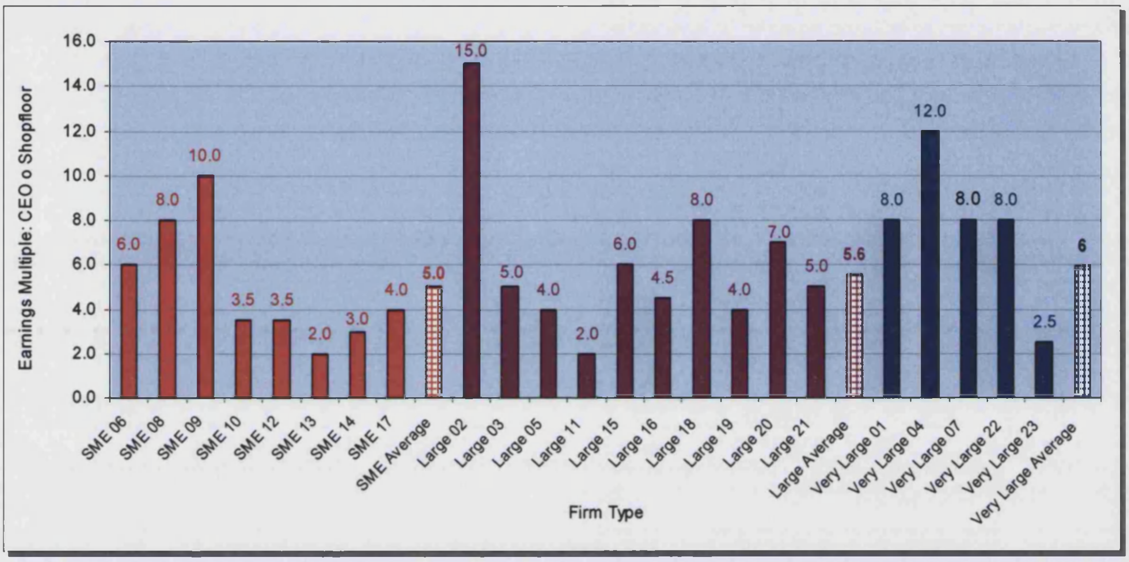

Chart 55: Earnings multiple between CEO and shop floor

The earnings multiple for CEOs of large firms varied from 2.0 to 15.0. In the case of the smallest multiple (large 11), the family owners of this firm capped the level of remuneration paid to their CEO, with agreement at the year’s outset what the figure would be if he achieved his targets. Two large firms’ CEOs were paid a multiple of 4.0, with both firms (large 05, 19) being publicly listed companies, and the Board setting the maximum that the CEO could earn. This was also the case for another firm (large 16), with the CEO cutting expenses and investment to ensure that his capital targets were not exceeded in order to maximise his bonus, which was 4.5 times shop floor average earnings: “You don’t think that I am going to spend on things like new equipment, computers and ICT when it will cost me my bonus?” Two further publicly listed companies’ CEOs (large 03, 21) received part of their remuneration based on the group’s performance. They also sought to maximise their bonus through the deferral of some expenses (in order to maximise profit), including ICT and capital. One other newly appointed CEOs (large 15) multiple was 6.0, with a similar expenditure-minimisation strategy employed. The earnings multiple for CEO of the independent primogeniture firm was 7.0, which was awarded through a family controlled board. In contrast, another firm (large 18) was a public entity, with the newly appointed CEO achieving all of his targets for restructuring the business and achieving his earnings multiple of 8.0 which he believed was too low: “It should be in the double digits for what I have gone through. That's the board's decision though and I am pushing hard to change this." The final firm's CEO (large 02) obtained the highest earnings multiple of the sample (15.0), managing an independent, non-family owned business. His remuneration was agreed to by the board, and included revenue and margin targets.

The lowest CEO earnings multiple amongst SMEs (SME 13) was 2.0, for the head of an independent family owned business, which was also the smallest firm in the sample: "We don't make enough for me to be paid any more. If we did, I would be." The next largest earnings multiple (3.0) was for the second smallest firm in the sample (SME 14), which was independent family owned. The CEOs feedback was the same as the previous CEO: "We are a small business, and I can't be paid any more." Two firms paid their CEOs the same earnings multiple (3.5). One firm was independent family owned (SME 10), with the board dictating the CEOs remuneration, but allowing for 'upside' if he exceeded his targets: "I will make more this year because I landed some good contracts. Next year, if I don't do the same, I will receive less- or more if I improve on this." The second firm (SME 12) had an affiliation with a public entity, but the firm was still operating autonomously with the board determining the CEOs remuneration: "I don't have the same constraints as the other guys in other parts of the parent company. They want me to grow the business aggressively, and if I can do that, I also share in the benefits. I am luckier than most in that respect." Another firm's CEO (SME 17) was part of a publicly listed entity with the CEOs earnings multiple (4.0) aligned to a similar figure for other comparable firms in the group. The CEO had met his targets consistently and was able to receive this figure for the past 3 years. The CEOs of the remaining three SMEs' achieved higher remuneration multiples.

One firm's CEO (SME 06) managed the second primogeniture firm in the sample with an earnings multiple of 6.0: "We have implemented sound governance, and we agree amongst the family board what my targets for the business are, and what I can be paid. It's not about 'gouging' the firm, otherwise we won't have a firm left." The second firm amongst this group (SME 08) was part of a publicly listed company, with the CEO able to maximise his earnings through an uncapped formula. This permitted him to earn an earnings multiple of 6.0 through the renewal of his contract. The final firm's CEO (SME 09) obtained the third highest earning multiple (10.0). The firm was independent non-family owned, with the CEO growing revenues year-on-year and enhancing his remuneration as a result with the board endorsing a contract that permitted him to accomplish this; "I have been driving 10-25 per cent revenue growth and am attracted to do so with a flexible incentive structure." The earnings multiple of the CEO appeared to affect ICT use in a small number of firms, where an incentive plan existed that encompassed net profit, and where the curtailment of some ICT expenditure could maximise this.

7.4.6 The Number of Organisational Levels between the CEO and the Shop Floor

The firm's organisational structure may affect its performance through its managers:

> The organization of a firm determines tasks, competencies, and incentives for the various roles in a firm such that the expected performance of the middle management optimally supports the productivity of the front-workers, in order to maximize the firm's value added (Van den Brink and Ruys, 2007; p2).

The number of organisational levels between the CEO and the shop floor is the final attribute reviewed, using the following definition.

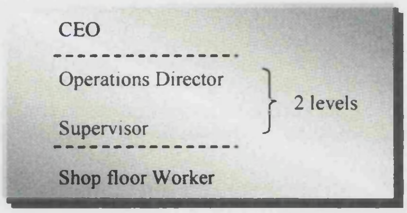

Figure 23: Calculating organisational levels

In the sample, the average number of organisational levels increased along with firm size. SMEs displayed the fewest number of levels, with an average of 2.6. This increased to 3.0 for large firms, and 3.6 for very large firms, as depicted in table 85.

Firm Type	Levels: CEO to Shopfloor
SME 06	3.0
SME 08	3.0
SME 09	3.0
SME 10	3.0
SME 12	3.0
SME 13	2.0
SME 14	2.0
SME 17	2.0
SME Average	2.6
Large 02	3.0
Large 03	2.0
Large 05	4.0
Large 11	2.0
Large 15	3.0
Large 16	4.0
Large 18	2.0
Large 19	3.0
Large 20	4.0
Large 21	3.0
Large Average	3.0
Very Large 01	2.0
Very Large 04	3.0
Very Large 07	4.0
Very Large 22	4.0
Very Large 23	5.0
Very Large Average	3.6

Table 85: Organisational levels between CEO and shop floor

Chart 56 presents the data side-by-side, highlighting the variations within and between firm-types.

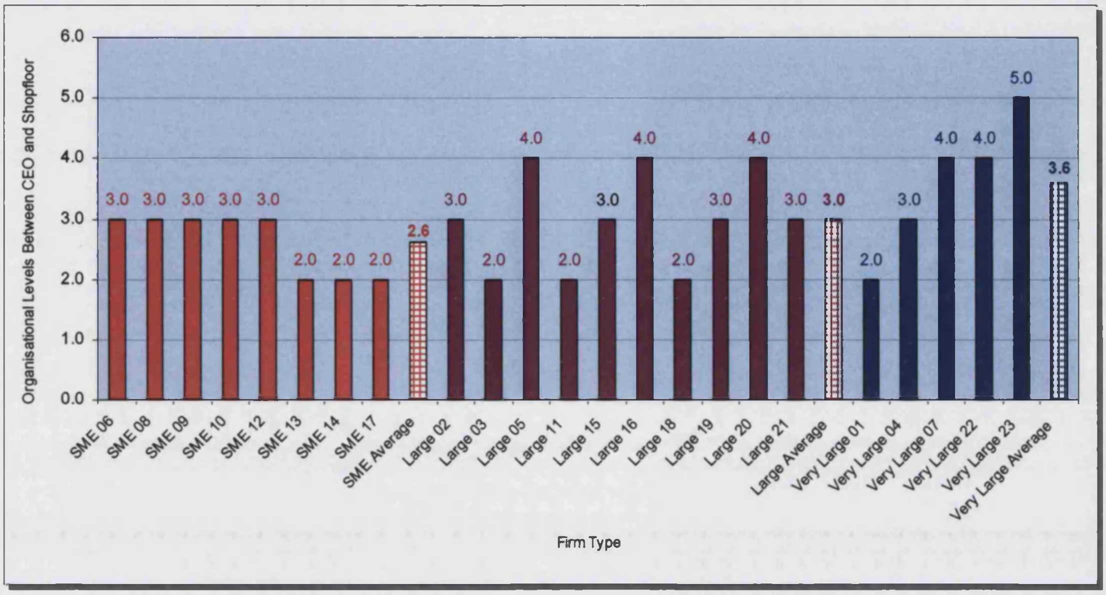

Chart 56: Organisational levels between CEO and shop floor

Very large firms displayed an average of 3.6 organisational levels between the CEO and the shop floor. The lowest number of organisational levels was 2 (very large 01). This firm's CEO was a strong advocate of a flat organisational structure and over time removed a number of levels. Another very large firm displayed 3 levels between the CEO and shop floor workers (very large 04), with the CEO aggressively focused on growing the business via acquisitions: "I care less about the number of people below me and more about the top line growing." Two other firms displayed 4 organisational levels between the CEO and the shop floor. One of these firms (very large 07) was in the process of removing a level by amalgamating two supervisory roles immediately above shop floor workers, with the operations director managing fewer individuals as a result. Another firm (very large 22) displayed four organisational levels between the CEO and the shop floor. In addition to the final very large firm (very large 23), which displayed five organisational levels, this firm was part of a large international group with a significant corporate centre and complicated activities at the apex of the aerospace pyramid. Both firms' senior managers believed that the organisational levels in their firms were required in order to allow them to adequately manage their operations.

Large firms had an average of 3 organisational levels between the CEO and the shop floor. Three firms displayed 2 levels, with two of these publicly listed (large 03, 18). Two firms were part of publicly listed entities with one of these (large 18) utilising a complicated manufacturing process, whilst the second (large 03) was larger and part of a considerable international group. It manufactured a broad product range with considerable machining and tooling required. Both firms reduced their organisational levels to 2 over the past three years. The third firm (large 11) was independent family owned and also displayed 2 organisational levels separating the CEO from the factory floor. The firm's CEO believed that these levels were adequate in order for the firm to manage its production effectively, and did not plan to reduce these in the future: "I am comfortable with the number of people in the hierarchy. We are pretty lean so reducing the reporting lines further would only make things counter-productive." Four firms displayed 3 organisational levels between the CEO and the shop floor, with three of these publicly listed (large 15, 19, 21) and one independent non family owned (large 02). The independent firm's CEO believed that the number of levels in his firm was required to manage the diverse products and services offered. Of the three publicly listed firms, one firm (large 15) was in the process of removing a level due to restructuring. Another firm (large 19) was part of a large international entity, with the CEO believing that his firm's organisational levels granted him flexibility. The remaining publicly listed firm displayed 3.0 organisational levels (large 21) and was also part of a large international group. The number of organisational levels was defined by its CEO and senior management team.

The three final large firms all reflected 4.0 organisational levels between the CEO and the shop floor. Two firms were publicly listed (large 05, 16) with another being the second independent primogeniture firm (large 20). The organisational levels in this firm had changed over the past 10 years, with the addition of one level. The CEO had assisted with this change and believed that the existence of the current organisational levels supported the business: "We operate a very complex business with no tolerance for error. The managers we have in place are there to ensure this occurs, and there is no way we could do with any fewer." A further two publicly listed firms (large 05) manufactured a complex number of products for use in a range of aircraft, with the operations director intending to reduce organisational levels by one: "We will most likely make a change at the supervisor level and merge current roles. We are still looking at it, but the opportunity exists to streamline some shop floor supervision." The remaining firm's (large 16) CEO was progressing with the restructuring of a newly acquired business, including the reduction of both staff and organisational levels: "The place is a mess. It's no wonder it was on the edge of being shut down. We have too many people and not enough business."

SMEs displayed the smallest average number of organisational levels (2.6), divided between two levels: one third of SMEs displayed 2 organisational levels separating the CEO from the shop floor, and two thirds displayed 3 levels organisational levels. Three firms displayed a difference of two organisational levels between the CEO and the shop floor (SME 13, 14, 17) with two of these independent. One firm was family owned (SME 13), with the second non-family owned (SME 14). The family owned firm was the smallest one in the sample, with the CEO defining the current low number of levels: "I suppose I could have more than the one level between me and the shop floor, but I would also get more grief by being so close to the production environment." The non-family owned firm was the second smallest firm in the sample, with the CEO active on business development and leaving his commercial and operations manager to run the business: "I leave the daily stuff to them, and they are comfortable with the number of guys reporting to them." The third firm amongst this group was publicly owned (SME 17), with the number of levels believed to be adequate by the management team, with no plans to alter this.

Five remaining firms displayed 3 organisational levels between the CEO and the shop floor (SME 06, 08, 09, 10, 12). One of these was an independent primogeniture firm (SME 06) with the CEO dictating the number of levels he required within the firm: "The business needs to have the current levels, because we have multiple product streams and I need them managed properly." Two further firms were independent, with one (SME 09) non-family owned. The firm operated complex machinery and equipment for the design of specialised assemblies, which the operations director believed required a 'taller' organisational structure: "I have promoted guys through the ranks that know many areas of the business." The other independent firm was also non family-owned (SME 10) with the management team intending to reduce the number of organisational levels by one, due to cost pressure. The two final firms were owned by publicly listed entities, with one (SME 08) still operating as an independent firm, with the CEO supporting the existing number of organisational levels: "We think the current reporting structure works well, with three levels between me and the shop floor." The remaining firm (SME 12) also belonged to a publicly listed entity with the senior management team believing that the existing organisational levels were required for the effective management of the business.

The number of levels between the CEO and the shop floor appears to have a marginal effect on ICT use, particularly in the case of smaller firms. Where organisational levels are fewer, some CEOs engage in a greater degree of direct communication with senior managers and other employees. Many larger firms with fewer levels followed more formal communication processes, with the CEO often emailing subordinates despite close physical proximity in the office. Managerial practices directly affected the establishment and maintenance of the number of levels in the organisation, which in turn affected the extent to which ICT was utilised in some instances. Where a greater number of levels existed, and reflected more complex and larger firms, ICT was often utilised to a greater degree in communication between managers, and with some other areas within the firm.

Section III: Synthesis

8. Discussion of Hypotheses

The firm's milieu has long been touted as conferring particular advantages if it results in 'clustering' with similar or complementary firms (Porter, 1990). The UK aerospace sector exhibits such clustering and is a major contributor to the economy and employment and the second largest in the world, behind the U.S.[70] The sector is also typified by significant polarisation with a small number of large firms commissioning the majority of all downstream production activities, which are subsequently undertaken by many small firms. Since the late 1990's, competition has been progressively increasing from low-cost economies vying for UK aerospace work, with a heterogeneous response observed in this study from UK aerospace managers. Their practices are pivotal in defining their firm's response to competition and the efficient use of both resources and assets, including ICT. The latter is not divorced from the practices of managers, but to date, this link has not been adequately explored in the literature.

The mediating influence of ICT on firm performance was found to vary within firm-type and between firm types. This study has discovered that some firm managers place lower importance on its use and a greater emphasis on their own managerial practices as an influencer of firm performance. The manifestation of this was evident in their actions, policies, and interactions with employees. The ability to measure managerial practices has to date been elusive and poses a stumbling block to a firm-level assessment of this variable on a firm's operations, ICT investment and ultimately, performance. This study brings these elements together for the first time to 'peel the organisational layers' and place this discussion into a *location* context, reinforcing its topical nature and also making it relevant for policy makers. The final stage of the investigation explores these principal themes through a number of hypotheses grouped within seven principal areas:

- H1: Macro/aggregate level results
- H2: Managerial practices scores
- H3: Firm types
- H4: ICT utilisation
- H5: Labour/Resources
- H6: Business practices
- H7: Location (physical, virtual)

[70] House of Commons papers 151-I. The UK aerospace industry: Fifteenth report of session 2004-05: [Vol. 1].

The first hypothesis represents an overarching category that explores the integrated (aggregate) nature of the study's themes. The following sections investigate each area through its hypotheses.

8.1 H1: Macro/Aggregate Level Results

This study investigates multiple variables that can potentially affect a firm's performance. It is acknowledged that causality cannot be attributed within the dynamic milieu being investigated due to the plethora of variables impinging upon it that can't be controlled or isolated, but that under such circumstances it is acceptable to identify correlations and trends. At the overarching level, the research is framed by the interplay between four key variables, as depicted in figure 24: *managerial practices; ICT investment, ROCE* and *productivity.* The numbers in brackets refer to the associated hypotheses which are addressed in this section.

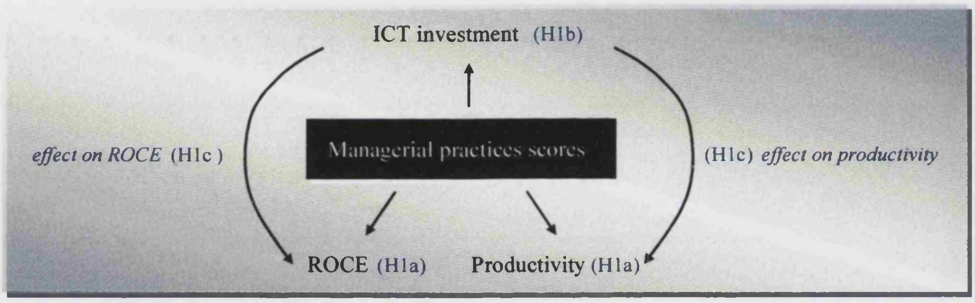

Figure 24: The study's overarching variables and their interplay

Hypotheses:

H1a: Firms with higher managerial practices scores have a higher level of productivity and return on capital employed (ROCE).
H1b: Poor managerial practices do not result in lower ICT investment.
H1c: ICT investment does not affect the level of productivity and ROCE.

Each of these hypotheses is explored in greater detail below.

H1a: Firms with higher managerial practices scores have a higher level of productivity and return on capital employed (ROCE).

This hypothesis assesses the effect of managerial practices on productivity and ROCE at the aggregate level. At this level of investigation, no individual threads are reviewed due to the consolidated nature of the vantage point.

Productivity

Firms with higher managerial practices scores displayed higher levels of productivity, as measured by sales per employee. Chart 42 in section 7.2.2.1 depicts the firms' scores and their corresponding productivity, reproduced below in a reduced form as chart 57, which depicts the relative movement between the two results.

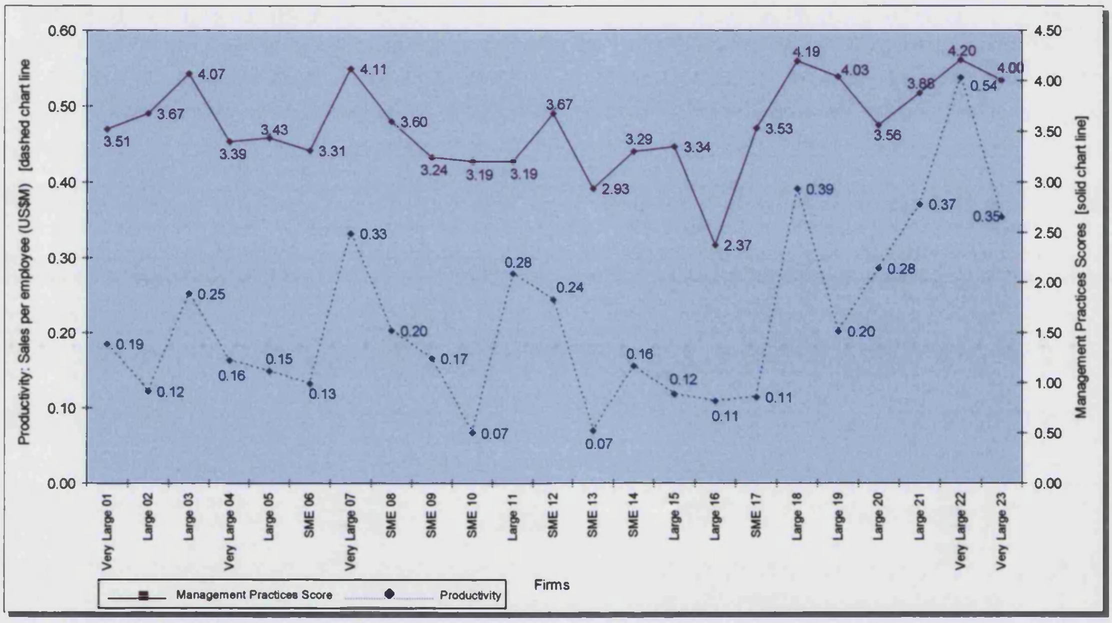

Chart 57: Managerial practice scores vs. productivity (chart 42 reproduced)

The graphed data appear to indicate that higher managerial practice scores are associated with more productive firms. These results are congruent with the conclusions from the recent CEP-McKinsey studies of a combined 5,000 firms internationally (Bloom et al, 2005; 2007). Quantitative analysis was undertaken to establish if any statistically significant relationship existed between the observed mirrored movements between these variables. As depicted in section 7.2.2.2, correlation analysis yielded a coefficient of 0.73 between managerial practices scores and productivity, indicating the existence of a significant linear relationship between the two. Regression analysis confirmed this, with a significant result supporting the rejection of the null hypothesis that higher managerial practices scores were not associated with higher productivity. The previous CEP-McKinsey research obtained a correlation of 0.98 between these variables, indicating a very high degree of related movement between the two.[71] This study extends the CEP-McKinsey research into a single sector, with the results reinforcing the validity of using managerial practices scores as a proxy for firm performance across firm-types. In-situ investigations and multiple remote interviews with additional individuals provide true firm-level analysis and additional information on *how* and *why* results occurred.

[71] McKinsey and CEP *Management Matters* database, 2008.

This study's methodology of 'peeling the organisational layers' through firm level analysis reveals many of the underlying issues and causes that underpin the firm's performance and extends the previous work in assessing managerial practices, firm performance and the use of ICT. The data highlight that a minority of firms obtained higher managerial practices scores and lower productivity. By 'looking beneath the surface', the opportunity exists to explore the underlying causes for such results, which did not follow the general pattern of observations. Two notable cases reflected these polar results. One large firm (large 02) obtained a managerial practices score of 3.67 that was above the sample average, and one of the lower productivity scores of the sample (US$0.12m). Despite the firm's adoption of lean tenets and a focus on talent management in the production environment, the firm placed a low priority on ICT skills and training in addition to the function not being actively supported by senior managers. The IT manager did not believe that he possessed adequate financial resources to maximise the use of technology, replacing faulty hardware and struggling to ingrain the use of ICT within the culture and working practices of the organisation. The combination of these factors highlighted the reduced role and emphasis on ICT within the firm. A second large firm (large 19) displayed a high managerial practices score (4.03) but lower productivity (US$0.20m). The firm performed well in the production environment and placed high priority on ICT skills. Despite an IT department of seven staff and annual ICT expenditure in the top 10 per cent of firms sampled, two factors diminished the day-to-day effectiveness of the function: (i) an overtly confrontational relationship between the CEO and the IT manager, with the former promoting a negative view of the function throughout the organisation, and this view mirrored by other senior managers; and, (ii) a lengthy annual ICT budget process that required dual approval by head office and the CEO, resulting in an extended process that elicited further confrontation through conflicting efforts with respect to the ICT and technology budget (which included capital expenditure). The first of these two firms displayed a negative return on capital (minus 7.40 per cent), whilst the second obtained a return of 12.56 per cent, which was low compared to the majority of firms with a comparable managerial practices score, and even firms that obtained lower managerial practices scores. The statistical analysis undertaken in section 7.2.2.2 yielded a significant result, permitting acceptance of the hypothesis that firms with higher managerial practices scores have a higher level of productivity.

ROCE

The data indicates that a relationship exists between managerial practices scores and return on capital employed (ROCE). Chart 58 below is chart 47 from section 7.2.3.1, depicting the firms' scores and their corresponding ROCE, reproduced in a reduced form.

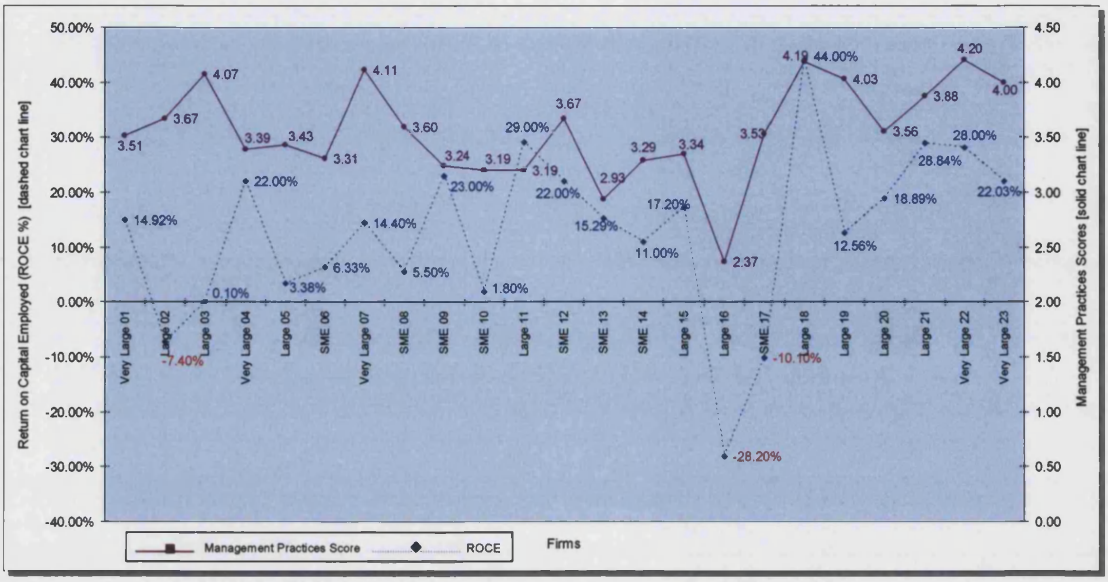

Chart 58: Managerial practices scores vs. ROCE (chart 47 reproduced)

Correlation undertaken on this data in section 7.2.3.2 yielded a coefficient of 0.4973 and a statistically significant egression result that permitted rejection of the null hypothesis that firms with higher managerial practices scores were not associated with higher ROCE. The previous CEP-McKinsey research of 5,000 firms yielded a higher correlation coefficient of 0.85,[72] with both results statistically significant and allowing acceptance of the hypothesis that firms with higher managerial practices scores have a higher ROCE.

Firm-level qualitative investigation has highlighted the complex and interwoven nature of variables that can potentially influence the firm's operations and include the type of capital employed; the composition, education, skills and ongoing training of the workforce; the nature of the relationship between the firm's leader and the senior management team, and in turn, between the latter and the workforce; the nature of the ICT function, including investment, training, size; managerial practices, and others. ROCE can be affected by any of these endogenous variables in addition to exogenous ones. A statistically significant relationship between ROCE and managerial practices is supported by in situ observations of firm employees carrying out their tasks. This included their use of technology and ICT, with the effect of managerial practices evident through how employees were expected to utilise the firm's assets in going about their day-to-day tasks. A small number of firms obtained high managerial practices scores and a low ROCE. The methodology employed provides the opportunity to explore the firm-level influencing factors for these results and contribute to the quantitatively focused approach of much of the current research. One of the overriding factors that appeared to be contributing to a lower ROCE amongst many firms was the extremely competitive nature of the aerospace sector. This included primes and large firms 'forcing down' prices directly

[72] McKinsey and CEP *Management Matters* Database, 2008.

with suppliers, and tenders that increasingly included overseas bidders as well. The higher elasticity of demand inherent in the manufacture of many components often resulted in narrow margins through the threat of 'switching' by major customers. Since the late 1990's, this has been exacerbated by increased direct competition from offshore countries such as India and China, with the UK no longer representing the physical boundary defining competitive participation. In addition to competitive pressure, a number of factors were observed amongst some firms that possessed a low ROCE and higher managerial practices scores:

- These firms tended to be poorly performing and had recently been acquired with new management teams installed and improved practices introduced. Insufficient time had elapsed to assess whether these practices could have made a contribution to ROCE.
- New firm owners had restructured the business, with this affecting profit before tax and interest (used to calculate ROCE) through write-downs, redundancy and other restructuring costs, in order to improve the near and long term return on capital. No example occurred of a firm undertaking this whilst under an existing ownership structure.
- Despite higher average managerial practices scores, talent management remained an area that displayed room for improvement, including staff retention, and poor performing individuals being moved out of their roles in a timelier manner.

Interviews and discussions with non-managerial production employees revealed that the overwhelming majority believed that the way they were managed had a direct effect on their firm's performance. Less than half believed that if given the chance, they could improve the way they currently performed their duties. The key reasons cited by those who did not believe they would improve performance included; current practices being satisfactory; little opportunity existing to alter the current work routine; no personal motivation existing to do so due to a lack of incentives including personal, financial or career oriented ones. Employees from all areas of the business (management, shop floor, support) recognised that collectively, their contribution could affect the way their firm used its assets and was able to generate revenues and profits or losses as a result. This was strongest amongst those engaged in a production function but reflected the general position that workers were cognisant of the effect that managerial practices had on both their individual and collective efforts. This is at odds with the notion that shop floor workers were 'naïve' and bereft of an understanding of the consequences of their efforts (and those of their managers) on firm performance supporting research positing that the inclusion of workers in the communication process can support sustainable business improvement (Henderson and McAdam, 2003).

H1b: Poor managerial practices do not result in lower ICT investment.

The sample firms displayed varying degrees of ICT investment, as measured by spending on ICT as a proportion of revenue. This is believed to be the most relevant means of comparing ICT spending as it is agnostic of the absolute value of the expenditure (i.e. it is not comparing the absolute amount spent by one firm against another). In order to protect the key identifying features of the participating companies, including revenue, the individual figure for ICT as a proportion of revenue has been suppressed. The data are presented for comparative purpose, with this approach not diminishing the value of the anonymous information. Chart 59 presents the firms' total annual ICT expenditure (including staffing costs), juxtaposed against managerial practices scores. The chart displays considerable variation in the expenditure of ICT as a proportion of revenue across the sample (including the annual ERP component), irrespective of their managerial practices scores or firm-type.

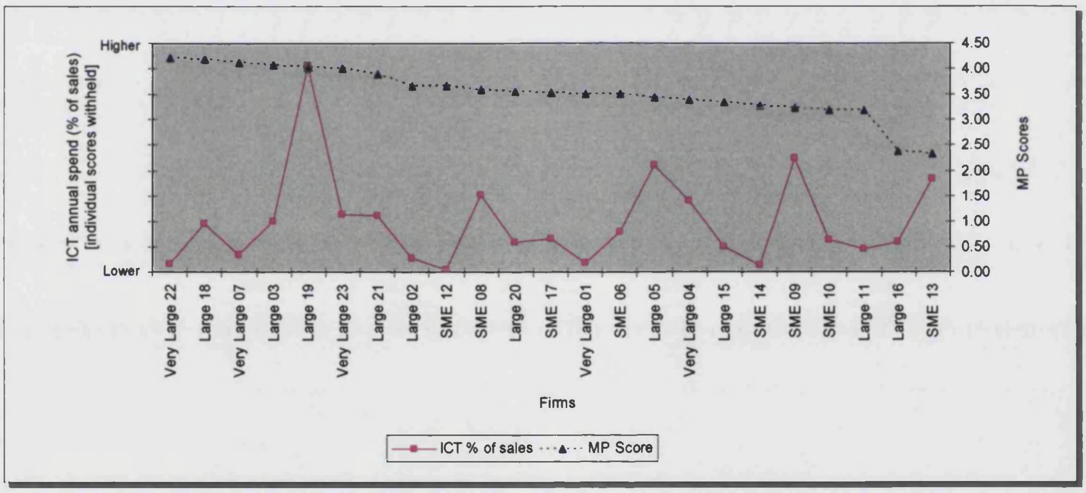

Chart 59: Managerial practices scores vs. annual ICT expenditure

Firms located in the left of the chart displayed the highest managerial practices scores, but with the exception of a spike, this does not correspond to higher ICT investment. Many of these firms displayed some of the lowest levels of ICT investment. The majority of very large firms were located within the top 25 per cent of firms with respect to managerial practices scores with two of these firms concurrently displaying lower ICT investment levels. The highest scoring SME obtained the eighth highest managerial practices score and the lowest ratio of ICT investment. SMEs and large firms are randomly dispersed amongst the remaining declining managerial practices scores, with a varied level of ICT investment observed against both the corresponding managerial practices score and the firm-type. A number of firms placed in the lowest 25 per cent of the sample with respect to managerial practices scores, displayed some of the highest ICT investment levels, as reflected by the lowest scoring firm in the sample. The results are inconclusive, with many lower scoring and higher scoring firms both investing similar low amounts in ICT, but equally. Correlation analysis was undertaken between managerial practices scores and ICT expenditure, as depicted in table 86 below.

	Annual ICT Spend (incl. ERP)	Management Practices Scores
Annual ICT Spend (incl. ERP)	1	
Management Practices Scores	0.0012750228	1

Table 86: Correlation results between ICT spending and managerial practices scores

The almost negligible correlation indicates an insignificant relationship between these variables. Firm-level investigation and statistical analysis yielded a p value of 0.99, which exceeds the significance level of 0.05 (see Appendix H), and does not support the rejection of the hypothesis, indicating that poorer managerial practices do not in themselves result in a lower level of ICT expenditure.

The results are believed to warrant further investigation with a larger sample. A number of the firms were engaged in replacing management teams in underperforming plants, or had recently been acquired and were in the process of being turned around by new owners and the installation of new managers. The management practices scores obtained reflect the poorer practices existing at the time that interviews took place, and lower ICT investments either due to previous management decisions, or as a result of new times prioritising plant upgrades ahead of ICT investment. As such, the existence of better managerial practices was not a pre-requisite for higher ICT expenditure. This was the case both where ICT was diffused throughout the manufacturing environment, and where it was concentrated in other areas such as CAD, engineering, and others. Managers in firms obtaining high managerial scores and investing low amounts on ICT also either believed that that the current level of ICT was adequate, or that there were impediments to this increasing further, which were out of their control. This included organisational constraints such as HQ limiting ICT spending; the willingness of the CEO to approve higher ICT expenditure, and others. A number of these themes have been explored within this study and have been presented through a number of hypotheses. The expansion of the study to a larger sample would diminish some of these issues and provide an opportunity to review the results in a wider context.

H1c: ICT investment does not affect the level of productivity and ROCE

This hypothesis is segmented into its two constituent strands which explore the interplay between ICT investment and; (i) productivity, and; (ii) ROCE. ICT is a potential organisational influence on firm performance, with expenditure and use affected by a number of variables, as depicted in figure 25 below which has been defined as an output from this study.

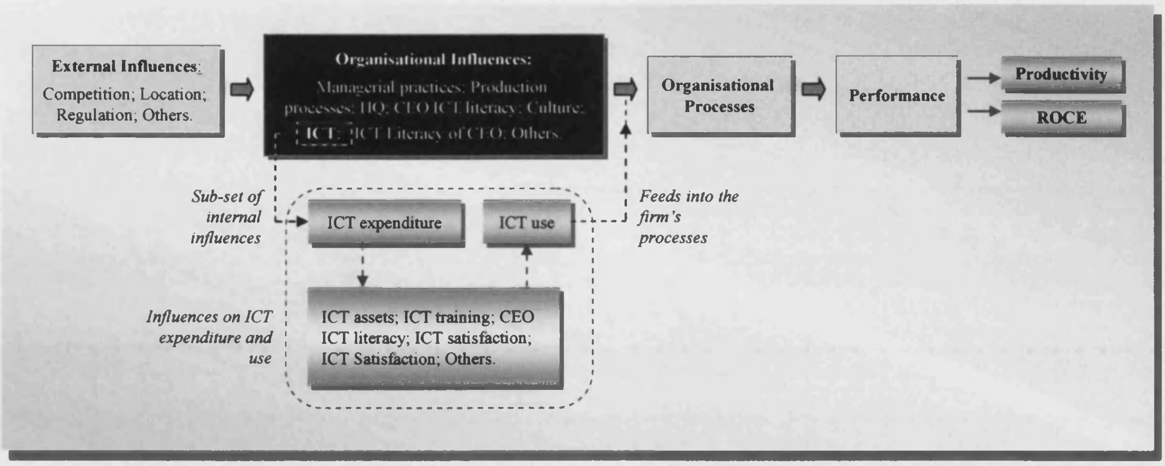

Figure 25: The role of ICT as a potential organisational influence on firm performance

ICT use is a part of a firm's organisational processes which impinges, and is impinged upon, other variables at firm-level that act as 'organisational complements' and are integral to making ICT work effectively.[73] Two measures of this firm's efficiency are productivity and ROCE, with both explored in this study, mirroring the CEP-McKinsey methodology. These are defined below.

(i) Labour productivity

In order to assess the relationship between ICT and productivity, a standard production function was utilised ('Cobb Douglas function') contrasting the previous regression equations. This followed Bloom et al's (2005) methodology when assessing these variables, and minimises division bias that would result from the use of sales over labour ("labour productivity") and ICT expenditure over sales. A measurement error in sales would subsequently generate a negative correlation mechanically and an inaccurate result. The production function involved taking logarithms ('ln') in order to generate a relationship between ln(sales/worker) and ln(ICT/worker) Formally, a Cobb-Douglas production function in employment and ICT capital is defined as,

$$\ln Y = a + \alpha \ln L + \beta \ln C$$

where Y = output (proxied by sales), L = workers, C = ICT capital and a is a constant term (Hicks neutral efficiency).

[73] Bresnahan and Saxenian, 2001.

Using *Stata*, a widely utilised statistical package, the study generated statistically significant results for ICT and productivity, as depicted in the table 87 and in Appendix I (A):

```
Number of obs =      23
                                                      F(  2,    20) =   65.84
                                                      Prob > F      =  0.0000
                                                      R-squared     =  0.8624
                                                      Root MSE      =  .80029

------------------------------------------------------------------------------
             |               Robust
      lsales |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lemp |   .8828396   .1503689     5.87   0.000     .5691755    1.196504
        lict |   .3663525   .0967975     3.78   0.001     .1644364    .5682687
       _cons |   8.234051   1.006473     8.18   0.000     6.134585    10.33352
------------------------------------------------------------------------------
```

Table 87: Cobb Douglas results- ICT and productivity

The two coefficients of labour ('lemp') and ICT ('lict) show very statistically significant results at the 1 per cent level, with p values less than this. This permits the rejection of the null hypothesis that a equals zero and that (1- a) equals zero, and that no relationship exists between the variables. The results support Bloom et al's (2005) conclusions that ICT enhances firm performance, with the coefficients of labour and capital of 0.88 and 0.366 respectively also displaying a general conformity to factor inputs of production of 0.7 and 0.3 respectively, further reinforcing the results. In order to conclude a review of this relationship, capital was added to the above production function. Although still yielding a positive significant result for ICT, a subsequent reduction occurred in the size of the coefficient and its significance level.[74] This is believed to be a factor of the sample size, which could be expanded in follow-on studies.

Discussions revealed that employees did not necessarily perceive ICT as contributing to productivity due to the perception that ICT 'often works in the background' and that the production process and productivity were separate from ICT. In some firms, where ICT was strongly integrated into the production process, such as to monitor performance metrics, schedules and inventory levels, there was greater perception of this as a value-adding system, but this was not a widely held view even in such firms. The use of ICT by administrative staff was perceived by the majority of managers as being 'essential', but not necessarily 'adding value'. A minority of managers believed that a greater alignment between ICT and production/ERP tools would result in more efficient ordering and payment processes. These elements were prevalent amongst firms obtaining both high and low managerial practices scores.

[74] ICT was now significant at the 10.2 per cent level, compared to the 1 per cent level when only labour and ICT were included, as depicted in table 87. The coefficient was also smaller at 0.2100495. This mirrors the trend in the results obtained in section 7.2.5 when the regression of multiple variables in that production function resulted in a reduction of the significance for ICT.

(ii) ROCE

The firms displayed varying ROCE across the corresponding range of annual ICT investment, as displayed in chart 60 below.

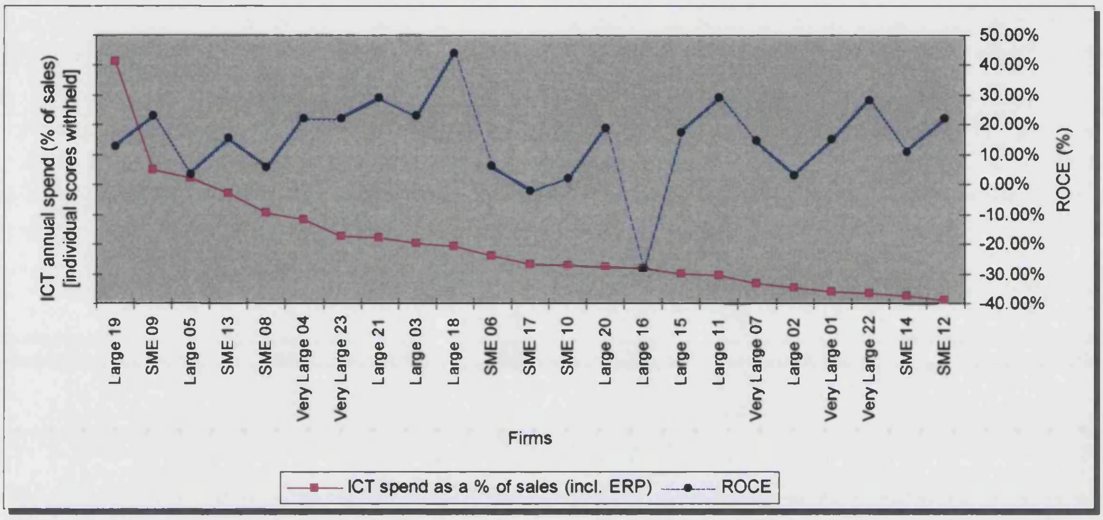

Chart 60: Annual ICT expenditure vs., ROCE

The data indicate that higher annual ICT expenditure does not correspond to a higher ROCE. Correlation analysis confirms this, with the correlation coefficient too low to be of significance. This is confirmed by an insignificant relationship between these variables, reflected by a p value of 0.8391, which exceeds 0.05 level of significance (see [B] Appendix I). This does not permit the rejection of the ROCE component of the hypothesis that annual ICT spend by itself does not affect ROCE. Table 88 depicts the correlation results.

	Annual ICT Spend (incl. ERP)	ROCE
Annual ICT Spend (incl. ERP)	1	
ROCE	0.044807285	1

Table 88: Correlation results between ICT spending and ROCE

The firm-level investigation of capital use and ICT mirrors the approach undertaken for the assessment of productivity, with the same front-end elements being reviewed, including the influences on ICT expenditure, its use, and the degree to which ICT was ingrained in the production process. These issues were highlighted in the previous section assessing productivity and are not replicated here. Based on the random ROCE results obtained against the various levels of ICT investment, the statistically insignificant correlation coefficient, and the observations made, this hypothesis is not accepted.

8.2 H2: Managerial Practices Scores

Two hypotheses were defined with managerial practices scores being the primary focus of investigation:

H2a: Firms with higher managerial practices scores have a higher utilisation of ICT in communicating with suppliers, customers, and the sales force.
H2b: There is no difference in the perception of ICT between firms with better and poorer managerial practices scores.

These encompass the deployment and utilisation of the communicative aspects of ICT (H2a) in addition to how ICT is perceived by better and poorer performing firms (H2b).

H2a: Firms with higher managerial practices scores have a higher utilisation of ICT in communicating with suppliers, customers, and the sales force.

This hypothesis was segmented into its two components: (i) supplier communication and (ii) sales force communication.

Communication with Suppliers and Customers

Table 89 presents the results of the average response of managers on the use of ICT between the firm and its suppliers. The responses were ranked according to the firms' managerial practice scores (right hand side). In addition, the use of meetings has been presented on the left hand side of table for comparative purposes. The qualitative firm-level assessment of communicative ICT used between firms and their sales force and staff did not result in evidence of disproportionately high or low utilisation according to managerial practices score: firms with high scores utilised ICT to the same degree as many low scoring firms. Where particular modes of ICT were not used as intensively as others, such as video conferencing or CAD sharing, the trend was equal across firms.

The most intensively used ICT mode was for email, with all but two firms displaying high use. This was followed by telephony, with all but four firms depicting high use. In the case of email, the two firms displaying a medium degree of usage were in the lowest quarter of the sample. In both cases, the results are believed to be inconclusive. The integration of software applications for communicative purposes displayed some more intense utilisation amongst firms with higher managerial practices scores, but this was confined to a small number of firms. Four of these were very large firms and amongst the largest in the sample in terms of revenues and employees. Insufficient evidence exists as to whether this result was due to the complexity, size and dispersed nature of these firms' operations, or if it was due to managerial practices scores.

Firm	[for Comparison] Meetings High/Med/Low	Telephone High/Med/ Low	Fax High/Med/ Low	E-mail High/Med/ Low	Video conferencing High/Med/ Low	Integration between software applications High/Med/Low	Cad Sharing High/Med/ Low	MP Score
Very Large 22	Medium	Medium	Low	High	Low	Medium	Low	4.20
Large 18	High	High	Medium	High	-	Low	-	4.19
Very Large 07	High	High	Medium	High		Medium	-	4.11
Large 03	High	Medium	Medium	High	Low	Low	-	4.07
Large 19	High	High	Medium	High	Low	Medium	-	4.03
Very Large 23	High	High	Medium	High	Low	Medium	Low	4.00
Large 21	Low	High	Low	High	-	Low	-	3.88
Large 02	High	High	High	High	-	-	-	3.67
SME 12	Low	High	Medium	High	-	-	-	3.67
SME 08	High	High	Medium	High	-	Low	-	3.60
Large 20	High	High	Low	High	-	-	-	3.56
SME 17	High	High	Low	High	-	-	-	3.53
Very Large 01	High	High	Low	High	-	Medium	-	3.51
SME 06	High	High	Medium	High	-	Low	-	3.51
Large 05	Low	Medium	Medium	High	-	Low	-	3.43
Very Large 04	High	High	Medium	High	-	Low	-	3.39
Large 15	Medium	High	Medium	High	Low	Low	-	3.34
SME 14	Low	Medium	Medium	Medium	-	-	-	3.29
SME 09	High	High	Medium	High	-	Low	-	3.24
SME 10	High	High	Medium	High	Low	Low	-	3.19
Large 11	High	High	Medium	High	-	High	-	3.19
Large 16	High	High	Low	High	-	-	Low	2.37
SME 13	Medium	High	Medium	Medium	-	Low	Low	2.33

Table 89: Utilisation of ICT by the firm in communication with suppliers and customers

The use of meetings was included, in order to provide a reference point with a 'traditional' communication mode in the firm. The majority of firms utilised meetings to a high degree, despite the prevalence of substitutive ICT. On the basis of firm-level investigations, the hypothesis that higher managerial practices scores are associated with higher utilisation of ICT in communicating with suppliers, customers and the sales force is not accepted.

Communication with the Sales Force and Employees.

The use of ICT to communicate with the sales force and employees did not appear to be correlated with higher managerial practices scores, mirroring the results for communication with suppliers and customers, as depicted in table 90. The intensity of ICT use did not display significant variations between managerial practices scores within each ICT category. Any variations observed were minor and not sufficient to permit conclusions to be drawn. The only observed grouping of intensity occurred for meetings, provided as a benchmark for comparative purpose, with a higher proportion of firms displaying marginally lower intensity for higher managerial scores. These firms were also amongst the largest in the sample, with managers choosing to communicate with the sales teams and employees by ICT in many instances, despite where meetings could have been utilised. This also reflected these firms employing a higher number of sales people and keeping them 'on the road' for longer.

Firm	[for Comparison] Meetings High/Med/Low	Telephone High/Med/ Low	E-mail High/Med/ Low	Fax High/Med/Lo w	Video conferencing High/Med/ Low	Integration between software applications High/Med/Low	File Transfer High/Med/ Low	CAD Sharing High/Med/ Low	MP Score
Very Large 22	Medium	High	High	Low	Low	Medium	Medium	Low	4.20
Large 18	High	High	High	-	-	Medium	Low	-	4.19
Very Large 07	Medium	High	High	-	-	Medium	Medium	-	4.11
Large 03	High	High	High	-	-	Low	Low	-	4.07
Large 19	High	High	High	-	-	Medium	Medium	-	4.03
Very Large 23	Medium	High	High	Medium	Low	Medium	Medium	Low	4.00
Large 21	High	High	High	-	-	Medium	Low	-	3.88
Large 02	Medium	High	High	-	-	Low	Low	-	3.67
SME 12	High	High	High	-	-	-	Low	-	3.67
SME 08	High	High	Medium	-	-	Low	Low	-	3.60
Large 20	High	Medium	High	-	-	Medium	Medium	-	3.56
SME 17	High	High	High	-	-	Low	Low	-	3.53
Very Large 01	High	High	High	-	-	Low	Low	-	3.51
SME 06	High	High	High	-	-	Medium	Medium	-	3.51
Large 05	High	High	High	-	-	Low	Low	-	3.43
Very Large 04	High	High	High	-	-	Low	Low	-	3.39
Large 15	High	High	High	-	-	Medium	Low	-	3.34
SME 14	High	High	Medium	-	-	-	-	-	3.29
SME 09	High	High	High	-	-	Medium	Medium	-	3.24
SME 10	High	High	High	-	-	Medium	Low	-	3.19
Large 11	High	High	High	-	-	Medium	Medium	-	3.19
Large 16	High	High	High	-	-	Medium	Low	Low	2.37
SME 13	High	High	Medium	-	-	Low	Low	Low	2.33

Table 90: Utilisation of ICT by the firm in communication with the sales force and employees

The use of ICT to communicate with sales and other employees appeared to be agnostic of how well the firm was run, leading to the rejection of this hypothesis.

H2b: There is no difference in the perception of ICT between firms with better and poorer managerial practices scores.

Firm-level investigations revealed that with the exception of one firm, the highest scoring 15 firms for managerial practices all had positive views of ICT. Chart 61 displays the results, with ICT views translated to numbers; a positive view has been assigned a value of "1"; a negative view assigned "-1", and a neutral view assigned "0."

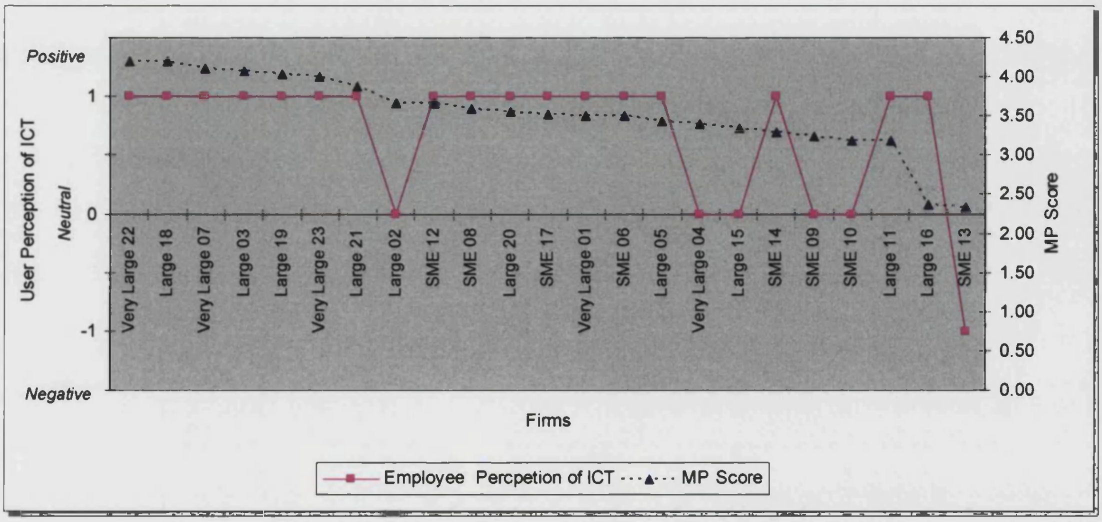

Chart 61: Managerial practices scores vs. user perception of ICT

The results provide evidence that firms with higher managerial practices scores have positive internal views of ICT, although an increase in the sample size is recommended in order to assess this further. For scores below 3.40 (which represents over one third of the sample), almost two thirds of firms held a less than positive view of ICT.

Firm-level analysis revealed that a confrontational relationship existed between the CEO and the IT director for four firms in the sample, but this translated to only two cases of a lower perception of ICT, including one negative view. Contributing factors to lower perceptions of ICT included; scarcity of ICT assets; overtly negative managerial views of ICT; complex (production) programmes that made usage difficult; the perception by staff that ICT was being used monitoring their effort, and others. Observations revealed that many managers who obtained higher managerial practices scores often espoused views that were congruent with their overall position on assisting their firm to enhance its performance, which in many cases included a positive view of ICT and efforts to make it inclusive. Correlation analysis yielded a positive significant correlation coefficient as depicted in table 91.

	User perception of ICT	Management Practices Scores
User perception of ICT	1	
Management Practices Scores	0.535400712	1

Table 91: Correlation results between user perception of ICT and managerial practices

This result is supported by regression analysis, which yielded a p value of 0.00846. This is less than the 0.05 level of significance, and is statistically significant. When complemented by firm-level observations, the hypothesis is rejected that there is no difference in the perception of ICT between firms with better and poorer managerial practices scores. It is recommended that further research is undertaken with a larger sample size in order to ensure that this is a reflective result.

8.3 H3: Firm Type

Three hypotheses were defined in order to assess the possible effect of the firm's ownership on key ICT-centric activities and managerial practices:

H3a:	Family owned and primogeniture firms have the same ICT investment and managerial practices scores as non-family owned firms within their firm-type.
H3b:	Managerial practices vary between different firm-types, but are similar within the same type of firms.
H3c:	A firm's ownership type affects the planning and expenditure approval process for ICT.

H3a: Family owned and primogeniture firms have the same ICT level of investment and managerial practices scores as non-family owned firms within their firm-type.

A firm's ownership structure has been posited to influence firm performance (Bloom and Van Reenen, 2007). Minimal research has focused on managerial practices with respect to primogeniture firms and the selection process of the CEO. Bloom and Van Reenen (2007) have undertaken the most visible recent research in this area, concluding that, "Family-owned firms in which the chief executive officer is chosen by primogeniture (the eldest male child) tend to be very badly managed.... Companies that select the CEO from all family members are no worse managed than other firms, but those that select the CEO based on primogeniture are very poorly managed," (p1354). The use of ICT in primogeniture and family owned firms is assessed in the context of their managerial practices with Chart 62 presenting the firms' ICT annual expenditure as a proportion of revenue (with identifying figures removed) versus managerial practices, with the two primogeniture and two family owned firms boxed and depicted by 'PG' and 'FO' respectively.

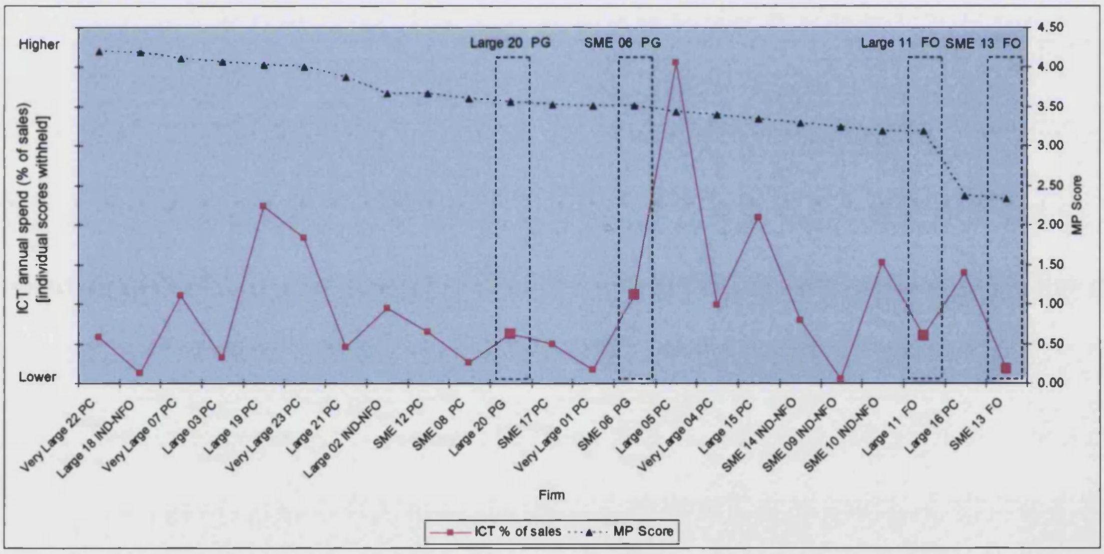

Chart 62: Managerial practices scores vs. ICT expenditure

The remaining two ownership types are 'PC', denoting a public company and 'IND-NFO' denoting an independent non-family owned company, with these initials following the firm's name. The results can also be segmented based on firm ownership across the four defined areas: publicly owned; independent non-family owned; primogeniture, and family owned. Managerial practices scores are presented in descending order within each ownership structure in chart 63.

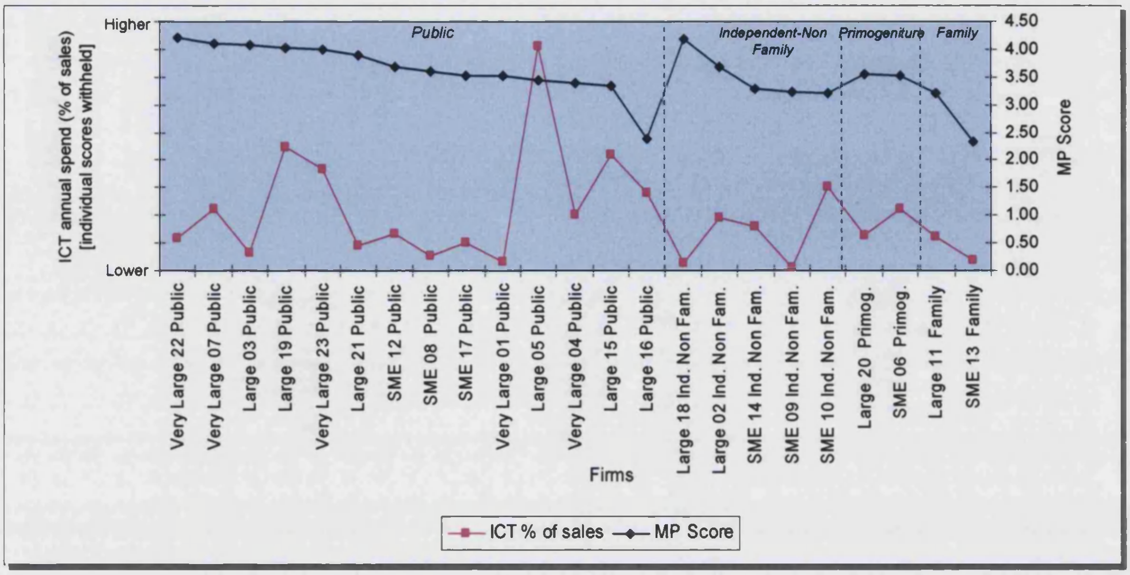

Chart 63: Managerial practices scores vs. ICT expenditure, by firm ownership

Two sample firms were primogeniture (large 20PG, SME 06PG) whilst a further two were family owned (large 11FO, SME 13FO), with two firm types represented: large firms and SMEs. The average managerial practices score for these two firm types, excluding primogeniture and family owned firms, were 3.62 and 3.42 respectively. Two of the four firms were large (one primogeniture and one family owned firm), and obtained managerial practices scores of 3.56 and 3.19 respectively. These scores are in line with the average for large publicly owned/non-family owned firms (3.62), or within a small variation from this score. These firms also had similar annual ICT expenditure. On the basis of these results, the hypothesis is accepted for both large primogeniture and family owned firms: they display the same level of ICT investment and managerial practices scores as non-family owned large firms.

The remaining two firms are both SMEs and include one primogeniture (SME 06PG) and one family owned firm (SME 13FO). These firms obtained average managerial practices scores of 3.51 and 2.33 respectively. The average managerial practices score for publicly owned/non-family owned SMEs was 3.34. Chart 62 above includes the results for these two firms, with the primogeniture firm's managerial practices score in line with this average, and its annual ICT expenditure exceeding many firms within its firm-type (SME). The family owned SMEs managerial practices score and annual ICT expenditure were considerably lower than the average for the publicly owned/non-family owned firms. On the basis of these results, the hypothesis is accepted for primogeniture firms within this firm type (SMEs) but it is rejected for family owned firms within this firm type.

H3b: Managerial practices vary between different firm-types, but are similar within the same type of firms.

The in-situ investigations explored the firms' activities through a combination of observations and interviews. Interviews with managers across the 18 managerial practices were averaged to yield a single score for each firm, which is reproduced below in chart 64, which is chart 34 presented in section 7.1.2.

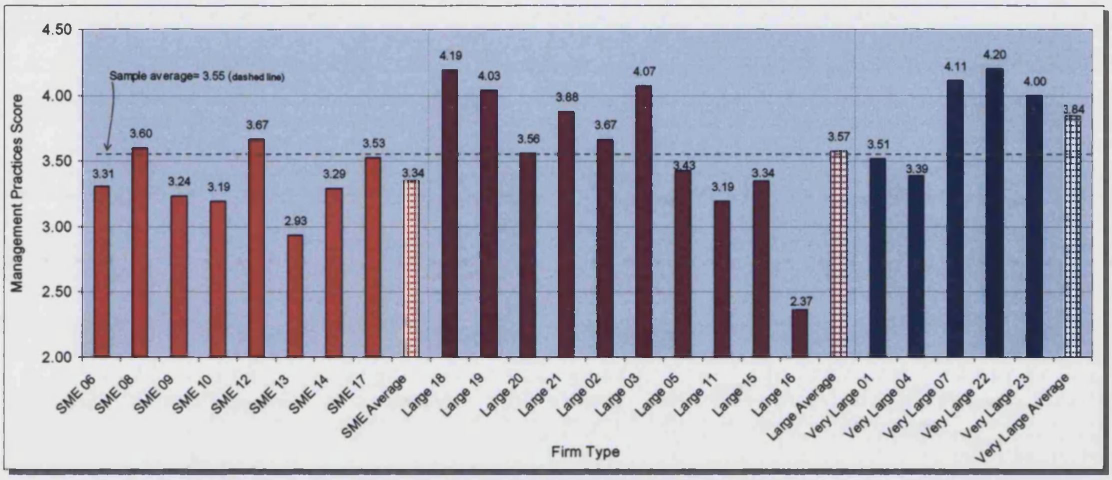

Chart 64: Managerial practices by firm type

The chart reveals the variation in managerial practices scores within each of the three firm types, with 0.74, 1.84 and 0.81 separating the highest and lowest scoring SMEs, large, and very large firms respectively. The average managerial practices scores are 3.34, 3.57, and 3.84 for SMEs, large and very large firms respectively, indicating a difference between the firm-types. The in-situ investigations supported the managerial practices scores captured through the interviews and confirmed the validity of the differences. Although managerial practices varied between firm types, they were not similar within the same firm-type, leading to the rejection of this hypothesis.

H3c: A firm's ownership type affects the planning and expenditure approval process for ICT.

Table 92 summarises the firms' ownership structure and the evaluation and planning approaches undertaken for ICT. Firm-level research revealed that in some cases, although no formal requirement existed for the head office (HQ) of a firm to be involved in the planning or approval process, this often occurred informally and was 'required'. If this did not occur, it could lead to the implementation of a formal process, which the majority of ICT and firm managers did not want, due to the perceived length of compliance and approval processes.

Firm	Firm Ownership	Formal ICT Planning	Evaluation of ICT expenditure: Business unit level	Evaluation of ICT expenditure: HQ Required
Very Large 01	Public	**Yes**	Formal	Formal
Large 03	Public	Yes	Informal	Formal
Very Large 04	Public	No	None	None
Large 05	Public	**Yes**	None	Formal
Very Large 07	Public	Yes	Formal	Formal
SME 08	Public	No	None	None
SME 12	Public	No	None	None
Large 15	Public	No	None	None
Large 16	Public	**Yes**	None	None
SME 17	Public	**Yes**	None	None
Large 19	Public	**Yes**	None	Formal
Large 21	Public	**Yes**	None	Formal
Very Large 22	Public	**Yes**	None	Formal
Very Large 23	Public	**Yes**	Formal	Formal
Large 02	Indep. Non Family	No	None	Informal
SME 09	Indep. Non Family	No	None	None
SME 10	Indep. Non Family	No	Informal	None
SME 14	Indep. Non Family	No	None	None
Large 18	Indep. Non Family	**Yes**	Formal	Formal
SME 06	Primogeniture	**Yes**	Formal	Informal
Large 20	Primogeniture	No	None	None
Large 11	Family Owned	No	None	None
SME 13	Family Owned	No	Informal	None

Table 92: Firm ownership and ICT planning and evaluation process

Firm level investigation revealed that publicly owned firms undertook a greater degree of formal planning, and required a greater degree of approval of their ICT expenditure, than other firm categories evaluation requirements. This was the result of a number of factors discussed throughout this study including the reporting requirements that such firms were required to follow; the greater division of duties due to larger and more complex organisations; more formally trained professional managers, and other factors. Despite the requirement by the HQ of a number of publicly listed firms to process ICT requests formally, this was not undertaken at business unit level by the majority of these firms. Non family owned and family owned firms did not engage in formal ICT planning, with one exception of a large firm that was undergoing considerable structural change, with only one incidence of an informal review of ICT expenditure plans by HQ. Of the two primogeniture firms, one undertook formal ICT planning, with the IT manager providing the details and ICT planned expenditure to the finance function of the company's HQ. The non-family owned independent firms were owned by venture capital firms and private business investors, who expressed a dislike for 'excessive bureaucracy', including formal planning and capital expenditure procedures. In addition, much of the proposed ICT expenditure amongst smaller firms was for lower-cost items such as a PC, laptop, etc., with this not believed to warrant a formal process. On the basis of the firm-level investigations, the hypothesis that the firm's ownership affects the planning and expenditure process for ICT is accepted.

8.4 H4: ICT Utilisation

Two hypotheses were defined to explore ICT utilisation:

H4a: Firms adopt e-commerce in a staged manner.
H4b: The perceived level of ICT success affects the degree of further ICT integration.

These hypotheses explore the adoption and diffusion of ICT, including its mediation properties, facilitated by user satisfaction.

H4a: Firms adopt e-commerce in a staged manner.

Sixty per cent of the sample firms had adopted e-commerce, as depicted in section 5.1.9. Large firms were the most active adopters, followed by very large firms, whilst around half as many SMEs as large firms adopted e-commerce. In almost all cases, cost was not depicted as a barrier to adoption, including within SMEs; managers believed that cost-effective solutions existed 'off the shelf', and that financial institutions and banks were often willing to assist with implementation. In almost all of the sample firms, the adoption of e-commerce followed a pattern that included firms establishing a local area network and utilising email to communicate with suppliers, before progressing to the exchange of files electronically and eventually, the implementation of e-commerce solutions that include e-ordering, e-payments, and others. There was an overwhelming propensity for managers in SMEs and some of the smaller large firms to adopt e-commerce in a staged manner, with this approach providing experience and exposure to what was for many managers a new mode of suppler and customer contact. Many perceived this as 'riskier' and requiring 'specialised assistance' due to the technology's engagement with payment solutions and ordering systems. The majority of managers in these firms did not feel comfortable undertaking this exercise without firstly gaining some experience with electronic communication and/or the internet. The majority of the largest firms in the sample also displayed a staged adoption of e-commerce, but many of these were early adopters of both 'simpler' activities such as internal communication networks (LAN's), a web presence, as well as displaying longevity in other more sophisticated elements such as wireless networks, VPNs, secure extranets, file transfers with suppliers and customers and integrated access to each other's ordering and stock controls. The majority of these managers viewed these as necessary and relevant precursors to commitments to e-commerce, with the security of data being a significant consideration, due in part to the often large monetary value of transactions and the sensitive nature of the data being transferred. The hypothesis is accepted, but with the recommendation that further research is undertaken to compare the adoption of e-commerce across firm-types utilising a larger sample size.

H4b: The perceived level of ICT success affects the degree of further ICT integration.

Firm level investigation assessed the degree to which managers were satisfied with their firm's ICT and whether this affected its level of adoption. Caldeira's (2002) methodology was utilised, as defined in section 5.3.3, with figure 17 reproduced below as figure 26.

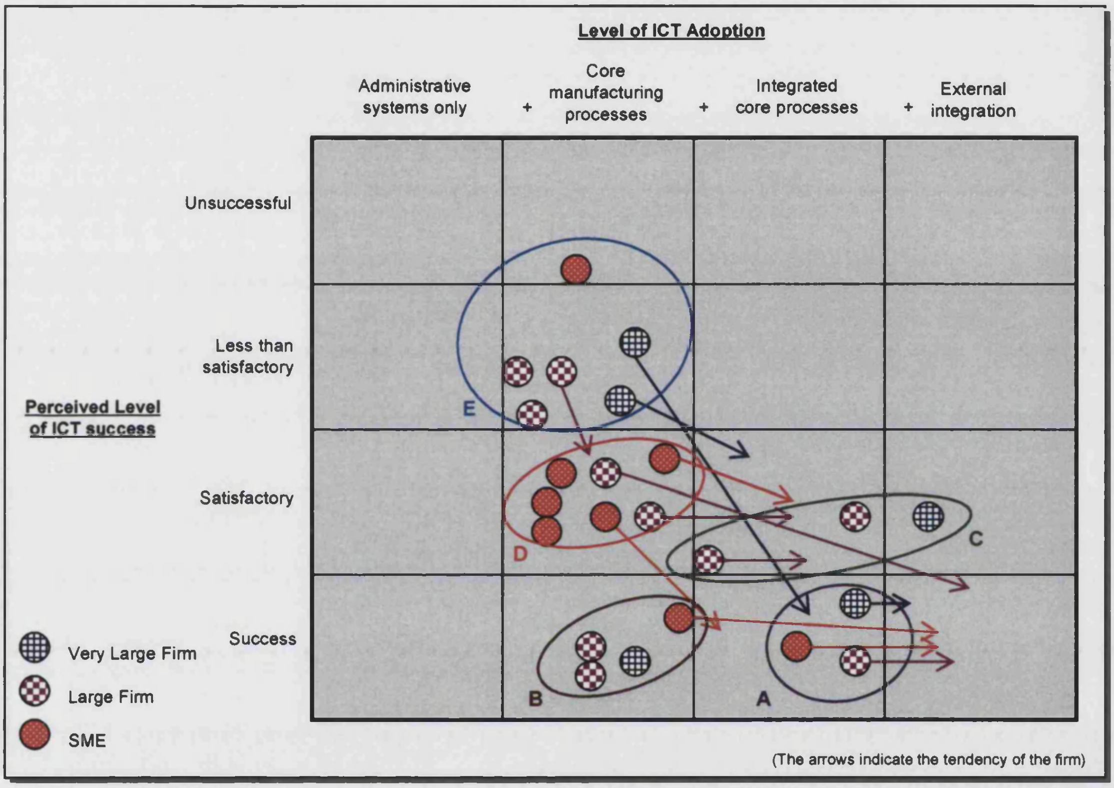

Figure 26: ICT success and adoption firm-type (replicated Figure 17)

The first stage of the investigation assessed manager's perception of the success of ICT within the firm. This was followed by an identification of the current and planned (future) level of ICT adoption and integration, with the latter indicated by arrows in this figure. Around half of the firms' managers did not intend to alter their firm's level of ICT adoption and integration in the future, with a third of these believing their ICT is not currently being satisfactorily utilised. The remainder were satisfied with their ICT, but were not planning to alter its level of adoption. Amongst the managers who were intending to alter the degree to which ICT was adopted and integrated, around one quarter were not satisfied with its current level of success. Some managers believed that a lack of understanding of ICT in the firm often contributed to a lower level of satisfaction, as did the complexity of some ICT and the lack of adequate training available. The remainder were satisfied and were intending to enhance its adoption and integration in the future. In both of these cases, some managers were intending to 'leapfrog' the level of integration, from one encompassing core manufacturing processes to the inclusion of other core processes and external elements. These results indicate that ICT does not need to be perceived as being a success in order for managers to adopt and integrate it further within the firm. One quarter of sample firms adopting ICT to a greater degree were within this category, in contrast to managers who perceived ICT as being less than successful and who remained undecided if they would integrate it further in the future. This evidence does not support the hypothesis that a perceived level of success for ICT is necessary before it is adopted and integrated further within the firm.

8.5 H5: Labour/Resource

Three hypotheses were defined in order to assess the possible influence of key organisational factors related to labour:

H5a: Wage pressure occurs for skilled people entering aerospace.

H5b: The CEOs level of ICT literacy does not affect ICT investment.

H5c: A higher level of formal education amongst managers and non-managers does not affect ICT investment.

Some of these are interlinked, whilst others reflect both internal and external influences.

H5a: Wage pressure occurs for skilled people entering aerospace.

Wage pressure is a complex theme with heterogeneous results obtained in the investigation of the manner in which skilled resources were acquired, or offered their services for employment. On the offering side, pressure was exerted in two primary ways. The first involved skilled individuals offering their services directly to companies, according to their location preferences. This encompassed a willingness to undertake minimal travel, commuting within a smaller radius, or relocating nationally or internationally. The decision on a work location was ultimately influenced by acquisition pressure, with companies responding to the approach of a skilled individual in a number of ways: accepting the salary being sought; counter-offering with a lower salary; rejecting the approach due to a lack of a position. Individuals who undertook the widest geographical job search obtained the highest salary amongst skilled individuals in the sample firms, with downward wage pressure cited as a key factor affecting their decision to seek employment in a wide geographic field. The conditions under which this pressure occurred varied and included: the existence of smaller firms that were not willing to offer salaries that matched the expectations of the skilled worker; firms that were located in lower-wage areas and predominantly employed unskilled labour; firms that had scaled back operations due to increased overseas competition in particular. Some skilled individuals had sought employment with the highest paying firms regardless of their UK location. These firms were most often large and characterised by more complex operations and a greater number of employees. Positions were often offered, or sought, at various organisational levels with salaries reflecting greater responsibilities and in some cases, more specialised R&D, technical and operational functions, resulting in a smaller pool of skilled individuals being available. In such cases, where supply displayed lower elasticity, some upward pressure existed on salaries. The same companies did not offer 'above average' wages to other non-skilled employees however and were similar to other firms seeking to minimise labour costs wherever possible. Some larger firms possessed 'desirable' names and were able to attract unskilled labour by offering health care, 'family days', flexible work patterns, and a perceived level of stability. The second way that downward wage pressure occurred originated from companies seeking skilled resources. In the majority of these cases, a salary was offered by the firm in order to attract the required skills. In some exceptional circumstances, particularly where the role was highly specialised, greater flexibility occurred on paying higher salaries. Skilled individuals tended to be price-takers within this chain of activity and were generally not able to adequately exert upwards pressure on wages.

These factors resulted in heterogeneous wage pressure being observed, with various influences impinging upon this including macro economic conditions; the willingness of the skilled worker to relocate; the willingness of firm managers to be flexible in their wages, and increasingly, wage decisions that are agnostic of geographical borders due to the growth of offshoring and overseas expansion by UK firms. Downward wage pressure appeared to be exerted overtly with unskilled labour as unionised firms engaged in enterprise bargaining and agreements with trade unions. In the case of non-unionised firms, a lower wage was offered on a 'take it or leave it' basis. Aerospace firms located in industrial clusters throughout the UK are an important source of local employment and are able to define the wage for unskilled labour where this is above the minimum wage. Downward pressure occurred for skilled labour when the firm sought to dictate the terms of engagement, in addition to when managers were responding to unsolicited approaches from skilled workers. This occurred in a minority of cases only, where highly specialised skills were required by firms and a shortage existed for those resources. Mobility was the principal mode utilised by some skilled workers seeking to secure a higher wage, although the results indicated that the higher cost associated with living in some regional centres/larger cities counteracted the higher salaries offered. Evidence emerged that downward pressure on unskilled wages as a result of offshoring or overseas production resulted in some spillover to skilled wages, with firms indicating that responsibilities were often reduced for some managerial positions. This in turn resulted in the re-classification of some positions and a reduction in the salary offered when advertised. On the basis of the evidence, the hypothesis is accepted that wage pressure exists for skilled people in aerospace. Evidence indicated that this hypothesis can be extended to unskilled resources as well.

H5b: The CEOs' level of ICT literacy does not affect ICT investment.

Just over half of the sample firms' CEOs were classified as ICT literate, displaying at least a basic knowledge of ICT and its use in the firm. Chart 65 plots this against the level of annual ICT expenditure, with a value of 1 and 0 denoting a CEO who was ICT 'literate' and 'illiterate' respectively.

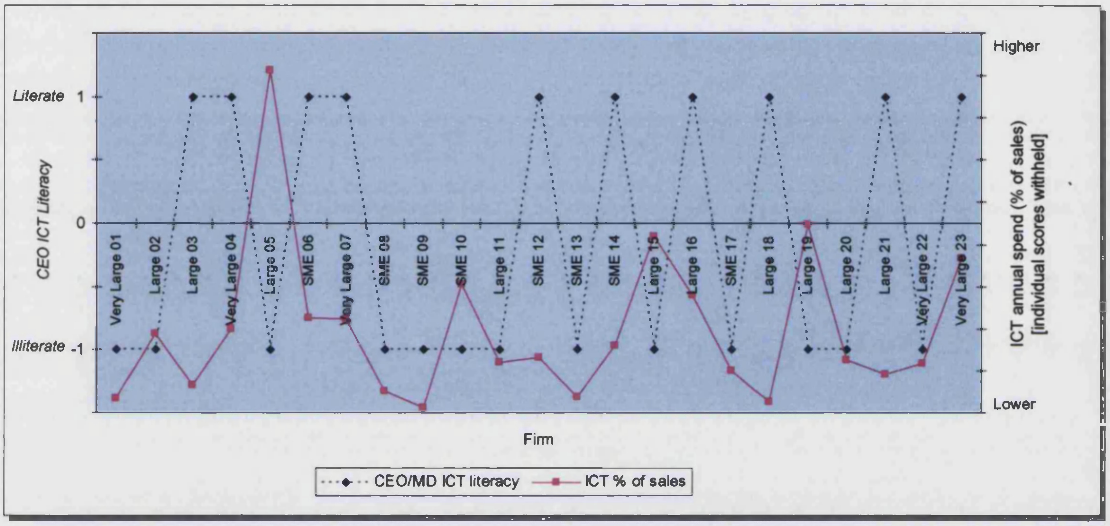

Chart 65: CEO literacy vs. annual ICT spend

Observations and data indicate that firms run by CEOs who display a high level of ICT literacy undertake a similar level of ICT investment as those with a CEO who possess a low, or insignificant level of ICT literacy. Some firms whose CEO was very ICT literate displayed a high level of annual ICT investment, and vice versa. It appears that firms run by an ICT-illiterate CEO displayed higher levels of annual ICT investment: four of the five highest spending firms were run by such CEOs. Correlation analysis revealed a low degree of negative correlation between CEO literacy and annual ICT spending, as depicted in table 93.

	Annual ICT Spend (incl. ERP)	CEO ICT Literacy
Annual ICT Spend (incl. ERP)	1	
CEO ICT Literacy	-0.100230239	1

Table 93: Correlation results between annual ICT spending and CEO literacy.

The correlation coefficient is negligible, but displays a negative sign indicating that lower ICT literacy could be related to higher annual ICT investment and vice versa. Caution is urged for the negative sign for this correlation, and due to discussions with managers and employees across the organisational spectrum revealing that the decision to invest in ICT was influenced in the sample by multiple factors including; the involvement of HQ in the budgeting and approval process; the size of the firm; firm sales; the view of ICT held by the CEO; the relationship between the CEO and the IT director, and others. The p value of 0.6490 is greater than the 0.05 level of significance, indicating that this is not a significant result. For these reasons, the hypothesis that the CEOs level of ICT literacy does not affect ICT investment is not rejected.

H5c: A higher level of formal education amongst managers and non-managers does not affect ICT investment.

Managers in the sample firms possessed a higher level of formal education than non-managers, as measured by their possession of a degree. The managerial category included all managers in the firm, which encompassed non-production personnel in engineering, finance, administration, R&D and other areas. Around half of the sample's managers possessed degrees, versus 15 per cent amongst non-managers. The level of formal education in the firms is presented in chart 66, measured against the corresponding level of ICT investment in descending order. Managers and non-managers in the three firms spending the highest amount on their ICT included those with some of the lowest levels of formal education in the sample. In contrast, the lowest spending three firms included managers and non-managers with the highest levels of formal education in the sample.

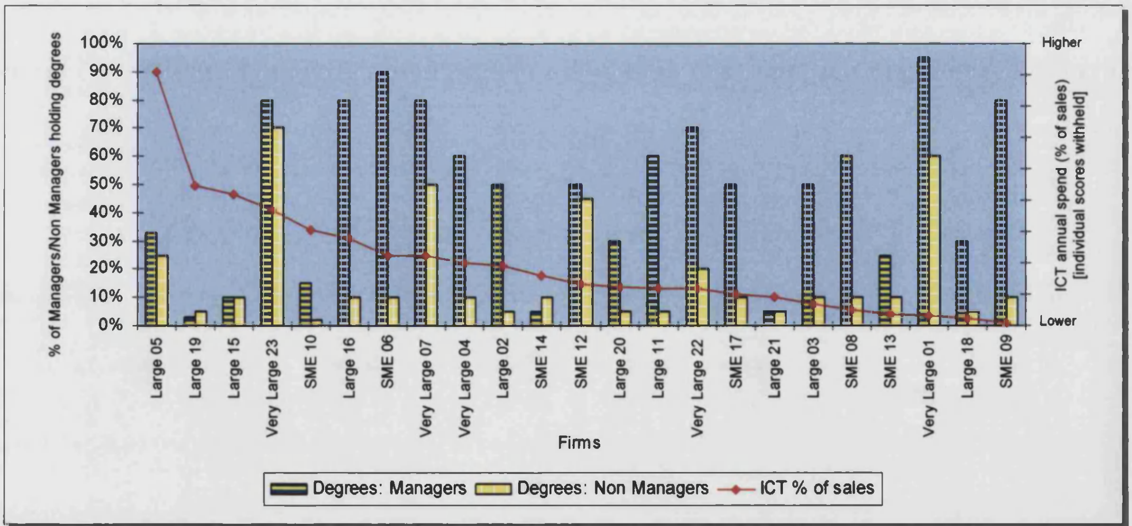

Chart 66: Managers and non managers with degrees vs. annual ICT spend

Firms positioned between these 'tails' displayed varying results for descending ICT spending, with a subtle pattern emerging: firms with managers and non-managers possessing lower aggregate levels of formal education appear to spend a higher amount on ICT. At the firm-level, very large firms displayed the highest proportion of formal education amongst managers and non-managers with almost two- thirds being amongst the highest spending firms for ICT. In many of these firms, degree educated non-managers comprised a high proportion of the workforce and were engaged in activities requiring formal training such as R&D, engineering, design, and others. This resulted in a smaller disparity between the formal education of level of managers and non-managers when compared to the majority of large firms and SMEs. Observations at firm level revealed that although many managers and non-managers were degree educated, this did not necessarily translate to increased ICT use, or in turn, higher ICT expenditure. Correlation of annual ICT spend with the formal education level of managers and non-managers was undertaken, with the first of these revealing a negative weak low correlation as depicted in table 94.

	Annual ICT Spend (inlc. ERP)	Managers With Degrees
Annual ICT Spend (inlc. ERP)	1	
Managers With Degrees	-0.22803757	1

Table 94: Correlation results between annual ICT spending and managers with degrees

The low correlation coefficient is not significant. A p value of 0.295 was obtained, which is greater than the 0.05 level of significance (see [A] Appendix L) and does not result in the rejection of this proportion of the hypothesis: the formal education of managers does not affect the level of ICT investment. This was also found to hold true for non-managers, with an insignificant correlation coefficient of 0.119 obtained as depicted in table 95, and an insignificant statistical result, with a p value of 0.588, which is greater than 0.05. On this basis, this proportion of the hypothesis was not rejected, with the formal education of non-managers not affecting the level of ICT investment.

	Annual ICT Spend (incl. ERP)	Non-Managers With Degrees
Annual ICT Spend (incl. ERP)	1	
Non-Managers With Degrees	0.119101388	1

Table 95: Correlation results between annual ICT spending and non-managers with degrees

Combined with firm level observations, the hypothesis that a higher level of formal education amongst managers and non-managers does not result in greater ICT investment is not rejected.

8.6 H6: Business practices

H6: Confrontational relationships between the CEO and the IT manager result in lower ICT expenditure.

Observations and interviews revealed that a confrontational relationship existed between the CEO and the IT manager in four of the sample firms, with a neutral relationship existing in a further three firms. A positive relationship was witnessed in the remaining firms. Chart 67 depicts these results, with a positive, neutral and negative relationship assigned the values of 1, 0, and -1 respectively, in order to plot the findings against annual ICT expenditure.

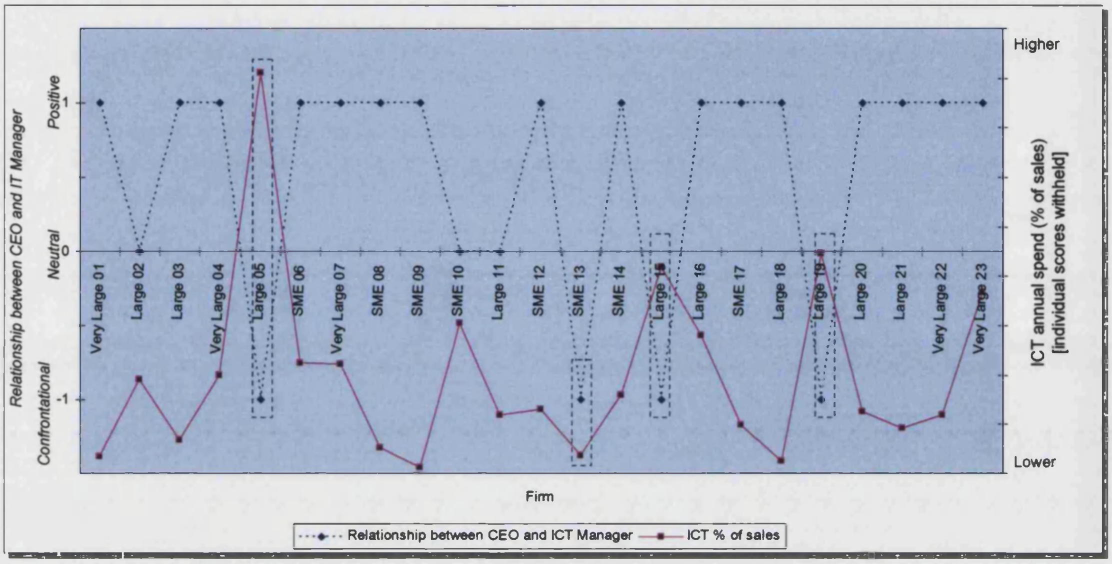

Chart 67: Relationship status between the CEO and IT manager vs. annual ICT spend

The four highlighted boxes denote firms with confrontational relationships, with three of these obtaining the highest three figures for the proportion of revenue spent on ICT. In addition, the three firms in which a neutral relationship was observed obtained high and mid-range ICT expenditure figures. All of the lowest ICT expenditure figures were obtained by firms that displayed positive relationships between the CEO and the IT manager. A correlation coefficient of -0.588 in table 96 indicates a moderate level of negative correlation, supporting observations that a negative and neutral relationship between the CEO and IT manager often resulted in increased ICT expenditure and did not have an adverse result in diminishing ICT expenditure.

	Annual ICT Spend (incl. ERP)	Relationship Between CEO and IT Manager
Annual ICT Spend (incl. ERP)	1	
Relationship Between CEO and IT Manager	-0.588934924	1

Table 96: Correlation results for relationship between the CEO and IT manager vs. annual ICT spend

Regression analysis yielded a p value of 0.0031, which is lower than the 0.05 significance level, leading to a significant result and the rejection of the hypothesis that a confrontational relationship resulted in lower ICT expenditure (see [A] Appendix M). As depicted in the Results section of this study, a confrontational relationship between the CEO and IT manager often did not impinge on ICT investment decisions, which in some cases, were controlled by a head office function. Where decision making occurred at the firm level, with the CEO exercising control over this, the confrontational relationship did not necessarily negate the ICT recommendations proposed by the IT manager. This was due to a number of reasons including the CEO accepting that they were in the best interests of the business, or that they were required in order to replace faulty or older hardware, and others. In the four firms in which confrontational relationships were observed between the CEO and the IT manager, the managerial practice scores obtained were the 5th, 15th, 16th and 23rd highest ones, with the latter three located in the lowest third of scores. This study revealed that managerial practices scores did not necessarily influence the nature of the relationship, with the personality of the CEO and IT manager discovered to be the most significant contributing factor. Further statistical analysis was undertaken, exploring the relationship between the CEO and the IT manager and the management practices scores of the firms. An insignificant correlation coefficient was obtained, as depicted in table 97.

	Management Practices Scores	Relationship Between CEO and IT Manager
Management Practices Scores	1	
Relationship Between CEO and IT Manager	-0.103259782	1

Table 97: Correlation for relationship between the CEO and IT manager vs. management practices scores

Although appearing counter-intuitive, investigation supports the rejection of the hypothesis that a confrontational relationship can lead to lower ICT investment and the negative moderate correlation obtained: in a number of instances, a confrontational relationship was associated with greater ICT investment.

8.7 H7: Location

Six hypotheses were defined for this theme with an equal number segmented into two strands of investigation: ***spatial*** (physical) and ***virtual*** proximity.

Spatial

H7a:	Firms cluster to take advantage of access to suppliers and customers.
H7b:	Location advantage is related to local skill levels.
H7c:	Firms source the majority of their supplies within their cluster and allocate a high proportion of their outsourced production within their cluster.

A number of these hypotheses explore beliefs that are ubiquitous amongst much of the cluster literature, particularly efforts positing the benefits of agglomeration.

H7a: Firms cluster to take advantage of access to suppliers and customers.

One quarter of the firm's managers cited proximity to customers and suppliers as a benefit of being located in a cluster, with the majority not believing that this was a cluster attraction for either of these factors. This was explored in section 6.2.1 using Yamawaki's (2002) typology, with table 98 below extracting the relevant results from table 55, with the dashed lines denoting the exclusion of other data and multiple responses permitted:

Firm Type	....	Access to supplier/ subcontractor	Access to customer base	....	No advantage
SME*	....	38%	25%	....	63%
Large*	....	10%	30%	....	70%
Very Large*	....	20%	20%	....	60%
Total^^	....	22%	26%	....	65%

* Figures reflect the results within each firm type
^^ Reflects the total results for all firms
Source: Yamawaki (2002)

Table 98: Cluster benefits for participation- Customer and supplier results (replicated Table 55- abridged)

Managers overwhelmingly believed that the decision to locate within a cluster was historical and held greater relevance for their firm in the past, citing a number of changes that have occurred since the late 1990's to diminish the benefits of co-location: customers were becoming more price elastic and demanding lower prices with increased frequency; the supply chain had increasingly become internationalised, with strong competition occurring from outside of the cluster, particularly from low-cost overseas companies; declining transport costs had 'opened up' competition from other firms nationally, but in turn this had also allowed clustered firms to compete for business in other locations.[75] Table 99 below is reproduced from table 56 in section 6.2.2, summarises the firms' distribution of suppliers within their clusters, indicating that for all firm-types, this represented a small proportion of their supply chain:

	SME	Large Firms	Very Large Firms	Entire Sample
Mean	12%	11%	10%	11%
Median	10%	11%	10%	10%
Mode	10%	10%	n/a	10%

Table 99: Mean median and mode for the sourcing of supplies within the cluster (replicated Table 56)

A minority of sample firms had been established since the late 1990's, and were smaller and privately owned. Managers and owners indicated that their firm was located in the cluster due to the personal preference of the latter and not necessarily in order to take advantage of proximity to

[75] Described as a 'dual-edged sword' by many managers.

suppliers and customers, whilst acknowledging that some potential customers might approach multiple firms in the same cluster, and that co-location could lead to a greater chance of meeting them. This was not believed to be a frequent occurrence however, with many managers citing the increased use of the internet by customers to find their firms, and the changes they have made to their work practices in order to accommodate a national, and in some cases, international, customer base. This includes the use of some ICT such as conference calls, fax and Skype for video calls, and the sending of samples before any site inspections occurs in some instances.

The majority of managers in larger publicly owned companies that were formed before 2000 and had been acquired, indicated that their parent company purchased their firm due to its attractiveness and fit as a business, without consideration of its location. In the minority of cases where the business was established earlier and was still owned by the same parent company, managers indicated that proximity to potential customers and suppliers was a more relevant driver in establishing its initial location than it is today. Around one third of the sample firms also engaged in intra-cluster activities. Although no accurate figure could be obtained outside of the past 10 years, some firm managers who had been employed with the firm for this period of time believed that intra-cluster activity represented 50-70 per cent of their firm's total activities before 2000, but that this figure, and had reduced by 20-60 per cent since. Managers indicated that the current level of intra-cluster activity also occurred with low frequency, with no firm manager reporting intra-firm activities occurring with high frequency. Other cluster benefits such as knowledge transfer and the forging of business alliances were not cited by the majority of firm managers as being a benefit in locating close to customers, suppliers, or other firms. Collectively, the factors observed did not support the hypothesis that firms clustered in order to have access to suppliers and customers. Interview data indicate that in the past, particularly before the early-mid 1990's, this is likely to have been a stronger factor influencing a firm's cluster location decision than it is today.

H7b: Location advantage is related to local skill levels.

Around one quarter of firm managers indicated that they had recruited skilled workers from within their cluster as defined in section 6.2.4. A minority cooperated with other cluster firms to foster skills, with this confined to a small number of large firms only. Table 100 replicates the results from Table 58, highlighting the lower emphasis on local skill levels as a facilitator for location advantage. The majority of managers indicated that the approach they utilised to obtain skilled workers from within their cluster reflects their general recruitment strategy and did not represent a cluster-specific one. In the first instance, this usually entails the identification of any appropriate individuals known to them who were working elsewhere, irrespective of their location.

Firm Type	On-the-job training	Inter-firm cooperation in skill formation	Recruit from outside of the cluster	Recruit from other firms in the cluster
SME	63%		13%	25%
Large	70%	10%	20%	30%
Very Large	80%		20%	20%
Total	70%	4%	17%	26%

(Multiple responses permitted)
Source: Yamawaki (2002)

Table 100: The development of the firms' skilled workers (replicated Table 58)

If this does not result in a successful outcome, managers subsequently utilise their preferred recruitment mode which often included local/regional and even national print media as well as online job sites. Managers also indicated that due to the limited number of comparable firms located in their cluster, they were increasingly required to search wider for skilled labour which in some instances entailed recruitment from overseas. Almost one fifth of firms recruited skilled labour from outside of their cluster utilising this approach, or utilising some of its elements.

The most prevalent mode of developing skills amongst sample firms was on-the-job training, with an average of 70 per cent of all firms engaging in this. Very large firms undertook this to a greater degree than both SMEs and large firms, reflecting the existence of more formalised organisational structures, greater training resources and budgets, and rotation of employees through a variety of roles and locations. The latter often permitted managers in this firm-type to rapidly bridge skills shortages without the need to engage in external recruitment. This was believed to be the optimal means of developing skilled workers, with fewer than 15 per cent of managers citing the availability of skilled workers as a benefit of clustering. Fewer than 10 per cent believed this to be the case for highly specialised individuals in areas such as engineering. The scarcity of comparable firms was cited as the major reason why many managers did not recruit from within their cluster, preferring to develop skills in-house where possible. Despite their smaller size and more limited resources, almost two thirds of SME managers preferred to develop on-the-job skills, in contrast to 80 per cent of managers in very large firms. This approach reflected the general view of managers that although their firm's location in a cluster offered some opportunities to recruit skilled resources, location advantage was not necessarily related to this. Managers tended to view their cluster as being situated within a wider geographic region that could be searched for skilled resources, with little (if any) distinction being made between the two areas (cluster versus wider area) in the recruitment approach utilised. The information and observations did not support the hypothesis that location advantage was related to local skill levels.

H7c: Firms source the majority of their supplies within their cluster and allocate a high proportion of their outsourced production within their cluster.

The literature highlighted the use of two proxies to indicate intra-cluster trade.[76] The first measures the firm's distribution of suppliers (within and outside of the cluster), whilst the second measures the proportion of outsourced production directed to firms within the cluster. These were explored in section 6.2.1, with hypothesis 7a also reviewing the distribution of suppliers, highlighting that around 10 per cent of the sample firms' suppliers were located within their cluster, with this figure relatively consistent across firm-types. Firm managers indicated that this had reduced by 20-60 per cent since the late 1990's. The current ratio of supplies sourced within the cluster does not support the view that a significant proportion of the firm's suppliers are located in close geographic proximity. The majority of firm managers and purchasing staff made their selection of suppliers for raw materials and other inputs primarily based primarily on cost. This was being driven by customers who were increasingly demanding lower costs. Firm employees would most often search for relevant suppliers both in the UK and abroad, and make their final selection after factoring in quality and transportation. The results did not support the hypothesis that the sample firms sourced the majority of their supplies from within their cluster.

The second proxy measured the level of outsourcing contracted to other firms located in the source firm's cluster and was explored in section 6.2.3. Table 57 from this section, reproduced below as Table 101, depicts the level of the firms' average total outsourced activities, including the average proportion of this allocated to within the cluster. Chart 68 also from this section, replicated below as Chart 32, illustrates the firm-level results.

Total outsourced	**SME**	**Large Firms**	**Very Large Firms**	**Entire Sample**
Mean	31%	37%	57%	39%
Median	32%	38%	55%	35%
Mode	33%	40%	n/a	40%
Outsourced to cluster	**SME**	**Large Firms**	**Very Large Firms**	**Entire Sample**
Mean	30%	12%	9%	18%
Median	20%	14%	10%	15%
Mode	15%	15%	10%	15%

Table 101: Mean, median and mode for outsourcing activities (replicated Table 57)

An average of 40 per cent of the sample firms' production was outsourced, with around half of this directed to firms within the cluster, representing one fifth of total production. Discussions with firm managers indicated that increased competition from both overseas companies and those within the UK was continuing to result in customers outsourcing production in a dispersed geographic pattern.

[76] Liao and Hong, 2007.

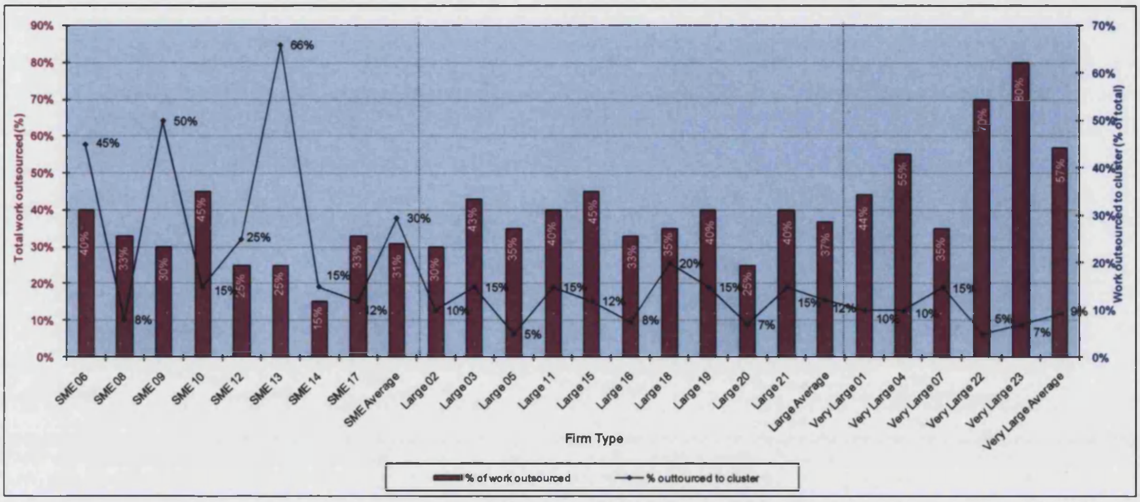

Chart 68: Total outsourcing by firms and the proportion undertaken within their cluster (replicated Chart 32)

Equally, sample firms were also following the same pattern as they took advantage of lower cost suppliers, in many cases irrespective of their location. Many firm managers also indicated that in some instances, even if they wanted to allocate further production to firms within their cluster, such as for labour intensive lower-skilled tasks, these firms were increasingly closing down due to competition from low-cost labour regions such as India and China. Some variation occurred in the proportion of work outsourced within clusters between SMEs and larger firms, with the former allocating a higher proportion than the latter. Further research is recommended to explore the outsourcing pattern between firm-types. The data and observations do not support the hypothesis that firms outsourced a considerable proportion of their production to other firms within their cluster.

Virtual proximity

This category encompasses the final three hypotheses investigating the theme of proximity, with the emphasis on virtual connectivity:

H7d:	Virtual clustering occurs with customers and suppliers outside of the firm's geographical cluster.
H7e:	Virtual clustering replaces the advantages of physical proximity.
H7f:	Virtual clustering is more prevalent amongst larger firms.

The hypotheses investigate the theme with reference to both the firm's geographical location and some characteristics of firm-type. Each of these is explored below.

H7d: Virtual clustering occurs with customers and suppliers outside of the firm's geographical cluster.

An average of just over half of the sample firms had undertaken some degree of virtual connectivity with almost 15 per cent engaging in this at a high level. The level of virtual clustering increased as the firm type increased, with the smallest firms undertaking both the lowest level of overall virtual clustering and with the lowest frequency. Table 61 from section 6.3.2 as Table 102 below, depicts the degree of virtual clustering by the firms.

Firm Type	Degree of *virtual* clustering
SME	
Low	38%
Medium	-
High	-
None	62%
Large Firm	
Low	-
Medium	40%
High	20%
None	40%
Very Large Firm	
Low	40%
Medium	20%
High	20%
None	20%
TOTAL	
Low	22%
Medium	22%
High	13%
None	43%

Table 102: Virtual clustering of firms (replicated Table 61)

A number of structural factors contributed to the adoption of and pattern of virtual clustering amongst firms, including their relationship with larger upstream firms, and primes. Firms that were contracted directly by primes were often required to adhere to stricter reporting, connectivity and operational requirements, including virtual connectivity, irrespective of their location. A number of these firms were located in the same cluster as their customers. If firm managers transacting with customers and/or suppliers within their cluster believed that benefits would ensue from some degree of virtual clustering, this was often undertaken providing that costs and capability permitted it, whilst in other cases, this was mandated by larger customers.

Discussions with firm managers and others did not indicate that firms predominantly engaged in virtual clustering with firms outside of their cluster or immediate location: this often occurred between firms within the same cluster and included the linking of ordering systems, e-commerce and virtual private networks for communication. Firm managers did not extend some ICT aspects of virtual clustering to firms within close physical proximity, such as web, video or telephone conferencing due to the ability to engage in face-to-face meetings with ease. The emergence of virtual clustering as a complementary element of spatial clustering is still largely absent in the literature and is generally counter to the major body of research. Based on the uptake of virtual connectivity observed, the pattern and rationale for its inception did not support this only occurring between firms and customers and/or suppliers that were located outside of the cluster. Although at times influenced by proximity, particularly where customers and suppliers located in more distant locations could be 'brought closer' via virtual clustering, this was not the primary reason for its adoption. This was confirmed through the engagement of virtual clustering between firms within the same physical cluster. The adoption of virtual clustering through the use of ICT supports the view that ICT can replace some face-to-face communication in certain trust situations once a basic level of trust has been established (Jones et al, 2000). Firm managers stipulated that without a factor of trust, the inter-firm relationships did not progress to a virtual milieu. The evidence does not support the hypothesis that virtual clustering only occurs with firms located outside of the firm's geographical cluster.

H7e: Virtual clustering replaces the advantages of physical proximity.

Virtual clustering was viewed by the majority of managers as both complementing and replacing some transactions and communication with customers and suppliers. It was perceived as being in its early stages of adoption, and possessing limitations that were related to the narrowness of what could often be communicated, with the continued requirement for face-to-face visits that were integral to some contracts. As depicted throughout this study, the majority of managers did not believe that agglomeration offered advantages to their firm, but that local firms were often selected based on the application of a number of selection criteria including price, quality and capability. Firm managers viewed virtual clustering as an alternative mode of communication and transacting that often resulted in greater economic and resource efficiencies. The impetus for adoption varied however and included customer pressure, a contractual requirement, or the desire of the firm's owners/managers to embrace virtual connectivity.

The majority of firm managers indicated that enabling virtual proximity often replaced some process-driven interaction with customers and suppliers irrespective if they were located within their physical cluster or not. The majority of initiatives were centred on obtaining efficiencies with customers and suppliers and included the integration of stock control systems; establishing secure extranet networks; the integration of CAD and other design solutions, and undertaking a greater degree of remote communication through teleconferencing, web and video conferencing, and the use of email instead of fax wherever possible. The automation of these functions and the obtaining of real-time data often resulted in the better adoption of lean manufacturing principles, bringing tangible benefits to many of the firms. These virtual clustering advantages were evident in firms engaging in trade with other firms both within and outside of their geographic clusters. The benefits of agglomeration that were reported by a minority of firm managers, including access to labour (skilled and unskilled) and customers and suppliers, were not replaced by virtual engagement due to the differing nature of the tenets of each: the use of e-commerce for example did not replace the recruitment of unskilled labour that had previously worked in aerospace firms. It did however streamline some of the more labour intensive processes that were utilised to pay orders and accounts irrespective if the firms were co-located. In the overwhelming majority of cases, no evidence was observed that firms replaced any advantages that firm managers reported from physical clustering with virtual clustering. For this reason, this hypothesis is not accepted.

H7f: Virtual clustering is more prevalent amongst larger firms.

As depicted in section 6.3.2, almost two thirds of smaller firms did not engage in any form of virtual clustering, in contrast to 40 per cent and 20 per cent of large and very large firms respectively. These results are depicted in Chart 69 on the following page, replicated from Chart33. The trend amongst the sample was for larger firms to engage in a greater degree of virtual clustering than smaller firms, and to do so with a higher frequency. No small firms engaged in virtual clustering at medium or high levels with the principal reasons cited including cost, lack of resources, complexity, lack of demand and others. These observations reflect the polarisation of the aerospace supply chain, with a small number of large firms engaged in sub-contracting from primes and tier one contractors, creating a buffer between the remaining majority of small firms located downstream in this sector. If small firms were not required to undertake virtual clustering by firms contracting them, this often did not occur. The larger of the small firms often approached the lower boundaries of large firms (in terms of sales and/or employees) with such firms accounting for the majority of virtual clustering activity encountered amongst SMEs. The frequency and degree of virtual clustering continued to increase as the firms became larger. Firm managers indicated that the closer their businesses were tied to primes and tier one aerospace firms, the greater the demands made upon them to adopt virtual clustering and other technology or processes.

The principal adoption driver was pressure from customers, irrespective of firm type, although some firm managers in predominantly larger firms indicated that they voluntarily adopted some elements of virtual clustering in order to try and achieve cost savings.

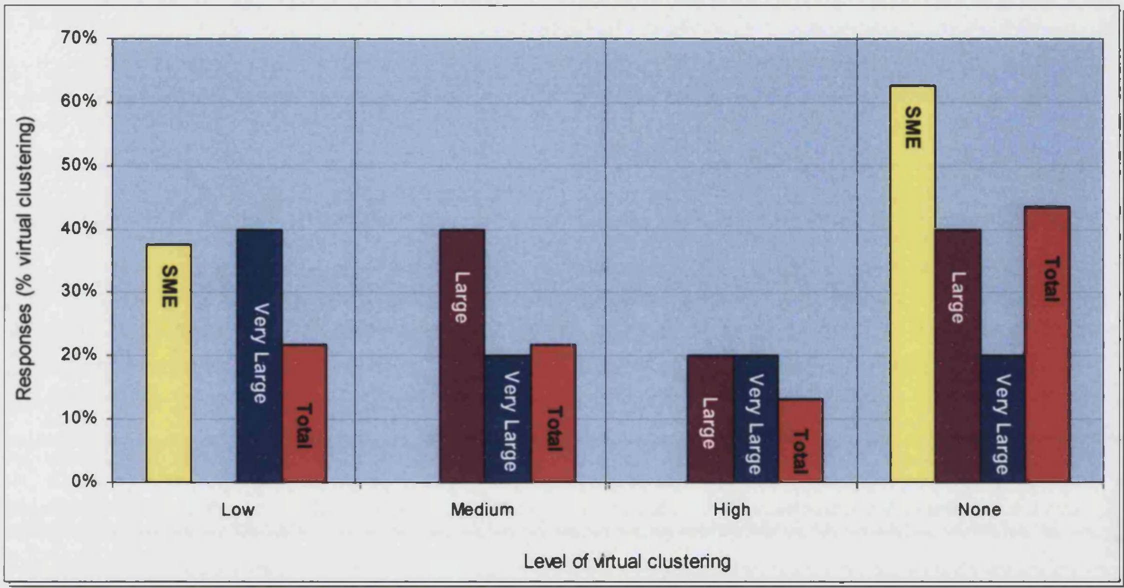

Chart 69: Firm degree of virtual clustering (replicated Chart 33)

The majority of firm managers across all firm types indicated that pressure to adopt virtual connectivity had increased over time, and was likely to continue. They did not believe that this would affect other elements of their participation in a cluster, but that they might replace process oriented ones and the need for a higher number of face-to-face meetings. There was little belief that virtual clustering would promote a digital community or the association of firms, although managers in larger firms believed that this could bring some positive benefits to the sector. Managers in larger firms adopted virtual clustering to a greater degree than managers in smaller firms, and did so with increased frequency. These managers indicated that in turn, they often 'pushed' these requirements to firms they sub-contracted work to on a 'back-to-back' arrangement. This included smaller firms, with managers in these firms citing this scenario as the primary reason their firm adopted virtual clustering. Based on observations and interviews with managers and other employees, there was strong evidence to support the hypothesis that virtual clustering was more prevalent in larger firms.

9. Conclusion and Contribution

9.1 Conclusion

This study set out to explore the influence of managerial practices on ICT-driven productivity in a clustered environment. This milieu is most often cited as offering benefits to its participants, but the results of this study have shown that this is not as applicable today as it was in the past for the majority of sample firms. The literature review has also clearly highlighted the clear deficit that exists at the junction of these themes, and a lack of tools available to quantify managerial practices. The CEP-McKinsey tool is amongst the first efforts to measure managerial practices, with significant testing occurring in over 5,000 firms in two major studies that confirmed its accuracy in predicting better performing firms based on their managerial practices scores. The statistically significant positive correlation between managerial practices scores and firm performance obtained by this research effort confirmed the applicability of the tool's inclusion within this study's schema, providing an empirical foundation and categorisation of management practices, within which ICT use could subsequently be explored. The CEP-McKinsey at-a-distance telephone interviews was also utilised for interviews within the firms, with additional data points added in some cases through the inclusion of other employees. The scores obtained in-situ in many cases reflected the results obtained in the initial telephone interviews, with quantitative analysis confirming that this was statistically significant and yielding the conclusion that better performing firms gained higher management practices scores. The results were congruent with those obtained by CEP-McKinsey in the 5,000 firm assessment, confirming the significance of managerial practices in affecting firm performance. This also represented one of this study's overarching conclusions. As the research for this dissertation unfolded, a number of other conclusions emerged.

One of this study's other overarching conclusions was the discovery of a strong and significant positive relationship between ICT investment and productivity. This conclusion is consistent with the results from the previous 5,000 firm study by CEP-McKinsey. Following the establishment of a significant relationship between management practices and productivity, and increased ICT investment and productivity, an assessment of the complementarity between ICT and management occurred. Despite the existence of these statistically significant relationships, the combination of the variables did not result in the observance of complementarity. The relationship was evident in a regression however between management and ICT against productivity, but this did not translate into complementarity when all of the interactions were combined. This is believed to be due to too small a sample however, with larger samples in the CEP-McKinsey research yielding complementarity (Bloom et al, 2005). The positive significance between ICT and performance contrasted with a small number of studies that found mixed or inconclusive results between these variables where performance was utilised as a measure for managerial practices (Stiroh 1998). Performance does not always identify well run firms, or those utilising ICT better, as this study has highlighted. Some aerospace firms displayed higher managerial practices scores and lower performance due to one particular recurring factor: restructuring efforts. In a number of firms, 'turnaround' exercises were underway, including new teams being installed to implement better practices in poor performing businesses. This introduces a lag between the implementation of good practices and the improvement of economic and operational performance. In some cases, other factors were observed to inhibit the diffusion of better management practices and potentially higher ICT expenditure including head office intervention; budgetary constraints (at HQ and the local level); the motivations of the CEO, and others. Future assessments of ICT expenditure within firms could incorporate a review of whether a head office controls ICT, as witnessed in a proportion of the sample, with this often overlooked in the current research. Two further related conclusions were reached by this study. First, the degree of ICT literacy possessed by the CEO does not necessarily affect ICT investment. Second, a positive relationship between the CEO and the IT manager does not necessarily result in higher ICT investment. Confrontational relationships between these individuals sometimes resulted in higher ICT investment, whilst in some cases, positive relationships resulted in low ICT investment. Support for the ICT function by the CEO sometimes translated into ICT becoming recognised as a complementary resource within the firm, but this did not necessarily translate into a greater degree of investment or utilisation. These observations confirm that some internal elements of the firm's operation affect ICT investment and its returns, and are congruent with recent research (Caroli and Van Reenen 2001).

One of the more surprising conclusions of the study was that ICT satisfaction was not a prerequisite for further ICT investment. Managers and employees cited other organisational impediments to ICT investment including a lack of training; the complexity of the technology; a lack of senior management support; budgetary constraints, and others. Satisfaction levels were not determined by the size of the investment, with this result congruent with recent research (Burn and Szeto, 2000). The increasing adoption of more sophisticated ICT by the sample firms, such as ERP, was evident amongst SMEs in particular, and led by the penetration of dominant global ERP companies such as SAP. This is contrary to recent findings in more traditional production sectors (Dyerson and Harindranath, 2007) but this could be due to the technology-centric nature of the aerospace sector and the lower pricing strategy adopted by major ERP companies to penetrate it. Other conclusions in this study are congruent with the literature, including that ICT in SMEs often competes with more pressing business concerns and that owner/managers often do not perceive ICT as offering them long term solutions to business sustainability (Bayo-Morionesau and Lera-Lopez, 2007).

The areas of worker skills, education and ICT investment yielded mixed conclusions, with some of this study's results being congruent with research positing that no relationship exists between educational levels and enhanced ICT investment and utilisation (Rai and Patnayakuni, 1996), whilst some results indicated the existence of positive relationship between these variables, supporting other studies (Falk, 2004). This study also revealed that in a small number of cases, educational levels enhanced the ability of skilled workers to utilise and interpret data more effectively, and to manage more sophisticated ICT, including ERP. The ICT literacy of the firm's CEO also did not affect ICT investment or utilisation in the majority of cases, supporting the conclusions of some studies (Akhavan and Jafari, 2008).

The remaining anchor point of the study, the location of the firm, yielded some of the most surprising conclusions which should be of relevance to policy makers who continue to develop a 'one-size-fits-all' approach to promoting location. Contrary to the majority of the literature positing the benefits of agglomeration, this study discovered that the majority of firm managers did not believe that their location offered advantages in accessing suppliers, customers and skills today, compared with the past. Many firms recruiting skilled and unskilled workers both within their cluster and outside of it and also engaged with suppliers and customers in the same manner, with a large proportion of both of these based outside of the firms' cluster. Customer pressure to reduce costs, concomitant to, or perhaps as a result of, increasing globalisation and competition from low-cost countries, was cited by firm managers as the most significant factor precipitating their agnostic view of a supplier's location and which reduced the importance of face-to-face interaction, contrary to some cluster literature (Driffield and Munday, 2000). A further related unexpected result was that the use of ICT for virtual communication between firms and their suppliers and customers was not influenced by location and occurred with firms in close proximity to each other in a cluster in addition to those located at a greater distance: "There are many high-technology or other knowledge-intensive companies that are very loosely or not at all connected to their local environment which makes the bold generalisations related to the role of regions debatable" (Kolehmainen, 2002; p3).

This study confirmed that that the manner in which firms are managed affects their performance, ICT investment and its utilisation. Surprisingly, some managerial attributes such as the nature of the relationship between the CEO and the IT manager, and the success or failure of previous ICT implementations, had a lower influence that anticipated. In 'peeling the organisational layers' to discover the factors contributing to this, a mixed picture emerged. In some cases, firms with both high managerial practise scores and high ICT investment were highly productive, whilst in others, they were not. The latter was partly explained by a number of poorly performing firms that had recently been acquired and new managerial teams installed, with any effect on results not yet evident. In other cases, where new improved managers have been in place for an adequate period of time preceding this study, continued poor performance could not be accounted for by this factor, and was observed to be contributed to by factors such as the quality of the firm's customer base, its product mix, the nature of its technology, and macro factors such as competition. Location was not an influencing factor in the implementation of ICT between firms, with deeper initiatives such as the integration of inventory systems, ERP and e-ordering occurring between firms irrespective of their proximity, and primarily driven by commercial and competitive pressures. At an overarching level, the ownership of the firm was found to influence both the planning and expenditure of ICT, with variations in managerial practices existing within firm types and between them, affecting the factors of production as mediated by organisational actors and ICT. Firm-level exploration revealed variations in the execution of managerial activities that both influenced, and were influenced by, the aerospace ecosystem in which they were ensconced and the acceptance of some hypotheses and the rejection of others. Whilst confirming that managerial practices matter, this study also revealed *how they matter,* and what impact they have on ICT. When juxtaposed against a firm's performance, the information obtained through the use of an integrated holistic methodology incorporating an at-a-distance and up-close approach provides the explanation for many of the results. This study is currently both unique and makes an original contribution in the process.

9.2 Contribution

The effect of managerial practices on productivity and ICT is not adequately explored in the literature. Some research has explored the impact of managerial decision making on technology investment (Lefebvre et al, 1997; Suitaris, 2001), but minimal investigation has occurred on the impact this might have on firm productivity. The influence of managerial policies and actions on firm activity remains relatively unexplored, with the only directly applicable research in this field being from Bloom et al (2005; 2006). Although this is currently leading work, it is primarily econometric and utilises an 'at a distance' approach predicated on telephone interviews. This study adopts the CEP-McKinsey methodology at its outset, before extending it further. This process includes the initial use of the tool to quantify management practices before additional interviews are added at numerous organisational levels (contrasting the single point in the original methodology), and in-situ investigations that replicate interviews face-to-face at numerous organisational levels and exploratory investigations that focus on a number of the study's themes. The use of business clusters as an environment in which to assess the defined activities also enhances this study making an original contribution. Despite the plethora of work existing on business clusters, the themes of management practices and ICT utilisation have not been investigated within this context. This study addresses the lacuna at the nexus of managerial practices, ICT, business clusters and productivity, through an interdisciplinary approach that draws on information systems, management studies and economics. The defined framework facilitates the exploration of the *actual* effect of managerial practices. In addressing these issues, theoretical and empirical contributions are made, concomitant to the addition of a new reference point in the literature.

9.2.1 Theoretical Contribution

This study makes a theoretical contribution to the current literature through the incorporation of a number of leading methodologies in one schema, and the extension of these to explore topical themes in a multidisciplinary manner encompassing information systems, management, and economics. This study goes further than the research from which it has drawn upon, providing evidence and data that bridge some of the current theoretical deficits. This includes a more detailed assessment of the factors influencing location in a 21st Century context, addresses some of the shortcomings of current proximity theories as highlighted by Martin and Sunley (2003): "To be convincing, cluster theory ought to be able to specify a priori how different sorts of clusters are likely to develop under different conditions. Otherwise, explanation is reduced to a 'best-fit' exercise on a case by case basis" (p23). This study has 'scratched the surface' of this issue, but in the absence of readily available data, has made a theoretical contribution, demonstrating that identification with a cluster appears to be of lower relevance for many aerospace firms today than it has been in the past. An additional theoretical contribution has been made in the granular assessment of ICT as a mediating tool in the enhancement of firm performance which is currently missing in the literature. The UK focus of this study has established data that can be compared with the results of other countries, particularly the US, if the study is replicated, partly addressing Bloom et al's (2005) question: "Why are US firms able to achieve these 'IT friendly' organisational forms and their European counterparts cannot?"(p20). Logistical, time and cost considerations did not permit this study to be a multi-country assessment. A further theoretical contribution has been made by providing an understanding of how managerial practices in UK aerospace firms can impact their ICT and technology utilisation, as well as their location. Further research can complement this contribution in order to address Bloom et al's (2006) recommendation that, "it is important to follow up these firms in order to examine the extent to which management practice evolves over time" (p27). The holistic, interdisciplinary framework of this study extends the current narrower investigation of managerial practices, and in the process makes a theoretical contribution, addressing the shortcomings evident in the literature. The theoretical model developed depicts the mediation of firm performance via ICT as influenced by managerial practices within the organisation, and their interplay with location. This provides a theoretical layer glaringly absent from current theory, which can spur future research agendas.

9.2.2 Empirical Contribution

The literature primarily addresses the interplay between information systems and organisational participants at an aggregate level. This study makes an empirical contribution by using a fine-grained firm-level assessment of the effects of managerial practices on ICT-driven productivity. This assimilates one of the only tools available for the quantification of managerial practices with firm-level quantitative and qualitative investigations of these, ICT, and location. The exploration of the use of ICT in the firm and its choice of location have drawn upon a number of relevant studies and their methodologies, which extract empirical data whilst concomitantly providing a springboard for the gathering of supporting qualitative information. This study is one of the first efforts to bridge the deficit at the locus of the themes of management, ICT and location, utilising a methodology that assimilates leading tools in a schema that extends their current application in order to identify possible influences on firm performance. The cadre of data generated empirically underpin the investigation, with further observations and information complementing this at a number of levels. The fusing of a number of leading methodologies addressing a defined lacuna, coupled with their subsequent extension in a schema that is replica table, makes an empirical contribution. The vantage point created in the process also provides an opportunity for additional research to be undertaken.

9.2.3 Contribution to the Literature

The study of the influence of managerial practices on ICT driven productivity is almost completely unaddressed in any discipline. This becomes acute when the issue of location is incorporated, contrasting the plethora of research only addressing agglomeration and the perceived benefits of clustering. Despite this volume of material, minimal research addresses the firm-level drivers for clustering or businesses location decisions, especially in a 21st Century context, with the increasing ubiquity of ICT. By bringing these themes together under one investigative umbrella, this study makes a leading and original contribution to the literature. Secondly, when this lacuna is combined with the topical nature of the subject matter in both the private and public sector, other researchers could be spurred to explore individual strands identified in this study, including those that yielded more surprising results. Third, the interdisciplinary nature of the research makes a broad contribution to the literature in more than one discipline. Fourth, this research lends itself to an integration with current economic studies on productivity practices that seek empirical 'up close' firm level data to compare against their aggregate results. Such studies do not explore the effect of managerial practices on ICT, nor do they provide analysis in an intra, inter-firm, or social context.

9.3 Limitations

Whilst the study is believed to be a robust investigation of the relationship between managerial practices, ICT and firm performance in the aerospace sector, a number of limitations exist. First, the small sample does not permit all quantitative tools to yield results from the combination of some variables that are observed in individual results. This was particularly the case with the inclusion of a greater number of variables in a production function. Second, the results from the sample may not be representative of the broader aerospace sector and may be confined to the group assessed. The use of multiple case-studies seeks to minimise this however. The study's results are not expected to hold for every firm in aerospace, but it is believed that recommendations can be drawn from the findings which might benefit aerospace firms outside of the investigated cases. It is recognised that even if this occurs, the study may only be valid to the aerospace sector. Third, the issue of replication may be a limitation of the study. The methodology is unique, with a fused approach incorporating the administering of a questionnaire with secondary research and in-situ observations. The use of the CEP-McKinsey questionnaire requires training and practice in order for its correct use to occur. This is essential for in its absence, the interview might be rendered invalid due to the scores not reflecting the responses being provided. It is acknowledged that this training cannot be readily obtained, which could inhibit a comparable study occurring. Fourth, the evidence collected might not be of sufficient quality to be a true reflection of the managerial practices of the firm and the ICT utilised. Fifth, the introduction of any leading questions in the questionnaire has the potential to 'talk up' a manager's results and diminish the quality of the data collected. Sixth, the mix of firms selected might not be truly representative of the sector. The firms were selected from across the major UK -aerospace clusters, with the final mixture defined by those willing to participate and other considerations including logistical ones. If the selected firms were not representative of the sector, this could limit the generalisability the study.

9.4 Directions for Future Research

This study has 'scratched the surface' of the influence of managerial practices on ICT mediated firm performance, and is currently one of the only such firm-level explorations. The limited research occurring on managerial practices within the firm is not adequately addressing the use of ICT or utilising in-situ firm-level observations. This study has sought to bridge this gap and explore these themes within the spatial agglomeration that characterises the aerospace sector, whilst concurrently extending the investigation into the milieu of virtual clustering. In doing so, a number of themes emerged that lend themselves to further research. One of these is the role that ICT plays in the development and maintenance of local industrial clusters. This study has revealed that many firm managers were agnostic of the distance between their firm and their suppliers and customers when implementing a virtual cluster. Currently however, no studies exist that investigate this in sufficient detail. Additional research could be undertaken exploring firm manager's use of virtual clustering. A further area identified for future research is the relationship between firm ownership, ICT use and performance, with a particular focus on primogeniture firms. A limited number of studies have explored the performance of managerial practices in primogeniture firms and posit that poorer performance is a characteristic of these firms (Bloom and Van Reenen 2006). Additional research could explore if primogeniture status constitutes a sizeable liability to firm performance (Bennedsen et al 2007), or if the results discovered in this study are more reflective of firm performance under this type of ownership. The limited sample size in this study prohibits further conclusions being reached. The aerospace sector is ideal for further exploration of this theme due to the high degree of inherent competition which has been posited to affect firm performance and perhaps compensate for firm ownership status (ibid).

Although a number of this study's results were not statistically significant, in some cases, the trends were contrary to those expected and warrant further research. One such result is the process of e-commerce adoption by various firm-types. Although this study supports the hypothesis that this occurs in a staged manner overall, it is believed that further research could lead to a better understanding of the drivers influencing adoption in specific firm-types. This could benefit policy makers developing initiatives aimed at improving the adoption and use of e-commerce, particularly within smaller firms. A further area warranting additional research is wage pressure for skilled aerospace workers. This issue is topical and the focus of some activity by policymakers as they attempt to maintain a skilled UK aerospace industry. A more detailed understanding of the factors that lead to this type of worker moving around within the UK, as well as relocating outside of the Country, could be of assistance to both national and local policy makers seeking to retain skills. One of the final directions identified for possible future research is the exploration of employee perception of ICT and the relationship that this may have with the adoption of ICT within the firm. This study reveals that the successful adoption of ICT is not a precursor to its further implementation. A more detailed investigation of this issue is recommended utilising a qualitative firm-level approach. It is believed that this can permit a more detailed assessment to occur of the influence that previous and current ICT successes and failures have on the subsequent adoption and implementation of ICT.

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APPENDIX A: DETAILS OF THE SURVEY QUESTIONNAIRES

TABLE A1: MANAGEMENT PRACTICE INTERVIEW GUIDE AND EXAMPLE RESPONSES

Any score from 1 to 5 can be given, but the scoring guide and examples are only provided for scores of 1, 3 and 5. Multiple questions are used for each dimension to improve scoring accuracy.

(1) Modern manufacturing, introduction

a) Can you describe the production process for me?
b) What kinds of lean (modern) manufacturing processes have you introduced? Can you give me specific examples?
c) How do you manage inventory levels? What is done to balance the line?

	Score 1	Score 3	Score 5
Scoring grid:	Other than Just-In-Time (JIT) delivery from suppliers few modern manufacturing techniques have been introduced, (or have been introduced in an ad-hoc manner)	Some aspects of modern manufacturing techniques have been introduced, through informal/isolated change programs	All major aspects of modern manufacturing have been introduced (Just-In-Time, autonomation, flexible manpower, support systems, attitudes and behaviour) in a formal way
Examples:	A UK firm orders in bulk and stores the material on average 6 months before use. The business focuses on quality and not reduction of lead-time or costs. Absolutely no modern manufacturing techniques had been introduced.	A supplier to the army is undergoing a full lean transformation. For 20 years, the company was a specialty supplier to the army, but now they have had to identify other competencies forcing them to compete with lean manufacturers. They have begun adopting specific lean techniques and plan to use full lean by the end of next year.	A US firm has formally introduced all major elements of modern production. It reconfigured the factory floor based on value stream mapping and 5-S principles, broke production into cells, eliminated stockrooms, implemented Kanban, and adopted Takt time analyses to organize workflow [these are all forms of lean/modern manufacturing techniques].

(2) Modern manufacturing, rationale

a) Can you take through the rationale to introduce these processes?
b) What factors led to the adoption of these lean (modern) management practices?

	Score 1	Score 3	Score 5
Scoring grid:	Modern manufacturing techniques were introduced because others were using them.	Modern manufacturing techniques were introduced to reduce costs	Modern manufacturing techniques were introduced to enable us to meet our business objectives (including costs)
Examples:	A German firm introduced modern techniques because all its competitors were using these techniques. The business decision had been taken to imitate the competition.	A French firm introduced modern manufacturing methods primarily to reduce costs.	A US firm implemented lean techniques because the COO had worked with them before and knew that they would enable the business to reduce costs, competing with cheaper imports through improved quality, flexible production, greater innovation and JIT delivery.

(3) Process problem documentation

a) How would you go about improving the manufacturing process itself?
b) How do problems typically get exposed and fixed?
c) Talk me through the process for a recent problem.
d) Do the staff ever suggest process improvements?

	Score 1	Score 3	Score 5
Scoring grid:	No, process improvements are made when problems occur.	Improvements are made in one week workshops involving all staff, to improve performance in their area of the plant	Exposing problems in a structured way is integral to individuals' responsibilities and resolution occurs as a part of normal business processes rather than by extraordinary effort/teams
Examples:	A US firm has no formal or informal mechanism in place for either process documentation or improvement. The manager admitted that production takes place in an environment where nothing has been done to encourage or support process innovation.	A US firm takes suggestions via an anonymous box, they then review these each week in their section meeting and decide any that they would like to proceed with.	The employees of a German firm constantly analyse the production process as part of their normal duty. They film critical production steps to analyse areas more thoroughly. Every problem is registered in a special database that monitors critical processes and each issue must be reviewed and signed off by a manager.

(4) Performance tracking

a) Tell me how you track production performance?
b) What kind of Key Performance Indicators (KPIs) would you use for performance tracking? How frequently are these measured? Who gets to see this KPI data?
c) If I were to walk through your factory could I tell how you were doing against your KPI's?

	Score 1	Score 3	Score 5
Scoring grid:	Measures tracked do not indicate directly if overall business objectives are being met. Tracking is an ad-hoc process (certain processes aren't tracked at all)	Most key performance indicators are tracked formally. Tracking is overseen by senior management.	Performance is continuously tracked and communicated, both formally and informally, to all staff using a range of visual management tools.
Examples:	A manager of a US firm tracks a range of measures when he does not think that output is sufficient. He last requested these reports about 8 months ago and had them printed for a week until output increased again.	At a US firm every product is bar-coded and performance indicators are tracked throughout the production process; however, this information is not communicated to workers	A US firm has screens in view of every line. These screens are used to display progress to daily target and other performance indicators. The manager meets with the shop floor every morning to discuss the day past and the one ahead and uses monthly company meetings to present a larger view of the goals to date and strategic direction of the business to employees. He even stamps napkins with key performance achievements to ensure everyone is aware of a target that has been hit.

(5) Performance review	a) How do you review your Key Performance Indicators (KPIs)? b) Tell me about a recent meeting c) Who is involved in these meetings? Who gets to see the results of this review?		
	Score 1	**Score 3**	**Score 5**
Scoring grid:	Performance is reviewed infrequently or in an un-meaningful way, e.g. only success or failure is noted.	Performance is reviewed periodically with successes and failures identified. Results are communicated to senior management. No clear follow-up plan is adopted.	Performance is continually reviewed, based on indicators tracked. All aspects are followed up ensure continuous improvement. Results are communicated to all staff
Examples:	A manager of a US firm relies heavily on his gut feel of the business. He will review costs when he thinks there is too much or too little in the stores. He admits he is busy so reviews are infrequent. He also mentioned staffs feel like he is going on a hunt to find a problem, so he has now made a point of highlighting anything good.	A UK firm uses daily production meetings to compare performance to plan. However, clear action plans are infrequently developed based on these production results.	A French firm tracks all performance numbers real time (amount, quality etc). These numbers are continuously matched to the plan on a shift-by-shift basis. Every employee can access these figures on workstations on the shop floor. If scheduled numbers are not met, action for improvement is taken immediately.
(6) Performance dialogue	a) How are these meetings structured? Tell me about your most recent meeting. b) During these meeting, how much useful data do you have? c) How useful do you find problem solving meetings? d) What type of feedback occurs in these meetings?		
	Score 1	**Score 3**	**Score 5**
Scoring grid:	The right data or information for a constructive discussion is often not present or conversations overly focus on data that is not meaningful. Clear agenda is not known and purpose is not stated explicitly	Review conversations are held with the appropriate data and information present. Objectives of meetings are clear to all participating and a clear agenda is present. Conversations do not, as a matter of course, drive to the root causes of the problems.	Regular review/performance conversations focus on problem solving and addressing root causes. Purpose, agenda and follow-up steps are clear to all. Meetings are an opportunity for constructive feedback and coaching.
Examples:	A US firm does not conduct staff reviews. It was just "not the philosophy of the company" to do that. The company was very successful during the last decade and therefore did not feel the need to review their performance.	A UK firm focuses on key areas to discuss each week. This ensures they receive consistent management attention and everyone comes prepared. However, meetings are more of an opportunity for everyone to stay abreast of current issues rather than problem solve.	A German firm meets weekly to discuss performance with workers and management. Participants come from all departments (shop floor, sales, R&D, procurement etc.) to discuss the previous week performance and to identify areas to improve. They focus on the cause of problems and agree topics to be followed up the next week, allocating all tasks to individual participants.

(7) Consequence management

a) What happens if there is a part of the business (or a manager) who isn't achieving agreed upon results? Can you give me a recent example?
b) What kind of consequences would follow such an action?
c) Are there are any parts of the business (or managers) that seem to repeatedly fail to carry out agreed actions?

	Score 1	Score 3	Score 5
Scoring grid:	Failure to achieve agreed objectives does not carry any consequences	Failure to achieve agreed results is tolerated for a period before action is taken.	A failure to achieve agreed targets drives retraining in identified areas of weakness or moving individuals to where their skills are appropriate
Examples:	At a French firm, no action is taken when objectives are not achieved. The President personally intervenes to warn employees but no stricter action is taken. Cutting payroll or making people redundant because of a lack of performance is very rarely done.	Management of a US firm reviews performance quarterly. That is the earliest they can react to any underperformance. They increase pressure on the employees if targets are not met.	A German firm takes action as soon as a weakness is identified. They have even employed a psychologist to improve behavior within a difficult group. People receive ongoing training to improve performance. If this doesn't help they move them in other departments or even fire individuals if they repeatedly fail to meet agreed targets

(8) Target balance

a) What types of targets are set for the company? What are the goals for your plant?
b) Tell me about the financial and non-financial goals?
c) What does Company Head Quarters (CHQ) or their appropriate manager emphasize to you?

	Score 1	Score 3	Score 5
Scoring grid:	Goals are exclusively financial or operational	Goals include non-financial targets, which form part of the performance appraisal of top management only (they are not reinforced throughout the rest of organization)	Goals are a balance of financial and non-financial targets. Senior managers believe the non-financial targets are often more inspiring and challenging than financials alone.
Examples:	At a UK, firm performance targets are exclusively operational. Specifically volume is the only meaningful objective for managers, with no targeting of quality, flexibility or waste.	For French firm strategic goals are very important. They focus on market share and try to hold their position in technology leadership. However, workers on the shop floor are not aware of those targets.	A US firm gives everyone a mix of operational and financial targets. They communicate financial targets to the shop floor in a way they found effective – for example telling workers they pack boxes to pay the overheads until lunchtime and after lunch it is all profit for the business. If they are having a good day the boards immediately adjust and play the "profit jingle" to let the shop floor know that they are now working for profit. Everyone cheers when the jingle is played.

(9) Target interconnection

a) What is the motivation behind your goals?
b) How are these goals cascaded down to the individual workers?
c) What are the goals of the top management team (do they even know what they are!)?
d) How are your targets linked to company performance and their goals?

	Score 1	Score 3	Score 5
Scoring grid:	Goals are based purely on accounting figures (with no clear connection to shareholder value)	Corporate goals are based on shareholder value but are not clearly communicated down to individuals	Corporate goals focus on shareholder value. They increase in specificity as they cascade through business units ultimately defining individual performance expectations.
Examples:	A family owned firm in France is only concerned about the net income for the year. They try to maximize income every year without focusing on any long term consequences.	A US firm bases its strategic corporate goals on enhancing shareholder value, but does not clearly communicate this to workers. Departments and individuals have little understanding of their connection to profitability or value with many areas labeled as "cost-centers" with an objective to cost-cut despite potentially disproportionately large negative impact on the other departments they serve.	For a US firm strategic planning begins with a bottom up approach that is then compared with the top down aims. Multifunctional teams meet every 6 months to track and plan deliverables for each area. This is then presented to the area head that then agrees or refines it and then communicates it down to his lowest level. Everyone has to know exactly how he or she contributes to the overall goals or else they will not understand how important the 10 hours they spend at work every day is to the business.

(10) Target time horizon

a) What kind of time scale are you looking at with your targets?
b) Which goals receive the most emphasis?
c) How are long term goals linked to short term goals?
d) Could you meet all your short-run goals but miss your long-run goals?

	Score 1	Score 3	Score 5
Scoring grid:	Top management's main focus is on short term targets	There are short and long-term goals for all levels of the organization. As they are set independently, they are not necessarily linked to each other	Long term goals are translated into specific short term targets so that short term targets become a "staircase" to reach long term goals
Examples:	A UK firm has had several years of ongoing senior management changes – therefore senior managers are only focusing on how the company is doing this month versus the next, believing that long-term targets will take care of themselves.	A US firm has both long and short-term goals. The senior managers know the long-term goals and the short-term goals are the remit of the operational managers. Operations managers only occasionally see the longer-term goals so are often unsure how they link with the short term goals.	A UK firm translates all their goals – even their 5-year strategic goals - into short-term goals so they can track their performance to them. They believe that it is only when you make someone accountable for delivery within a sensible timeframe that a long-term objective will be met. They think it is more interesting for employees to have a mix of immediate and longer-term goals.

(11) Targets are stretching

a) How tough are your targets? Do you feel pushed by them?
b) On average, how often would you say that you meet your targets?
c) Are there any targets which are obviously too easy (will always be met) or too hard (will never be met)?
d) Do you feel that on targets that all groups receive the same degree of difficulty? Do some groups get easy targets?

	Score 1	Score 3	Score 5
Scoring grid:	Goals are either too easy or impossible to achieve; managers provide low estimates to ensure easy goals	In most areas, top management pushes for aggressive goals based on solid economic rationale. There are a few "sacred cows" that are not held to the same rigorous standard	Goals are genuinely demanding for all divisions. They are grounded in solid, solid economic rationale
Examples:	A French firm uses easy targets to improve staff morale and encourage people. They find it difficult to set harder goals because people just give up and managers refuse to work people harder.	A chemicals firm has 2 divisions, producing special chemicals for very different markets (military, civil). Easier levels of targets are requested from the founding and more prestigious military division.	A manager of a UK firm insisted that he has to set aggressive and demanding goals for everyone – even security. If they hit all their targets he worries he has not stretched them enough. Each KPI is linked to the overall business plan.

(12) Performance clarity

a) What are your targets (i.e. do they know them exactly)? Tell me about them in full.
b) Does everyone know their targets? Does anyone complain that the targets are too complex?
c) How do people know about their own performance compared to other people's performance?

	Score 1	Score 3	Score 5
Scoring grid:	Performance measures are complex and not clearly understood. Individual performance is not made public	Performance measures are well defined and communicated; performance is public in all levels but comparisons are discouraged	Performance measures are well defined, strongly communicated and reinforced at all reviews; performance and rankings are made public to induce competition
Examples:	A German firm measures performance per employee based on differential weighting across 12 factors, each with its own measurement formulas (e.g. Individual versus average of the team, increase on prior performance, thresholds etc.). Employees complain the formula is too complex to understand, and even the plant manager could not remember all the details.	A French firm does not encourage simple individual performance measures as unions pressure them to avoid this. However, charts display the actual overall production process against the plan for teams on regular basis.	At a US firm self-directed teams set and monitor their own goals. These goals and their subsequent outcomes are posted throughout the company, encouraging competition in both target setting and achievement. Individual members know where they are ranked which is communicated personally to them bi-annually. Quarterly company meetings seek to review performance and align targets.

(13) Managing human capital

a) Do senior managers discuss attracting and developing talented people?
b) Do senior managers get any rewards for bringing in and keeping talented people in the company?
c) Can you tell me about the talented people you have developed within your team? Did you get any rewards for this?

	Score 1	Score 3	Score 5
Scoring grid:	Senior management **do not** communicate that attracting, retaining and developing talent throughout the organization is a top priority	Senior management believe and communicate that having top talent throughout the organization is a key way to win	Senior managers are evaluated and held accountable on the strength of the talent pool they actively build
Examples:	A US firm does not actively train or develop its employees, and does not conduct performance appraisals or employee reviews. People are seen as a secondary input to the production.	A US firm strives to attract and retain talent throughout the organization, but does not hold managers individually accountable for the talent pool they build. The company actively cross-trains employees for development and challenges them through exposure to a variety of technologies.	A UK firm benchmarks human resources practices at leading firms. A cross-functional HR excellence committee develops policies and strategies to achieve company goals. Bi-monthly directors' meetings seek to identify training and development opportunities for talented performers.

(14) Rewarding high-performance

a) How does you appraisal system work? Tell me about the most recent round?
b) How does the bonus system work?
c) Are there any non-financial rewards for top-performers?
d) How does your reward system compare to your competitors?

	Score 1	Score 3	Score 5
Scoring grid:	People within our firm are rewarded equally irrespective of performance level	Our company has an evaluation system for the awarding of performance related rewards	We strive to outperform the competitors by providing ambitious stretch targets with clear performance related accountability and rewards
Examples:	An East Germany firm pays its people equally and regardless of performance. The management said to us "there are no incentives to perform well in our company". Even the management is paid an hourly wage, with no bonus pay.	A German firm has an awards system based on three components: the individual's performance, shift performance, and overall company performance.	A US firm sets ambitious targets, rewarded through a combination of bonuses linked to performance, team lunches cooked by management, family picnics, movie passes and dinner vouchers at nice local restaurants. They also motivate staff to try by giving awards for perfect attendance, best suggestion etc.

(15) Removing poor performers

a) If you had a worker who could not do his job what would you do? Could you give me a recent example?
b) How long would underperformance be tolerated?
c) Do you find any workers who lead a sort of charmed life? Do some individuals always just manage to avoid being fixed/fired?

	Score 1	Score 3	Score 5
Scoring grid:	Poor performers are rarely removed from their positions	Suspected poor performers stay in a position for a few years before action is taken	We move poor performers out of the company or to less critical roles as soon as a weakness is identified
Examples:	A French firm had a supervisor who was regularly drinking alcohol at work but no action was taken to help him or move him. In fact, no employee had ever been laid off in the factory. According to the plant manager HR "kicked up a real fuss" whenever management wanted to get rid of employees, and told managers their job was production not personnel.	For a German firm it is very hard to remove poor performers. The management has to prove at least three times that an individual underperformed before they can take serious action.	At a US firm, the manager fired four people during last couple of months due to underperformance. They continually investigate why and who are underperforming.

(16) Promoting high performers

a) Can you rise up the company rapidly if you are really good? Are there any examples you can think of?
b) What about poor performers – do they get promoted more slowly? Are there any examples you can think of?
c) How would you identify and develop (i.e. train) your star performers?
d) If two people both joined the company 5 years ago and one was much better than the other would he/she be promoted faster?

	Score 1	Score 3	Score 5
Scoring grid:	People are promoted primarily upon the basis of tenure	People are promoted upon the basis of performance	We actively identify, develop and promote our top performers
Examples:	A UK firm promotes based on an individual's commitment to the company measured by experience. Hence, almost all employees move up the firm in lock step. Management was afraid to change this process because it would create bad feeling among the older employees who were resistant to change.	A US firm has no formal training program. People learn on the job and are promoted based on their performance on the job.	At a UK firm each employee is given a red light (not performing), amber light (doing well and meeting targets) a green light (consistently meeting targets very high performer) and a blue light (high performer capable of promotion of up to two levels). Each manager is assessed every quarter based on his succession plans and development plans for individuals.

(17) Attracting human capital

a) What makes it distinctive to work at your company as opposed to your competitors?
b) If you were trying to sell your firm to me how would you do this (get them to try to do this)?
c) What don't people like about working in your firm?

	Score 1	Score 3	Score 5
Scoring grid:	Our competitors offer stronger reasons for talented people to join their companies	Our value proposition to those joining our company is comparable to those offered by others in the sector	We provide a unique value proposition to encourage talented people join our company above our competitors
Examples:	A manager of a firm in Germany could not give an example of a distinctive employee proposition and (when pushed) thinks the offer is worse than most of its competitors. He thought that people working at the firm "have drawn the short straw".	A US firm seeks to create a value proposition comparable to its competitors and other local companies by offering competitive pay, a family atmosphere, and a positive presence in the community.	A German firm offers a unique value proposition through development and training programs, family culture in the company and very flexible working hours. It also strives to reduce bureaucracy and seeks to push decision making down to the lowest levels possible to make workers feel empowered and valued.

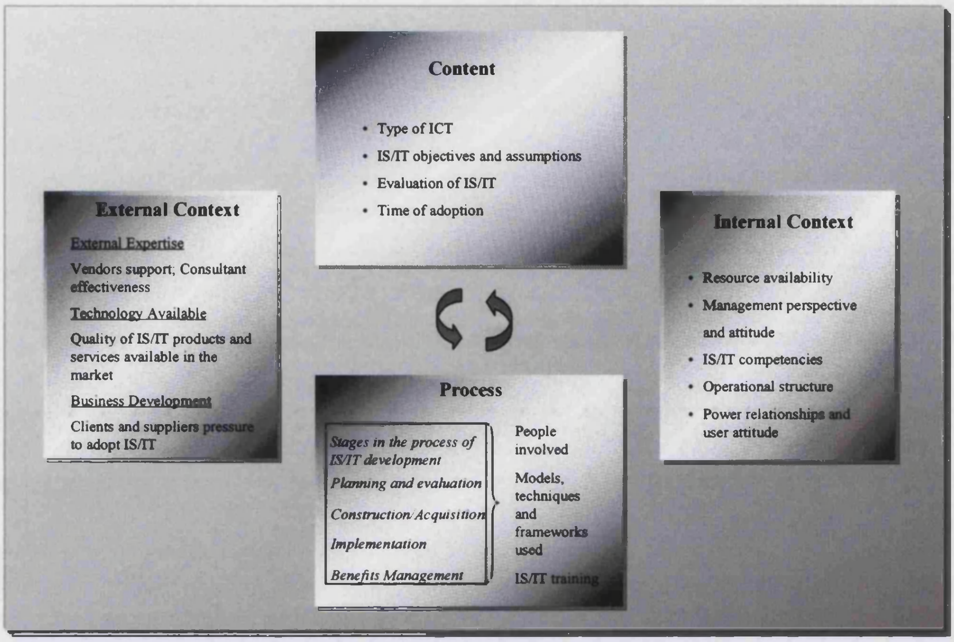
(18) Retaining human capital

a) If you had a star performer who wanted to leave what would the company do?
b) Could you give me an example of a star performers being persuaded to stay after wanting to leave?
c) Could you give me an example of a star performer who left the company without anyone trying to keep them?

	Score 1	Score 3	Score 5
Scoring grid:	We do little to try to keep our top talent.	We usually work hard to keep our top talent.	We do whatever it takes to retain our top talent.
Examples:	A German firm lets people leave the company if they want. They do nothing to keep those people since they think that it would make no sense to try to keep them. Management does not think they can keep people if they want to work somewhere else. The company also will not start salary negotiations to retain top talent.	If management of a French firm feels that people want to leave the company, they talk to them about their reasons for leaving and what the company could change to keep them. This could be more responsibilities or a better outlook for the future. Managers are supposed to "take-the-pulse" of employees to check satisfaction levels.	A US firm knows who its top performers are. If any of them signal an interest to leave the firm pulls in senior managers and even corporate Head Quarters to talk to them and try and persuade them to stay. Occasionally they will increase salary rates if necessary and if they feel the individual is being underpaid relative to the market. Managers have a responsibility to try to keep all desirable staff.

<u>**APPENDIX B: INVESTIGATIVE FRAMEWORK FOR IS AND ICT IN THE FIRM**</u>

The investigative framework for exploring IS and ICT in the firm was drawn from Caldeira and Ward (2003) who modernised Pettigrew's earlier work. It was based on the following schema, which is depicted in the text that follows. This has been supplemented by this study's author in order to facilitate a broader exploration of ICT areas and themes.



(Source: Caldeira and Ward, 2003, based on Pettigrew)

A. Content (Internal)

- Type of ICT
    - What is used?
    - Define it by system, software, hardware telecom solutions, broadband? etc
    - If more than one SME exists within a company structure, separate data out by SME
    - What is the level of ICT adoption?
        - Administrative systems
        - Core manufacturing processes
        - Core integrated processes
        - External integration

- ICT objectives and assumptions
    - What drove the decision to use the ICT?
    - Has this changed over time?
    - What assumptions influenced the decisions? i.e. business objectives? Operational? Financial?
    - Are there ever conflicts in selecting ICT?
    - How are these resolved? Formal? Informal? Length of time taken to resolve.
    - Who drives the objectives? CEO? IT Director/Manager?
    - Are objectives part of broader plans? Or are they 'stand-alone'?
    - Are objectives clearly conveyed throughout the organisation?
    - Are these objective set together with any trading partners? If so, are objective similar for all firms?

- Evaluation of ICT
    - Obtain clear assessment of the assumptions underpinning decisions
    - If it is, what does the evaluation cycle look like?
    - Who in the company is aware of these issues? Is staff involved? Per cent management decision: staff
    - Who prioritises ICT investment?
    - What criteria are used?

- Time of adoption.
    - What is the average length of time between request and allocation of ICT?
    - What happens if ICT is deemed 'urgent'?
    - Are there any organisational issues to contend with when ordering ICT?
    - What process exists to define acceptable uses of ICT? Boundaries set by whom? Parameters for adoption?
    - Conflicts in the adoption of ICT? Resolution?

B. External Context

External Expertise

- Vendors involvement and support
    - Reasons for selecting vendors?
    - How are vendors involved in the ICT process? Examples?
    - Support received from vendors
    - Financial support- discounts? Full price? Maintenance agreements?
    - Have vendors influenced previous decisions on ICT investment?
    - Relationships with external vendors: remote; physical; on-site; influence on internal decision process;

- External effectiveness.
    - Have ICT (IT/IS) consultants been used in the past?
    - Objectives in using consultants
    - Cultural issues between the firm and consultants.
    - Who selects external resources? Any issues/conflicts due to the use of external resources? Impact on ICT
    - Deliverables. On time?
    - Examples? Include scale of project, £, time, divisions affected
    - How much spent on consultants: per cent business IS/IT budget; absolute £
    - Aims of using consultants
    - Effective?
    - Used again? Where proposed
    - Who is responsible for relationship with consultants? How is this managed? Attempts at influence?
    - Communication process with consultants? Email? Written? Formalised?

Technology Available

- Quality of ICT products and services available in the market.
    - How does the selected product compare with competing ones?
    - Only product available?
    - Any issues affecting production due to quality?
    - Have these been rectified? Timely manner?
    - Any issues buying internationally?

Business Environment

- Clients and suppliers: pressure to adopt ICT.
    - Any specific processes, standards, or targets set for the company's production?
    - Past examples of those adopted and time fames, locations.
    - Main motivation cited for these
    - Changes in environment over last 3-5 years?
    - Environmental pressure on ICT overall
    - Main changes in requests by these two over time: Relationships and shift of these.
    - Changes in ICT made to conform?

- Clusters: Virtual Physical Influence. How is firm linked to customers? Sub-contractors? Digital?
    - How long? Benefits? Costs? Strategy?
    - Uniform ICT policy across participants? Who dictates this?
    - How is ICT determined across cluster?
    - Do firms share ICT information? Training? Other policies?
    - Are common suppliers used? Is training shared?
    - Future plans for cluster participation
    - Impediments to ICT adoption for cluster; Likely to change? Waiting for trigger point/event?
    - How is cluster participation selected?
    - Other background and issues on cluster/virtual links

- Social Issues:
    - Community in which the firm is 'embedded'
    - Benefits of ICT to the community?
    - National policy issues?
    - Political issues: local agencies? Influence on decision making? Supported by local grants? Influence of any specific individual within the community? Pro/con.
    - Press issues and influence of lobby groups?
    - Environmental issues of influence
    - Spillovers into the community? Positive social capital? Social connectedness?
    - Embededness: Social networks within the firm. Map these; Confidence between the firm and suppliers/actors; Hierarchy of the firm;
    - Do the firms' ICT policies affect the community at all? Vice versa?
    - Key relationships between firms and the community

C. Process

- Stages in the process of ICT development: People involved
    - Outline the people involved decision/gate process for ICT introduction
    - Is formal planning involved for ICT?
    - Is ICT a part of business and operational planning?
    - Changed over time? Why if so?
    - Is HQ involved in this?
    - What is the sign off jurisdiction for the people/titles involved?
    - How much of this has been driven externally, versus internally? Examples.

- Planning and Evaluation Models: techniques and frameworks used
    - Outline the people involved decision/gate process for ICT introduction
    - Is a formal process followed when selecting ICT? Who? Separate Dept?
    - What technique/framework is used?
    - Evolved over time? Why? Plans to change?

- Construction / Acquisition
    - Is all ICT acquired? If not, is any developed in-house?
    - Decision: one versus another. Process, influences, etc
    - Changed over time?
    - Collaboration with others?

- Implementation: ICT training
    - How is implementation approached?
    - Outline ICT training strategy in the company. Examples.
    - Criteria for training
    - How often? Updating skills
    - New staff. Any ICT training?
    - 'Bottom up' training. How deep does this go? Basic MS products? Stepped up from there.
    - Other training: what and why?

- Benefits Management
    - IS ICT monitored over time to report on its benefits?
    - If so how? If not, why?
    - IS any type of benchmarking used?
    - How is satisfaction with ICT measured?
    - If not happy with this, what changes are made?
    - Does this need top level approval?

D. Internal Context

- Financial resources
    - Are adequate financial resources available for ICT investment?
    - What are these? Relative and per cent
    - Last time major investment made: Size
    - How is ICT financed? Retained earnings? Grants? Borrowings? Other (what)
    - Is funding an issue in ICT investment?
    - If divisional company. Is HQ involved? Threshold of investment decisions (£/$).
    -

- Human Resources

  - ICT recruitment policy
  - Identification process of talent/skills
  - Priority in the business of ICT skills
  - Is there a team/person internally that manages training? External?
  - Is training attached to any specific events? I.e. new ICT, cyclical, new staff hire etc.

- Management perspectives and attitudes;
  - How is ICT function perceived by senior management?
  - Is CEO/CEO involved in ICT decisions? Planning? Processes?
  - Has the CEO any ICT experience?
  - Historical account of some ICT decisions and involvement of senior management
  - Attitude of management throughout the company to ICT
  - Is management aware of broader ICT issues?
  - How are competitors vis-à-vis company attitude?

- ICT competencies;
  - How are these identified?
  - Are these a priority?
  - Is there a strategy for maintaining competence in ICT?
  - How do gaps get identified and bridged? Do they?

- Organisational structure;
  - Org chart?
  - Has this changed over last 3-5 years?
  - Proactivity of senior management?
  - How does it compare with competitors?
  - Where does ICT fit in structure?
  - Is there an IS function and how does this fit in structure?

- Power relationships
  - What is the culture like within the company? Define it? ('ICT-friendly?')
  - Are there factions? Who dominates?
  - Are staff monitored in any way? How?
  - Influences on managers? How active is CEO?
  - Other influences in the firm? Owners? Shareholders?
  - Other external influences? Cluster? Elsewhere?
  - Reporting structure; decision making hierarchies.

- User attitudes
  - How do users in general rate ICT? Assess relative level of ICT success
    - Unsuccessful;
    - Less than satisfactory
    - Satisfactory
    - Success
  - Does it assist their day-to-day functions?
  - Stock take of ICT used
  - Issues/problems with ICT?
  - Management support of its use?
  - Does management follow through on ICT issues? Examples of either and consequences; How is it prioritised?
  - Staff attitudes to ICT introduction. Displaced? Threatened? Accepting?
  - Any reactions to ICT? 'Rebellion'? Protest? Impact on the firm? Has this been resolved?
  - Any fundamental changes to the functioning of the firm as a result?
  - Do users want to see any changes?
  - How do they rate the company's use of ICT? Culture? ICT-friendly?
  - How does it compare with their experience in the sector?
  - What would they change?
  - Internal barriers? What could be done better?
  - Does ICT help in performing their tasks?
  - Last time they went on training.
  - Is promotion dependent on any skills upgrade? Any trade qualifications require use of ICT?
  - Other ICT issues.

APPENDIX C: REGRESSION RESULTS – FIRM SIZE

Management Practices vs. Firm Size: Employees and Revenues

Regression: Managament Practices Score vs Firm Size (Employees)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.285794845
R Square	0.081678694
Adjusted R Square	0.037949108
Standard Error	0.435274229
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.353882695	0.353883	1.867813	0.18618077
Residual	21	3.978736736	0.189464		
Total	22	4.332619431			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.475582236	0.106483705	32.63957	1.76E-19	3.254137249	3.697027223	3.254137249	3.697027223
X Variable 1	7.58941E-05	5.55317E-05	1.36668	0.186181	-3.95905E-05	0.000191379	-3.95905E-05	0.000191379

Regression: Managament Practices Score vs Firm Size (Revenues)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.279834334
R Square	0.078307254
Adjusted R Square	0.034417124
Standard Error	0.436072509
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.339275532	0.339276	1.784165	0.195935766
Residual	21	3.993343899	0.190159		
Total	22	4.332619431			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.497439443	0.099586256	35.1197	3.88E-20	3.290338488	3.704540398	3.290338488	3.704540398
X Variable 1	7.41449E-11	5.55091E-11	1.335727	0.195936	-4.12925E-11	1.89582E-10	-4.12925E-11	1.89582E-10

APPENDIX D: REGRESSION RESULTS - PERFORMANCE

Management Practices vs. Productivity and ROCE

MP vs Productivity

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.729675003
R Square	0.532425609
Adjusted R Squa	0.510160162
Standard Error	0.082456045
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.162582021	0.162582021	23.9126394	7.77368E-05
Residual	21	0.142778987	0.006798999		
Total	22	0.305361008			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.47076968	0.141742833	-3.3212944	0.003244346	-0.765540033	-0.17599932	-0.76554003	-0.17599932
X Variable 1	0.19371399	0.039613866	4.890055153	7.77368E-05	0.111332446	0.276095534	0.111332446	0.276095534

Regression: ROCE v MP

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.497392826
R Square	0.247399623
Adjusted R Squa	0.21156151
Standard Error	13.69761835
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1295.221429	1295.221429	6.903254707	0.015740651
Residual	21	3940.119719	187.6247485		
Total	22	5235.341148			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-48.6028942	23.546354	-2.06413673	0.05157741	-97.57021777	0.364429422	-97.5702178	0.364429422
X Variable 1	17.2900695	6.580665109	2.627404557	0.015740651	3.604827279	30.97531171	3.604827279	30.97531171

APPENDIX E: REGRESSION RESULTS - INTERVIEWS

Management practices scores: Comparing interviews

[A] Regression Results: Interview one versus interview two

Interview 1 with interview 2 including originally interviewed person being re-interviewed.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.888038381
R Square	0.788612167
Adjusted R Squ	0.778546079
Standard Error	0.244757053
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4.693244856	4.693244856	78.34346585	1.569E-08
Residual	21	1.258026319	0.059906015		
Total	22	5.951271176			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.389208835	0.372114516	1.045938328	0.307480038	-0.3846457	1.163063331	-0.384645662	1.163063331
X Variable 1	0.948519863	0.107163044	8.851184432	1.56905E-08	0.72566211	1.171377611	0.725662115	1.171377611

Interview 1 originally interviewed person's result removed from interview 2

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.888631058
R Square	0.789665157
Adjusted R	0.779649212
Standard E	0.244146686
Observatio	23

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	1	4.699511485	4.699511485	78.84080458	1.49E-08
Residual	21	1.251759691	0.059607604		
Total	22	5.951271176			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Jpper 95.0%*
Intercept	0.357489936	0.374482418	0.954624085	0.350628442	-0.421289	1.136269	-0.421289	1.136269
X Variable :	0.959915515	0.108107914	8.879234459	1.48801E-08	0.735093	1.184738	0.735093	1.184738

[B] Z-test scores: Interview one versus interview two

z-Test: Two Sample for Means

	Variable 1	*Variable 2*
Mean	3.65173913	3.554718196
Known Variance	0.270512326	0.190468724
Observations	23	23
Hypothesized Mean Difference	0	
z	0.685311205	
P(Z<=z) one-tail	0.246573781	
z Critical one-tail	1.644853627	
P(Z<=z) two-tail	0.493147563	
z Critical two-tail	1.959963985	

APPENDIX F: REGRESSION RESULTS – ICT AND REVENUES

ICT expenditure (as a proportion of revenue) versus revenue

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.251341541
R Square	0.06317257
Adjusted R Square	0.01856174
Standard Error	1656085209
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3.88377E+18	3.88377E+18	1.416081478	0.247329325
Residual	21	5.7595E+19	2.74262E+18		
Total	22	6.14788E+19			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1191695078	513404314.6	2.321162959	0.03042115	124012361.3	2259377795	124012361.3	2259377795
X Variable 1	-45953908754	38616982588	-1.189992218	0.247329325	-1.26262E+11	34354502583	-1.26262E+11	34354502583

APPENDIX G: REGRESSION RESULTS – FORMAL EDUCATION AND PROFTABILITY

[A] Formal education of managers vs. firm profitability

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.069825988
R Square	0.004875669
Adjusted R Squan	-0.042511204
Standard Error	186486629.5
Observations	23

ANOVA

	df	SS	MS	F	Significance F
Regression	1	3.57826E+15	3.5783E+15	0.102890701	0.751558088
Residual	21	7.30323E+17	3.4777E+16		
Total	22	7.33901E+17			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-24281041.18	76560120.85	-0.31714999	0.754261367	-183496527.9	134934445.5	-183496527.9	134934445.5
X Variable 1	43794177.49	136530069.7	0.3207658	0.751558088	-240135644.7	327723999.6	-240135644.7	327723999.6

[B] Formal education of non-managers vs. firm profitability

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.349321376
R Square	0.122025424
Adjusted R Sq	0.080217111
Standard Error	175166074.3
Observations	23

ANOVA

	df	SS	MS	F	Significance F
Regression	1	8.95546E+16	8.95546E+16	2.9186881	0.1022998
Residual	21	6.44346E+17	3.06832E+16		
Total	22	7.33901E+17			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-60966168.94	49802183.4	-1.22416659	0.2344463	-164535478.7	42603140.77	-164535478.7	42603140.77
X Variable 1	330923196.6	193701672.6	1.708416826	0.1022998	-71901481.94	733747875.2	-71901481.94	733747875.2

APPENDIX H: REGRESSION RESULTS –ICT SPENDING VS MANAGERIAL PRACTICES SCORES

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.001275023
R Square	1.62568E-06
Adjusted R Squar	-0.047617345
Standard Error	0.009358244
Observations	23

Correlation

	Column 1	Column 2
Column 1	1	
Column 2	0.001275023	1

ANOVA

	df	SS	MS	F	Significance F
Regression	1	2.98982E-09	2.98982E-09	3.41394E-05	0.995393223
Residual	21	0.001839111	8.75767E-05		
Total	22	0.001839114			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.009754812	0.014400478	0.677394992	0.505550305	-0.020192622	0.03970225	-0.020192622	0.039702245
X Variable 1	2.3584E-05	0.004036361	0.005842894	0.995393223	-0.008370488	0.00841766	-0.008370488	0.008417656

APPENDIX I: REGRESSION RESULTS –ICT SPENDING VS PRODUCTIVITY and ROCE

[A] ICT spending vs. productivity

```
reg lsales lemp lict, rob

Linear regression                                      Number of obs =      23
                                                       F(  2,    20) =   65.84
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.8624
                                                       Root MSE      =  .80029

------------------------------------------------------------------------------
             |               Robust
      lsales |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lemp |   .8828396   .1503689     5.87   0.000     .5691755    1.196504
        lict |   .3663525   .0967975     3.78   0.001     .1644364    .5682687
       _cons |   8.234051   1.006473     8.18   0.000     6.134585    10.33352
------------------------------------------------------------------------------
```

[B] ICT spending vs. ROCE

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.044807285
R Square	0.002007693
Adjusted R Square	-0.04551575
Standard Error	0.009348852
Observations	23

	Column 1	*Column 2*
Column 1	1	
Column 2	0.04480728	1

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3.69238E-06	3.692E-06	0.04224637	0.839130259
Residual	21	0.001835422	8.74E-05		
Total	22	0.001839114			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.009498084	0.002556924	3.7146517	0.00128267	0.004180668	0.014815499	0.004180668	0.014815499
X Variable 1	0.002655709	0.012920693	0.2055392	0.83913026	-0.024214342	0.02952576	-0.024214342	0.02952576

APPENDIX J: REGRESSION RESULTS –USER SATISFACTION vs. MANAGEMENT PRACTICES SCORES

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.535400712
R Square	0.286653922
Adjusted R Square	0.252685061
Standard Error	0.483064494
Observations	23

Correlation

	Column 1	Column 2
Column 1	1	
Column 2	0.53540071	1

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1.969187812	1.9691878	8.43872637	0.008469236
Residual	21	4.900377405	0.2333513		
Total	22	6.869565217			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1.443796832	0.743340311	-1.9423093	0.0656313	-2.989657628	0.102063964	-2.989657628	0.102063964
X Variable 1	0.605256176	0.208353489	2.9049486	0.00846924	0.171961378	1.038550975	0.171961378	1.038550975

APPENDIX K: REGRESSION RESULTS –ICT SPENDING vs. CEO LITERACY

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.100230239
R Square	0.010046101
Adjusted R Square	-0.037094561
Standard Error	1.032370513
Observations	23

	Column 1	*Column 2*
Column 1	1	
Column 2	-0.1002302	1

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.227129237	0.227129237	0.213109	0.649087697
Residual	21	22.38156641	1.065788877		
Total	22	22.60869565			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.021102914	0.320046018	-0.065937123	0.9480516	-0.68667504	0.644469213	-0.68667504	0.644469213
X Variable 1	-11.11302213	24.07305731	-0.46163734	0.6490877	-61.17568522	38.94964095	-61.17568522	38.94964095

APPENDIX L: REGRESSION RESULTS –FORMAL EDUCATION OF MANAGERS, NON-MANAGERS

[A] Managers with degrees vs. ICT spending

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.22803757
R Square	0.052001133
Adjusted R Square	0.00685833
Standard Error	0.290210853
Observations	23

Correlation

	Column 1	Column 2
Column 1	1	
Column 2	-0.2280376	1

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.097017836	0.097017836	1.1519252	0.295325384
Residual	21	1.76866912	0.084222339		
Total	22	1.865686957			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.554499041	0.089968501	6.163257516	4.09E-06	0.367399301	0.741598781	0.367399301	0.741598781
X Variable 1	-7.263090404	6.767204604	-1.07327779	0.2953254	-21.33626274	6.810081929	-21.33626274	6.810081929

[B] Non managers with degrees vs. ICT spending

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.119101388
R Square	0.014185141
Adjusted R Square	-0.032758424
Standard Error	0.195931678
Observations	23

Correlation

	Column 1	Column 2
Column 1	1	
Column 2	0.1191014	1

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.011600238	0.011600238	0.3021743	0.588321581
Residual	21	0.806173675	0.038389223		
Total	22	0.817773913			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.150074261	0.060740938	2.470726762	0.0221319	0.023756566	0.276391957	0.023756566	0.276391957
X Variable 1	2.511476434	4.568780746	0.549703865	0.5883216	-6.989823225	12.01277609	-6.989823225	12.01277609

APPENDIX M: REGRESSION RSULTS- RELATIONSHIP BETWEEN CEO & IT MANAGER vs. ICT INVESTMENT

[A] Relationship between IT manager and CEO vs. ICT annual ICT expenditure

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.588934924
R Square	0.346844345
Adjusted R Square	0.315741695
Standard Error	0.653699754
Observations	23

Correlation

	Column 1	Column 2
Column 1	1	
Column 2	-0.5889349	1

ANOVA

	df	SS	MS	F	Significance F
Regression	1	4.765339699	4.765339699	11.151601	0.003109819
Residual	21	8.973790736	0.427323368		
Total	22	13.73913043			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	1.022530901	0.202653989	5.045698356	5.381E-05	0.60108886	1.443972941	0.60108886	1.443972941
X Variable 1	-50.90290764	15.2431239	-3.339401292	0.0031098	-82.60271901	-19.20309626	-82.60271901	-19.20309626

[B] Relationship between IT manager and CEO vs. management practices scores

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.299357243
R Square	0.089614759
Adjusted R Square	0.046263081
Standard Error	0.771760559
Observations	23

Correlation

	Column 1	Column 2
Column 1	1	
Column 2	0.2993572	1

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1.231228861	1.231228861	2.0671578	0.165237255
Residual	21	12.50790157	0.595614361		
Total	22	13.73913043			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1.169978064	1.187586215	-0.98517316	0.3357545	-3.63969879	1.299742662	-3.63969879	1.299742662
X Variable 1	0.47859158	0.332872747	1.437761379	0.1652373	-0.213655191	1.170838352	-0.213655191	1.170838352

APPENDIX N: REGRESSION RSULTS – MANAGEMENT PRACTICES VERSUS FIRM SIZE: EMPLOYEES AND REVENUES

[A] Management practices versus revenues

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.279834334
R Square	0.078307254
Adjusted R Square	0.034417124
Standard Error	1645804187
Observations	23

	Column 1	*Column 2*
Column 1	1	
Column 2	0.2798343	1

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4.83272E+18	4.83272E+18	1.7841654	0.195935766
Residual	21	5.68821E+19	2.70867E+18		
Total	22	6.17148E+19			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-3019380212	2829155186	-1.067237396	0.2979807	-8902930484	2864170060	-8902930484	2864170060
X Variable 1	1056137473	790683891.8	1.335726558	0.1959358	-588179688.8	2700454636	-588179688.8	2700454636

[B] Management practices versus employees

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.285794845
R Square	0.081678694
Adjusted R Square	0.037949108
Standard Error	1639.114599
Observations	23

	Column 1	*Column 2*
Column 1	1	
Column 2	0.2857948	1

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5018247.235	5018247.235	1.8678131	0.18618077
Residual	21	56420630.07	2686696.67		
Total	22	61438877.3			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-2819.571941	2817.655713	-1.000680079	0.3283734	-8679.20775	3040.063868	-8679.20775	3040.063868
X Variable 1	1076.219249	787.4700532	1.366679589	0.1861808	-561.4143701	2713.852868	-561.4143701	2713.852868

APPENDIX O: REGRESSION RSULTS- ROCE vs EMPLOYEES AND REVENUES

[A] ROCE versus Employees

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.128523589
R Square	0.016518313
Adjusted R Square	-0.030314148
Standard Error	15.65834958
Observations	23

	Column 1	*Column 2*
Column 1	1	
Column 2	0.1285236	1

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	86.47900315	86.47900315	0.3527108	0.558926497
Residual	21	5148.862145	245.1839117		
Total	22	5235.341148			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	11.61632706	3.830594541	3.032512822	0.0063327	3.650169651	19.58248448	3.650169651	19.58248448
X Variable 1	0.001186407	0.001997673	0.593894567	0.5589265	-0.002967981	0.005340795	-0.002967981	0.005340795

[B] ROCE versus Revenue

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.184992882
R Square	0.034222366
Adjusted R Square	-0.011767045
Standard Error	15.51677339
Observations	23

	Column 1	*Column 2*
Column 1	1	
Column 2	0.1849929	1

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	179.1657625	179.1657625	0.7441358	0.398083874
Residual	21	5056.175385	240.7702564		
Total	22	5235.341148			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	11.55938679	3.543578943	3.262065549	0.0037252	4.190110989	18.92866259	4.190110989	18.92866259
X Variable 1	1.70386E-09	1.97518E-09	0.86263305	0.3980839	-2.40376E-09	5.81147E-09	-2.40376E-09	5.81147E-09