

**SUPPORT STAFF AND  
INTELLECTUAL CAPITAL:  
EVIDENCE FROM THE UNIVERSITY OF OTAGO**

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## **ABSTRACT**

Intellectual capital is quickly becoming a source of competitive advantage. Therefore, it is important to ensure intellectual capital, consisting of human capital, structural capital, and relational capital, is being created and managed in an efficient way. Previous studies have demonstrated that the interaction between the three forms of capital significantly increase intellectual capital in private sector organisations. This study focuses on what has been argued as the largest producers of intellectual capital, higher education institutions; more specifically this study focuses on the University of Otago. The aim of this study is to determine whether ancillary support staff assist in the creation of intellectual capital at the University of Otago. As the University of Otago is a public organisation, it is important to ensure intellectual capital is managed efficiently to improve organisational performance.

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# 1. INTRODUCTION

As physical capital becomes a common commodity within competing organisations, knowledge and intellectual capital is becoming increasingly important as a form of competitive advantage. It is important to understand how to manage intellectual capital and competitive advantage to ensure a successful future. As the driving factors of the economy change from physical capital to knowledge capital, organisations need to rethink their systems, structures and processes to make better use of their intellectual capital.

This study focuses on the role of support staff in the production of intellectual capital at the University of Otago. Over the past seven years support staff<sup>1</sup> have increased by 18%. With large increases in support staff at the University of Otago, and many other higher education institutions, their value is coming under scrutiny (Phipps, 2011). It is important to study the role of support staff to determine where they add value. According to Rhoades (1998), support staff create more intellectual capital than what is generally perceived. Support staff play an intricate role as a mechanism to support and satisfy the internal and external challenges (Cabrita and Vaz, 2006). Universities are arguably the largest intellectual and knowledge organisation, not necessarily in terms of organisation size but in knowledge creation and dissemination (Goddard, 1998; Jones, Meadow and Sicilia, 2009). New Zealand universities are publicly funded, making this study important to ensure the University of Otago is as efficient as possible when employing support staff and managing intellectual efficiently.

There are three forms of intellectual capital: human capital, structural capital and relational capital. Human capital is the academic staff of the university because they are the revenue generating professionals. According to Bontis (2001), human

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<sup>1</sup> Later defined as ancillary support staff.



capital (therefore academic staff) are the drivers of intellectual capital creation. Support staff are employed by the University of Otago as a mechanism to assist in optimal intellectual capital and ultimately overall business performance. Existing literature on universities removes relational capital, which encompasses external relationships and the reputation, as an influencing factor on intellectual capital (Sanchez et al., 2009; Fazlagic, 2005; Jones, Meadow & Sicilia, 2009).

This research questions whether support staff assist in the creation of intellectual capital in the University of Otago. Cabrita and Vaz (2006), Bontis (1998) and Agndal and Nilsson (2006) have shown that intellectual capital is created from the interaction between all three forms of capital. They suggest that a lack or inefficiency in one will create lower overall business performance. In the university setting, since relational capital is removed from the equation, the relationship and interaction between support staff and academic staff creates intellectual capital. Bontis (1998, p.71) goes as far to say that academic staff are 'practically useless' without the assistance from support staff.

When analysing the definitions of structural capital, discussed later in this study, there is a debate on the role of support staff. Camison, Marquis and Devece (2000) believe that structural capital takes into account the knowledge from the past. They believe the role of support staff is to maintain the value of intellectual capital. Jones, Meadow and Sicilia (2009), when measuring intellectual capital at universities, did not include measures of structural capital and only include human capital as the creators of intellectual capital. Without employing structural capital to maintain the value of intellectual capital, then the knowledge created by the human capital would dissipate. For the University of Otago, once the academic staff generate the knowledge and intellectual capital, the support staff are employed to maintain its value. On the other hand, Bontis (1998) believes that support staff assist in the creation of intellectual capital. Bontis (1998, p. 66) says structural capital are the 'mechanisms and structures... that can help support employees in their quest for

optimal intellectual performance.’ The interaction between support staff and academic staff create intellectual capital. Even though academic staff are the main drivers and creators of intellectual capital, support staff can be used to further develop the creation of intellectual capital.

For this study, two models have been created. The first model is to test whether support staff act as a moderating variable in the relationship between academic staff and revenue (a metric used to measure intellectual capital). If support staff are a moderating variable, then there is reasonable support to suggest they interact with academic staff to assist in the creation of intellectual capital. In the second model, revenue is the mediating variable in the relationship between academic staff and support staff. According to this model, academic staff are employed to generate knowledge, developing intellectual capital, which requires support staff to maintain its value. If there is support for this model then support staff maintain the value of intellectual capital.

A total of 12 hypotheses were created to test whether: (1) academic staff are at the forefront of intellectual capital creation, (2) support staff assist in the creation of intellectual capital, and (3) support staff maintain the value of intellectual capital. To determine whether academic staff drove the creation of intellectual capital a time-series-cross-sectional regression was run between changes in revenue and changes in academic staff. Since support staff could act as a moderating variable, an interaction term was created between support staff and academic staff, which was then added into the original regression explained above. Vuong’s (1989) Model Selection Test was implemented to determine whether the additional variance explained by the interaction term was statistically significant. And finally, first order partial correlation was implemented to determine the relationship between changes in revenue and changes in support staff, while removing the influence of academic staff numbers from both variables.

The results indicate the role of support staff is to maintain intellectual capital. Vuong's (1989) Model Selection Test suggested the interaction term did not explain significantly more variance in revenue than what was already explained by academic staff alone. The partial correlations between support staff and revenue, although at times not large, were always significant. Therefore, it can be concluded that support staff at the University of Otago are currently employed to maintain intellectual capital.

Further analysis of the results has shown revenue has grown faster than support staff, and more specifically revenue from research has grown faster than support staff orientated towards research. The University of Otago needs to ensure that intellectual capital is efficiently maintained, and so some future research needs to be conducted to determine the optimal ratio of revenue to support staff; this is further discussed later. Another major implication from this study is to focus on the development of intellectual capital. The intricate relationships required between support staff and academic staff may not have formed and developed. But by building and creating an organisation culture focusing on relationship development support staff may better assist in the creation of intellectual capital.

Future research can focus on using the models created as a means to value other aspects of structural capital to determine whether it assists in the creation, and maintenance, of intellectual capital. Literature on how support staff maintain intellectual capital, along with the optimal number of support staff required to maintain intellectual capital, needs to be developed. Future research may also want to focus on the inclusion of a relational capital measure to represent the reputation of the universities, as this could be a contributing factor towards intellectual capital.

This thesis is organised into 6 chapters. Chapter 2 will go over the literature surrounding the topic of intellectual capital and support staff, from which the research models and hypotheses are created and developed in Chapter 3. Chapter 4

discusses the data and research methods used. Chapter 5 presents the study's results. Finally, Chapter 6 discusses these results, highlighting implications, limitations and future research before concluding.

## **2. LITERATURE REVIEW**

Over the past decade there has been a large increase in the number of support staff at the University of Otago. This increase has occurred not just at this university but at many other higher education institutions, as well as private organisations, around the world. This rise in support staff is now coming under scrutiny (Phipps, 2011), with researchers evaluating the value added aspects of the support staff. Here, in New Zealand, the universities are heavily publicly-funded by the Government, in order to keep costs as low as possible for students. Due to increases in support staff in what is essentially a public organisation, this study has come in a timely manner. We are operating in a knowledge economy, one where the future performance of an organisation is no longer based on their plant, property and equipment, but the knowledge and intellectual capital of the organisation. This intellectual capital movement has given rise to new conceptual frameworks on how intellectual capital is developed for knowledge-based organisations and universities alike. This research questions whether the fore-mentioned support staff assist in the creation of intellectual capital at the University of Otago. I believe it is important to answer this question as the number, and subsequently cost of, support staff continues to increase. In a public organisation, are these support staff significantly assisting in the creation of intellectual capital and therefore future value?

### **2.1 THE KNOWLEDGE ECONOMY**

It is becoming increasingly evident that the drivers to the success of many organisations are no longer their plant and machinery used in manufacturing. Petty and Guthrie (2000, p.156) describe this change, by characterising it as “the rise of the new economy.” This new economy, the knowledge economy, is based on intellectual capital developed (or at times purchased) by the organisation (Petty and Guthrie, 2000). In particular, the success is based on the knowledge within the organisation.

Drucker (1993) goes as far as to say that knowledge is the only meaningful resource within this new economy and Suciu et al. (2011) believe that 80-90% of the value added is created from intellectual capital. This stream of thought was first identified, and written about by Bell in 1968. Bell believed that knowledge organisations would be the leading form of company in the post-industrial society, those companies that principally rely on the human capital, competencies, knowledge and intellectual capital, instead of their physical assets. After all, you don't pay your lawyer \$500 an hour for his desk and office, but for his knowledge (Stewart, 1991).

In a survey undertaken by Chase (1997) examining the views of 143 participants from a range of countries, 132 of those respondents reported their organisation operates in a knowledge environment. This figure is supported by other researchers (Skyrme & Amidon, 1997; Wiig, 1994), showing that many organisations view themselves as a knowledge organisation, competing in this new knowledge economy. This global phenomenon, to some extent being declared a paradigm shift (Weatherly, 2003; Brooking, 1996), of knowledge intensive products and services is continuing to increase.

In years prior to 1980 the book value of any given organisation was near equal to the market value of the said organisation (Chen, Cheng & Hwang, 2005) However, since the rise of this new knowledge economy, the market value has grown, and continues to grow, becoming more distant from the book value of the organisation. In the late 1980's and the early 1990's companies began to invest heavily in human capital and their knowledge. By doing this, organisations created the pillar from which this knowledge economy came about (OECD, 1999). According to Schmidt (2002), this change is the market taking into account the intangible assets, like knowledge, that are not in the books of the organisation, but are heavily involved with creating future value. As reported by Dzinkowski (2000), the disassociation between market value and book value can exceed eleven to one, which was the case for Microsoft in 1996. This marked the movement away from the traditional

industrial economy to the knowledge economy, highlighting again, what is believed to be a paradigm shift.

So, where do universities fit into this new 'knowledge economy', an economy based on intellectual capital and research? The Organisation for Economic Co-operation and Development (OECD) (1996) and The World Bank (1998) published reports that discussed how education is a massively undervalued form of knowledge, and that education has the ability to shape the path for the future, in terms of the way we work, the way organisations are structured, and the way society operates.

## **2.2 THE KNOWLEDGE ORGANISATION**

According to Suciu et al. (2011, p. 422) "knowledge based organisations attach a great importance to the investment in human capital." The importance of people is not just in regards to their individual knowledge and skills, but also in regard to the internal processes specific to that organisation. Like with many definitions, there is no universally accepted meaning of knowledge organisations, with every author changing it slightly. Knowledge organisations that highly value their human capital and knowledge are able to consistently create knowledge (Nonaka, 2007), apply techniques to maximise this knowledge (Liebowitz, 1998), disseminate it throughout their products (Nonaka, 2007) and are able to effectively support further knowledge acquisition, application and dissemination (Wiig, 1999).

The knowledge and human capital that has been built up and developed is important to the organisation's quest to build and maintain competitive advantage (Evans & Wurster, 1997; Rayport & Sviokla, 1995). Organisations are allocating more and more resources to their intangible assets, investing not only in knowledge and human capital components but also in the different forms of structural capital (i.e.

those ways in which the knowledge is supported and captured [Wu, Ong & Hsu, 2008]).

There are thousands of knowledge organisations operating both domestically and internationally. When considering knowledge organisations, many would consider those companies that deal with fast paced technology and IT, companies like Apple, Microsoft and Google and, even closer to home in New Zealand, with companies like Diligent, Wellington Drive Technologies and Xero. However, arguably, given the parameters in the definition above, universities and other higher education institutions, would be the largest and most common knowledge organisations (Jones, Meadow and Sicilia, 2009; Goddard, 1998). This is because the key goals of any university are simply knowledge creation (research) and knowledge dissemination (teaching), with their most important investment being human capital and knowledge (Sanchez and Elena, 2006). Jones, Meadow and Sicilia (2009) describe the three functions of knowledge organisations: (1) knowledge creation, (2) knowledge extraction, and (3) knowledge transmission. These three functions align with the two goals of universities and higher education institutions.

The role of universities in this knowledge economy is key, as human capital and knowledge, are crucial elements to value creation and therefore to economic wealth (Canibano et al., 2000). Universities are more than just innovators and creators of technology; they are more valuable to the nation's primary source of knowledge creation than what is often perceived (Florida, 1999). The European Commission (2003) reports that universities employ 34% (on average) of the total number of researchers in Europe and that it is crucial to support them. Florida (1999) also believes universities must ensure they have the correct systems and infrastructure in place to promote research processes. Ultimately, this comes down to the structural capital and support staff (Florida, 1999).



Knowledge capital is an emerging field, within an even larger emerging field of intellectual capital (Leibowitz & Suen, 2000). The Organisation for Economic Cooperation and Development (OECD, 2001) discusses how intellectual capital research has begun to break its way into the public sector; and in many ways it is a crucial public good, as a result of how it greatly affects countries' overall performances.

## **2.3 INTELLECTUAL CAPITAL**

### *2.3.1 History of Intellectual Capital*

The rise of this new economy has changed the way businesses operate. As discussed earlier, the ever increasing disassociation between book and market value has meant that organisations have been able to generate excess earnings (earnings above what was expected from their tangible assets alone). Over time, managers, consultants and academics discovered intangibles, deeming intangibles the reason why market value was able to grow well beyond book value (Schmidt, 2002). What was created from this understanding was a new class of assets, called intangible assets, going well beyond the concept of goodwill.

Slowly, it became clear the organisation's intangible assets, including intellectual capital, were often the drivers of financial performance. In 1980, Itami completed a study on the performance differences among organisations, concluding that the difference in performance was due to the organisations' intangible assets (Harrison & Sullivan, 2000). Sveiby and Risling (1986), and Teece (1986) produced a book and an article, respectively, which related to the management of intangible assets and methods for the best way to extract the most value from them.

The concept of intangible assets was further refined by Stewart (1991, 1994), bringing in the idea of intellectual capital<sup>2</sup>. He wrote two articles in Fortune Magazine discussing how the firm's intellectual capital, or more importantly the firm's employees, was related to the overall performance of that firm. In this knowledge-based economy, it is the intangibles of an organisation that drive performance, build and maintain a competitive advantage, and create the essential elements for future value creation and economic wealth (Lev, 2001). Since the mid-1990's, the focus has changed from describing and defining this phenomena to understanding how to measure and manage it. From my perspective, one of the key developments of this era was the framework proposed by Bontis (1998), which describes how intellectual capital is created. It is this framework which this research is based upon.

### *2.3.2 Defining Intellectual Capital*

Intellectual capital is a complex concept; and even with the existing literature and research on the concept, it is difficult to define. As Petty and Guthrie (2000) identified, there is a plethora of literature creating various definitions of intellectual capital. One of the most comprehensive definitions has been put forward by CIMA (Chartered Institute of Management Accountants) (2001, p.6) as "the possession of knowledge and experience, professional knowledge and skill, good relationships, and technological capacities, which when applied will give organisations a competitive advantage." Additional definitions by Roos et al. (1997) comprise intellectual capital into a thinking, or human, element and a non-thinking, structural, element. And further still is Sveiby's (1997), categorisation of intellectual capital into human capital, structural capital and relational capital.

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<sup>2</sup> Following from the research of Lev (2001), from this point onwards both the terms intangible assets and intellectual capital will be used interchangeably. Even though they have slight differences, distinguished by the way they were generated, these are immaterial to the conduct of the present study.

Authors	Definition of IC
Edvinsson and Malone (1997)	Knowledge, applied experience, organizational technology, relations with customers and professional skills that give organizations competitive advantages in the market.
Sveiby (1997)	Combination of intangible assets that generate organizational growth, innovation, efficiency and stability.
Bontis (1998)	Intangible resources of the firm
Lev (2001)	Basic relations between innovation, organizational practices and human resources that generate intangible assets.
Bradley (1997)	Skills related to the transformation of knowledge and intangible resources into resources that create wealth, both for organizations and nations.
Bueno (2005)	Accumulation of knowledge that creates value or cognitive wealth of an organization and is a compound of different intangible assets (intellectual) or resources and capabilities based on knowledge. When these are activated in conjunction with other tangible or physical assets, the firm produces goods and services and generates competitive advantages or essential competencies in the market.

**Table 1: Definition of Intellectual Capital, taken from Garcia-Alvarez, Mariz-Perez and Alvarez, 2011, p.42.**

Garcia-Alvarez, Mariz-Perez and Alvarez (2011, p.42) note that many of these definitions have “common certain essential characteristics, such as the notion of intangibility and the capacity of these assets have in order to generate future value for the organisation.” These characteristics can be seen in the definitions within Table 1, all having aspects of hidden or intangible qualities, with key terms like ‘knowledge’ and ‘thinking’, which highlights the idea that firms cannot necessarily own or physically touch the asset. The former President and CEO of Infosys

(formerly Infosys Technologies), Nandan Nilekani, reiterated the future benefit aspect of the definition by saying “intellectual capital... enables them (Infosys) to outperform their competitors in the future” (Bhasin, 2011, p.22). This point is further backed up by Edvinsson and Sullivan (1996, p. 361) where they define intellectual capital as “knowledge that can be turned into value”. In other words, the firm’s intellectual capital is essential to ensure the firm gains a competitive advantage.

## **2.4 TRIPARTITE DIVISION OF INTELLECTUAL CAPITAL**

Over time, broad consensus has broken intellectual capital down further into sub-categories. As Sveiby (1997, p.76) has stated... “the invisible part of the balance sheet can be classified into a family of three.” The three parts to this ‘family’ are: internal (structural) capital, external (relational/customer) capital, and human capital. Bontis (2001) points out that historically many accounting systems have taken into account parts of the internal structure (for example, infrastructure), whereas the other two forms of capital (external and human) have not previously been considered in accounting systems.

### *2.4.1 Relational Capital*

Nazari and Herremans (2007, p. 597) define relational capital as “the ability of an organisation to interact positively with business community members to motivate the potential for wealth creation by enhancing human and structural capital.” Simply put, the relational capital consists of relationships, with customers, suppliers, stakeholders etc. It also includes other aspects like the brand name, trademarks, and reputation; this is the ‘image’ of the company (Petty and Guthrie, 2000). Petty and Guthrie (2000) go on to describe how this component of intellectual capital is highly influenced by market related variables. For universities and higher education institutions, only two parts of this tripartite are related to intellectual capital: ‘the intellectual capital of a university consists of human capital and structural capital’ (Fazlagic, 2005, p. 4; Sanchez et al., 2009; Jones, Meadow & Sicilia, 2009). Jones,

Meadow and Sicilia (2009) chose not to include relational capital in their study, because even though it is important to measure the satisfaction of students and the state, the satisfaction does not measure intellectual capital. Academic staff are driven and motivated to work with other top academic staff (Rowley, 1996), therefore a case could be made that suggests relational capital is embedded in academic staff (Shih, Chang & Lin, 2010). If the reputation of current academic staff can entice other leading academic staff, this will better assist in the creation of intellectual capital. Even though institutions could rank themselves, as a form of reputation, and use this as a marketable tool to help leverage future value, relational capital is excluded from studies focused on intellectual capital at universities. The exclusion of relational capital is further discussed in Chapter 6.

#### *2.4.2 Human Capital*

Human capital is the area that has received the most attention (Petty and Guthrie, 2000). Attention, not just from academics, but also from practitioners and management from within organisations. Employee competence (knowledge) “includes the capacity of employees to act in a wide variety of situations... [where actions are] directed outwards to the task of generating revenues by solving customer problems” (Sveiby, 1997, p. 76). Simply put, human capital are the ‘professional’ employees of an organisation who are directly involved with the revenue generating process. In the university setting, such professionals are the academics<sup>3</sup>, as they are most likely to be directly involved in teaching and research (Fazlagic, 2005).

In any knowledge organisation, university or higher education institution, it is the human capital that is at the forefront of the creation of knowledge and consequently intellectual capital (Bontis, 2001). Bhasin (2011, p.16) states that the “future drivers of any economy will no longer be the capital, land or equipment, but

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<sup>3</sup> Academics include lecturers and researchers.

the people and their knowledge.” However, human capital also has the ability to destroy the intellectual capital created by simply leaving the organisation. Therefore it is becoming crucial for those knowledge organisations and universities alike to be able to retain their employees. In addition to retention, organisations need to harness and leverage their employees’ knowledge into future value; this is where the support of structural capital comes in.

#### *2.4.3 Structural Capital*

Some authors conceptualise structural capital as the complete culmination of all the different forms of knowledge, including knowledge creation, transfer, dissemination and integration (Sveiby, 1997). Therefore, in this sense structural (internal) capital means “the knowledge embedded in organisational structures and process” (Petty & Cuganesan, 2005, p. 41). Authors like Edvinsson (1997), however, believe that structural capital can be broken further down into two types of capital: organisational capital and technological capital. The latter refers to the capacities required by the organisation for employees to complete activities at this present moment in time. The former, organisational capital, refers to “systematic or internalised organisational knowledge, such as organisational routines, decision-making processes or planning and control systems... it includes an improvement in the transfer of knowledge and, therefore, an efficacy improvement” (Garcia-Alvarez, Mariz-Perez and Alvarez, 2011, p.43).

Additional definitions of structural capital contain characteristics of control and to some extent ‘ownership’, implying the knowledge has been imbedded within the organisation (Table 2). This knowledge does not necessarily have to be developed or internalised from within the firm, it can also be purchased and sourced from outside the company (Sveiby, 1997).

Cabrita and Vaz (2006) state as the definition of structural capital, although it might be better viewed as the purpose, the organisation’s ability to support and

satisfy the external and internal challenges. This leads to the two streams of thought that stem from the structural capital literature. One of those is that structural capital maintains value (Camison, Marquis & Devece, 2000); it takes into account the knowledge from the past that is embedded in the organisation. The second stream of thought is where structural capital supports and helps to develop and build knowledge in order to optimise intellectual capital; one where they provide the tools for knowledge development.

<b>Authors</b>	<b>Definitions of Structural Capital</b>
Alama (2007)	Intangibles that determine the manner of working of a company.
Carson et al. (2004)	Processes and procedures that arise from employee intellectual contribution.
Ordoñez de Pablos (2004)	Knowledge that remains in the organization when employees return to their homes and, therefore, is owned by the firm. In this sense, SC is integrated by organizational routines, strategies, process manuals and databases.
Zornosa et al. (2000)	Knowledge that the organization has internalized and that remains within its structure processes or culture although employees leave.
Kogut & Zander (1996)	Elements that belong to the organization and that facilitate its configuration as an entity providing coherence and superior principles for coordination.
Euroforum (1998)	Knowledge that can be reproduced and shared and, therefore, becomes somewhat explicit.
Bontis (1996)	Those technologies, methodologies and processes that make the functioning of the organization possible, this is, basically the elements that define the working mode of the firm.

**Table 2: Definition of Structural Capital, taken from Garcia-Alvarez, Mariz-Perez and Alvarez, 2011, p.43.**

The use of support staff within the definitions contained in Table 2 has not been considered within this structural element. However, Bontis (1998, p. 66) describes how structural capital are those “mechanisms and structures of the organisation that can help support employees in their quest for optimum intellectual performance and therefore overall business performance.” Therefore it is the support staff that assist in the creation of knowledge, as well as the transfer of knowledge.

## **2.5 SUPPORT STAFF**

Sveiby (1997) was the first to introduce support staff into the structural category in his Intangible Asset Monitor (IAM), a scorecard used to measure intellectual capital and monitor movements over time. Although Sveiby does not specifically define to what extent support staff contribute to intellectual capital, he states they are the ‘backbone of the organisation’ (2001, p. 352). Infosys Technologies Ltd applied the IAM in their annual reports, defining and operationalizing support staff as all staff who are not involved in the production activities. If we were to follow the same ideas of Infosys, then support staff would be any other staff member who is not an academic or faculty member.

Leslie and Rhoades (1995) believe that when it comes to support staff at universities and higher education institutions, the separation of those staff into two categories is necessary. The first category comprises institutional support staff, or those staff who are deemed to be required in order for the organisation to operate. The second category is known as academic and student support, or those ancillary support staff whose role it is to assist and support in research, teaching and student related activities. This second category is how I operationalize and define support staff. These are the support staff that are most involved, even though it is indirect, with the revenue generating process. This is what Desouza and Raider (2006) describe as secondary revenue. For example, at the University of Otago specific divisions like the Higher Education Development Centre have been designed to



develop more, and a higher quality level of, research and also provide assistance by offering additional teaching to students.

#### *2.5.1 Increase in Support Staff*

It is not just at the University of Otago that support staff, both the number and cost of, have increased. There have been increased levels of support staff, a form of structural capital, in other higher education institutions, as well as in many knowledge organisations. It is important to research why there has been an increase in support staff as they could be creating additional intangible value yet not to be recognised. James (1990) believes that some of the better and more renowned managers are those that build organisations by using growth techniques, and not cost cutting techniques. This same belief is shared by Chowdhury and Lang (1996), where an increase in support staff can, and according to their study has, the ability to improve both short and long run performance. According to these authors, the reason why support staff numbers continue to increase is because of the increased level of performance that they offer. This performance is the secondary revenue they create according to Desouza and Raider (2006). As is explained later on, this view is not shared by The Centre for College Affordability (2010).

With major developments in information technology and computing over the past decade, it is surprising that technology has not been able to take over and replace some, or many, of the activities carried out by support staff at the University of Otago. Ovretviet (1997) discussed the changes in support staff in medical and health care providers, discussing how technology is able to reduce support staff. And, unlike universities and other knowledge organisations, the growth and increase in support staff has stopped and is beginning to actually decrease. This is because health care providers are able to utilise technology, replicating the same activities and providing the same service as support staff would, but in a more efficient and effective manner. According to Hilmer and Donaldson (1996) while computers and technology are able to perform better analysis, mathematical and

sorting tasks, they are incapable of understanding the complexities of human relationships and communications. And furthermore, the value generated by the academic staff (which is teaching and research) is not produced by technology. Although faster computers have been able to make staff more efficient, this is insignificant in terms of overall efficiency.

Leslie and Rhoades (1995), like myself, also believe it is important to ask why there has been an increase in support staff. One of their many reasons is an increased emphasis towards alternate or indirect revenue generation (as described earlier as secondary revenue). The authors go on to note that support staff are perceived as a potential revenue-generating unit. They argue that support staff “produce higher education outputs and, more importantly, are superior to faculty in enhancing revenues” (p. 189). The use of the term ‘enhancing’ is crucial, suggesting there is some interaction between support staff and academic staff which will produce higher levels of revenues.

## **2.6 HOW IS INTELLECTUAL CAPITAL CREATED?**

Intellectual capital is, for many organisations, the key driver to a sustainable competitive advantage. Intellectual capital creates and then applies knowledge to amplify organisational value. Edvinsson and Sullivan (1996, p.361) say that intellectual capital is essentially “knowledge that can be converted into value.” The importance of structural capital in developing sustainable competitive advantage cannot be overstated. Structural capital is the component of intellectual capital which has been internalised and imbedded into the organisation, therefore giving it that quality of ‘ownership’ (Camison, Marquis & Devece, 2000). Both human capital and relational capital are not etched in stone. Human capital can leave, fall sick, or retire. Relational capital can be lost when relationships are broken.

Pike, Rylander and Roos (2002, p. 659) describe how “[as] the business society develops, the key steps in the value creation has ascended an intellectual staircase.” In other words, as organisations begin to operate in a growing knowledge economy, some of the methods used to analyse value creation are not relevant for these knowledge organisations. Examples are given, from the industrial society showing where humans act as extensions to the value creating machinery, not as value creating assets themselves. Skandia (1994) even go as far to say that human capital and structural capital are good indications of the company’s ability to generate future value and excess earnings.

Garcia-Alvarez, Mariz-Perez and Alvarez (2011) put forward a three step process on the creation of intellectual capital. The first step is the creation of knowledge by the employees of the organisation; this is the human capital aspect. Once the knowledge is created, it is shared, used and spread throughout external stakeholders of the organisation, i.e. the networks and relationships the company has with its outside stakeholders. Lastly, the knowledge is imbedded and internalised into the company through the implementation of processes and tools within the firm’s structural capital. By following these steps the future value of the knowledge can be realised, and the gains will be received in the future. The knowledge itself will seldom affect performance directly. Instead it is the intangible relationships and interactions that indirectly create future value (Kaplan and Norton, 2004).

Cabrita and Vaz (2006, p.13) propose a ‘value platform’ model, based on the idea that “intellectual capital is a matter of creating and supporting connectivity between all sets of expertise, experience and competencies inside and outside the organisation.” This model highlights how the interaction between the three forms of intellectual capital creates firm value; these three constructs are dependent upon one another. The absence or shortfall in one of those constructs will affect the remaining

elements, and ultimately the overall organisational performance. This is shown by the statement made by Cabrita, Vaz and Bontis (2007, p. 276);

*“Organisations cannot generate a sustainable competitive advantage without the ideas, skills, attitudes, and talents of knowledge workers. However, talented employees (human capital) are practically useless without the supportive structure of an organisation (structural capital) that can utilise and service client’s needs (relational capital).”*

Bontis (1998) tells a similar story, where knowledge latent employees (human capital) need to be coordinated (structural capital) in the best possible way to meet and satisfy the goals of the customer (relational capital) in order to create and maximise organisation value. After all, it is the employees of a knowledge company that get the work done. Human capital is necessary to create firm value, however it is not sufficient. Therefore, it is the constant interplay between all three components that allow organisations to leverage this intangible into firm value. If this interplay does not exist, the isolated stocks of human capital will be wasted, as the knowledge in the employee’s minds is not retained or leveraged by the organisation in order to create value. Figure 1 is a depiction of how intellectual capital is created according to Cabrita and Vaz (2006) and Bontis (1998).

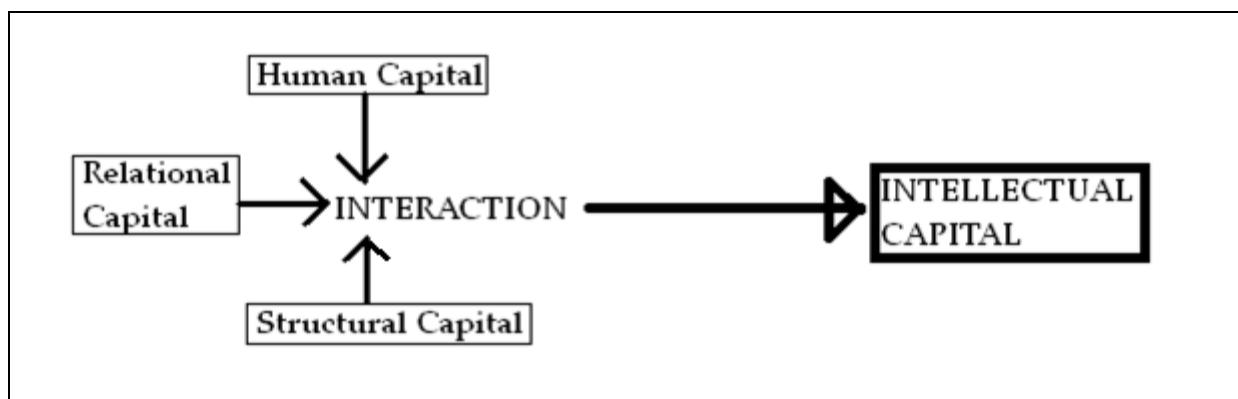


Figure 1: Creation of Intellectual Capital

## 2.7 INTELLECTUAL CAPITAL CREATION AT UNIVERSITIES

These three forms of capital should be in constant interplay in order to leverage the human capital and knowledge within the organisation. However, in the University setting, based on the work from Leitner (2004, along with; Sanchez et al., 2009; Fazlagic, 2005 ), the relational capital aspects would not be included in the conceptual framework. This means that the constant interplay between human capital and structural capital will lead to intellectual capital (Figure 2). More specifically, the academic staff are 'practically useless' (Bontis, 1998) without the grounding and support from the structural capital, which assist in the optimisation of their knowledge resources.

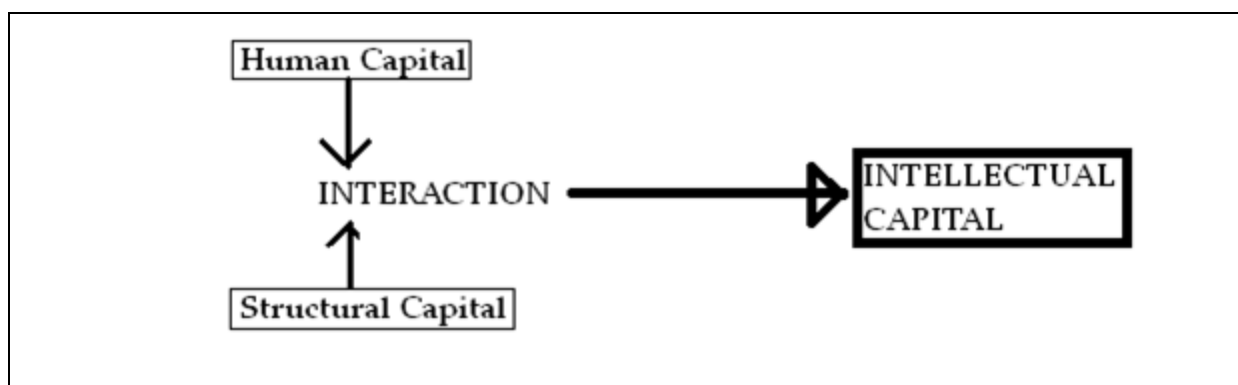


Figure 2: Intellectual Capital creation in Universities

Generally, especially in tough economic times, the support staff are hardest hit and the first ones to go (Phipps, 2011). The role these support staff play in assisting academics and faculty members, in terms of teaching and research, are essential. A reduction in these staff may result in a decrease in revenue, because when the level of structural capital decrease then the interaction between structural capital and human capital will also decrease. According to Rhoades (1998) support staff create more value than what is generally perceived. They are able to generate outputs and create value by supporting and assisting students, while also acting as a device to help produce more research at a higher level. Although, Rhoades states

that it is important to measure support staff efficiency and productivity, he does not state how to do so.

The Centre for College Affordability (2010) issued a publication addressing the issue of increased support staff at universities, and also produced various solutions on how to 'solve' this problem. They believe that the increase in support staff is because there is no incentive for upper management to downsize due to the high level of public funding. According to The Centre, a decrease in support staff would not only lower costs but increase efficiency and employee productivity. Furthermore, it would also help refocus the goals of universities back to knowledge creation and dissemination. This same thought is also shared by Crone (1998). The belief here is that the support staff are taking resources away from knowledge creation and dissemination. Here the resources represent financial resources; money that could be spent on academic staff – those that directly create the revenue. However, in order to optimise knowledge, within what is considered a prime knowledge organisation, there must be interactions between both human capital and structural capital. By increasing one and decreasing the other, this will hinder the ability of a university to generate and produce knowledge, as well as handicap the transfer of this knowledge through the institution towards the student level.

## **2.8 STRUCTURAL CAPITAL MAINTAIN VALUE**

As alluded to earlier, there is a small divide in some of the definitions of structural capital. As discussed above, some scholars believe structural capital helps develop, build and grow intellectual capital. Others, however, view structural capital as simply maintaining the value of intellectual capital. If this was the case, then the human capital would create the knowledge, and this would develop into intellectual capital. After which, the structural capital would be required to maintain that level of intellectual capital. This process is depicted in Figure 3. Camison, Marquis and Devece (2000) believe the role of support staff is not to create intellectual capital but

to maintain its value. Therefore, structural capital takes into account the knowledge that has been embedded in the organisation. In other words, once the knowledge has been transformed into intellectual capital, and therefore future wealth, support staff are required to ensure this wealth is maintained and sustained into the future.

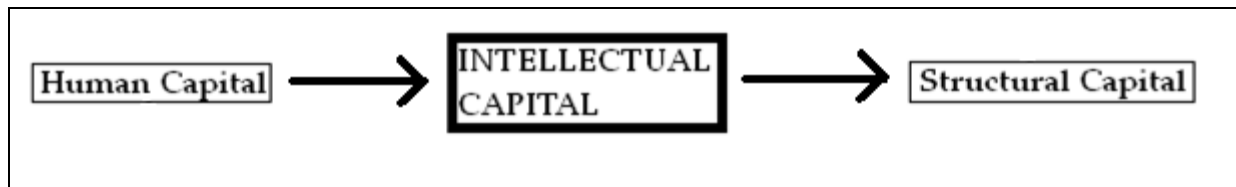


Figure 3: Structural Capital maintain Intellectual Capital

If support staff are, in fact, employed to maintain intellectual capital value and wealth, then we should see an increase after intellectual capital has been recognised. Without them, then the knowledge that has been transformed into wealth would dissipate.

Jones, Meadow and Sicilia (2009) created a scorecard in which to measure the intellectual capital of universities, adapting models that were designed for private sector (for profit) organisations into ones specific for the public sector. They created measures and metrics which would indicate the creation and growth, or the retraction, of intellectual capital. The metrics presented by Jones, Meadow and Sicilia (2009) are only measures of human capital, and not measures of structural capital. They believe that structural capital is not part of the creation of intellectual capital and future wealth. This suggests that structural capital comes after intellectual capital has been created, which means the support staff are in fact there to maintain that wealth.

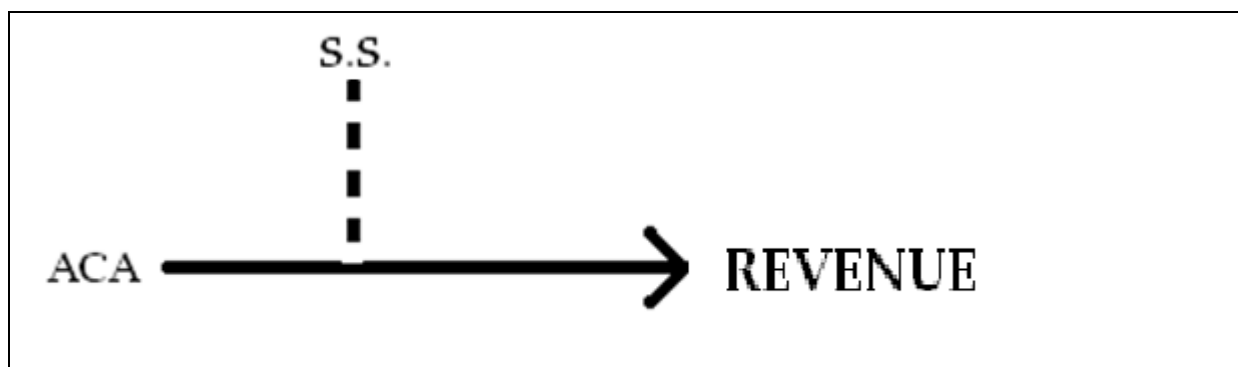
### 3. RESEARCH MODELS & HYPOTHESES

The literature surrounding structural capital and intellectual capital seems to suggest support staff play one of two roles. In one role, they interact with the academic staff to boost intellectual capital, and therefore revenue; in the second role they act as a means to maintain intellectual capital. Research on intellectual capital (Bontis, 2001; Bontis et al., 1999; Booth, 1998) is normally used to create a scorecard to monitor various metrics relating to intellectual capital, with revenue often represented as one of those metrics. Therefore, in this study revenue is used as a proxy for intellectual capital.

The interaction between support and academic staff creates the basis for the first of two models which will be tested on the University of Otago. In this model (Model 1), revenue is the dependent variable, with the main predictor being academic staff (ACA) and support staff (S.S.) acting as the moderator variable. Here, the support staff are a moderating variable in the creation of intellectual capital. The first two hypotheses to be tested are:

H1: Academic staff drive revenue.

H2: Support staff moderate the relationship between academic staff and revenue.



**Model 4: Support Staff create Intellectual Capital**



Clark (1996) separates the growth of universities revenues into two types, substantive growth and reactive growth. The first of these, substantive growth, is knowledge led; based on the research of the University. This is where the growth in revenue comes from an increase in both the quality and quantity of research. Alternatively, reactive growth is led by student demand; under this thought, growth in revenue comes from an increase in student numbers. It would be expected that growth in revenue from research (teaching) is be due to an increase in the interaction between academic staff and support staff who focus on research (teaching). This leads to four more hypotheses to test:

H3: Academic staff drive revenue from research.

H4: Support staff from research moderate the relationship between academic staff and revenue from research.

H5: Academic staff drive revenue from teaching.

H6: Support staff from teaching moderate the relationship between academic staff and revenue from teaching.

In contrast to Model 1, Model 2 has support staff employed after revenue has been generated. This model states that academic staff create the revenue, this revenue then leads to an increase in support staff. The role of the support staff is different under this second model. Here they are not employed to develop and build intellectual capital, but to sustain and maintain it. This is the idea of Jones, Meadow and Sicilia (2009), where the academic staff create intellectual capital, therefore revenue. Once the knowledge from the academic staff is turned into revenue, it is then 'owned' by the university. This means that if revenue increases, support staff will also increase. It is also what Ordonez de Pablos (2004) believes when discussing the knowledge that is left behind after the academics have left for home. Therefore, the knowledge that is left behind is the intellectual capital and revenue recorded at the University of Otago. The support staff's role is to sustain and maintain that level

of knowledge and intellectual capital imbedded in the university. This creates the first two hypotheses to be tested under Model 2:

H7: Academic staff drive revenue.

H8: Revenue influences support staff.



**Model 5: Support Staff maintain Intellectual Capital**

Again, following the work done by Clark (1996), the components within Hypotheses 7 and 8 can be separated into teaching and research. This will allow the analysis of why support staff have increased, along with where they have increased. Support staff may increase due to an increase in teaching revenue because student numbers have gone up, in accordance with the principles under Model 2. This results in another four hypotheses to be tested:

H9: Academic staff drive revenue from research.

H10: Revenue from research influences support staff from research.

H11: Academic staff drive revenue from teaching.

H12: Revenue from teaching influences support staff from teaching.

## 4. DATA & METHODOLOGIES

### 4.1 DATA

The data collected for this study was sourced from the University of Otago. The University of Otago has many divisions<sup>4</sup> (e.g. academic division, research division) and four schools (e.g. school of business), within each of these are departments, and in some cases sub-departments. Where possible, information was obtained at sub-departmental level. If sub-department level was not available, then information was obtained at departmental level. This resulted in a combination of 48 departments (8) and sub-departments (40). Information was obtained from 2005-2011. This study could only go back to 2005, as beyond this point the information was likely to be inaccurate and difficult to retrieve at the sub-departmental and departmental level due to a change in computer systems and software. Overall, 336 observations were obtained in panel (time-series-cross-sectional) data form.

Financial data was collected from the four schools. This data included revenue generated by each sub-department (or department), showing how much revenue was earned. This was then broken into research revenue (performance based research funds and externally funded research) and teaching revenue (student fees and vote education) in order to further analyse the hypotheses in more depth. Information on the number of support staff and academic staff was also gathered from the Human Resource department at the University of Otago. Average full time equivalent (FTE) head count was obtained for both the departments within the schools and the external departments outside of these four schools.

From a list of all support divisions within the University of Otago the institutional staff (i.e. hostel accommodation staff) were removed, leaving only the

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<sup>4</sup> These divisions are the institutional and ancillary support divisions; to separate between the support staff within the schools, the support staff within divisions are called secondary support staff.

ancillary support staff. The ancillary support staff from the external divisions needed to be allocated to the revenue generating departments within the four schools<sup>5</sup>. The sub-departmental (or lowest possible) level within the support services were divided into either teaching (P.A.S.S. staff) or research (i.e. research division) based on their role, either driven by student numbers or by academic FTE staff numbers. These two drivers were selected because they relate to teaching and to research respectively. The support staff were allocated to departments either based on total student numbers for that department or by total FTE academic staff. Although this allocation system may not be a true representation of how much time is spent by external support staff with the revenue generating department, it is a reasonable and objective method.

## 4.2 METHODOLOGIES

### 4.2.1 Model 1: Support Staff Create Intellectual Capital

To test whether the interaction between academic staff and support staff is a significant contributor towards sales, a hierarchal regression was undertaken. Using hierarchal regression, focuses on the change in R-squared, showing how much variance in revenue is explained by academic staff, and how much more is explained by the interaction between support and academic staff. Stepwise regression measures more than just how much additional variance is explained by adding another independent variable; it also describes whether this additional explanation is significant. Here, the additional independent variable added was the interaction between support staff and academic staff. This results in two equations:

$$R_{it} = a + b_1ACA_{it-1} + e_{it} \quad (\text{Eq. 1})$$

$$R_{it} = a + b_1ACA_{it-1} + b_2(ACA_{it-1} * SS_{it-1}) + e_{it} \quad (\text{Eq. 2})$$

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<sup>5</sup> From here on, support staff refers to ancillary support staff.

Where revenue (R) is our dependent variable on the left hand side, with independent variables on the right hand side being academic staff ( $ACA_{it-1}$ ) and the interaction term between academic and support staff ( $ACA_{it-1} * SS_{it-1}$ ). Both of the independent variables were lagged by one year, the reason being two-fold. Since intellectual capital has the capacity to generate future wealth, the knowledge that is created by the academics and support staff will be transformed into revenue at a later date. In this case we are assuming that it takes one year for academic and support staff to create future value. The second reason is to intuitively eliminate reverse causality. Reverse causality is like the chicken and the egg case, based on which one caused which. In this study, it means does academic staff drive revenue or does revenue drive academic staff. According to Nickell (1996), lagging the independent variable (academic staff) by one or two time periods is an intuitive way of dealing with reverse causality. Nickell's way removes reverse causality by exploiting the temporal cause and effect sequence, addressing the conceptual problem. Although two stage least squares would be the better method to counter reverse causality, it requires an instrument variable. This variable must be significant in explaining your independent variable (academic staff), however it must not be related to your dependent variable (revenue). Because of the relationship between academic staff and revenue, finding an instrument variable is very difficult.

Because the data that has been collected is in panel form, having both time series and cross sectional attributes, the first step was to run a Hausman Specification Test (1978) to verify whether fixed effects or random effects should be used when absorbing the error. Fixed effects are best when studying the impact independent variables have on the dependent variable over time (Greene, 2008). Simply put, fixed effects means the slope, or the gradient, of the line is the same for each department, therefore making the intercept of the line the differentiating factor between each department. Whereas, random effects are the opposite of fixed effects, as the intercept is constant between departments, it is the gradient of the line which

changes. The distinction between the two types of models is based on how we want to generalise our sample. Under fixed effects we draw inference to the sample size, therefore comparing the 48 departments with one another, and not the entire population (Stock & Watson, 2007).

In order to test whether fixed effects or random effects is best for our model, the Hausman Specification Test (1978) was used. The Hausman test compares the estimates of the model under both random and fixed model specifications, with a significant p-value suggesting the most accurate model to use would be fixed effects. Under the null hypothesis, the estimates within the random effects model will be the same as under the estimates with a consistent fixed effects model. However, under the alternative hypothesis, there will be a significant difference between the random and fixed estimates; therefore fixed effects will be the best model to use if the Hausman statistic showed a significant p-value.

For this study, a hierarchical linear regression is used because it allows us to see the unique contribution that the interaction term of academic and support staff has on revenue, and whether this is significant. In other words, does Equation 2, above, explain significantly more variance of the dependent variable, revenue, than Equation 1. If this is the case, then the interaction term that is contained in equation two is significant and would suggest that the interaction between support staff and academic staff creates significant value. In order to determine whether the difference in variance explained is significant, Vuong's (1989) Likelihood Ratio statistic compares the difference between the adjusted R-squared of both models.

Vuong's Model Selection test (1989) creates a null hypothesis which states that both models are equal in explaining the dependent variable. Vuong's Model Selection test also creates an alternative hypothesis, where one of the two models is superior in explaining the outcome variable. To perform tests on these two hypotheses, a series ( $m_{it}$ ) is constructed from the regression residuals and the sum of

the residual squares that were estimated from the two models (Model X and Model Y).

$$m_{it} = 1/2 \log[RSS_x/RSS_y] + n/2[(e_{xit}^2/RSS_x) - (e_{yit}^2/RSS_y)]$$

Where RSS is the residual sum of the squares for each model and  $e$  is the regression residuals for each model. Once  $m_{it}$  is calculated, a regression of a constant, including an error term, is estimated.

$$m_{it} = c + e_{it}$$

The Vuong's statistic is then estimated through this equation, where  $t$  is the  $t$ -ratio of the constant ( $c$ ) from above and  $n$  is the number of observations.

$$z = t * [(n-1)/n]^{1/2}$$

A large, positive, statistically significant Vuong's statistic means that Model Y is superior and more accurate at explaining the dependent variable compared to Model X. However, if the Vuong's statistic is significant and negative, this is the reverse from the previous situation and as a result Model X out performs Model Y. In a case where the statistic is not significant then both models are equal in describing the dependent variable and no one model is more accurate.

#### *4.2.2 Model 2: Support Staff Maintain Intellectual Capital*

The literature suggests, under the framework for Model 2, support staff sustain and maintain intellectual capital after it has been created by the academics. What is of interest here is the correlation between revenue and support staff, as a significant correlation here would suggest that support staff are involved with maintaining the value of intellectual capital. A simple correlation would not work in this case, because it wouldn't show the true and unique relationship between support staff and revenue, as other factors could be influencing this relationship (Guilford, 1973). Regressing support staff and revenue, to find the correlation and strength of the relationship, is not necessarily going to show the true relationship

due to the affects that other variables can have. In this study, academic staff are highly likely to affect both revenue and support staff, which in turn may affect their relationship with one another.

Because simple regression is sometimes unclear due to the confounding influence of a third variable, in this case academic staff, the challenge is how to control for the variance created by the third variable. One way to deal with this variance is to create a specified pre-set value for the third variable, which remains constant. Alternatively the variance can be removed mathematically using first order partial correlations. Partial correlation is “the relationship between one of the independent variables and the dependent variable, given that the other independent variable(s) are held constant statistically” (Sharma, 2007, p. 527).

Written  $r_{xy-z}$ , partial correlation is the correlation between the residuals when regressing X with Z and Y with Z. This would be regressing the errors from the correlations between support staff with academic staff and revenue with academic staff; this is more formally written as (Sharma, 2007):

$$R_{xy-z} = [r_{xy} - (r_{xz} * r_{yz})] / [(1 - r_{yz}^2) * (1 - r_{xz}^2)]$$

In other words, academic staff was regressed on both support staff and revenue individually, the residuals from both of those regressions are put into a zero order correlation where the result will be the unique correlation between support staff and revenue, holding constant for any influence that academic staff may have.

Reverse causality is also a problem under Model 2, subsequently lagging relevant variables to exploit the temporal time-effect sequence. Academic staff is lagged by two time periods. While revenue is lagged only by one period, because under model two revenue will lead to support staff.

Partial correlation is normally used to analyse how much of an impact the third variable has on the relationship between the other two variables. This would be



done by comparing the correlation under zero order and then under first order, partialling out the third variable. This study is interested in the strength and direction of the unique relationship between support staff and revenue, partialling out academic staff. There are two possible ways, under partial correlation, where support staff do not maintain the value of intellectual capital. The first of these is where a negative correlation would suggest an increase in sales would decrease the level of support staff, therefore support staff do not maintain intellectual capital. Support staff, also, would not maintain revenue if the correlation is statistically weak.

## 5. RESULTS

### 5.1 MODEL 1: SUPPORT STAFF CREATE INTELLECTUAL CAPITAL

#### 5.1.1 Hypothesis 1 and 2

A Hausman Specification Test was conducted between revenue and the lag of academic staff to determine whether to use fixed or random effects. Here, a significant p-value would suggest fixed effects are the more superior model to use. Therefore, in order to regress revenue and lagged academic staff, fixed effects are used because the Hausman p-value was significant at 0.0000 (Panel A, Appendix). Table 3 shows lagged academic staff has a strong significant relationship with revenue, shown by a p-value of 0.0000. Furthermore, the adjusted R-squared of 0.8951 suggests academic staff explain a significant portion of revenue. The regression coefficient of 303,086.6 suggests that for every FTE academic staff personnel, the university will generate \$303,086.60 worth of revenue in a year's time. Because of this, Hypothesis 1 is accepted as academic staff cause revenue.

	Coefficient	Std. Error	t	p-value
Academic Staff (t-1)	303086.6	6144.227	49.33	0.000
Constant	158586.6	252959.7	0.63	0.531
Model's R-squared = 0.8955; F-statistic = 2433.32, p-value = 0.0000				

**Table 3: Regression of Revenue on Academic Staff (t-1)**

Again a Hausman Specification Test was conducted in order to test Hypothesis 2, where revenue is regressed against the lag of academic staff and the interaction term. The p-value of 0.000, shown in Panel B (Appendix), results in the use of fixed effects regressions. The adjusted R-squared from the regression between revenue and academic staff and the interaction term (Table 4)<sup>6</sup>, of 0.898, is slightly higher than without the interaction term. Suggesting the interaction between

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<sup>6</sup> Information regarding the co-efficient and significance of both academic staff and the interaction term has been excluded due to multi-collinearity.

support staff and academic staff explains additional variance in revenue. Since the adjusted R-squared has increased, Vuong's Model Selection Test is required to determine whether this increase is significant. The positive Vuong's statistic of 0.409 (Table 4) suggests the inclusion of the interaction between support staff and academic staff creates a more accurate representation of revenue. However, this statistic is not significant. Therefore, the interaction between support staff and academic staff does not significantly explain revenue better than academic staff themselves. There is sufficient information to reject Hypothesis 2, as support staff do not act as a moderating variable in the relationship between revenue and academic staff.

Previous Regression R-squared	0.8955
Regression with Interaction R-squared	0.8988
Increase in R-squared	0.0033
Vuong's Statistic	0.409

**Table 4: Summary of change in R-squared**

#### *5.1.2 Hypothesis 3 and 4*

These same tests were conducted to determine whether support staff involved with research generate intellectual capital and ultimately revenue from research. The Hausman Specification Test was used with revenue from research as the dependent variable and lagged academic staff as the independent. The resulting statistic of 0.6605 (Panel C, Appendix) supports the use of random effects, as opposed to fixed effects. Hence, revenue from research is regressed against lagged academic staff under random effects. The adjusted R-squared of 0.779 suggest that academic staff do drive revenue from research, this supports Hypothesis 3.

	Coefficient	Std. Error	z	p-value
Academic Staff (t-1)	142464.1	4470.219	31.87	0.000
Constant	-1362371	189346.1	-7.20	0.000
Model's R-squared = 0.7800; Wald Chi <sup>2</sup> = 1015.67, p-value = 0.0000				

**Table 5: Regression of Revenue from Research on Academic Staff (t-1)**

Before the interaction between academic staff and support staff involved with research can be analysed, a Hausman statistic must be generated to determine whether fixed or random effects is used. A large Hausman statistic found in Panel D (Appendix), of 0.9643, results in a random effects test to be undertaken. Adding the interaction term between academic staff and support staff from research into the original regression from above increased the adjusted R-squared, from 0.779, to 0.792 (Table 6). Again, because there is an increase in adjusted R-squared, this interaction term does explain some variance in revenue from research. The additional explanation from the interaction term is, however, non-significant according to Vuong's statistic. Because of the increase in the adjusted R-squared; adding the interaction term creates a better model, shown also by Vuong's statistic of 0.759. Because Vuong's statistic is not significant, Hypothesis 4 is rejected; support staff involved with research do not act as a moderating variable in the relationship between research revenue and academic staff.

Previous Regression R-squared	0.7800
Regression with Interaction R-squared	0.7920
Increase in R-squared	0.0120
Vuong's Statistic	0.759

**Table 6: Summary of change in R-squared relating to Research**

### 5.1.3 Hypothesis 5 and 6

As with the previous two hypotheses relating to research, Hypotheses 5 and 6 analyse whether support staff focused towards teaching create or maintain intellectual capital. A Hausman Specification statistic of 0.6803 (Panel E, Appendix)

suggests the regression between revenue from teaching and academic staff be conducted using random effects. The result of this regression supports Hypothesis 5, showing academic staff drive revenue from research. This is supported by a significant p-value of 0.000 (Table 7), an adjusted R-squared of 0.7384, and a 160740.1 regression coefficient.

	Coefficient	Std. Error	Z	p-value
Academic Staff (t-1)	160740.1	5643.18	28.48	0.000
Constant	1517455	232515.5	6.53	0.000
Model's R-squared = 0.7394; Wald Chi <sup>2</sup> = 811.34, p-value = 0.0000				

**Table 7: Regression of Revenue from Teaching on Academic Staff (t-1)**

The interaction term between support staff from teaching and academic staff is entered into the Hausman Specification Test along with revenue from teaching and academic staff. This resulted in a statistic of 0.916 (Panel F, Appendix), therefore random effects is used for regressions. In order to test whether support staff from teaching is a moderating variable and assists in the creation of intellectual capital, a random effects regression was run with revenue from teaching against academic staff and the interaction term including support staff from teaching. The interaction term with support staff from teaching was not a significant contributor to this model, rejecting Hypothesis 6. Indicating support staff from teaching do not act as a moderating variable. The adjusted R-squared decreased from 0.7384 to 0.7380 (Table 8). As a result of this, Vuong's is not required because of the decrease in adjusted R-squared. A decrease in adjusted R-squared when adding an interaction term means less variance in revenue from teaching is explained. Therefore, academic staff alone explains more variance in teaching revenue than adding the interaction term.

Previous Regression R-squared	0.7394
Regression with Interaction R-squared	0.7399
Increase in R-squared	0.0005
Vuong's Statistic	NA

**Table 8: Summary of change in R-squared relating to Teaching**

## **5.2 MODEL 2: SUPPORT STAFF MAINTAIN INTELLECTUAL CAPITAL**

### *5.2.1 Hypothesis 7 and 8*

The results of the regression between revenue and academic staff have already been discussed. It can be seen that academic staff drive revenue and Hypothesis 7 can be accepted. Hypothesis 8 is examining whether revenue drive support staff. First order correlation, removing the influence of academic staff, shows the correlation between support staff and revenue to be 0.5359. This correlation is also very significant at a level of 0.000, shown in Table 9. Because the correlation is significant, we can see that revenue does influence support staff. Therefore Hypothesis 8 can be accepted.

	Revenue (t-1)	Support Staff
Revenue (t-1)	1.000	
Support Staff	0.5359 (0.0000)	1.000

**Table 9: Partial Correlation between Revenue and Support Staff**

### *5.2.2 Hypothesis 9 and 10*

Previous tests confirm Hypothesis 9 as academic staff drive revenue from research. The next test determines whether revenue from research drive support staff involved with research. Table 10 shows the results of a partial correlation between revenue and support staff from research holding academic staff constant. Although the correlation of 0.1695 is reasonably weak it is highly significant at

0.0085. This supports Hypothesis 10, as revenue from research acts as a mediating variable between academic staff and support staff orientated towards research.

	Revenue from Research (t-1)	Support Staff from Research
Revenue (t-1) from Research	1.000	
Support Staff from Research	0.1695 (0.0085)	1.000

**Table 10: Partial Correlation between Revenue from Research and Support Staff involved with Research**

### 5.2.3 Hypothesis 11 and 12

Support has already been offered for Hypothesis 5 as academic staff drive revenue from teaching. Therefore, Hypothesis 11 can be accepted as these two hypotheses are identical. Table 11 shows the partial correlation between revenue earned from teaching and support staff orientated towards teaching. Again, it can be seen there is a significant and positive correlation between revenue from teaching and support staff orientated towards teaching when partialling out academic staff. Suggesting that revenue from research acts as a mediating variable in the relationship between academic staff and teaching support staff. Therefore, Hypothesis 12 can be accepted, suggesting revenue earned from teaching is maintained by teaching support staff.

	Revenue from Teaching (t-1)	Support Staff from Teaching
Revenue (t-1) from Teaching	1.000	
Support Staff from Teaching	0.3939 (0.0000)	1.000

**Table 11: Partial Correlation between Revenue from Teaching and Support Staff involved with Teaching**

### 5.3 POST-HOC TESTS

Additional post-hoc tests have been conducted as a means to test whether proximity or specialisation has an influence on the ability of support staff to create or maintain intellectual capital. Literature has not focused on the effects of proximity or specialisation of support staff in intellectual capital. However, it is important to analyse these trends to determine whether universities should employ support staff internally or externally to academic departments. For this, support staff were divided into two separate categories, either primary or secondary. Primary support staff are those directly within the revenue generating department or sub-department. And secondary support staff were all other support staff from external departments and divisional offices that were not classified as primary. A case can be made for the interaction between academic staff and primary support staff to have a greater influence when it comes to creating or maintaining revenue. This is because primary support staff are in closer proximity to academic staff and would be in a better position, due to their relationship, to assist in the creation of intellectual capital. On the other hand, secondary support staff may be able to assist in the creation of intellectual capital due to specialisation. Secondary support staff have a clearer and specific role compared to primary support staff, making them more specialised in assisting in the creation of intellectual capital.

#### *5.3.1 Primary Support Staff*

The first test is to examine whether primary support staff, while interacting with academic staff, assist in the creation of revenue. It has already been determined, under Hypothesis 1, that academic staff do drive revenue. Therefore, would the increase in primary support staff significantly increase revenue? Vuong's statistic was used to determine whether the addition of the interaction term was significant. The original regression between revenue and academic staff resulted in an adjusted R-squared figure of 0.895 (Table 3 from above). This increased slightly to 0.899 (Table 12) when the interaction between primary support staff and academic staff was



entered onto the right hand side of the equation<sup>7</sup>. Even though the interaction term explained more variance in sales, according to Vuong's statistic the increase in adjusted R-squared was not significant (Table 12). In other words, primary support staff do not act as a moderating variable in the relationship between revenue and academic staff. Therefore, the increase in primary support staff does not significantly increase the level of intellectual capital at the University of Otago.

Previous Regression R-squared	0.8955
Regression with Interaction R-squared	0.8992
Increase in R-squared	0.0037
Vuong's Statistic	0.6189

**Table 12: Summary of change in R-squared relating to Primary Support Staff**

Primary support staff have a strong correlation of 0.900 with revenue. However, when the effects of academic staff have been removed this decreases to 0.440, shown in Table 13. Partialling out academic staff has a large impact on the strength of the correlation, however, the correlation of 0.4402 is still significant. This supports the idea that primary support staff maintain intellectual capital.

	Revenue (t-1)	Primary Support Staff
Revenue (t-1)	1.000	
Primary Support Staff	0.4402 (0.0000)	1.000

**Table 13: Partial Correlation between Revenue and Primary Support Staff**

### 5.3.2 Secondary Support Staff

Secondary support staff do not have the same proximity as primary support staff, however, they are assumed to be more specialised. As a result secondary support staff may be better able to interact with the academic staff to act as a

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<sup>7</sup> Random effects was used for this regression, Panel G, Appendix.

moderating variable and create additional revenue. As discussed previously, the amount of variance explained in revenue by academic staff is 0.895 (Table 3 from above). The interaction term between secondary support staff and academic staff is placed on the right hand side of the equation the adjusted R-squared increases to 0.896 (Table 14)<sup>8</sup>. The resulting Vuong's statistic is 0.250 suggesting the addition of the interaction term explains more variance in sales, and therefore secondary support staff assist in the creation of intellectual capital. However, the Vuong's statistic, and the increase in value created by the secondary support staff, is not significant. Secondary support staff do not act as a moderating variable.

Previous Regression R-squared	0.8955
Regression with Interaction R-squared	0.8962
Increase in R-squared	0.0007
Vuong's Statistic	0.250

**Table 14: Summary of change in R-squared relating to Secondary Support Staff**

Since secondary support staff do not assist in the creation of intellectual capital, the next test will be to determine whether they maintain the value of intellectual capital. The first order correlation between revenue and secondary support staff, removing the influence that academic staff has on both variables, is significant at 0.0000 and has a positive correlation statistic of 0.4823 (Table 15). This finding supports the idea that revenue acts as a mediating variable in the relationship between academic staff and secondary support staff, and for that reason secondary support staff maintain the value of revenue and intellectual capital.

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<sup>8</sup> Random effects was used for this regression, Panel H, Appendix.

	Revenue (t-1)	Secondary Support Staff
Revenue (t-1)	1.000	
Secondary Support Staff	0.4823 (0.0000)	1.000

**Table 15: Partial Correlation between Revenue and Secondary Support Staff**

## 6. DISCUSSION & CONCLUSION

### 6.1 DISCUSSION

#### *6.1.1 What is this study about?*

This research questions whether support staff assist in the creation of intellectual capital at the University of Otago. As support staff continue to rise, the importance of this study grows; as it is important to determine what role support staff have in terms of intellectual capital. Phipps (2011) wrote an inquisitive article scrutinising the value created by support staff. Publishers like The Centre for College Affordability (2010) believe support staff do not create value, instead they create inefficiencies and increase the cost of education. The Centre believes a reduction in support staff is required to increase efficiency and refocus universities' goals towards knowledge creation and dissemination. With the high level of public funding, The Centre believes management have no incentive to decrease and down size support staff. However, according to Cabrita, Vaz and Bontis (2007) support staff are an integral part in the creation of intellectual capital by interacting with academic staff. Camison, Marquis and Devece (2000) believe support staff maintain value, without them the stock of intellectual capital would diminish.

#### *6.1.2 What do the Results suggest?*

##### Model 1: Support Staff Create Intellectual Capital

According to Model 1 support staff interact with academic staff to create and develop intellectual capital, and generate significantly more future wealth and revenue than academic staff would alone. From the results, there is support to suggest that academic staff drive total revenue, including revenue from teaching and research. However, hypotheses two, four and six were all rejected as there was no evidence to suggest support staff add intellectual value through the interaction with academic staff. Thus, support staff do not act as a moderating variable in the

relationship between academic staff and revenue. Given this, there is support for the initial relationship between academic staff and revenue. However, there is no evidence to suggest support staff interact with academic staff to significantly increase revenue and intellectual capital. Therefore there is partial support for Model 1. Firer and Williams (2003) and Kamukama, Ahiauzu and Ntayi (2010) believe these results are not unexpected as they argue that the interactions are both industry and country specific. Bontis (1998) found intellectual capital increased due to the interaction between the three forms of capital in large private sector organisations; these same interactions may not effect intellectual capital creation in smaller (in relation to the study conducted by Bontis) public sector organisations.

These results are in contrast to those found by Cabrita and Vaz (2006), who focused their research on Portuguese Banks. Cabrita and Vaz (2006) found the interaction between human, structural and relational capital have a better relationship to organisational performance than without the interaction. They found that the interaction between the three forms of capital significantly contributed to organisation performance. They also found that relational capital acted as a moderating variable in the relationship between human capital and intellectual capital. Previously stated researchers, similar to this study, excluded relational capital as an influence on intellectual capital at Universities. Universities in the USA, like Harvard, Yale and M.I.T., and in the UK, like Oxford and Cambridge, would certainly debate the exclusion of relational capital. The reputation generated over years of operation is likely to influence intellectual capital. Therefore, the inclusion of a market related variable, further discussed in future research, may interact with academic staff and support staff to explain significantly more variance in revenue and assist in the creation of intellectual capital.

## Model 2: Support Staff Maintain Intellectual Capital

Already thoroughly discussed, it is no surprise that academic staff are the creator of intellectual capital. Since support staff do not significantly create additional future wealth, their role must be to maintain value. This is supported by the partial correlation analysis between revenue and support staff, where the influence of academic staff has been removed. This follows the work from Camison, Marquis and Devece (2000) who believe support staff maintain the value of intellectual capital. There is support for hypotheses eight, 10 and 12, where revenue is a mediating variable between academic staff and support staff. There is a positive, and significant, relationship between the three types of revenue and the respective types of support staff. Indicating structural capital maintains the stock of intellectual capital to ensure knowledge is transformed into wealth before it is depleted.

Although the first order correlation between revenue and support staff is significant, at times the strength of the correlation could be considered weak. For example, the correlation between revenue from research and support staff from research is only 0.1695. However, this is not the case with revenue and support staff from teaching. This suggests either a large amount of the explanation of the increase in support staff from research is explained by something other than revenue from research. Or, in order to maintain the value and wealth of intellectual capital, fewer support staff are required.

## 6.2 IMPLICATIONS

The results suggest the current role of support staff is to maintain intellectual capital. Roos et al. (1997) stated that human capital creates structural capital, and most of the time this transformation comes through the financial capital of the organisation. Academic staff are employed to generate intellectual capital and revenue, in turn employing support staff to maintain and sustain that level of wealth

and intellectual capital. The role of support staff is to ensure the correct systems, procedures and structures are operating to maintain value and competitive advantage. Support staff allow the university to exploit the intellectual capital, generated by academic staff, to ensure the competitive advantage is maintained into the future. The University of Otago, and other higher education institutions, should ensure support staff are employed after intellectual capital has been generated. If support staff are employed before intellectual capital is created then it is inefficient for the University of Otago.

Since 2005 the University of Otago has had significant growth in both intellectual capital and support staff. Given that support staff are employed to maintain intellectual capital and are a result existing of intellectual capital, it would be expected to see an increase in both. From 2005-2010 revenue increased by 27%, while over the period from 2006 to 2011 support staff increased by 17%. During 2005-2010 revenue from research increased by 63%, while support staff orientated towards research increased by 18% from 2006-2011. In terms of teaching, in from 2005 to 2010 revenue from teaching increased by 15%, and between 2006-2011 teaching support staff increased by 16%.

If a 1:1 ratio (revenue/support staff; 1% change in revenue to a 1% change in support staff) is assume then the University of Otago should employ significantly more support staff to maintain the value of intellectual capital generated from research. What this could means is that without increasing support staff orientated towards research then the University of Otago is not able to fully utilise the intellectual capital generated as a competitive advantage. Given the results of the post-hoc tests, these support staff could be employed internal or external to the department given the role of primary and secondary is to maintain support staff. It is, however, unlikely to have a 1:1 ratio like above due to economies of scale. Further research, outside the scope of this paper, needs to be conducted to determine the optimal ratio of revenue to support staff. This could be done be determining the high

performing academic departments and the low performing academic departments. Creating categories of the revenue to support staff ratio; i.e. category 1 has a ratio of up to 0.8, category 2 has a ratio of 0.81 to 1.20, and category 3 has a ratio of 1.20. These categories are then matched to the high and low performing academic departments to determine whether one category is better matched to the higher and lower performing departments. The optimal ratio category is matched to higher performing academic departments and the University of Otago should ensure other departments have the same ratio to ensure intellectual capital is efficiently maintained.

There is a rather large gap in the literature pertaining to the maintenance of support staff. Previously stated researchers seem to suggest structural capital and support staff are employed as a means to maintain intellectual capital. However, no researcher has gone on to discuss how they might do so. Therefore, there may be another reason why we are seeing an increase in support staff after revenue. Balkin and Gomez-Mejia (1987) and Tosi et al. (2000) studied managerial behaviour, in some part, to organisation size. These authors found that self-serving management are driven to achieve personal goals of power and prestige. One of the key mechanisms used to achieve these goals is to increase the size of the organisation. In other words, egotistical managers are increasing the size of their organisation to make themselves feel more power and have a greater prestige. Since the literature surrounding how support staff would maintain intellectual capital is vague, the increase in support staff may not be to maintain intellectual capital, however, it may be to satisfy the personal goals of management.

#### *6.2.1 Changing the Role of Support Staff*

The role of support staff can change as the University changes and the relationship between academic staff and support staff develops. The majority of the increase in support staff has come about in the last decade. Given this reasonably short period of time, the relationships required to create intellectual capital may not



have properly and fully developed (Agndal & Nilsson, 2006). After some time, new relationships will be formed, with the potential for strong interactions to develop. Support staff, as the literature suggests, can have a role creating in the intellectual capital. Therefore, support staff may have dual roles, one where they assist in the creation of intellectual capital and the other where they maintain its value. This study's current findings suggest support staff at the University of Otago employs support staff serve to maintain value. It is possible to use these support staff, or employ more, to assist in the creation of intellectual capital as well as maintaining it. Once relationships are developed between academic staff and support staff, the interaction will become stronger and better assist in the creation of intellectual capital (Agndal & Nilsson, 2006). Existing relationships and interactions will then help form the basis for further relationships and interactions to develop.

Intellectual capital is created through the relationships internal to the company (academic staff and support staff), and at times external (relational capital/reputation). It is important to figure out a way to turn informal and social relationships into formal intra-organisational interactions that will generate intellectual capital and ultimately revenue (Agndal & Nilsson, 2006). However, the intra-organisational interactions do not form themselves; the University needs to create a culture for these relationships to develop, and once these are developed they will continue to grow (Rose, 2000). These relationships are created by the individuals, with the assistance of the organisation, and would not form if carried out in isolation.

Intellectual capital at the University of Otago is generated by the academic staff. The University needs to ensure effective measures are in place to facilitate the development of relationships and interactions to exploit the creation of intellectual capital. Any costs incurred formulating controls should be viewed as a future investment used to generate future wealth. The governance and management that guide the future direction and strategy of the University must have strong support

and constantly communicate the value of knowledge and knowledge creation, from the top down, through both the academic and support staff (Rose, 2000). Benevene and Cortini (2010) support this with the belief that organisational culture sets the scene for the interaction between human capital and structural capital.

### **6.3 LIMITATIONS AND FUTURE DIRECTIONS**

There are several limitations to this study, most of which can create the basis for future research. The first is the allocation of support staff. Support staff were allocated to academic departments using a driver that was believed to best represent the staff members' jobs, either student focused (student numbers) or research focused (number of academic staff). This method was reasonable and objective. However, it may not truly represent the time and effort these support staff allocate towards specific departments. Future research could develop a new allocation system that better represents the time and cost used by the revenue generating departments. This may be based on an internal costing if a system is in place, or by interviews with the ancillary support staff themselves.

FTE head count was obtained to measure both academic staff and support staff. A different, and potentially superior, measure would be salaries, because this measure takes into account the level and productivity of the staff members. For example, based on a head count approach a senior lecturer is counted at the same amount as a professor. However, a professor is expected to produce knowledge and disseminate this at a higher level compared to a senior lecturer. This expectation helps to explain why a professor is paid a larger salary. A salary-based approach would give a better estimate of staff 'numbers'. However, information on staff salaries at the level of the 48 academic departments was unavailable. Therefore FTE staff numbers were used instead. In future research, salaries could give a more accurate representation of the 'number' of academic and support staff. Or perhaps a weighting system would be used, where, for example, a professor is weighted at 1.0,

an associate professor is weighted at 0.9 etc. Although this is an arbitrary weighting allocation, it may be a closer representation of staff 'numbers'.

Financial data was collected to represent intellectual capital for the revenue generating departments within the four schools. The use of revenue could be a misrepresentation of the University of Otago's intellectual capital. In what is essentially a public organisation, revenue is unlikely to be a main goal or objective. Therefore, measures for intellectual capital should be more orientated towards the goals and objectives of the University, which are knowledge creation and dissemination. Potentially a better measure that could be used in the future is the percentage of students who passed and the number of publications. This represents the two main objectives of the University, both research and teaching, while removing a less important objective of revenue.

Multiplying support staff and academic staff together is a simple way, considered the norm under exploratory statistical analysis, to measure the interaction between the two terms. However, this does not represent the relationships that have been formed over time. A more accurate metric representing the relationships may result in a more accurate outcome and should be considered with future research.

As eluded to earlier on, studies on universities in the past have not included relational capital as a contributing factor to the creation of intellectual capital. Many universities develop a strong reputation over time and use this as a marketable tool to entice both students and academic staff. Future research should include a market related variable, this could be one of, or a combination of, size, subject range, age and research intensity. This market related variable may be the catalyst in the relationship between academic staff and support staff. Therefore, its inclusion into the interaction term should be considered.

Further research could analyse what the optimal number of support staff are to ensure intellectual capital is created and maintained efficiently and effectively. Too few support staff and intellectual capital will lack development and stocks of intellectual capital will lose value. Too many support staff will lead to inefficiencies and over employment. To add to this point, by using salaries to value the 'number' of academic and support staff, cost-benefit analysis could be used to conclude at what stage support staff are no longer adding value.

Other aspects of structural capital can be substituted into the models created in this study instead of support staff. This can be used to determine whether the new variable to represent structural capital assists in the creation of intellectual capital or maintains its value. For example, the number of computers or the investment into journals and books in the library could be used instead of support staff

## **6.4 CONCLUSION**

This study was designed to test whether support staff at the University of Otago assisted in the creation of intellectual capital. Given the results, three findings were evident: (1) academic staff drive intellectual capital creation, (2) support staff do not assist in the creation of intellectual capital, and (3) support staff maintain the value of intellectual capital. Analysis of the findings show support staff are employed after revenue has been generated, implying they serve to maintain the value of intellectual capital. However, the systems and procedures on how support staff maintain intellectual capital are vague and the increase in support staff may be a mechanism used by management to meet their personal goals. Management at the University of Otago should consider the organisational culture and continuously work towards developing the relationship and interaction between academic and support staff in order to further develop and create intellectual capital. Improvements to this study could be made, with respect to using salaries instead of FTE staff numbers and focusing on a metric to represent the interaction between

academic staff and academic staff. Along with these improvements, future research should focus on determining the optimal number of support staff to ensure their most efficient use in both creating and maintaining intellectual capital. Studies focusing on intellectual capital at universities are limited. This is an introductory study on the value of support staff in universities and knowledge organisations. It should be pursued further and refined by both practitioners and academics as a means to test both the role of support staff and the efficiency they offer.

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## 8. APPENDIX

**PANEL A:** Hausman Specification Test Hypothesis One

	Fixed	Random
Academic Staff (t-1)	104647.2	275588.6
Chi <sup>2</sup> = 86.38; p-value = 0.0000		

**PANEL B:** Hausman Specification Test Hypothesis Two

	Fixed	Random
Academic staff (t-1)	-69362.09	111245.6
Academic and Support Staff Interaction (t-1)	2113.014	1254.46
Chi <sup>2</sup> = 133.09; p-value = 0.0000		

**PANEL C:** Hausman Specification Test Hypothesis Three

	Fixed	Random
Academic Staff (t-1)	142606.8	142464.1
Chi <sup>2</sup> = 0.19; p-value = 0.6605		

**PANEL D:** Hausman Specification Test Hypothesis Four

	Fixed	Random
Academic staff (t-1)	92005.6	91894.46
Academic and Support Staff Interaction (t-1)	888.3992	888.5031
Chi <sup>2</sup> = 0.07; p-value = 0.9643		

**PANEL E: Hausman Specification Test Hypothesis Five**

	Fixed	Random
Academic Staff (t-1)	160479.8	160740.1
Chi <sup>2</sup> = 0.17; p-value = 0.6803		

**PANEL F: Hausman Specification Test Hypothesis Six**

	Fixed	Random
Academic staff (t-1)	172872.2	173007.1
Academic and Support Staff Interaction (t-1)	-160.9795	-159.3871
Chi <sup>2</sup> = 0.18; p-value = 0.9155		

**PANEL G: Hausman Specification Test Primary Post-Hoc Tests**

	Fixed	Random
Academic staff (t-1)	254336.1	254452.6
Academic and Primary S.S. Interaction (t-1)	481.9699	481.6629
Chi <sup>2</sup> = 0.02; p-value = 0.9889		

**PANEL H: Hausman Specification Test Secondary Post-Hoc Tests**

	Fixed	Random
Academic staff (t-1)	283422.2	282657.4
Academic and Primary S.S. Interaction (t-1)	599.7195	625.6247
Chi <sup>2</sup> = 0.56; p-value = 0.7565		