EXPLORING CONSTRUCTION PRODUCTIVITY STATISTICS IN NEW ZEALAND

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Attestation of Authorship

I, Van Dai Tran, hereby declare that this submission is my own work and that, to the bestof my knowledge and belief, it contains no material previously published orwritten by another person (except where explicitly defined in acknowledgements), nor material which to a substantial extent has beensubmitted for the award of any other degree or diploma of a university orother institution of higher learning.

Signed: ……

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ABSTRACT

Productivity growth is strongly correlated to economic growth and increases in welfare. This fact also holds true at the industry level and is particularly true in the NZ construction industry, since productivity growth in this sector may have significant effects on the affordability of housing in the country. In recent years construction in NZ has been subjected to a series of reports that have either highlighted 'failure' to grow productivity or have exhorted the industry to improve its 'poor performance'. However thus far little by way of analysis has gone into the productivity figures that have been quoted, nor has much been done to explain and justify if or why these figures are correct or incorrect.

This research seeks to deconstruct construction productivity figures in NZ and explain the patterns over recent years of 'poor performance' in comparison with other industries. As such it will examine the nature of the NZ construction industry and analyse the historic statistics related to its labour productivity.

The research found that while factors influencing inputs of labour productivity measure such as labour and material costs remained stable, factors impacting the corresponding outputs such as house and land prices, value of work in Non-residential and Infrastructure construction grew significantly between 1997 and 2007. Given the positive skewing effect of standard economic indicators (inflation etc) on construction labour productivity figures, the relatively poor performance of construction is worrying for the industry. The paper concludes by demonstrating labour productivity in construction is significantly worse performing than previously suspected.

Key words: construction, labour productivity, deconstruction, industry performance

CHAPTER 1

1. INTRODUCTION TO RESEARCH AND PROBLEM STATEMENT

1.1. Background

Productivity addresses the question of how efficiently resources are used in the production of goods and services (Holzer& Nagel, 1984). It is the key determinant of value, and all other factors that influence value (quality, service, price), of these goods and services. Ultimately, productivity is one of the important factors that have significant impacts on economic growth, standard of living and increases in welfare(Heap, 1992; Sobhani, 2008; Black et al, 2003).

At company level, improving productivity is fundamental to survival of firms because it means that they can meet their obligations to workers, shareholders, and governments while remaining competitive (or even improve its competitiveness) in the market place (Wikipedia, 2010). At industry level, productivity improvement is essential for the health of the whole sector, as it is seen as the only valid way to pay for increased standard of living (Heap, 1992). In the context of the construction industry, productivity improvement is particularly important because inadequate increases in productivity will mean shaper rises in construction costs, with adverse social implications and declining work for the industry (Ganesan, 1984). In New Zealand, this fact holds true because productivity growth in the construction sector may have significant effects on the affordability of housing in the country (Davis, 2007).However, it has been acknowledged that productivity, especially in the construction industry, has always been very difficult to measure and control (Ganesan, 1984; Motwani et al, 1995). Construction tasks are generally complex and inter-dependent such as those in major projects; as such they are hard to quantify when assessing and measuring productivity. This technical difficulty is compounded further by the fact that the sector is influenced by external factors such as economic situations (recession or boom periods), political changes (government commitments or effects of legislations) or innovation. Therefore, productivity measures must be treated with care (Heap, 1992).

There are a number of methods used in measuring productivity. The choice between them depends on the purpose of productivity measurement and, in many instances, on the availability of data (OECD, 2001). Generally, productivity measures can be divided into single factor productivity measures, which relate a measure of output to a single measure of input; or multifactor productivity measures, which relate a

measure of output to a bundle of inputs. Another distinction, of particular relevance at the industry or firm level is between productivity measures that relate some measure of gross output to one or several inputs and those which use a value-added concept to capture movements of output. Figure 1 summarises the main productivity measures:

Figure 1: Overview of productivity measures

Type of output measure	*Type of input measure*			
	Labour	*Capital*	*Capital and labour*	*Capital, labour and intermediate inputs (energy, materials, services)*
Gross output	Labour productivity (based on gross output)	Capital productivity (based on gross output)	Capital-labour MFP (based on gross output)	KLEMS multifactor productivity
Value added	Labour productivity (based on value added)	Capital productivity (based on value added)	Capital-labour MFP (based on value added)	-
	Single factor productivity measures		*Multifactor productivity (MFP) measures*	

Source: OECD

Of these, measure by value-added labour productivity is the most widely used method in assessing and evaluating the performance of the NZ construction industry. Labour productivity measure shows the time profile of how productively labour is used to generate output. Labour productivity changes reflect the joint influence of changes in "capital, intermediate inputs, as well as technical, organisational and efficiency change within and between firms, the influence of economies of scale, varying degrees of capacity utilisation and measurement errors" (OECD, 2001). However, one must be careful in interpreting labour productivity because it does not equal performance since this is a partial productivity measure which tries to reflect the joint influence of a host of factors (Alfeld, 1988; OECD, 2001). As noted in the OECD Manual, at the aggregate level, value-added based labour productivity "forms a direct link to a widely used measure of living standards, income per capita". This means that changes in factors such as working hours, unemployment, labour force participation rates and demographic are adjusted in order to translates productivity directly into living standards.

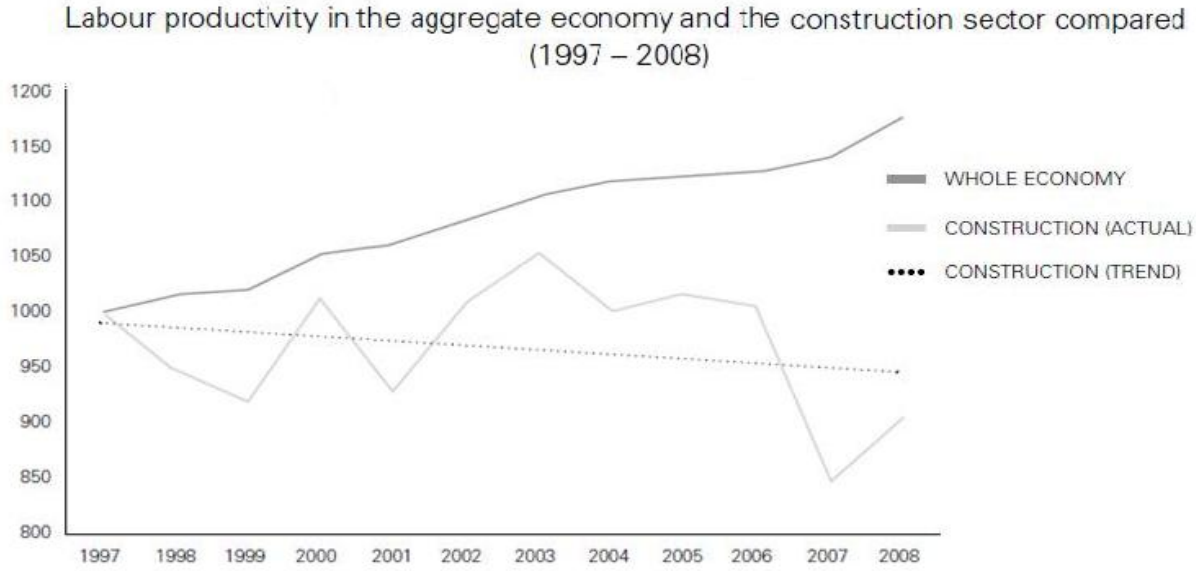
In recent years, a number of studies have been commissioned to investigate the productivity trends, especially labour productivity, in the NZ construction industry. The main reason for this specific consideration is due to the nature of the industry. Construction is generally a labour-intensive industry and as such improving the productivity of labour constitutes a prime target. Data required for the construction of labour productivity index series are more readily available than other series. Capital productivity series are hard to obtain. Statistics New Zealand (SNZ) publishes labour data quarterly intervals, whereas the capital series for construction is given yearly.

Although these studies vary significantly in details and depth, they nonetheless highlight some worrying signs for the sector, as the overall theme is that labour productivity in NZ construction has been low and has declined over time. In order to address this issue formally, a Productivity Taskforce made up of industry and central government leaders was established in 2009 to overlook and develop:

- a sector wide skills strategy
- an improved approach to the procurement of construction projects

In the past, productivity studies in NZ, particularly in construction labour productivity, have been brief on the issue. Even though a number of methods have been developed and analysed, these studies have in general failed to identify factors that affect the productivity performance in this sector. The representation of labour productivity in construction is therefore often misleading and as a consequence fails to explain the causes of its (poor) performance. A graph included in the “Report of the Building and Construction Sector Productivity Taskforce” is an example. This graph was extracted from a report previously produced by Davis (2007) for the Department of Building and Housing.

Figure 2: Labour Productivity Figure



Source: Nick Davis (2007), Construction Sector Productivity Scoping Report, MartinJenkins, Wellington

This research project was initiated from the lack of understanding of data presented in Figure 2. The objective of the research is to deconstruct “broad brush” statistics into a more meaningful representation of labour productivity in the NZ construction industry. Without clear delineation between industry section and representation of external impact factors, NZ construction’s “productiveness” cannot be fully understood and therefore may deter the effort to improve the performance of the industry. This research will serve as the foundation for further investigations into this subject matter in New Zealand. It relates directly to Building Research Association of NZ’s (BRANZ) mission to promote a knowledge transferring medium in NZ between the research community and the industry by identifying where productivity and competitiveness can be improved.

1.2. Problem Statement

Although the construction industry is a major sector of the New Zealand economy, it has experienced a period of decline in productivity. To address these deficiencies, efforts are underway to measure construction productivity at three levels: task, project, and industry. Department of Building and Housing (DBH) have commissioned a study into this area and the “Report of the Building and Construction Sector Productivity Taskforce” was released in 2009. However, due to the technical nature of the study, this report only summarises its results, which is represented by the graph above.

The root of the problem is that the data embodied in the labour productivity chart is ambiguous, given the time series based plot indicated. Much of the variability of the productivity components may be as a result of extraneous factors having a lag effect on productivity. Whatever the factors involved, at present there is a significant requirement to understand the true nature of this particular issue and get the best that we can from the data. Failing which to identify what are more appropriate data sources, and/or measurements, in order to inform the decision making of our industry leaders for the future. This, I believe, will add significant value to the report of the C&B Productivity Taskforce and thus allow better value to be made from policy in the New Zealand construction industry. In essence, there is a requirement therefore to explore the nature of the data presented, and establish the factors affecting productivity over time. To this end there is an opportunity to engage quickly a research to tackle the nature of this problem.

Figure 2 shows an interesting phenomenon. That is despite the financial hardship the New Zealand construction industry faced in 2008 due to the global recession, the graph shows an up-turn on the productivity line. Questions will need to be asked of industrial practitioners to establish the reasons behind this up-turn. For example, what accounts for this up-turn? Can it be related to industry taking the opportunity to downsize and eliminate less capable operatives? Alternatively was the productivity uplift as a result of commodity prices such as steel, increasing the measured value of industry output and thus labour productivity? There is an implication that there are a substantial number of qualitative aspects of this research issue that will significantly enhance the explanation of quantitative results and thus inform planning in the industry. Along with this, conflation of data and the selective citing of limited statistics, whose goal is to provide simplification of the issues for a wider readership, need to be improved in order to plan effectively for the future of construction. The research therefore investigates factors which influence construction productivity from 1997-2008. It will provide answers to these questions and build a platform for future planning in this industry.

1.3. Research Aims and Objectives

Productivity studies into NZ construction have either highlighted ‘failure’ to grow productivity or have exhorted the industry to ‘improve’ its ‘poor performance’ (Black

et al, 2003; Davis, 2007; Janssen et al, 2008; Taskforce, 2009). Little by way of analysis has gone into the productivity figures that have been quoted, nor has much been done to explain and justify if or why these figures are correct or incorrect. Moreover, all these studies seem to have failed to identify factors which may have significant contribution to the continual decline in labour productivity that construction has experienced. This research seeks to deconstruct construction productivity figures in NZ and explain the patterns over recent years of 'poor performance' in comparison with other industries. As such it will examine the nature of the NZ construction industry and analyse the historic statistics related to its labour productivity. This will provide an overall understanding of the sector as well as those extraneous factors that may have significant influences on NZ construction.

The relationships of the research questions and stated objectives are inextricably interlinked in the development of the research detailed in this thesis. A summary of the relationships is given in Table 1.

Table 1: Relationship of Research Questions with Objectives

Research Question	Correlating Objective
Research Question 1	Objective 1
Research Question 2	Objective 2
Research Question 3	Objective 3

In particular, the three main research questions are:

A. What is the current performance of labour productivity in the NZ construction industry?
B. What are the factors affecting this performance?
C. What can the industry and the academic community do to help improving labour productivity in the NZ construction industry?

Correspondingly, the objectives of this work are hence:

a. To re-examine existing studies on labour productivity in NZ construction
b. To identify factors that may affect performance of construction labour productivity

c. To set up a platform for future research in this area in NZ

1.4. Methodology, Research Variables and Techniques

The methodological framework for this research looks at the nature of NZ construction and performance of labour productivity in this sector. There are2 main domains to this research:

i) The collection and reconstruction of NZ construction labour productivity index series
ii) The explorations of extraneous factors affecting this performance

These domains may be described as sub-systems within the overall project process. For each of these domains, the dynamics and understanding of the issue need to be established. This conclusion results in the formulation of the thesis research questions. The resolution of these research questions in turn necessitates the use of elite interviews from practicing professionals in construction. Ultimately they serve as confirmations of this study.

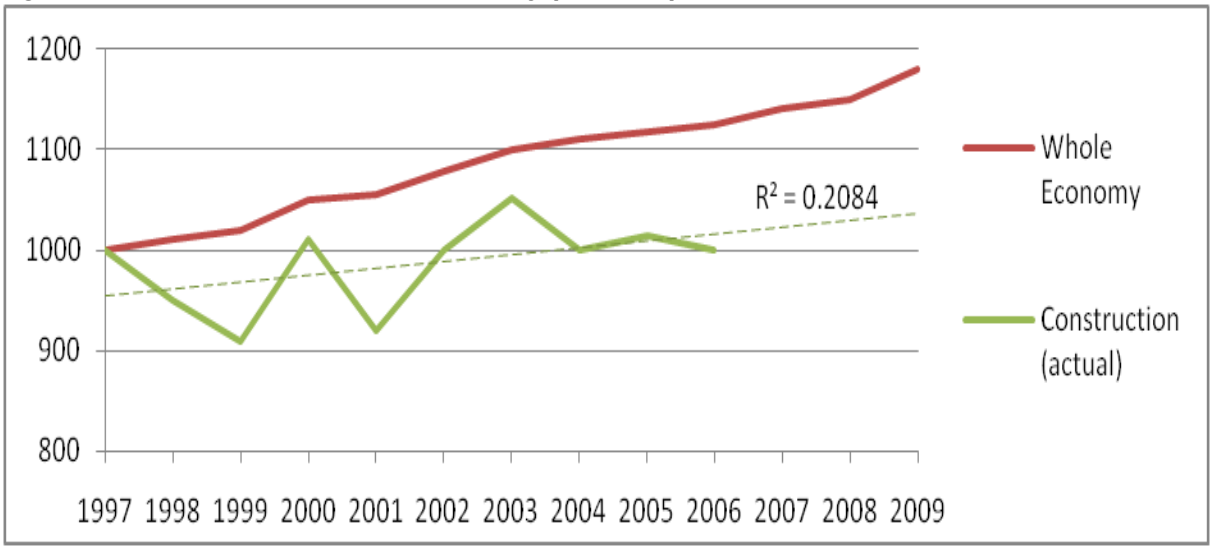
The data collected will be used in the analysis of relationship between multiple factors. This exercise aims to confirm whether or not these extraneous factors have any significant effects on labour productivity performance; and to establish a theoretical model relating all these factors. These results then serve as the basis for further research in this area. This is an ambitious goal on the author's part and even though it is more suitable to a higher level research, i.e. Doctorate level, the author feels that an attempt in this instance is necessary.

1.5. Justification for the Research

Worldwide, similar statistically-based justifications are used to motivate the construction sector to redouble its efforts to innovate and improve performance. This, it is contended, is a conceptually difficult position to sustain. There would appear to be a tendency for reports citing such limited statistical evidence as those in Figure 2 to seek to push an agenda onto the construction industry, and indicate a distinct willingness to selectively cite statistics outside of context. Taking the statistics from Figure 2 and removing from the data figures for years 2007 and 2008, produces Figure 3. The application of a regression line through the construction productivity

figures visually demonstrates a close correlation between productivity growth in construction and in other industries – although admittedly slightly below those of the whole economy. Interestingly, in this case, the 07/08 productivity decline closely follows on behind the impact of new provisions in the NZ Building Act (2004) which became significant in late 2006.

Figure 3: Construction Labour Productivity (modified)



Source: Davis, 2007

Furthermore, the problem with productivity measurement is a significant issue in NZ. Currently no official measure exists (Davis, 2007). This compounds other extant problems such as the availability and quality of data. Further, previous productivity studies tend to conflate statistics to reduce the complexity in their explanations. Consequently, all these issues make it difficult to derive strong conclusions from these studies because extraneous factors that may have significant influences on labour productivity and their effects were largely over-looked. This research investigates these issues in detail in order to establish a framework for further research in labour productivity of NZ construction.

The NZ construction industry may expect the main benefits from this research, including:

- Better understanding the nature of productivity within New Zealand
- Understanding the linkage between policy and productivity
- Establishment of more appropriate measures of performance for NZ

- Understanding productivity key to developing sustainable and profitable construction sector in NZ
- More effective and productive legislative decision making for the construction sector
- Better understanding of the deleterious impact of politics on construction

1.6. Structure of the Research

The thesis is structured into 6 chapters, which progress in accordance with the identified research objectives. **Chapter 1** comprises an introduction, which in addition to listing key aims has also described the purpose of the research. Finally, a summary of the various elements of the thesis is provided.

Chapter 2 introduces the academic literature on productivity, labour productivity (LP) in construction and subsequently evaluates the current understanding of LP in general and within the NZ construction sector in particular. This chapter concludes by setting the research questions that the research seeks to answer.

Chapter 3 discusses the methodology adopted for the conduct of this research and the reasoning behind the choice of the research instrument. Particular attention is given to the issues of the philosophical construct of the research, philosophical positioning of its design and consequent validity. The chapter also provides the wider theoretical justification for the proposed methodology with reference to the established typology of social science. A research strategy is also developed which enables the approach to be evaluated in practice.

Chapter 4 presents an analysis of the data collected. Relationships between all factors are then established. This chapter provides a foundation for further discussions on the subject matter.

Chapter 5discusses the issues arising from the study with reference to the preceding theory. The data collected is used in the development of a conceptual graphical model. By evaluating the problems, research questions, objectives and methodology, this chapter pulls the whole thesis together. The chapter paves the way for drawing of conclusions and subsequent recommendations.

Chapter 6 provides an overview of the thesis and summarises the key conclusions. Specific consideration is given to the research limitations together with the limitations of the adopted research strategy. Finally, the overall conclusion and 'contribution to knowledge' are summarised and recommendations are made for further research.

CHAPTER 2

2. LITERATURE REVIEW AND PRELIMINARY ANALYSIS OF NEW ZEALAND CONSTRUCTION LABOUR PRODUCTIVITY

2.1. Introduction

This chapter reviews available and relevant literature in relation to construction industry productivity in New Zealand and factors which may significantly affect this performance. Limitations in productivity studies such as the lack of measurement methods and issues such as the availability of data series and the quality of these data will be explored in detail.

The nature of the construction industry will also be looked at. This will provide an overall understanding of the sector as well as those extraneous factors that may have significant influences on the New Zealand construction sector.

Employment outlook in the industry also provides crucial information on how the sector performs and will perform in the future. Links will be established so that an understanding of dynamics of the New Zealand construction industry can be achieved.

2.2. Defining Productivity

Productivity is important at all levels in the economy. Productivity has been identified as the key determinant of a country's standard of living. For companies, productivity is important given its link to profits. And for employees, productivity is important because of its link to wages and consumption these wages can finance (Janssen et al, 2008).

Productivity has been formally defined by the Organisation for European Economic Cooperation as: "the quotient obtained by dividing output by one of the factors of production. In this way it is possible to speak of productivity of capital, investment, or raw materials according to whether output is being considered in relation to capital, investment or raw materials, etc" (Sumanth, 1984). It must be noted that productivity is a relative concept with comparisons either being made across time or between different production units.

Productivity is represented by:

$$\frac{Outputobtained}{Inputexpended};$$

where unit of measurement of both outputs and inputs is given in dollar values (NZ$) or in any other relevant unit.

2.2.1. Index number methodology

This paper utilises the index number methodology to measure aggregate and industry productivity. In general, a productivity index is defined as the ratio of an output index to an input index, that is:

$$A^t = \frac{Q^t}{I^t}; t = 0 \ldots T$$

where A^t is a labour productivity index, Q^t is an output index and I^t is a labour input index. Each index represents accumulated growth from period 0 to period t.

Construction of both input and output indices is required in calculating productivity at the aggregate and industry levels. As noted in Black et al (2003), because inputs and outputs are heterogeneous, it is not possible to simply add all inputs (outputs) to get

an input (output) index. Both inputs and outputs therefore need to be weighted to form aggregate and sub-aggregate input and output indices. However, it is not always apparent which weighting procedure should be used to form input and output series and on what basis this should be chosen. Some of the most common index formulae (Laspeyres, Paasche, Fisher and Tornqvist) are listed below.

Suppose information on prices and quantity of I outputs is available for period t=0…T. Denote the price and quantity vectors as $p^t = ({p_1}^t, \dots, {p_I}^t)$ and $q^t = ({q_1}^t, \dots, {q_I}^t)$ respectively; the Laspeyres (L^t), Paasche (P^t), Fisher (F^t), Tornqvist (T^t) quantity indices are defined as follows:

$$L^t = \frac{\sum_i {p_i}^0 \times {q_i}^t}{\sum_i {p_i}^0 \times {q_i}^0}$$

$$P^t = \frac{\sum_i {p_i}^t \times {q_i}^t}{\sum_i {p_i}^t \times {q_i}^0}$$

$$F^t = (L^t \times P^t)^{\frac{1}{2}}$$

$$T^t = \prod_i \left(\frac{{q_i}^t}{{q_i}^0}\right)^{\frac{1}{2}\times({w_i}^0 + {w_i}^t)}$$

for $t = 0, \dots, T$ and $i = 1, \dots, I$ and where ${w_i}^t = \frac{{p_i}^t \times {q_i}^t}{\sum_i {p_i}^t \times {q_i}^t}$

Of these, Tornqvist and Fisher index formulae are the most widely used by statistics officials around the world.

2.2.2. Basic types of productivity

2.2.2.1. Partial productivity

Partial productivity is the ratio of output to one class of input (labour, capital or material). This gives rise to Labour productivity, Capital productivity or Material productivity respectively. In this report, emphasis is on labour productivity because:

- We want to be consistent with the subject studied
- It is closely related to individual incomes and therefore living standard
- It can be measured with reasonable reliability

Labour productivity measures can be based on either a gross output or on the value-added concept. The simplest measure of labour productivity is output per worker. An increase in output per worker can be observed either by requiring workers to produce more in the hours they work or if they work longer hours. The latter is a disadvantage of this definition.

The second measure of labour productivity is output per hour worked. The advantage of this method over the previous one is that it takes into account variations of number of hours worked per worker, rather than the numbers of employees, as the measure of labour input. With an increase in part-time employment, hours worked provides the more accurate measure of labour input. But the main disadvantage is that the hours worked data is less reliable than the employment data.

Capital productivity is also of special interest because it shows the time profile of how productively capital is used to generate values. Like labour productivity, capital productivity measures can be based on either a gross output or on the value-added concept. Both labour productivity and capital productivity changes reflect the joint influence of changes in capital (& intermediate input in case it is based on gross output), technical, organisational and efficiency change within and between firms, the influence of economies of scale, varying degrees of capacity utilisation and measurement errors (OECD, 2001).

2.2.2.2. Multifactor productivity (MFP)

Multifactor productivity (MFP) is the ratio of the value-added concept of output to the sum of associated labour and capital inputs. MFP indices show the time profile of how productively combined labour and capital inputs are used to generate added value. This method serves as an analysis of micro-macro links, such as the contribution of an industry to the economy-wide multifactor productivity growth and living standards (OECD, 2002).The main advantage of MFP measure is the ease of aggregation across industries and that the data required is directly available from national accounts. However, its main drawbacks and limitations are that the multifactor productivity is not a good measure of technology shifts at the industry level. When based on value added that has been double-deflated with a fixed weight

Laspeyres quantity index, the measure suffers from the conceptual and empirical drawbacks of this concept (OECD, 2002).

In this research, the focus is on the partial productivity type of measurement and is based on the value-added concept.

2.2.3. Gross or Value-added

There are two approaches in measuring outputs in order to construct productivity series: gross output approach and value-added approach. The gross output approach attributes the productivity gains across all inputs, including intermediate inputs while the value-added method attributes the gains from the more efficient utilisation of intermediate inputs to capital and labour (Janssen et al, 2008)

In 2002, the OECD ranked the most commonly used methods in constructing productivity series in its publication “Measuring Productivity-OECD Manual” (OECD, 2002). Among them, the most frequently computed productivity statistic is the value-added based labour productivity, which then followed by the value-added capital-labour MFP.

To be consistent with previous reports upon which this research is investigating, the data used in this report will mainly be sourced from Statistics New Zealand (SNZ). SNZ’s System of National Accounts identifies the main output of Gross Domestic Product (GDP) as “the measure of the value added from all economic activity in New Zealand” (SNZ, 2010).Even though it is possible to construct productivity series using output based on both gross and value-added concepts, in this report, focus is on the latter case.

2.2.4. Levels and Growth rates

A “level” refers to the value of a certain indicator at a given point in time. Productivity levels measure the dollar value (or any other types of measure) of output or value added for a given levels of input. However, due to their sensitivity to the units of measurement of inputs and outputs, productivity levels are rarely of primary interest.

The focus of productivity measurement is therefore on the growth rates. A “growth rate” shows how fast an indicator has risen (or declined) over a certain period. While

productivity levels are important from the overall efficiency perspective, the more pressing concern for policy makers is whether this efficiency is improving or not (Davis, 2007).

MAIN LITERATURE IN RELATION TO NEW ZEALAND ECONOMY AND CONSTRUCTION INDUSTRY

There have been a number of investigations into the productivity performance in New Zealand. Their analyses, findings and summaries will be included in this section.

2.3. Black, Guy and McLellan (2003)

In their working paper for the New Zealand Treasury, Black et al (2003) established the productivity series for the New Zealand economy for period 1988 to 2002. Their series are for "ongoing monitoring of New Zealand's productivity performance and for use in further analyses investigating the evolution, sources and determinants of New Zealand's productivity growth" (Black et al, 2003). Overall, this report put more emphasis on the performance of the New Zealand economy on the aggregate level, even though performance of the construction industry is briefly mentioned.

2.3.1. Methodology

Black et al (2003) utilised the index number approach to measure productivity of aggregate and industry levels. Input and output indices were constructed first to calculate the productivity. Indices are obtained by using weighted inputs and outputs with the weights being input costs and output prices respectively. In addition, chaining of productivity indices is employed in this report. This is because a chained quantity index compares quantities between periods taking into account information on weighting changes in the intervening period and also "chaining direct indexes usually reduces substitution bias" (Black et al, 2003).

2.3.2. Data

The main source of data in this working paper comes from SNZ, consisting of values and volumes of output, labour and capital, with:

- Output: sourced from SNZ's System of National Accounts (1993) production-based GDP series
- Labour: comes from SNZ's two surveys: the Quarterly Employment Survey (QES) and Household Labour Force Survey (HLFS). Of these, the HLFS hours worked data are the preferred measure.

- Capital: Industry capital stock data comes from SNZ's productive capital stock series. Additional interpolation was needed to complete the capital stock series up to 2002.

2.3.3. Findings

Key findings are summarised below:

Table 2: Average multifactor productivity growth by industry

March Year	Primary	Mining & Quarrying	Construction	Manufacturing	Electricity, Gas & Water
1988 to 1993	-0.52%	-1.91%	-4.59%	0.29%	1.11%
1993 to 2002	2.45%	0.72%	0.25%	-0.16%	-0.93%
1988 to 2002	1.38%	-0.23%	-1.51%	0.00%	-0.21%

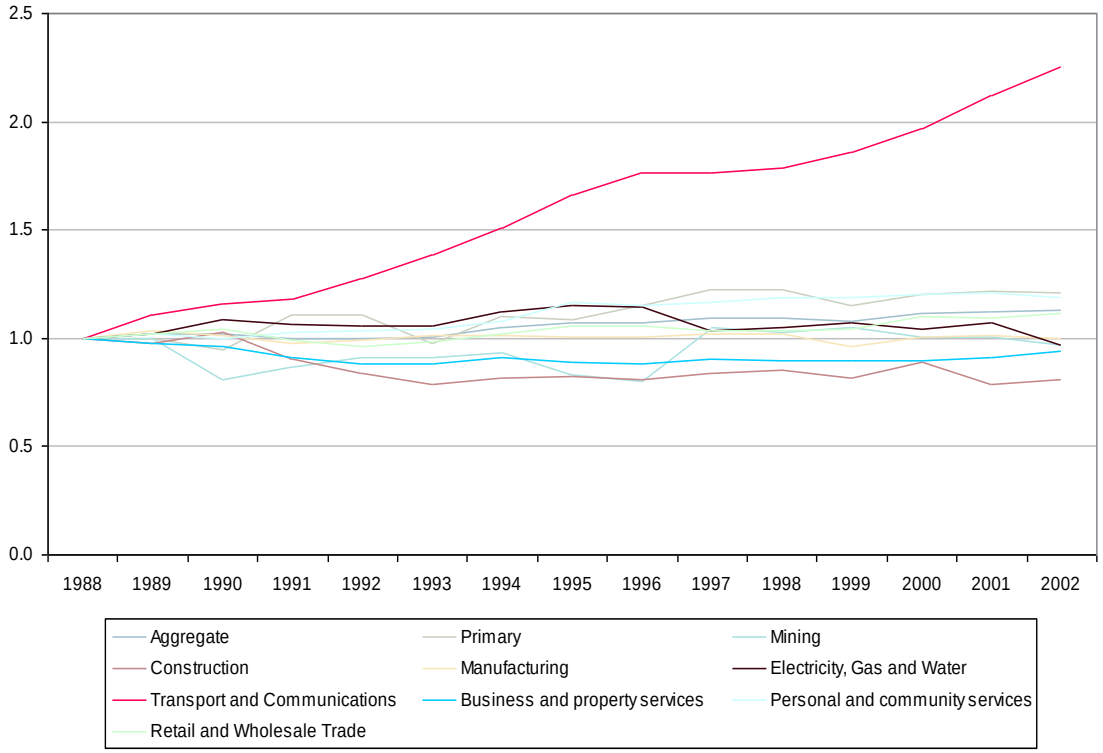
March Year	Transport & Communications	Business & Property Services	Personal & Community Services	Retail & Wholesale trade
1988 to 1993	6.75%	-2.54%	0.82%	-0.38%
1993 to 2002	5.52%	0.74%	1.48%	1.40%
1988 to 2002	5.95%	-0.44%	1.24%	0.75%

Source: BGM (2003)

On average, the multifactor productivity growth in the construction industry was the worst in all sectors considered. Over this period, the MFP of construction industry declined by an average of 1.5% per annum while the average growth of in term of MFP of the whole economy is 0.88% per annum. Figure 4illustrates the effect of poor MFP growth in the sector over time.By 2002, performance of MFP in the construction sector was almost 20% lower than that in 1988. This is a significant decline indeed.

Even though this type of work in measuring productivity has its merits, it is unclear of the applicability in the case of the construction industry. In particular, how information obtained from this study can be used to inform the key decision makers (DBH for instance) on how to improve the industry's performance.

Figure 4: Industry Multi-Factor Productivity Series



Source: BGM (2003)

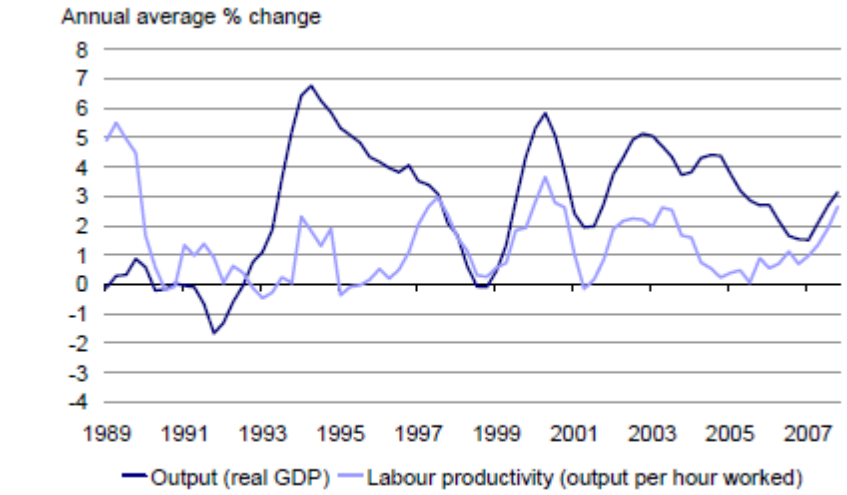
2.4. Janssen and McLoughlin (2008)

Janssen &McLoughlin (2008) is part of a series of working papers that the New Zealand Treasury aims at addressing NZ's long term productivity performance and factors that may be inhibiting NZ from reaching its potential; and also it "examines the evidence surrounding New Zealand's productivity performance at an aggregate level" (Janssen et al, 2008).

2.4.1. Methodology

The GDP series and the number of actual hours worked from the HLFS are sources from SNZ for labour productivity analysis. In order to reduce data volatility and seasonal variation, the report has averaged this quarterly data over the year from March 1988 to December 2007.Its effects are shown in Figure 5:

Figure 5: Economy-wide output and labour productivity growth (1989-2007)



Source: The Treasury, Statistics New Zealand

2.4.2. Data

Similar to the Black et al (2003) report, Janssen et al (2008) used real GDP and value-added method as main measures of outputs at aggregate and industry levels respectively. Even though the hours paid data obtained from QES has been recommended by SNZ in calculating labour productivity at industry level, this report actually used hours worked data because it "examines the whole economy (the QES excludes some industries), do not want to include holidays and other paid leaves, and the Treasury forecasts are on an hours-worked basis" (Janssen et al, 2008)

2.4.3. Findings

The performance of economy-wide labour productivity is shown in Figure 5. There appears to be some degrees of volatility in the labour productivity growth year to year. Furthermore, peaks of labour productivity tend to match peaks of business cycle. The reverse is also true. Exceptions to this rule of thumb are when labour input exhibits significant change (e.g. economic growth was high despite low labour productivity growth and low in 1989 despite high labour productivity growth) (Janssen et al, 2008).It was postulated by that the possible cause for the lower-than-expected observed labour productivity growth in recent years was due to changes occurring in the NZ labour work force, that is "during times of high employment growth, new workers tend to dampen observed productivity growth" (Janssen et al, 2008). As new workers enter employment, even if they have high levels of formal

qualifications, they are generally less productive than existing workers. Consequently, the observed productivity growth experiences a temporary reduction. Until these workers gain sufficient job-relevant knowledge or experience, productivity should return to its original rate.

In terms of industry level, growth in labour productivity is presented in the table below:

Table 3: Output, jobs, labour productivity and contribution to labour productivity growth by industry (seven years to March 2007)

Annual average growth (%)	Output	Jobs	Labour productivity (output per job)	
			Total	Contribution (percentage points)
Total measured sector	**3.4**	**3.1**	**0.3**	**0.3**
Primary	1.5	2.7	-1.2	-0.1
Manufacturing	1.9	0.9	1.0	0.2
Electricity, gas & water	1.4	-0.9	2.2	0.0
Construction	4.1	7.4	-3.1	-0.2
Wholesale trade	2.4	2.6	-0.2	0.0
Retail trade	4.6	3.1	1.5	0.1
Hospitality	3.0	3.5	-0.6	0.0
Transport & storage	3.0	2.9	0.1	0.0
Communications	6.8	0.3	6.5	0.3
Finance & insurance	4.9	2.8	2.1	0.2
Business services	5.0	4.3	0.6	0.0
Culture & recreation	5.2	3.8	1.3	0.0
Personal & other	3.2	3.5	-0.3	0.0

Source: Gross Domestic Product, Linked Employer-Employee Data (December 2006 year was used for job growth as data for the March 2007 quarter were not available), Statistics New Zealand; Treasury calculations

Decomposition of table 3 shows that while of labour productivity growth in the 13 measured sectors considered experience an increase of 0.3% per annum, the construction industry exhibits the lowest level of growth in labour productivity, with a decrease of 3.1% per annum despite its high employment growth. The expansion in this industry was due to factors such as “high net migration inflow, previously low interest rates, declining household sizes and infrastructure investment” (Janssen et al, 2008).

Overall, this study made improvements from Black et al (2003) in the way that it breaks down components of the productivity statistics and offered explanations to the phenomena underlying productivity performance. However, like the previous

study, in the author's opinion, this work lacks the rigour required to convincingly inform the key decision makers of what factors affects the sector's productivity performance.

2.5. Davis (2007)

The Davis (2007) report was prepared on behalf of DBH. It analysed "whether there is a problem of low or declining productivity growth in the building and construction sector in NZ" and "factors that may contribute to this situation" (Davis, 2007).

2.5.1. Methodology

Davis (2007) was based on a number of previous studies, including BMG (2003), Fox (2005), Law &McLellan (2005), Law, Buckle &Hyslop (2006) and Mason & Osborne (2007). All of these reports have one theme in common: the low level of annual growth (some actually decreasing) of labour productivity in New Zealand construction.

2.5.2. Data

Like previous studies, the main provider of data for the construction of the labour productivity series in the Davis report is SNZ (Davis, 2007). More specifically:

Construction sector

- Chain-volume series for gross domestic product, expressed in 1995/96 prices, for the construction sector;
- Total hours worked in main job in the construction industry, for people aged 15 and over, sourced from the Household Labour Force Survey;
- Chain volume series for the productive capital stock in the construction sector, expressed in 1995/96 prices; and
- Capital and labour income shares series for the construction sector.

Economy

- Chain-volume series for gross domestic product, expressed in 1995/96 prices, for all industries;
- Total number of actual hours worked in the economy, sourced from the Household Labour Force Survey;

- Chain volume series for the productive capital stock in all industries, expressed in 1995/96 prices; and
- Capital and labour income shares series for the 'measured sector'

The data was utilised to construct the updated series for labour, capital and multifactor productivity for both the aggregate market sector and the construction sector covering period from 1997 to 2006.

2.5.3. Findings

It was acknowledged by the author that even though the calculations in this report had been reviewed by SNZ, these are not official measures of productivity and thatthere are important differences in both approach and source data for the aggregate productivity measures that SNZ and Martin-Jenkins used (Davis, 2007). Key findings are included below:

Table 4: Comparative Productivity Statistics (1997-2006)

	Construction Sector			Aggregate Economy		
	Labour	**Capital**	**Multifactor**	**Labour**	**Capital**	**Multifactor**
Average annual growth rate	0.3%	-0.2%	0.3%	1.3%	0.2%	0.9%
Standard deviation	6.4%	7.9%	6.4%	1.1%	1.4%	1.2%

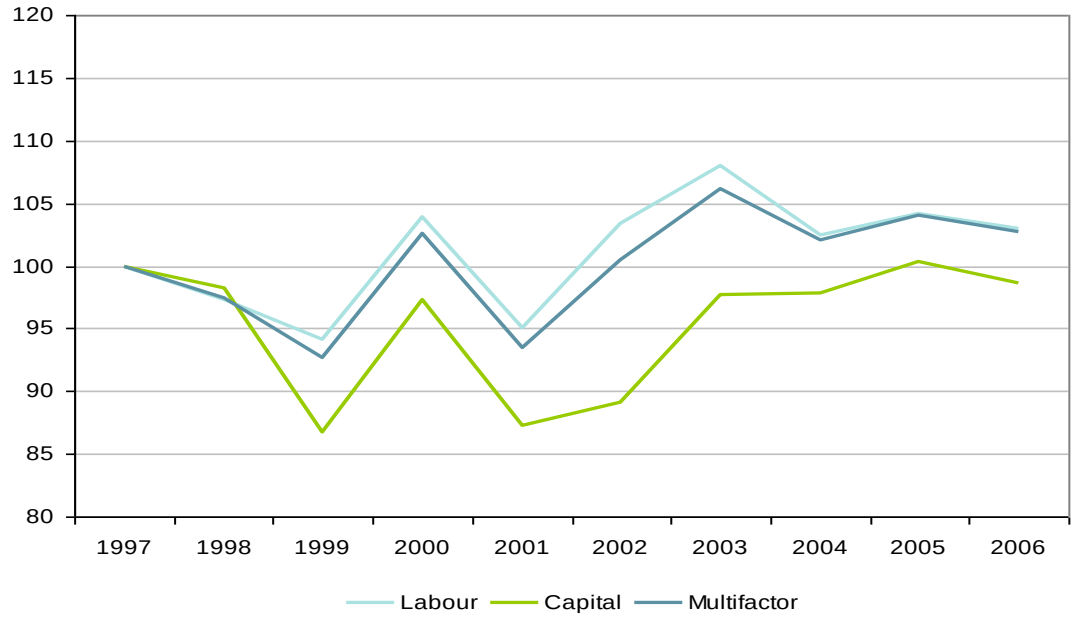
Source: Department of Building and Housing

Davis (2007) found that there are problems with the productivity performance of NZ construction, namely:

- All three productivity measures in the construction sector is much lower than those in the aggregate market sector
- Over this period, labour productivity in the construction industry has fallen short of aggregate labour productivity growth by 10 percentage point

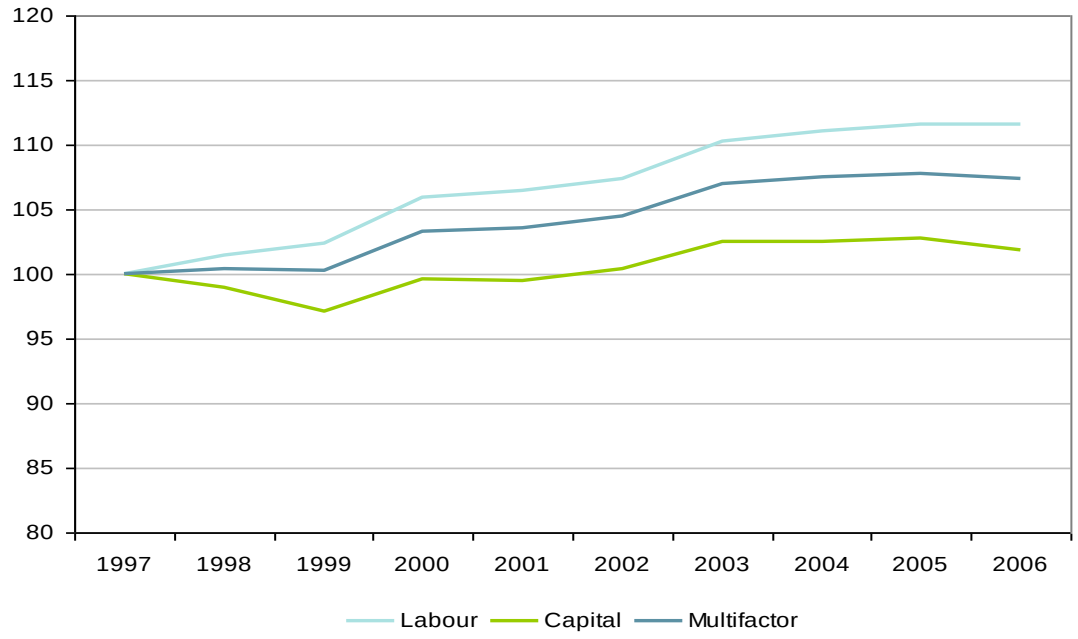
This effect can be graphically illustrated below:

Figure 6: Construction Sector Partial and Multifactor Productivity Estimates



Source: Department of Building and Housing

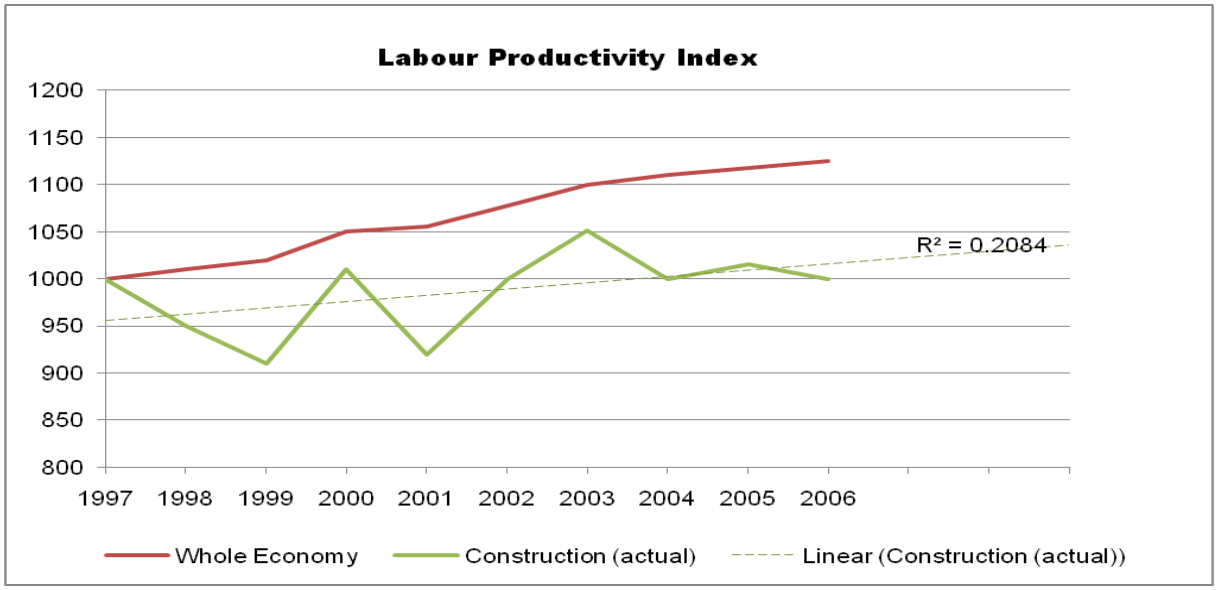
Figure 7: Aggregate Economy Partial and Multifactor Productivity Estimates



Source: Department of Building and Housing

The combination of aggregate productivity growth and the New Zealand construction productivity growth is shown below:

Figure 8: Aggregate productivity growth vs. Construction Industry productivity growth



Source: Based on Davis (2007)

It is interesting to note that despite the lower-than-expected performance of construction productivity growth, the trend in the New Zealand construction industry in this case is actually increasing as shown on the linear regression line.

2.6. Allan, Yin and Scheepbouwer- CAENZ (2008)

In 2008, the New Zealand Centre for Advanced Engineering (CAENZ)carried out a study into the cyclical nature of NZ construction. This study aims to "establish and communicate a shared understanding of the key drivers in the boom/bust cycles of the construction industry" and to "inform the industry about what it needs to know in term of quantitative or qualitative data that would help further explain the interplay and interactions between the industry players, the environment, other industries and government" (Allan et al, 2008).

2.6.1. New Zealand construction industry

It was noted that there are three most significant boom periods in the NZ construction industry: the "Think Big Era": 1977-1982; the "Construction Boom":1984-1987 and an additional boom period from 1992- 2007 (Allan et al, 2008).

2.6.1.1. The “Think Big Era”

The government of this period invested around NZ$6 billion per year (mainly from borrowed money) funding large-scale industrial projects (due to the perceived permanent high oil prices during this period) in order to create thousands of jobs and support the local production and processing of energy. This in turn acted as a stimulus for the growth in the New Zealand construction industry. However, this boom cycle was short-lived due to the influences from external environment such as the international oil situation and “left New Zealand with over NZ$28 billion of debt” (Allan et al, 2008).

2.6.1.2. The Construction Boom

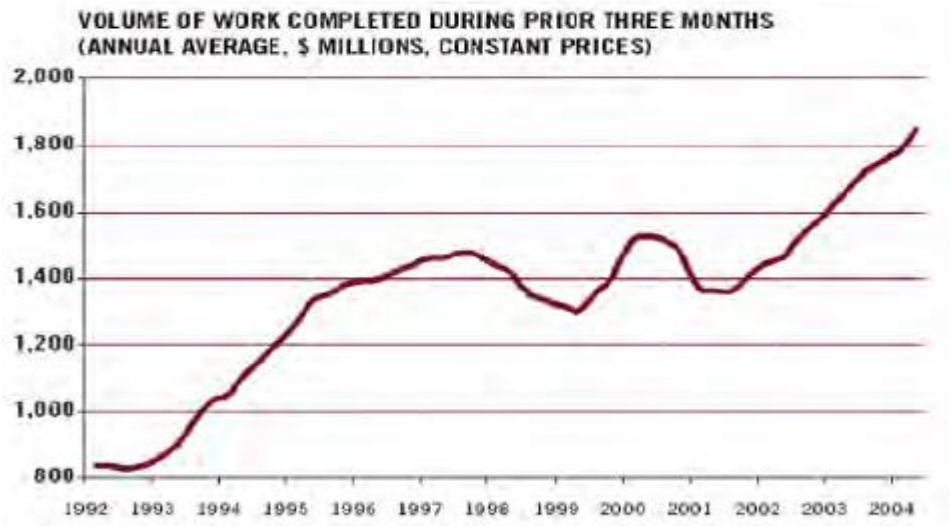
In the mid-1980’s the government decided to liberalise the economy and the financial sector was deregulated (e.g.: floating of exchange rates; removal of controls on interest rates, wages, and prices; and reduction of marginal rates of taxation). The subsequence growth in the financial sector, coupling with the restructuring of government departments increased the demand for new office buildings (Allan et al, 2008).

This business-friendly environment, along with the rise in the exchange rates, signalled the market to invest in the construction industry because “there were far greater returns on investments in this sector” (Allan et al, 2008). The New Zealand construction industry then experienced a significant downturn in 1987, followed by the crash of stock market worldwide. The consequence of this period is the over-supply of non-residential property in the 1990’s and a sharp decline in the number of people employed in the industry.

2.6.1.3. The Recent Decades

The construction industry in New Zealand, in the period from 1992 to 2007, showed a steady growth in term of the overall output figures, despite small fluctuations in 1999 and 2001 as illustrated in Figure 9 below:

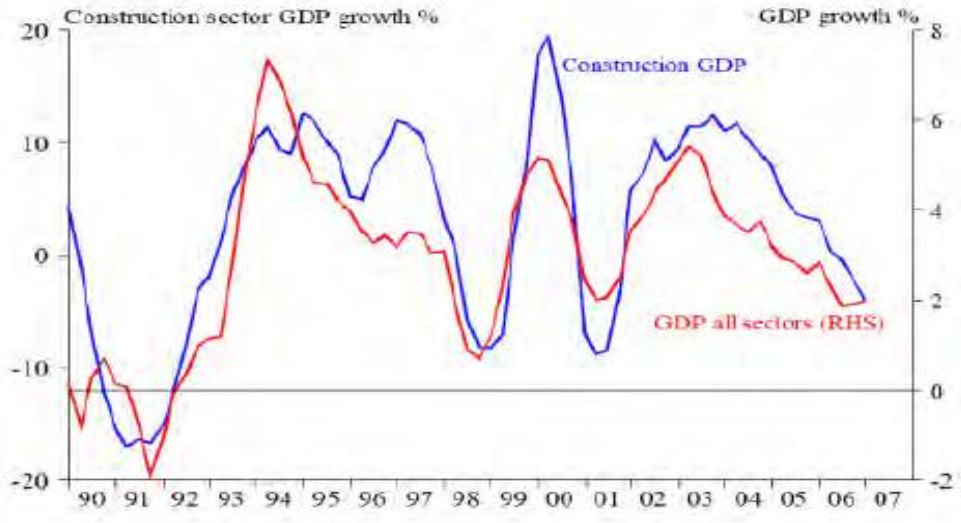
Figure 9: Volume of construction work completed 92-04



Source: Statistics New Zealand

The CAENZ study also reports a close relationship between the output growth of the New Zealand construction industry and the growth in national GDP. The two sources follow each other closely but with the former swings more extremely (see Figure 10). It has also been observed that in addition to this, the duration of construction cycles are longer than the economic cycle as well (Allan et al, 2008).

Figure 10: Construction GDP growth compares to National GDP growth.



Source: Reserve Bank New Zealand

2.6.2. Implications for the construction industry in New Zealand

The CAENZ study highlights the lack of formal or accepted definition of the construction industry or its boundary, structure and purpose in the quest to understand the behaviour of the New Zealand construction industry with “some

writers consider it as involving only site activity when others include planning and design functions and even extend it to cover manufacturing, and supply of material and components, finance projects and management of existing construction items" (Allan et al, 2008). This situation creates significant problems when one attempts to describe the relevant sub-system or segments of the industry.

From the economic perspective, the cyclical nature of the construction industry often causes waste in the system due to poor use of resources at a national level, while businesses experience added instability and certainty in planning, particularly human resources, which causes waste and increased costs. Allan et al (2008) shows that the average labour turnover rate in NZ construction over the past 20 years is about 20% and this in turn can have a significant impact on the wider economy and social well-being. Loss of productivity can also be observed due to poor resource utilisation. This is because purchasers of construction work tend to seek best value for money and budget certainty in the industry. However, during the boom phase, prices are often inflated and competitions are reduces due to full-order book while during the bust cycle, the trends lead to competitive cost-cutting with reduced quality. This contradiction has long appeared to be widely accepted across the construction industry and has also created a negative perception about the industry.

2.6.3. CAENZ Analysis and Findings

A series of interviews and workshops and the use of soft system approach were employed in this study to try to understand the whole construction cyclical system.

2.6.3.1. Methodology

The authors undertook 2 workshops in Auckland and Wellington to "elicit feedback from key industry representatives", "14 face to face interviews with senior executives from a range of stakeholder organisations" and Grounded Theory, a research method which the theory is developed from the data, was employed to "provide detailed and systematic procedures for data collection, analysis and theorizing" (Allan et al, 2008). In addition, Decision Explorer, a piece of qualitative software, was also utilised to "map the connections between concepts and to analyse the presence of loops and key nodes" (Allan et al, 2008).

2.6.3.2. Analysis

Analyses were carried out to identify effects of the boom-bust cycles on the Private House Building Sector, the Commercial Building Sector and the Infrastructure and Public Building Sector with relevant information employed for appropriate cases.

2.6.3.3. Findings

Much of the construction industry boom bust effect in New Zealand is caused by the industry's own internal system structure and behaviour rather than external shocks. A new thinking must be adopted by the industry and policy makers which:

- Recognises how co-dependencies and industry dynamics drive behaviours and profitability
- Adopt structures and cultures that reinforce communication and information sharing throughout the industry, particularly across industry sectors
- Encourages long-term strategic thinking instead of short-term profit seeking and speculation (Allan et al, 2008)

Allan et al(2008)made recommendations to smooth out the short-term peaks and troughs of the cycles:

- Government and large organisations should minimise delays in their procurement process and make forward planning for construction projects transparent to the rest of supply chain;
- Reductions should be made in government approved and funded projects: procuring faster and smaller projects rather than rolling projects together;
- Setting up construction industry alliance to share information across the entire supply chain;
- Retaining and training skilled and semi-skilled workers is critical to controlling the worst effect of fluctuations. Employment conditions need to become more attractive and internationally competitive;
- The industry should adopt and apply good cost estimating and cost control, with particular attention given to inflationary rises and methods for accounting for this

Overall, this study sufficiently explains the underlying behaviours which significantly affect the construction industry in NZ, namely the boom-bust cycle. This understanding is extremely useful in this investigation, as it equips the researcher with necessary knowledge to carry out such work. Moreover, it is anticipated that this study should supplement the current research in understanding the "real" performance in terms of productivity in the NZ construction sector.

2.7. Department of Labour (2009)

The Department of Labour (DOL) produced its report in 2009 to examine "how quickly the construction industry might recover, what the full impact on employment will be and which factors could influence employment growth" (DOL, 2009). This was done under consultation with key personnel from the Building and Construction Industry Training Organisation and the Department of Building and Housing. The paper was also an attempt to develop an outlook for the next couple of years based on an analysis of leading indicators of construction activity, recent business survey and the latest economic forecast (DOL, 2009).

2.7.1. Construction Employment in New Zealand

The employment in NZ construction has experienced rapid growth (66%) in the past ten years and by June 2009, 8.3 percent of the NZ workforce was employed in this sector. This growth was 2.6 times faster than the employment growth in the whole economy (25%) and was mainly due "largely to residential building construction and related work" (DOL, 2009).

This employment growth is especially fast in some sub-industry within the construction sector over the eight year period between 2000 and 2008. Table 5showsemployment growth in some sub-industries in this period:

Table 5: Employment by construction sector, 2000 to 2008

Construction Sub-industry[6]	2000	2008	2000 to 2008 growth
Other Construction Services	4,500	10,910	142%
Residential Building Construction	8,490	19,990	135%
Building Structure Services	4,250	7,980	88%
Building Installation Services	17,740	28,660	62%
Land Development and Site Preparation Services	5,700	9,100	60%
Heavy and Civil Engineering Construction	17,510	27,780	59%
Building Completion Services	10,330	15,290	48%
Non-Residential Building Construction	7,530	10,930	45%
Total Construction	**76,050**	**130,640**	**72%**

Source: Business Demography data, Statistics New Zealand

Of these, the Residential Building Construction and the Other Construction Services (including landscape construction) sectors showed strong growth rate, with employment more than doubling (142% and 135% respectively).The Building Structure Services (which includes concreting, bricklaying and roofing services) sub-industry also had a higher employment growth rate (88%) than the average sectorial growth rate (72%) in this period.

In terms of occupational changes within the industry, employment growth is shown below:

Table 6: Employment by occupation within the construction industry, 2001 to 2006

Occupation[8]	2001	2006	2001 to 2006 change
General Labourer	2,523	6,864	172%
Landscape Gardener	834	1,752	110%
Construction Manager	918	1,899	107%
Administration Manager	1,110	2,121	91%
Roofer	1,428	2,286	60%
Office Manager	1,278	2,001	57%
Builder (including Contractor)	13,557	21,057	55%
Bricklayer and/or Blocklayer	2,004	3,087	54%
Excavating Machine Operator	1,269	1,875	48%
Concrete Worker	1,455	2,055	41%
General Manager	3,369	4,731	40%
Plasterer	2,847	3,945	39%
Carpenter and/or Joiner	7,887	10,797	37%
Builder's Labourer	2,748	3,699	35%
Drainlayer	1,269	1,650	30%
General Clerk	3,315	4,272	29%
Electrician	6,609	8,445	28%
Plumber	4,071	5,124	26%
Heavy Truck or Tanker Driver	2,526	3,093	22%
Painter, Decorator and/or Paperhanger	7,044	6,954	-1%
Total Construction	**103,911**	**147,549**	**42%**

Source: 2001 and 2006 Censuses, Statistics New Zealand

The study emphasised that despite the high rate of growth in employment in all sub-industries and most of the occupational categories, the employees in the New Zealand construction industry tend to be vulnerable to changes in economic conditions. In particular, young workers and those with no qualification (which consists of at least 30% of workers in all occupations) were most likely affected because “employers are less motivated to hold on to these workers when there is little work” (DOL, 2009).

Employment of architects or engineers (those who had high qualifications, ie: degrees or higher) is expected to be the most resilient in the industry. This has been further supported by a recent report by the Department of Labour that employment in this area increased by 67% between 2000 and 2008 (DOL, 2009).

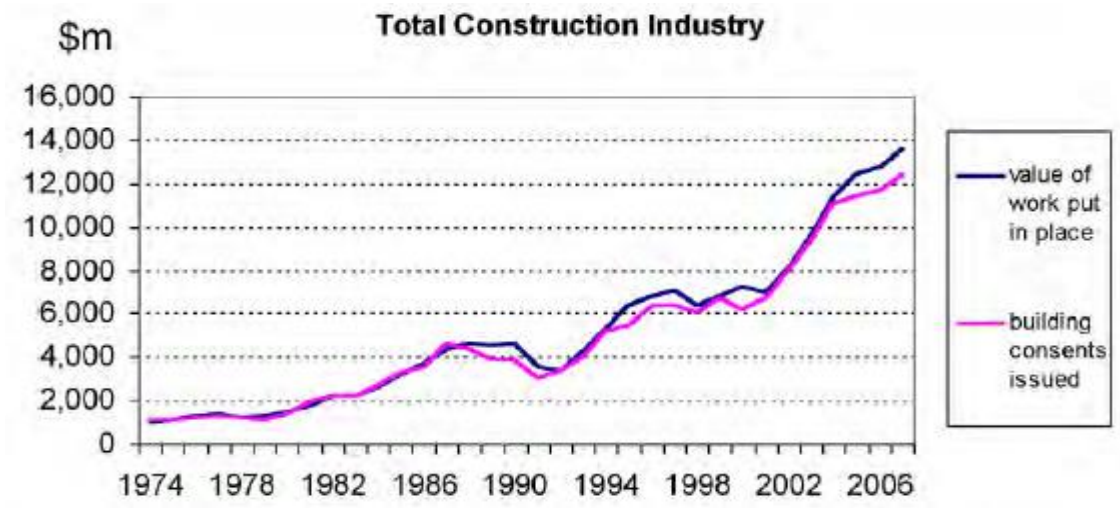
2.7.2. Methodology

The main source of construction employment in this report is the HLFS. This is the official survey of employment and unemployment in New Zealand and figures are provided on a quarterly basis. However, when HLFS results are not sufficiently detailed, data from the Business Demography and the New Zealand Census are employed (DOL, 2009). In addition, data on property sales and data on quarterly migration had also been sourced from REINZ and SNZ respectively to provide complete overview on factors that may affect employment in the construction industry.

2.7.3. Findings

Traditionally, indicators such as data of “Building Consent Issued” and “Value of Work Put in Place” have been used to assess the performance of the New Zealand construction industry. (Allan et al, 2008). The main reasons are because this data is readily available and also because they relate to how the market perceives the industry, i.e. whether it is worthwhile to invest in the industry or not. This can be illustrated in the graph below:

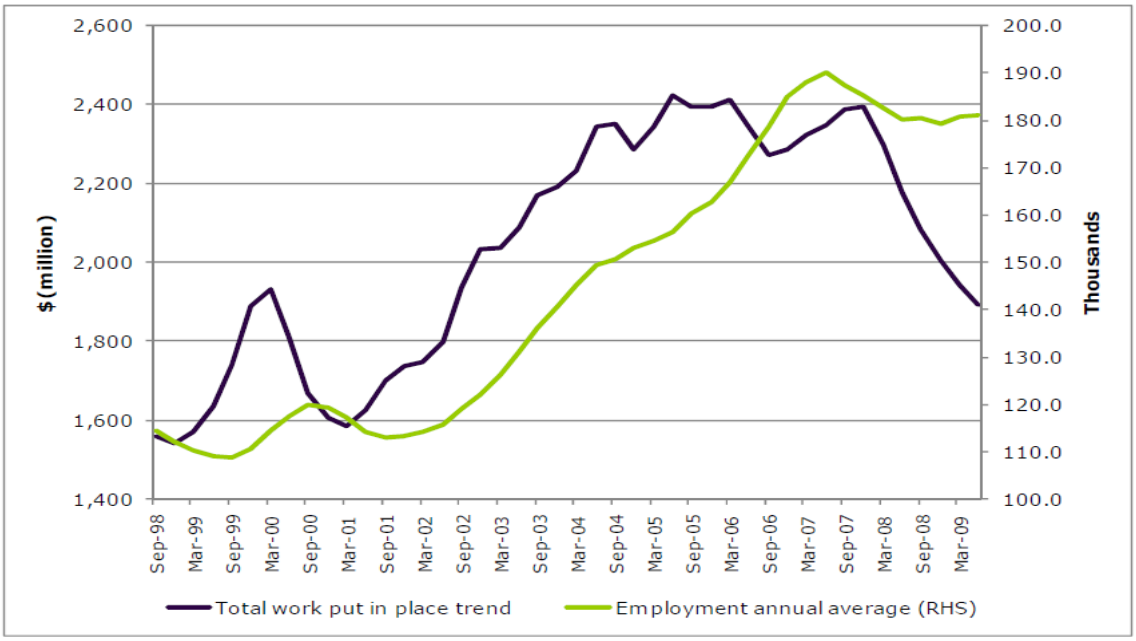
Figure 11: The performance of the total industry



Source: CAENZ (2008)

The graph above clearly illustrates this effect with the continual increase in both Building Consent Issued and Value of Work Put in Place. The DOL report found there is a close relationship between employment in the construction sector and the Value of Work Put in Place based on annual average data of HLFS (see Figure 12).

Figure 12: Trend of quarterly building activity (Sep '99 prices) compared to construction employment (1998 to 2009)



Source: Employment from HLFS, Work put in place from QBAS (Statistics NZ)

The two series follow similar trend, with value of building activity leading employment by about a year and half (DOL, 2009). Therefore, despite the sharp fall in value of building activity, the fall in employment in this industry has been just been more

moderate (down from 190,000 to 181,000, or equivalent to 5 percent). One reason for this, according to DOL, is the increase in the number of employed professionals (engineers, architects, quantity surveyors) and labourers may have compensated for the fall in the number of trade workers (DOL, 2009). Infrastructure projects, which are currently accounting for an increased share of construction activity, support employment of these occupations (and the likes of project managers, truck drivers and machine operators), while construction activity in the residential projects sees a reduced demand for trade workers such as electricians and plumbers. Nonetheless, this level of employment in the industry still remains historically high.

An interesting finding in this report is that the number of paid hours in the industry has fallen by 12 percent from its peak in March 2008. This means that across the whole sectors, employers tend to reduce their staff's hours worked of rather than losing workers. This allows them to "increase hours again when activity picks up, rather than have to recruit new staff that may be hard to find" (DOL, 2009). This may have some implications on levels of productivity growth in the industry.

Discussion

There are a number of points which can be extracted from these historical reports in relation to the performance, and/or factors which may affect the performance, of labour productivity in the New Zealand Construction Industry. Firstly, the data and the quality of data used for these analyses may have some implications on the representations of productivity series; this will be discussed in detail in subsequent section. Secondly, relationships between factors which contribute to the performance of construction labour productivity can be established. A thorough analysis of available data will be incorporated with the observation of historical events in (or around) the same periods in order to obtain a clear picture of these relationships. And finally, these relationships will serve primarily as the basis for future analysis and investigation in this Thesis.

2.8. Data and data quality

2.8.1. The data

Table 6 below summarises sources of data and for the productivity reports outlined above.

Table 7: Sources of data

Type	Report		
	Black et al (2003)	Janssen et al (2008)	Davis (2007)
Output	Value-added GDP series, provided by SNZ	Value-added GDP series, provided by SNZ	Value-added GDP series, provided by SNZ
Input	Hours worked data from HLFS, provided by SNZ	Hours worked data from HLFS, provided by SNZ	Hours worked data from HLFS, provided by SNZ

As shown in the Table 6 above, all studies above in this report used data provided by Statistics New Zealand as their main sources for the construction of labour productivity series. Janssen et al (2008) reported that different weighting methods on the hours worked data can, and often do, change the labour quality measured, and consequently labour productivity (Janssen et al, 2008, p.18). The implication of this is that there is a close relationship between labour quality and labour productivity, i.e.: any changes in labour productivity can be attributed to changes in quality of labour input (Janssen, 2008).

Statistics New Zealand is also the main data provider to the DOL (2009) report, with the construction employment is primarily based on the HLFS. However, Business Demography and the New Zealand Census are also employed whenever data in the HLFS are not sufficiently detailed (DOL, 2009). In addition to these statistical data, results from surveys such as the Quarterly Survey of Business Opinion and the National Bank Business Outlook are also utilised. These are surveys carried out by the New Zealand Institute of Economic Research and the National Bank respectively to conduct opinions regarding the “expectations of firms in the building and construction industry” from businesses in related fields (manufacturing and building, merchants, etc) nationwide, in order to confirm the analysis of leading indicators in that report (DOL, 2009). In essence, the outlook of the construction industry in all

aspects (employment, activity, et cetera) is verified as these confidence surveys agree with the previous analysis (DOL, 2009).Of all reports reviewed, sources of data in the work of Allan et al (2009) were not mentioned. Even though the author suspects that data for this report also come from SNZ, this has yet to be confirmed.

2.8.2. Data quality

Due to the time-series nature of data of New Zealand GDP (and construction GDP), employment and labour productivity, any assumptions or observations on the performance of productivity growth must be confirmed by tests to prove their validity. However, Black et al (2003) pointed out that "it is difficult to conclude that there has been a structural improvement in New Zealand's multifactor productivity growth given the short time period covered by the data (1988 to 2001)". In fact, they even suggested that the NZ economy actually experienced a "structural break in the early 1990s" with trend in labour productivity growth during the 1990s was shown to be "different than in the previous two decades" and evidence of a "significant change in New Zealand's GDP growth characteristics dating back to 1993" (Black et al, 2003). It is therefore important that a productivity data that cover a longer period is required in order to establish a comprehensive analysis.

In 2000, an upgraded set of National Accounts based on the System of National Accounts 1993 accounting standards was introduced by Statistics New Zealand along with the Australian and New Zealand System of Industrial Classification (ANZIC). Changes in the upgraded national accounts were backdated to 1987. Output data for all three productivity studies were sourced from SNZ's System of National Accounts production based GDP. Consequently, the GDP series at the two digit industry level were only available for the period 1988 to 1999. Nominal GDP data for the period 2000 to 2002 were projected forward following the method suggested in a previous study done by Diewert and Lawrence (2003). This method, however, does not allow for relative changes in price between industries but its merit is that the projection has "negligible effect on the aggregate productivity results" (Black et al, 2003).

In terms of labour input, industry hours worked data series based on the ANZSIC may also have implications on the labour productivity series. The hours worked data

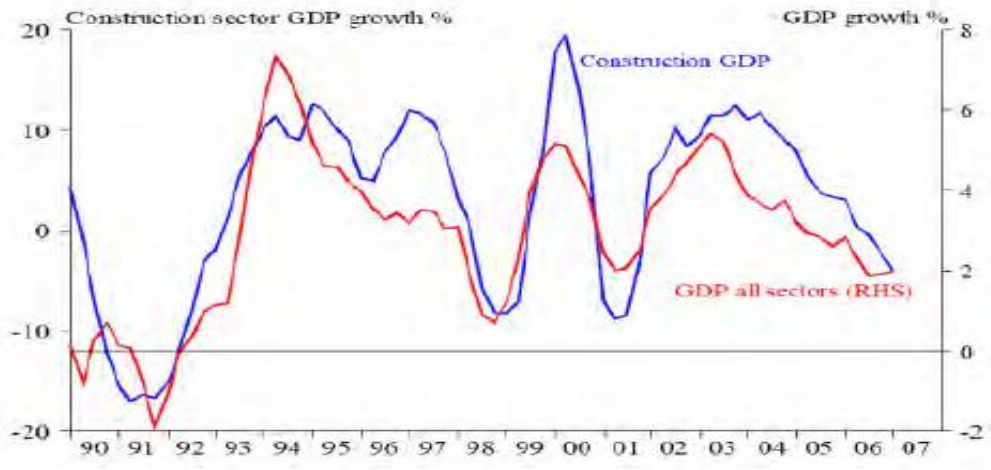
are “constructed at a more aggregate level” when compared with the production and income GDP accounts. That is, even though data on production and income GDP are available for 31 industries (two digit industry level), hours worked data are available for a more aggregate 9 industries (one digit industry level) (Black et al, 2003). In early 2000’s, SNZ changed the HLFS industrial classification based on NZSIC (which covered the period 1988 to 2002) to the HLFS based on ANZSIC system (which covered the period 1998 to 2002). This required the hours worked data series based on the HLFS ANZSIC to be backdated using the NZSIC hours worked data (Black et al, 2003). These changes may have some effects to the integrity of the data upon which productivity series are constructed.

2.9. New Zealand Construction Industry in the National Economy

In this section, the nature of NZ construction will be discussed in relation to wider economic environments (internationally and nationally) and how these environments affect the performance of this sector in the period 1997-2007.

Allan et al (2008) found there is a correlation between the market sector GDP growth in NZ economy and that of the NZ construction industry. However, the growth in the latter tends to swing more extremely than that of the former’s (see Figure 13):

Figure 13: Construction sector GDP growth



There are three periods that the growth of construction GDP out-performed that of the market sector, namely: 1994-1997, late 1999-early 2001 and early 2002-early 2006; and one period where the decline in construction GDP was steeper than the decline in the overall market GDP, mid 2000-early 2002. Overall, the two series

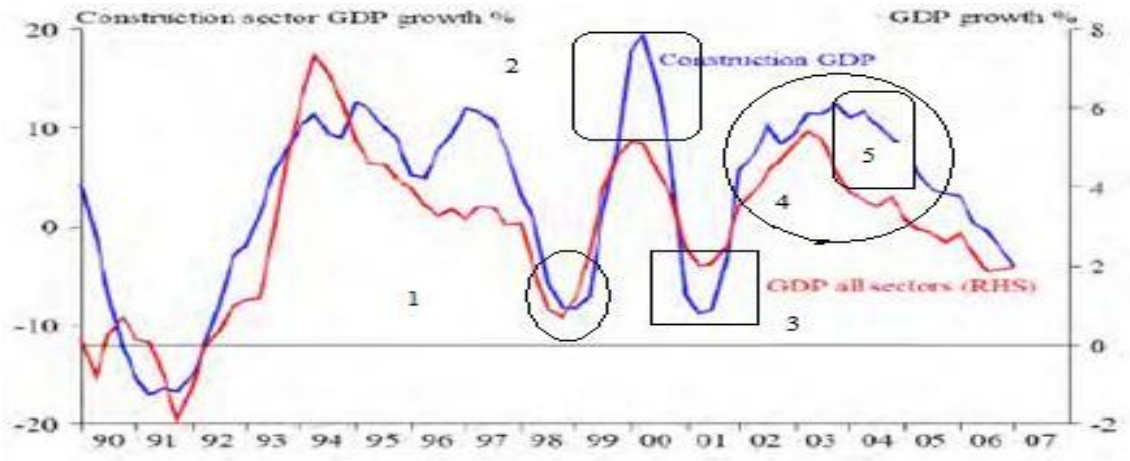
follow each other rather closely, i.e.: peaks and troughs in construction GDP growth tend to be in phase with those in market sector. This may not come as a surprise given the inter-locking relationship between the New Zealand construction industry and the wider economy:

- While the construction industry represents nearly 5 percent of total GDP in New Zealand, it influences the economy in other ways. For example, the industry is "often seen as a vehicle in the Government's economic policies through interest rates, public sector expenditure and the system of taxation". As a consequence, construction related indices are often used as the economy indicators in macroeconomics (Allan et al, 2008).
- Allan et al (2008) also reported that the industry has a "multiplying effect into other industries: for every $1 spending in the construction industry, $1.168 is generated as output into the economy"
- Conversely, the New Zealand economy can contribute significantly to the performance of the industry. For example: according to DOL (2009), during the construction boom, from 2001 to 2007, value of building activity increased by around 50 percent.

Despite this close relationship, the over-shooting and under-shooting periods in the Figure 10 illustrate the volatile nature of the construction industry compared to the performance of the New Zealand economy. One reason that the market sector performs better than the construction sector is, according to Allan et al (2008), that even though the two sectors are affected by the same underlying economic cycles, "noises" in individual industries are filtered away in the overall market sector performance. However, the significance of these observed over-shoots and under-shoot means that the construction industry in New Zealand is sensitive to economic fluctuations (Allan et al, 2008), i.e.: during boom periods (or times perceived as boom periods), significant investments are made into the industry (therefore more building projects (DOL, 2009), thus the over-shoots); and during recessionary times, the industry experiences hardship due to scarcity of investments (funding for projects get frozen, hence the under-shoot).This hypothesis can be verified by studying historical events in or around the periods of interest.

Figure below marks periods that will be under investigation:

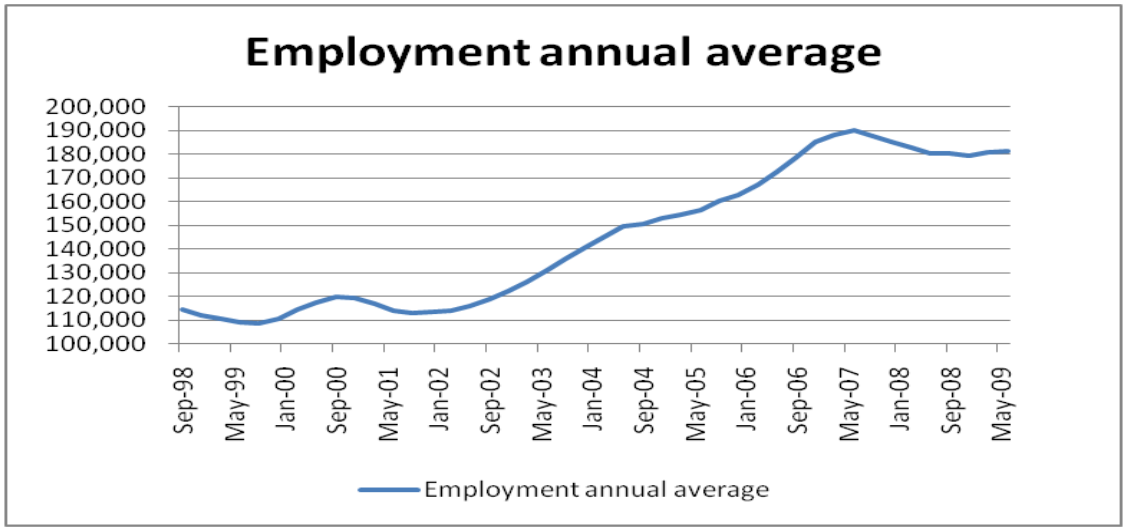
Figure 14: Segmentation of Construction sector GDP growth



We are only interested in five marked points on the graph because these periods are the most recent times with many significant events which have shaped the world's socio-economic landscape in general and New Zealand's in particular. Another reason to choose these periods is for comparative analysis with the trend in employment growth later.

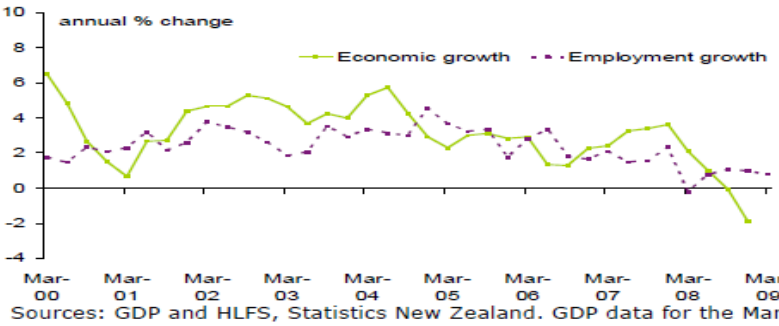
Employment in the New Zealand construction industry is generally affected by macro and micro economic conditions as well as any socio-logical changes within the country, within the region and to some extends the world. It is therefore important that the economic conditions outlined above must be taken into consideration when analysing trend in employment growth in this sector. The representation is shown in Figure 15.

Figure 15: Employment growth rate in New Zealand Construction Industry



Employment growth rate in the construction industry is much higher than that in the overall market sector over (approximately) the same period (DOL, 2009).

Figure 16: Economic growth and Employment growth (Mar 2000-Mar 2009)

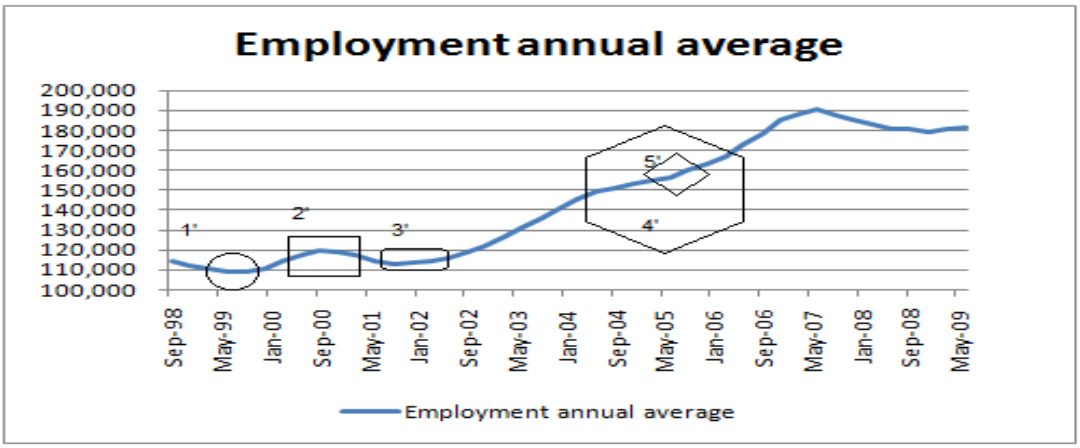


Sources: GDP and HLFS, Statistics New Zealand. GDP data for the March 2009 quarter will be released in June 2009

Figure 16 above, taken from Department of Labour's most recent report "Skills in the Labour Market Outlook", shows that over the period from March 2000 to March 2009, employment growth in New Zealand market sector averaged 2.2 percent per annum while over the same period, the average employment growth rate in the construction industry is 3.09 percent per annum. This further confirms the fact that the New Zealand construction industry is the fastest growing industry in this period (DOL, 2009).

Just like the analysis done on the construction GDP earlier, employment graph will be segmented into 5 different time periods (labelled 1'-5' corresponding to the same time periods considered in the construction GDP growth). Each period is analysed and evaluated carefully belowin order to establish linkages and relationships with the economy.

Figure 17: Segmentation of Construction sector employment growth



2.9.1. Period 1: 1997-1999

This period was marked by the Asian financial crisis, which had a domino effect on the world economy. This crisis ultimately had significant macro-level effects, including sharp reductions in values of currencies, stock markets, and other asset prices of several Asian countries (Wikipedia, 2010). Not only it affected these economies, the knock on effect was widespread throughout the world with the most significant one being the sharp reduction in oil prices, which "reached a low of US$ 8 per barrel towards the end of 1998". This was the main cause that contributed to the 1998 Russian financial crisis, which in turn triggered the collapse of Long-Term Capital Management in the United States "after losing $4.6 billion in 4 months" (Wikipedia, 2010).

The New Zealand economy at around this same period experienced some difficult times of its own. As in 1997, household balance sheets were stretched, the domestic housing market was softening rapidly and consumer confidence was in decline (Fallow, 2008). With two successive droughts 1997/1998 and 1998/1999, agriculture activity declined by about 5 percent in this period and given its significant contribution to the New Zealand economy, ultimately "knocked 1 percent off economic growth" (Fallow, 2008). These internal economic conditions, along with the slowdown in New Zealand's key Asian trading partners (due to the crisis) had a significant consequence to New Zealand with the economy was pushed into recession in the first half of 1998 (Fallow, 2008; Nations Encyclopedia, 2010; Treasury, 2009), which then helped lower New Zealand's annual GDP growth to 3.1% in 1997 (Nations Encyclopedia, 2010). Negative economic effects in the New Zealand economy might have been the major cause for the decline in the construction industry GDP. However, the construction GDP decline was not as steep as that in the economy and it rebounded earlier suggested that the sector seemed to be more resilient than the economy in this period.

These economic effects were the major driver for the decline in value of residential buildings, which in turns caused the contraction in NZ construction in this period. Oram (1999) reported that there was a 7 percent slump in Auckland house prices in this period with "house prices slipped in 1998 by 6.9 percent in North Shore, 7.4 in Auckland, 8.6 in Waitakere and 6.2 in Manukau". This drop in values was due to

“higher interest rates” which “put investors off buying rental properties” as well as the “uncertainty about job security” that “put first-home buyers off taking a mortgage”.

As a consequence, activity in the sector in this period was low given the relationship between levels of activity and the health of the economy. This in turn might have played a crucial role in the sector’s employment decline; because according to Saravanaperumal of Statistics New Zealand, “the demand for construction workers is derived from the demand for building and trade activities” (Saravanaperumal, 2008).

2.9.2. Period 2: 1999-2001

By 1999, there were signs that the Asian economies had begun to recover (Wikipedia, 2010; Cabinet Office, 1999). This recovery coupled the robust expansion of the U.S. economy and temporary deceleration of economic growth in Europe lead CAO (1999) to forecast that the world economy would recover at a moderate pace in 1999. The Japanese Cabinet Office also expected regulations in the international financial market to be improved and “greater efforts should be made to answer a question concerning how governments and international currency and financial systems should make up for the limitations inherent in such regulations.” (CAO, 1999).

The New Zealand economy performed strongly in this period despite the fact that inflation went up to 4% (which was outside the government's target range of 0 to 3%) in 2000 due to increased fuel cost. Exports were boosted due to a low New Zealand dollar, favourable weather and high commodity prices. As a consequence, the economy was estimated to had grown by 2.5% and real GDP growth improved to 4.6% in 2000 (Wikipedia, 2010; Nations Encyclopedia, 2010). On the other hand, mortgage rates in New Zealand in this period were “at historic low” (Fallow, 1999). These economic conditions might have been a stimulus for the strong growth of investment into the construction industry. The result was that a rapid rise in number of residential building consents could be observed. As Table 8 shows, the value of residential dwellings in 2000 is largest in the whole series: the number of new houses in 2000 increased by over 5000 units from the previous year (25,858 units in 2000 compared to 20,766 units in 1999). This means a significant amount of investments were made into the industry and it helps to explain the over-shoot in

construction GDP (MAF, 2010). Construction employment in this period enjoyed a brief growth thank to the strong growth in activities (see Fig. 15).

Table 8: Building Consents Summary

	Residential Buildings					
	New Dwellings			Dwelling Alterations and Additions		Total Residential Dwellings
Year ended 31 March	Units (no)	Value ($million)	Area (000 m^2)	Value ($million)	Residential Outbuildings Value ($million)	Value ($million)
1981	14 442	521.0	1 853	..	..	720.8
1982	19 006	850.3	2 488	..	..	1,119.9
1983	15 999	795.1	2 013	235.4	58.6	1,089.1
1984	20 226	1,035.9	2 531	267.3	63.1	1,366.3
1985	21 782	1,187.7	2 686	263.9	66.1	1,517.7
1986	23 035	1,403.0	2 848	280.5	74.0	1,757.5
1987	20 128	1,361.1	2 543	323.1	85.9	1,770.1
1988	19 886	1,577.2	2 515	343.1	85.7	2,006.0
1989	19 583	1,610.5	2 448	384.3	93.7	2,088.6
1990	22 851	2,057.7	3 030	383.1	112.8	2,553.6
1991	20 820	1,997.1	2 827	296.1	135.4	2,428.6
1992	17 563	1,704.1	2 466	283.9	129.9	2,117.9
1993	17 905	1,851.3	2 747	303.7	129.8	2,284.8
1994	19 361	2,172.1	3 102	355.9	151.7	2,679.7
1995	23 681	2,864.1	3 938	416.0	160.7	3,440.8
1996	21 256	2,741.9	3 647	459.2	159.8	3,360.9
1997	22 418	2,927.4	3 820	459.8	175.3	3,562.6
1998	25 565	3,252.0	4 077	499.1	187.3	3,938.3
1999	20 766	2,775.9	3 310	501.2	179.2	3,456.3
2000	25 858	3,533.2	4 262	543.5	186.2	4,262.8

Notes:

Source: *Key Statistics*, Department of Statistics

[1] *From 1September 1989, statistics exclude authorisations of less than $5,000 in value.*

[2] *From 1June 1996, multi-purpose buildings are split between the main building types.*

2.9.3. Period 3: 2000-2002

This is a turbulent period in the world economy with several significant and inter-related events happening, many of which ultimately shaped up the world's current socio-economic landscape. The first important event that happened in mid-to-late 2000 was the busting of the "dot-com bubble" due to the systematic collapse of share prices of high-tech companies in the United States of America with the "NASDAQ lost nearly 9 percent in just six days" (Wikipedia, 2010). This ultimately wiped out "$5 trillion in market value of technology companies from March 2000 to October 2002" (Wikipedia, 2010). September 11, 2001 is arguably one of the most important dates in recent world history with the terrorist attacks of the Twin Tower and other important landmarks in the USA. These attacks not only triggered what was to become the most marked political and military event in the first half of the

21st century but also had significant impact on the world's economy. The U.S. stock markets closed for a week and when they reopened, all major stock exchanges suffered major losses. It has been reported that $1.4 trillion (or $1.69 trillion in present day terms) worth of stocks lost in value for that week (Wikipedia, 2010). The effects did not stop there, with stock markets all over the world fell sharply immediately after the U.S. markets.

Despite these events, surprisingly the New Zealand economy experienced very little effect as the country was "still enjoying the flow-on effects of a year-long boom in export prices" (Cumming, 2002). As a further boost to consumer spending, the New Zealand Reserve Bank decided to cut interest rates in 2001. Cumming (2002) also reported that the economy was "helped by an immigration boom" which in turn might have acted as a stimulus for the "booming Auckland housing market". Nevertheless, important industries such as Tourism and Aviation suffered most from the 9/11 event with number of overseas visitors fell heavily and shares of Air New Zealand "nosedive" respectively (Cumming, 2002). The consequence is that New Zealand' real GDP growth was reduced to 2.3% (Nations Encyclopedia, 2010). The construction industry also fell, along with the economy. However, it was more sensitive to fiscal monetary changes and thereby dipped further than the GDP of the whole economy (Cumming, 2002; NZPA, 2002).

Number of building consents for both residential and non-residential buildings continued to grow over this period with growth rates of 9.7% and 16.54% respectively (Bascand, 2009).

Table 9: Building Consent Summary (Residential and Non-residential)

Building Consents Issued

By building type

Year ended March

Year	Dwellings			Non-residential buildings		Non-building construction[1]
	Number	Value $(million)	Floor area m^2(000)	Value $(million)	Floor area m^2(000)	Value $(million)
2000	25,858	3,533	4,261	1,249	2,336	178
2001	19,370	2,833	3,382	1,392	2,669	157
2002	21,262	3,353	3,876	1,621	2,906	170
2003	28,320	4,549	4,983	1,589	2,969	227
2004	31,823	5,657	5,814	1,873	3,355	254
2005	30,255	5,896	5,465	2,730	3,701	337
2006	25,406	5,461	4,894	2,845	3,577	415
2007	25,740	6,104	4,983	2,733	3,195	416
2008	24,533	6,272	4,852	3,015	3,574	460

(1) Works that require building consents but are not buildings, for example, retaining walls and swimming pools. Many civil engineering works, such as roads, require resource consents but not building consents, so are excluded.

Source: Statistics New Zealand

The boom in immigration over the past few years in New Zealand, coupled with the reduction in household sizes over the ten year period to 2001, might have been the main cause for the rise in the residential construction sub-industry (Cumming, 2002; Hutt City, 2010, p. 46). Non-residential construction sub-industry, which includes infrastructure projects and commercial premises, was more subdued in this period (DOL, 2005).

Despite the growth in building activity, employment growth experienced a small downturn in this period. There is currently no clear indication to what the cause for this was. However, this slight decline was not significant enough to have a major effect on our analysis.

2.9.4. Period 4: 2002-2006

Overall, the world had a more stable period in its history (except for the Iraq War in 2003). This period saw a strong growth of the world economy with growth rates being 4 percent and 3.2 percent for 2004 and 2005 respectively. This performance

was driven essentially by strong growth in China and the U.S (Pacific Islands Forum Secretariat, 2006).

The NZ economy averaged 4.0% annual growth in this period. Between 2003 and 2006, the domestic economy, employment and income growth and high international commodity prices were the main drivers of growth (Country Health Information Profile, 2007). Annual growth for the financial years 2002/2003 and 2003/2004 years was 4.2% and 4.7% respectively, growing to 4.8% in 2004/2005 (CHIP, 2007). Over the course of 2006, NZ economy slowed down due to negative impacts of the appreciated Kiwi dollar on exports and a slight drop in the housing market (PIFS, 2006). As a consequence, NZ's economic growth rate in 2006 was expected to be 0.9%, a much lower rate than in previous years (PIFS, 2006).

From 2002-2005, NZ experienced strong growths in population (from large net inflow of immigrants); job& wages and property investments from overseas. These economic conditions, coupling with low interest rates from 2001 to 2004, fuelled the demand in the NZ housing market, which then in turns act as the main drivers of growth in NZ construction (CHIP, 2007; Stephenson, 2006; Saravanaperumal, 2008). Stephenson (2006) reported that in 2004, real residential investment in New Zealand grew 4.5%, on the back of 19.8% growth in the previous year. This growth was clearly much stronger than that of the overall economy in the same period. The demand for building and trade activities therefore "boomed over the 2001-2006 period" and there was a related increase in employment in the construction industry, with number of individuals receiving wages and salaries and self-employed income in the construction industry increased by 41.1 percent (from 122,470 in 2001 to 173,200 in 2006) in contrast to the average 15.5 percent growth in all industries over the same period (Saravanaperumal, 2008).

2.9.5. Period 5: 2005-2006

This period is actually a sub-period of the previous one (period 4). We are interested in this period because despite having better performance than the economy, the New Zealand construction industry was in a rather steep decline. Investigation into the cause is therefore essential. Also, once understood, construction GDP growth in this period can then be used for comparative analysis with growth of the other

important variable which affects the sector's labour productivity (i.e. employment) and of labour productivity itself.

After 2004, the New Zealand economic growth eased as a result of high oil prices and increases in interest-rate. The economy remained flat in the second half of 2005 (Treasury, 2009). There was a recovery during 2006 as the exchange rate depreciated, but annual average growth of 1.7% for the year to December 2006 was well down from the peak of 4.4% in the year to 30 September 2004 (Treasury, 2009).

From the mid-1990s, the current account deficit increased from the 2.7% to 4.1% range which had prevailed between 1990 and 1994, to 6.4% in 2000 (Treasury, 2009). The increase in the deficit was primarily caused by the international income deficit increasing, reflecting NZ's increased net international liability position. An appreciation of the exchange rate saw the country's current account deficit reach 9.3% of GDP in the year to June 2006 as strong consumption and investment demand drove strong import growth (Treasury, 2009).

NZ construction in this period not only experienced these economic effects but it also went through significant changes within the sector due to new sets of requirements under the new legislation, the Building Act 2004. The Act "intended to ensure that buildings are designed and built correctly the first time" (Merry et al, 2008). It also "seeks to improve the quality of decisions made throughout the design and building processes by introducing a new framework for regulating building work and by establishing a licensing regime for building practitioners" (Merry et al, 2008). However, under this Act, residential builders and residential property developers were "subjected to new criminal and civil liabilities" and those who "purchase properties to flick-off for a profit "in trade" may now be caught by the provisions of the Act" (Selkirk, 2010). This might have had some negative effects on developments of residential buildings, which for some time had been a major contributor to GDP growth in the sector. Consequently, the dampening effects can be observed.

It is of interest because despite the high overall rate of employment growth in period 4', there seemed to be a slight slowdown in construction employment happened in early 2005 before the trend resumed. An analysis into this may be helpful in

understanding the relationship between construction GDP growth and employment growth.

2.10. New Zealand construction labour productivity revisited

Key findings in all productivity reports discussed earlier all have one theme in common: Labour productivity in the New Zealand construction industry has been poor and has fallen behind that of the New Zealand market sector for quite some time (Davis, 2007; Janssen et al, 2008; Black et al, 2003). Some studies have also made cross-country comparisons on performances of productivity growth between the New Zealand construction industry with that of other countries, notably with Australia and with the United Kingdom (Janssen et al, 2008; Black et al, 2003). The overall view in these cases is one of low performance in the New Zealand construction sector relative to construction sectors in these countries.

However, one must be careful in interpreting these results because of differences in accounting methods as well as in statistical methodologies utilised by officials in each country for the official data series. One good example is given in Black et al (2003). Here both Multifactor productivity series and the Labour productivity series of New Zealand aggregate market sector fell short of those produced by the Australian Bureau of Statistics (ABS). But when these series were converted to what Black called the “ABS equivalent” series, NZ’s performances were compatible to those of Australia’s (Black et al, 2003).

Our focus in this section, however, is on the labour productivity growth in the construction industry in NZ relative to that in the domestic market sector. Figure 18 below has been derived from Davis (2007) and Figure 19 was produced by the Department of Housing and Building. In his report, Davis (2007) only constructed the labour productivity series up to 2006. It is interesting to note that in this case, labour productivity growth in the New Zealand construction industry is shown to be improving over time (see the trend line).

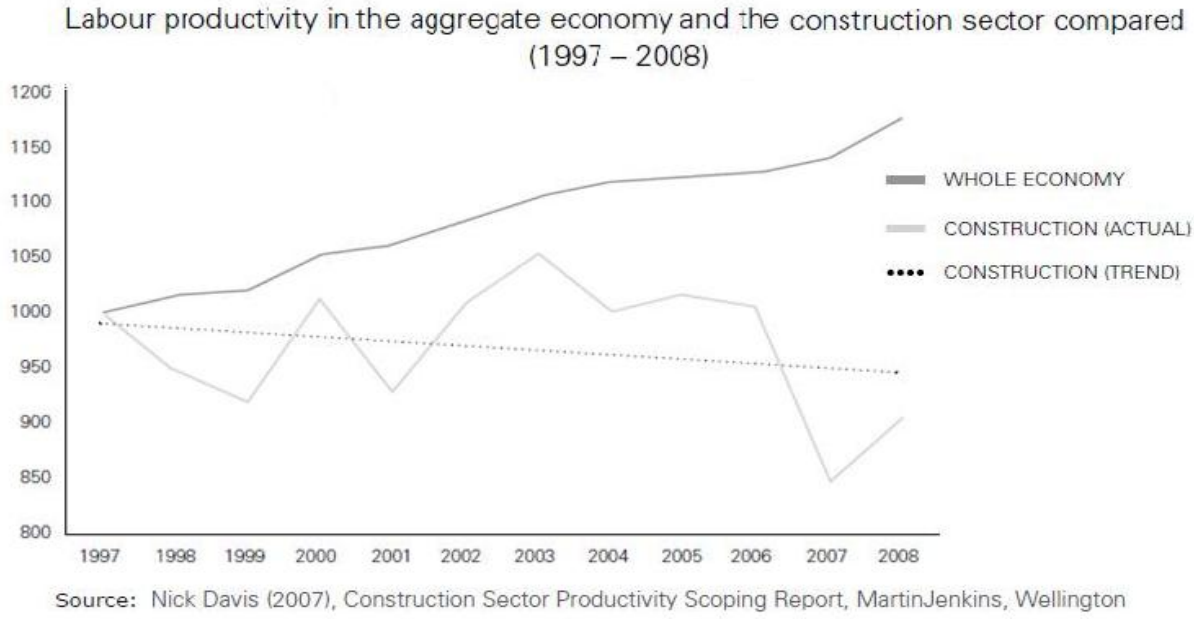
In contrast, DHB was able to establish labour productivity series up to 2008 thanks to the availability of the latest official data. However, as shown in this figure, the trend line is actually downwards, indicating a decline in construction labour productivity. The figure also shows a sharp upward turn in 2007. An investigation into the cause

of this decline and to why the upward turn happening is therefore important in order to understand the dynamics of the New Zealand construction industry.

Figure 18: Labour productivity compared: aggregate economy vs. construction

Source: Based on Davis (2007)

Figure 19: Labour productivity in the aggregate economy and the construction sector compared 1997-2008 (DHB, 2009)



2.11. Chapter Summary

Chapter 2 provided an overview of main current literature regarding the performance of labour productivity in the NZ construction industry. Factors which may affect this performance were also discussed carefully in order to get a full understanding of

their relationships and their likely impacts on construction labour productivity growth in NZ. All productivity reports available painted a bleak picture of NZ construction, with poor labour productivity growth over time. As noted in Davis (2007), there is evidence suggesting that “productivity levels in the construction sector in 2006 have not improved in the last 15 years”. Some writers have cautioned against strong conclusions from their works. Productivity measurements and quality of available data are the main issues in productivity studies in New Zealand (Janssen, 2008; Davis, 2007). Discussions as well as sufficient analysis into these technical issues have been incorporated in this report to outline potential problems which may arise in subsequence phases of this research.

A thorough review of a study into the cyclical performance of NZ construction was also included. It is important to understand of underlying behaviour of the industry so that its cyclical nature can be put in the context of a productivity study. The CAENZ study investigated the relationship between other related industries (such as agriculture, finance, etc) with the New Zealand construction sector in terms of their respective business cycles. A model was then built upon the available data using computer software and sophisticated mathematical techniques. This model was incorporated with engagement with key stakeholders to “try to understand the system behaviour and key indicators that are required to better predict and understand the whole construction cyclical system” (Allan et al, 2008).

An important report on employment in the construction sector in NZ was also reviewed. This work was carried out by the Department of Labour in 2009. Labour input is an essential factor in studying labour productivity. An understanding of this issue is therefore important. Overall, construction experienced significantly higher employment growth than the overall economy in the period considered with growth in some sub-industries was as high as 142%. But this trend has slowed down due to the economic conditions currently being experienced.

Upon understanding the nature of the construction industry and the corresponding employment market, a link between these was then established using historical data available. Important time periods on these data series were then matched with historical events over the approximately same period in order to acquire an overall

perspective of political and economic influences on NZ construction and ultimately on labour productivity.

The next step in this investigation is to set up a methodological framework upon which this research is based. Once this framework is in place, sequential tasks such as data collection, data series construction and analysis of these series will be undertaken.

CHAPTER 3

3. RESEARCH METHODOLOGY

3.1. Introduction

This chapter forms the methodological framework for this Master's Research. Research Methodology sets out the direction in which sequential tasks will be carried out for this research to reach fruition.

Philosophical background of Research Methodology is first established, which then followed by detailed discussions of research processes and research designs. Different types of research design will be explored.

Research approaches, which essentially are the building blocks of this research, will be analysed next. Appropriate research approaches will be selected based on the established philosophical framework and the suitability of each approach.

A research plan is then developed. The main tasks involved will be discussed thoroughly so that appropriate actions can be taken by the researcher.

3.2. Meaning of Research Methodology

Rajasekar et al (2006) defines "research" as "a logical and systematic search for new and useful information on a particular topic". Research oftentimes involves several, if not all, interconnected activities such as study, experiment, observation, analysis, comparison and reasoning. These activities are usually done sequentially, with each preceding task serves as guidance for the subsequent one. Therefore, in order to "glue" these tasks together in a research project, a philosophy of approach allied to appropriately selected tools and techniques must be developed. This combination of philosophy and technique is referred to as the methodology of the study (Easterby-Smith, 2004). A research methodology needs to be carefully identified, designed and applied appropriately in order to successfully complete such a research project.

Research Methodology is a "systematic way to solve a problem" (Rajasekar et al, 2006). In other words, it is the philosophy of studying how research is to be undertaken. Essentially, methodology is concerned with: why data should be collected; what data should be collected; where the data should be collected from; when the data should be collected; how the data should be collected and how the data will be analysed (Shakantu, 2005). Research Methodology should not be confused with Research Methods *per se*, which are essentially the "various

procedures, schemes, algorithms, etc. used in research" (Rajasekar et al, 2006). As Rajasekar et al (2006) pointed out, it is necessary that each research project has its own methodology because "even if the method considered in two problems is the same, the methodology may be different".

3.3. Philosophical Background of the Research

In order to establish the philosophical position of the research, it is necessary to examine its epistemological and ontological background. Sections 2.1 and 2.2 will discuss these issues. Thereafter it is necessary to situate the research background in the relevant framework.

3.3.1. Epistemological background

Epistemology refers to the question of how we know the world (Christou et al, 2010). It is the technical term of the "Theory of Knowledge" (Trochim, 2006). Marsh et al (2002) identifies two main epistemological strands: positivism and interpretivism. The difference between positivism and interpretivism is the way they approach knowledge. In the positivist approach, people and processes are seen as "constructions" while in the interpretive approach they are the "constructors" (Christou et al, 2010).

This theoretical difference in the two strands ultimately influences the way that researches are carried out under each respective approach. In positivism, scientific knowledge is established through the accumulation of verified facts. Science is thus, deductive and must be carried out in an objective way. Therefore the role of the research is primarily to test theories and create laws. This construction in essence gives the researcher the view that every phenomenon that exists can be reduced to an exhaustive set of hypotheses to test and questions to answer. Thus the hypothetico-deductive framework outlined is generally perceived to be what 'proper' science does; observing a phenomenon, constructing theories, postulating hypotheses to test, developing rigorous tests and then either accepting or rejecting a hypothesis on the basis of the test. This *weltanschauung* also underpins the philosophy behind related ideas such as logical positivism, rationalism and empiricism.

On the other hand, interpretivism maintains that social phenomena - the operation of the construction industry in New Zealand falls into this category - do not exist independently of our interpretation of them. Rather it is the interpretation or meaning of social phenomena, which affects social reality. Consequently, an objective analysis, which is the main premise of positivism, is impossible because the researcher is also part of the system being analysed and is therefore by definition not independent of the research issue. The role of the social researcher in the interpretative tradition is to study the social constructions of the individuals and present his/her interpretation of them (Christou et al, 2010). Table 1 below summarises research methods that often associate with each epistemological approach.

Table 10: Research Methods

Epistemology	Research Methods
Positivism	• Laboratories • Surveys • Quasi-experiments
Interpretivism	• Action research • Case studies • Ethnography

Source: Hopkins (2000)

Epistemologically, the problem being addressed by this research is essentially an investigation into a well-known problem in New Zealand and is in need of confirmation and explanation. Therefore the research must be interpretivist rather than objectivist.

3.3.2. Ontological background

Ontology refers to claims regarding the nature and structure of being (Rawnsley, 1998). A formal definition of ontology is given by Wikipedia (2010) thusly: “Ontology is the philosophical study of the nature of being, existence or reality in general, as well as the basic categories of being and their relations”. This definition is however suitable for such field as philosophy, where philosophical ideas can be put forward

and debated. An easy to understand definition is therefore needed for our research because we are interested in the essential ideas of Ontology rather than its philosophical aspect. A good definition of ontology is given by Gruber (1993) as: Ontology is “an explicit specification of a conceptualisation”, where conceptualisation refers to an abstract model of some phenomenon in the world by having identified the relevant concepts of that phenomenon (Gruber, 1993; Shakantu, 2005).

According to Chia (2002), there are two opposing ontological backgrounds in which sociologists and other researchers can base their methodology. These are Parmenidean and Heraclitean ontologies. The Heraclitean ontology emphasizes “the primacy of a fluxing, changeable and emergent world” while the Parmenidean ontology insists upon “the permanent and unchangeable nature of reality” (Chia, 2002). The opposition between a Heraclitean ontology of “becoming” and Parmenidean ontology of “being” provides researchers with the key for understanding contemporary debates in the philosophy of the social sciences and their implications for management research (Chia, 2002). As noted in Chia (2002), although there is “clear evidence of a resurgence of interest in Heraclitean-type thinking in recent years”, it is however the Parmenidean-inspired mindset which has “decisively prevailed in the West”.

In Parmenidean worldview, a representationalist epistemology, in which “signs and linguistic terms are taken to be accurately representing an external world of discrete and identifiable objects and phenomena”, ensues (Chia, 2002). Such a representationalist epistemology thus “inevitably orients our thinking towards *outcomes* and *end-states* rather than on the processes of change themselves” (Chia, 2002).

From an ontological perspective, the ultimate goal of forming a mathematical model to explain and predict labour productivity performance in the construction industry in this research implies a Parmenidean worldview. The nature of the problem needs to be as generalisable as possible, quantifiable and based on a limited structure of dynamic changes (employment, GDP). This combination of factors within the problem points strongly towards a positivistic philosophical standpoint for the research process. Consequently the research strategy designed must reflect both

positivistic and interpretivistic underpinnings. Section 4 establishes the research methodology of this project.

3.4. Methodological Framework of the Research

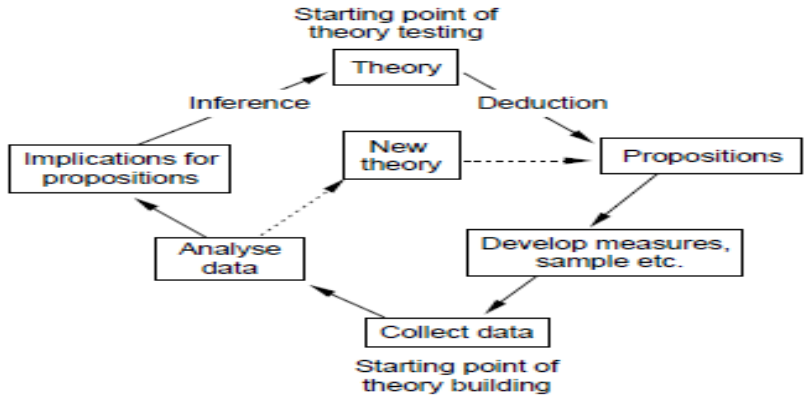
In this section, the overall methodological framework of this research project will be established. An overall picture of the chosen research methods in this paper will be presented. This framework will serve as the basis upon which the investigation into labour productivity performance of the New Zealand construction sector will be undertaken.

The secondary purpose of this section is to provide readers with a route map, so that the overall progression of this work can be easily observed.

3.4.1. Research Process

Although there are several different methodological frameworks available in conducting researches, oftentimes they involve a process which is made up of a sequence of highly interrelated activities as shown in the Figure 20 below.

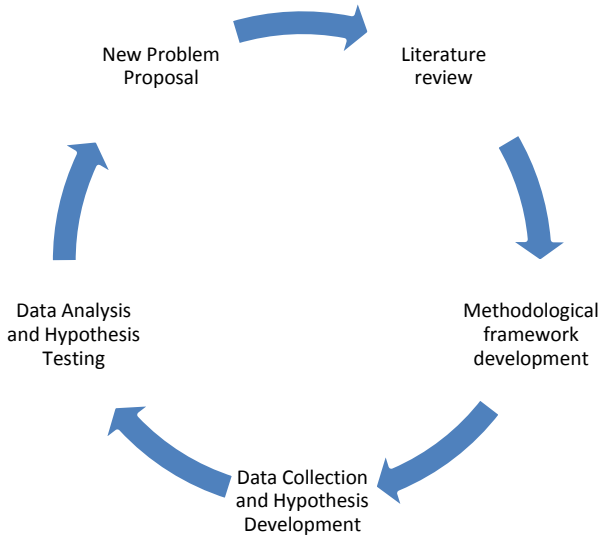
Figure 20: Logic of the research process



Source: internet

Note that not all activities or tasks in different researches follow the same order. Nonetheless, this pattern is relevant to most, if not all, researches. In this research project, the investigation into the labour productivity performance of the New Zealand construction industry will follow a similar pattern, as shown in Figure 21 below.

Figure 21: Research process in this Thesis



As stated in the Literature Review section, a mathematical model must be developed to confirm the findings in our preliminary analysis. It is a very ambitious attempt on the author's part, but due to the time restriction on this research in this instance (one year research project); this goal may not be achieved. The author therefore feels that this development can be considered as a new problem and can be researched further at the PhD level.

3.4.2. Research Design

Research design is a framework for a study that guides the collection and analysis of the data. Under this definition, a research design provides an operational plan, within which valuable outputs can be obtained through collecting, processing and analysing raw data to "enable us to answer the initial question as unambiguously as possible" (de Vaus, 2005). In other words, when designing research, we need to ask: given the research question, what type of evidence is needed to answer the question in a convincing way?

Essentially, there are three types of design frameworks that most research projects are based upon: Descriptive Research, Explanatory Research and Causal Research. Even though some authors have claimed that there is another framework (i.e. Reporting Research), but due to its nature (summarising facts, generating statistics etc) this is not usually considered as research (Cooper et al, 2003; Sobhani, 2008).

Therefore we discard this research design. The three main designs will be discussed below.

3.4.3. Descriptive Research

Descriptive research is a research design in which the major emphasis is on describing data and characteristics of the phenomenon being studied. It seeks answers to the questions of *who, what, where, when* and *how*.

This method finds its application in scientific disciplines such as social science or psychology, where a profile of problems is created and solved by researchers so that a general overview of the subject can be obtained; or in situations where it is not possible to test and measure a large number of samples needed for more quantitative experimentation (Shuttleworth, 2008; Cooper et al, 2003). Although the data description is factual, accurate and systematic, descriptive research does not explain interactions or relations between factors and therefore cannot be used to create a causal relationship, where one variable affects another.

3.4.4. Explanatory Research

Explanatory Research is a research design in which the major emphasis is on gaining ideas and insights of an issue or situation. It is particularly helpful in breaking broad, vague problem statements into smaller, more precise sub-problem statements, which in turns help determine the best research design and data collection methods. Explanatory Research goes beyond Descriptive Research in the way that it attempts to explain the reasons for phenomena that descriptive studies only observe (Sobhani, 2008). However, it often relies on secondary research such as reviewing available literature and/or data, or qualitative approaches such as informal discussions with consumers, employees, management or competitors, and more formal approaches through in-depth interviews, focus groups, projective methods, case studies or pilot studies and therefore any definitive conclusions drawn from these works must be treated with extreme caution.

3.4.5. Causal Research

This is a type of research design in which the major emphasis is on determining a cause-and-effect relationship. Causal Research typically involves an experiment,

where an independent variable is changed or manipulated to see how it affects a dependent variable by controlling the effects of extraneous variables, i.e. those variables that are different from dependent or independent variables but may have some effects upon a dependent variable but not necessarily on independent variables (APMF, 2010). This framework is particularly useful in measuring the impacts of a specific change may have on existing norms, and in turns allows the researcher to predict hypothetical scenarios so that appropriate decisions can be made should the change materialises.

3.4.6. Research Approach

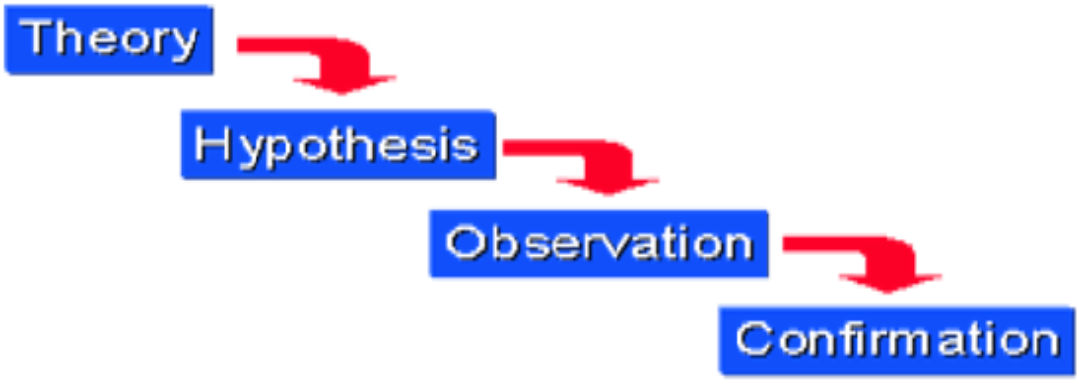
There are a number of approaches that a researcher can take when conducting a study. The main approaches will be discussed in detail below. The objective of this section is to give readers an overall understanding of available options. This understanding will in turn serve as a basis for the selection of appropriate approach for this project in the subsequent section.

3.4.6.1. Deductive approach and Inductive approach

Deduction and Induction are two broad methods of reasoning in logic. They are informally called “top-down” and “bottom-up” approaches respectively.

The Deductive reasoning works from the more general to the more specific. The schematic illustration of this approach is shown below:

Figure 22: Deductive reasoning



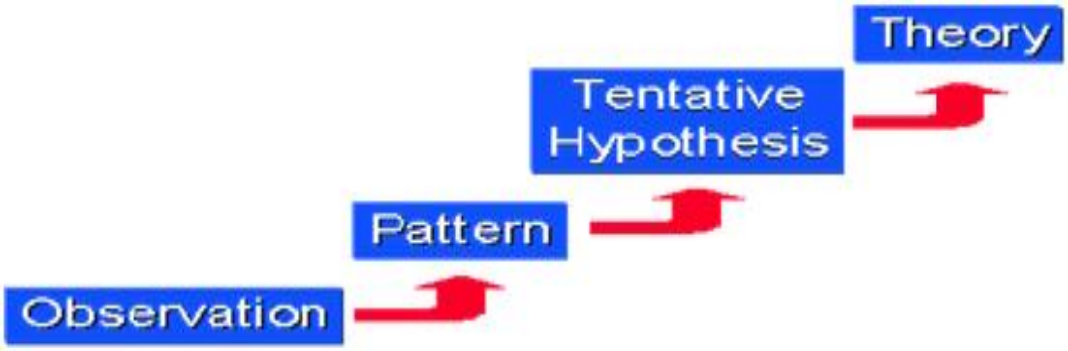
Source: Trochim, 2006

Here, a theory of the interested topic is proposed, which then is narrowed down to the more specific hypotheses. In order to address these hypotheses, they in turn

need to be narrowed down further when observations are collected and this ultimately enable us to test the hypotheses with specific data, i.e. a confirmation of the original theories (Trochim, 2006).

On the other hand, Inductive reasoning works the other way, moving from specific observations to broader generalisations and theories. This approach is illustrated below:

Figure 23: Inductive reasoning



Source: Trochim, 2006

In this approach, the researcher often begins with specific observations or measures. Patterns and regularities will then be detected. Tentative hypotheses that can be explored are then formulated based on the accumulation of such observations and finally he/she ends up developing some general conclusions or theories.

The two approaches have different "feel" to them when conducting research. According to de Vaus (2005), inductive reasoning is "more open-ended and exploratory by nature, especially in the beginning" while deductive reasoning is "more narrow in nature and is concerned with testing and confirming hypotheses".

3.4.6.2. Qualitative and Qualitative methods

Definitions of Qualitative and Quantitative methods will be given in here to give readers an overall understanding of these methods. They will also be compared to highlight their main differences.

3.4.6.2.1. Qualitative Method

Qualitative methods are "a set of data collection and analysis techniques that emphasize the fine grained, the process oriented, and the experimental and that

provide a means for developing an understanding of complex phenomena from the perspectives of those who are living it" (Barr, 2004). Qualitative research is exploratory in nature. It allows one to discover new variables as well as linkages between them; to reveal new processes and to bring the influence of context into sharp relief. Qualitative research is therefore particularly useful for creating a better understanding of complex processes and of the influence of individual perspectives in those processes (Barr, 2004).

Qualitative research encompasses a number of data collection techniques including observations, interviews, analysis of archival information such as documents, photographs etc, as well as a number of analytical methods including case study and grounded theory. This provides the researcher an opportunity to develop detailed understandings and thick descriptions of the phenomenon of interest. Because of this unique benefit, qualitative methods are most often utilised for theory building, when, for example, an existing phenomenon can be poorly understood and relevant variables and/or linkages cannot be specified.

3.4.6.2.2. Quantitative Method

Quantitative research refers to a "systematic empirical investigation of quantitative properties and phenomena and their relationships" (Wikipedia, 2010). In contrast to the Qualitative approach, in Quantitative research, the objective is to develop and employ mathematical models, theories and/or hypotheses pertaining to phenomena. As such, the process of measurement is central to quantitative research because it provides the fundamental connection between empirical observations and mathematical expressions of quantitative relationships

Quantitative research designs are either descriptive (subjects usually measured once) or experimental (subjects measured before and after a treatment). A descriptive study establishes only associations between variables while an experiment establishes causality (Hopkins, 2008). Statistical methods are often employed in this type of research design, from data collection and data verification, to validation and recording before the analysis can take place. The quantitative approach can require a big sample of data (hundreds or even thousands of subjects in the case of descriptive design) for reliability reasons; and software packages such

as SPSS and R are typically utilised in the analysis phase. Causal relationships are studied by manipulating factors thought to influence the phenomena of interest while controlling other variables relevant to the experimental outcomes (Wikipedia, 2010). Because of this limitation, Qualitative methods produce information only on the particular cases studied, and any more general conclusions are only hypotheses.

3.4.6.2.3. Qualitative and Quantitative methods compared

The discussions on Qualitative and Quantitative methods in this section form a basis for an understanding of the topic. Table 2 below combines this understanding with the discussions on other approaches given earlier to further illustrate the differences of these research designs.

Table 11: Qualitative and Quantitative compared

Quantitative Mode	**Qualitative mode**
Assumptions • Social facts have an objective reality • Primacy of method • Variables can be identified and relationships measured • Etic (outside's point of view)	**Assumptions** • Reality is socially constructed • Primacy of subject matter • Variables are complex, interwoven, and difficult to measure • Emic (insider's point of view)
Purpose • Generalisability • Prediction • Causal explanations	**Purpose** • Contextualization • Interpretation • Understanding actors' perspectives
Approach • Begins with hypotheses and theories • Manipulation and control • Uses formal instruments • Experimentation • Deductive • Component analysis	**Approach** • Ends with hypotheses and grounded theory • Emergence and portrayal • Researcher as instrument • Naturalistic • Inductive

• Seeks consensus, the norm • Reduces data to numerical indices • Abstract language in write-up	• Searches for patterns • Seeks pluralism, complexity • Makes minor use of numerical indices • Descriptive write-up
Researcher Role • Detachment and impartiality • Objective portrayal	**Researcher Role** • Personal involvement and partiality • Empathic understanding

Source: De Vaus

3.4.7. Selection of Research Methodology

Having established some knowledge regarding the philosophical background for this research as well as an understanding of available research designs and research approaches in preceding sections, we are now in a position to choose the right research methodology based on the requirements of our project. The chosen methodology must be relevant to the research objectives; and support these objectives being achieved within the allowable time frame of the project.

Due to the extensive involvement of many factors in this research and the need to investigate their relationships in detail in order to gain a full understanding of the performance of labour productivity growth in the construction sector in New Zealand, descriptive research is not considered suitable as a methodological framework based on its short-comings and therefore will not be considered in this project.

The objective of this research is to identify whether there is a problem with the performance of labour productivity growth in the New Zealand construction industry and if there is, what factors may have significantly contribution to this problem. In order to achieve this goal, extensive investigation will need to be carried out. Some major tasks involved include, but not limited to, review of data series available from Statistics New Zealand; review and reassess available literature relating to performance of labour productivity in New Zealand at the aggregate level as well as at the industry level, in particular the construction sector; interview with practicing professionals in this industry; collect and construct data series to confirm finding in

previous studies. Certain elements of Explanatory Research will therefore have their present in this work.

In addition, a full understanding on how factors such as business cycles in the New Zealand construction sector and employment growth may have on the industry's labour productivity growth is necessary in a study about labour productivity such as this one. As such, some experiments with the data series as well as some forms of statistical tests such as correlation testing are needed. This allows the researcher to confirm the results published in previous studies. This confirmation will in turn serve as a platform for a mathematical model to be formulated in subsequent phases of this Thesis. Causal research will therefore be employed in this Thesis based on its merits.

In relation to research approaches, Li et al (2008) pointed out that the Deductive approach is usually attached to positivism and the Inductive approach is associated with interpretivism. As noted in the Literature Review section, the goal of this research is to try to understand the performance and factors which influence the performance of labour productivity of the construction industry in New Zealand. In order to achieve this objective, essential areas which directly affect productivity in this sector (e.g. employment in construction industry and output (or output indicators) of the industry) will be carefully analysed. However, due to the significant influence that the construction sector in New Zealand has on the whole economy, extraneous areas such as economic conditions, housing demand, wages/salaries in the sector (and their growth), cost of building etc, will also be looked at. All of these factors will be synchronised so that an overall picture of labour productivity performance in this sector can be obtained and properly explained. Once this objective is achieved, this research paper will act as a basis for a more comprehensive study into this area; and perhaps a theory can be developed to generalise the nature of the New Zealand construction industry.

Moreover, this research also serves as a confirmation of previous studies done in New Zealand regarding the labour productivity performance of construction sector. A new labour productivity series for this sector will be constructed, based on data collected from Statistics New Zealand and from other agencies. This new series will first help to confirm (or contrast) the results in those studies and secondly form a

base for in-depth analysis in this research. Statistical analysis hence contributes significantly to the success of this research. With these ultimate goals in mind, essential elements of Inductive research and Deductive research approaches will therefore be chosen and implemented, so that a successful investigation into this area can be achieved.

As indicated in Table 3, Quantitative and Qualitative methods have close associations with Deductive and Inductive approaches respectively in academic research. This is due to the fundamental similarities in principal between each research approach and their respective research method. Natural differences of each research method as well as the contrasting operation of the environments (i.e. research approaches) within which these methods are to be carried out, also strengthen this relationship. In other words, each research approach is suitable to only one respective research method, as shown above. Since both Inductive and Deductive research approaches have been chosen as the preferred choices, based on the argument above, both Qualitative research and Quantitative research will be employed as the main analytical methods in this project. In doing this, benefits of both methods can be maximised and a meaningful answer can be obtained from the investigation.

In order to select the most appropriate research method, it is necessary to eliminate as far as possible those research methods that are not appropriate. Although there is a wide and varied selection of methods that could be adopted, these can be significantly reduced (Meredith et al, 1989). Table 4 summarises a distribution of appropriate research methods according to the nature of research problem being addressed.

Table 12: Framework for Research Methods (Meredith, 1989)

Approach to Knowledge Generation	Direct Observation of Object Reality	People's Perception of Object Reality
Logical Positivist / Empiricist	(A) Field Studies Field Experiments	(B) Structured Interviewing Survey Research
Interpretive	(C) Action Research	(D) Historical Analysis

	Case Studies	Delphi / Expert Panel Intensive Interviewing Introspective Reflection

The logic established earlier in this section allows us to eliminate inappropriate research methods without having to investigate their validity further. The research in essence does not involve any experiments of any kinds, since the investigation is on performance of labour productivity in the past. We can therefore confidently eliminate quadrant (A) of Table 4.

Furthermore, the performance of labour productivity in the New Zealand construction sector widely affects all facets of the country's economy (Allan et al, 2008). Consequently, it would seem illogical to investigate using case studies, where the investigation/study focuses on and is limited to one single area which we would like to address in this project; or action research, where collaborative enquiries and problem solving actions are required in the research to understand underlying causes in order to enable future predictions (since this is an individual investigation). Therefore, it is now possible to eliminate the research methods that appear in quadrant (C) of Table 4.

As a consequence of this elimination process, we are now in the position to develop a Research Plan which revolves around and involves some important aspects that are listed in quadrants (B) and (D) with confident.

3.5. Research Plan

The research plan is intended to give direction to researchers' efforts, and enable researchers to conduct systematic research (Shakantu, 2005). Research strategy clarifies the types of information the researcher needs to find. For instance, information requirements could be: background versus in-depth; scholarly versus popular; factual versus descriptive; historical versus current or primary versus secondary. The research detailed in this thesis can now be primarily focused on collecting published data, carrying out historical study and conducting interviews from experts/professionals in the construction sector in order to obtain and record opinions and data for further analysis. To this end there was a requirement to now establish specific components of the research plan.

3.5.1. Data Collection

Data collection is a term used to describe a process of preparing and collecting data for a project (Wikipedia, 2010). It is an important aspect of any type of research study. The purpose of data collection is to obtain information to keep on record, to make decisions about important issues, to pass information on to others. Primarily, data is collected to provide information regarding a specific topic (ABS, 2010). The accuracy of data collected can have significant impacts on the results of a study; inaccurate data ultimately lead to invalid results (UW, 2010).

Data collection methods vary along a continuum. At the one end of this continuum are Quantitative methods and at the other end of the continuum are Qualitative methods for data collection (UW, 2010). In this research, the emphasis is on the latter type.

Qualitative data collection methods play an important role in a research by providing information useful to understand the processes behind observed results and assess changes in people's perceptions. The most commonly used methods can be classified in three broad categories: in-depth interview, observation methods and document review. The characteristics of these methods have the following attributes:

- They tend to be open-ended and have less structured protocols (i.e., researchers may change the data collection strategy by adding, refining, or dropping techniques or informants);
- They rely more heavily on interactive interviews; respondents may be interviewed several times to follow up on a particular issue, clarify concepts or check the reliability of data;
- They use triangulation to increase the credibility of their findings (i.e., researchers rely on multiple data collection methods to check the authenticity of their results);
- Generally their findings are not generalisable to any specific population; rather each case study produces a single piece of evidence that can be used to seek general patterns among different studies of the same issue.

Data used in this project are mainly sourced from Statistics New Zealand. Statistics New Zealand has provided valuable information in forms of hours worked data, GDP

data, as well as the employment data for all kinds of study relating to productivity performance in New Zealand; particularly labour productivity performance in New Zealand construction sector, in the past (and continuing to do so). It is therefore logical for the author to use the same data, which has been publicly available for a period of time, for analysis in this research. This will help to confirm the results of previous studies.

In addition to data collected from Government Departments such as Statistics New Zealand or Department of Labour (for industry's employment growth), data available to the sector, such as those from Rawlinson's Handbook of Construction, will also be valuable to this research because these data come directly from the industry's main reference sources. These data will serve as the basis for the construction of wages data series and construction cost data series, which will then in turns act as catalysts for further investigation into, and help to answer the question of "what causes", the continual declination of labour productivity in the construction industry in New Zealand. Results from these questions may then perhaps act as building blocks for further developments in this field in forms of mathematical modelling of labour productivity performance in the country's construction sector.

Data collected from interviews of professionals involved in this sector in New Zealand will also be part of the research. However, due to their technicalities, interviews will be considered as a separate data collection method and will be discussed in details in subsequent section.

3.5.2. Interviews

A research interview is a professional conversation which has a structure by means of a careful questioning and listening approach with the purpose of obtaining thoroughly tested knowledge. A research interview is therefore defined as an interview "whose purpose is to obtain descriptions of the life world of the interviewee with respect to interpreting the meaning of the described phenomena" (Kvale, 1996). In a research interview, the researcher defines and controls the situation with him/her first introduces the topic of the interview and follows up on the subject's answers to the questions posed (Kvale, 1996). In this paper, qualitative interviewing

is employed to obtain opinions of practicing professionals and seasoned tradesmen in construction industry in order to explore the proposed question further.

In Qualitative interviewing, interview participants are most likely to be viewed as meaning makers, not passive conduits for retrieving information from an existing vessel of answers (Warren, 2001). Furthermore, the main purpose of this type of interviewing is to derive interpretations, not facts or laws, from respondent talk; it is also aiming to “understand the meaning of respondents’ experiences and life worlds” (Warren, 2001).

A specialised form of qualitative interviewing called “Elite interview” is utilised in this project. This kind of interview focuses on a particular type of interviewee, the elite individuals, and hence the name. “Elite individuals” are those who are considered to be “influential, prominent and/or well-informed people in organisations” and they are selected for interviews on the basis of their expertise in the construction industry in New Zealand (Marshall, et al, 1999).

Elite interview has been the chosen in this project based on its merits. Valuable information can be gained from participants because of the positions they hold in their respective organisations. An overall view of an organisation and their relationships to other organisations in the same industry as well as those in the wider economy can also be obtained. This is particularly useful in a study into labour productivity such as this one, because we would like to put the performance of labour productivity of the construction sector in the context of that in the wider economy for comparative analysis.

Being savvy individuals, elites respond well to intelligent, provocative and open-ended questions that allow them the freedom to use their knowledge and imagination. This is particularly important for researches such as this one because significant amount of industry insights and information can be achieved from these individuals.

However, there are disadvantages associated with this form of interviewing. The most notable disadvantage is the difficulty in gaining access to these individuals, as they are often somewhat elusive and busy people who operate under demanding time constraints. Another disadvantage in interviewing elites, according to Marshall

et al (1999), is that the interviewer may have to adapt the “planned-for structure” of the interview, based on the wishes and predilections of the interviewees. Moreover, these are intelligent and quick-thinking people who are well practiced at meeting the public and being in control, thereby during the interview, they can turn the interview around and take charge of it.

In addition to “Elite Interviewing”, another technique call “Snowball Sampling” will also be employed in the interviewing process. Snowball sampling is a technique for developing a research sample where existing study subjects recruit future subjects from among their acquaintances (Goodman, 1961). Due to the difficulty in making the initial contact with high-ranking managers in construction firms, this technique may prove useful in our investigation. The interview can be carried out on a small number of initial individuals and based on their referrals, more elites can be considered as potential interviewees.

3.5.3. Analysis

Analysis is the process of breaking a complex topic or substance into smaller parts to gain a better understanding of it. In particular, data analysis is the “process of bringing order, structure and interpretation to the mass of collected data” (Marshall et al, 1999). Qualitative data analysis is of special interest, as it is the main mean of extracting useful information from data and interviews collected, in this research. It is a search for general statements about relationships among categories of data.

As noted by Marshall et al (1999), there are two important factors one must bear in mind in analysing qualitative data: one is the minimal standardisation in terms of data collected across studies, i.e. each analysis will be a “uniquely designed event”. The other factor is that there are “multiple interpretations (and ways of arriving at them) available in the data”.

Nonetheless, there are two basic families of data analysis in qualitative method that “offer a general choice before project-specific aims and objectives are taken into account” (Marshall et al, 1999). The first family is the “content analysis”, where the contents of the data collected are explored to uncover either emergence of patterns or evidence of expected patterns. These processes can be managed with the aid of available software such as NVivo or Atlas, but the analysis itself has to be done by

the researcher. The other family member of qualitative analysis is grounded analysis. In this approach, the researcher's objective is usually "highly exploratory, targeted at answering a particular research question by allowing findings and interpretations to emerge from the data while searching for unexpected/emergent patterns" (Marshall et al, 1999). Grounded analysis offers a series of guided stages to be followed in order to reach the point where the model of explanation generated can be truly accounted for the data collected. We are interested in the latter family of qualitative analysis in this case because we want to answer the question in regard to the well-known problems relating to labour productivity growth in the New Zealand construction sector.

In addition to analysis using Qualitative methods, essential elements of Quantitative methods will also be employed in this research. This arises from the fact that there is a need for confirmations on results published in previous studies in this area.

It is therefore important for us to construct a new labour productivity series based on the data available in order to assist the comparative analysis process. This newly constructed series will then be compared with both the industry's employment data series and the industry's GDP series by means of correlation testing to obtain a meaningful explanation of the relationships between these factors and labour productivity in the sector.

3.6. Chapter Summary

This part of the Thesis has formed the methodological framework for this project. The Research Methodology has set out the direction in which sequential tasks will be carried out for this research to reach fruition.

Philosophical background of Research Methodology was introduced in the beginning of the chapter to give readers some understanding of the issue. Definitions of Epistemology and Ontology were given and their respective implication on this research was discussed in detail. Once this understanding was archived, a philosophical framework for this research, which consists of the Parmenidean ontological worldview and interpretive epistemology, was constructed.

Research processes and research designs have then been discussed in detail. In particular, different types of research design were explored. Their merits and drawbacks were analysed carefully to ensure all aspects were fully understood.

The natural step in this chapter is to talk about research approaches that the author would take in this investigation. A rigorous discussion was made to provide readers with a good understanding of these building blocks of the research. Appropriate research approaches was then selected based on the philosophical framework established earlier and the suitability of each approach for this project.

Due to the nature of research of this type, both qualitative and quantitative methods have been employed here. This is to maximise the benefits of each method so that a meaningful result can be obtained from this investigation into construction labour productivity performance, which may then serve as a basis for future development in this area.

Finally, a research plan was devised from the chosen approaches. This research plan consists of appropriate methods need to be taken in this investigation. The main tasks in this plan are data collection, interviewing and analysis. These tasks were then discussed thoroughly so that appropriate actions can be taken by the researcher.

The next step is for the author to develop a questionnaire for the interviews. Some potential interviewees have been identified with the help of Dr. John Tookey. Once the ethical approval process is completed, the author will contact these individuals to make arrangements for the interviews.Data will also be collected to aid the analysis process, along with results obtained from these interviews.

CHAPTER 4

4. RESEARCH ANALYSIS

4.1. Introduction

In depth analysis of the subject matter is offered in this chapter. Careful analysis of individual factor allows readers to understand their respective performances over time. Cross-comparisons between these factors and NZ construction labour productivity (and among the factors themselves) will be made in order to paint a complete picture of their relationships.

The NZ construction industry comprises a number of sub-industries which can be considered independently in our analysis. These sub-industries are: Civil construction, Building Services, Residential and Non-Residential and Infrastructure Construction. In this research, the emphasis is on the last three categories. The rationale behind this lies in the fact that civil construction is a machine dominated sub-industry and as such, workers in civil construction are more “productive” in value-added terms than those in the rest in the construction industry (Page, 2010). Therefore, it is important that we investigate the lower end of this industry, i.e. the other three sub-industries, in order to understand what factors affect their performances, and ultimately the performance of the whole sector.

With this in mind, extraneous factors which had not been included in previous studies such as land and house prices, infrastructure investments in NZ, will also be explored in detail in this chapter. Upon understanding the effects of these factors in relation to labour productivity, we should be in a position to draw a hypothesis about the performance of labour productivity of NZ construction sector.

Areas of Investigation

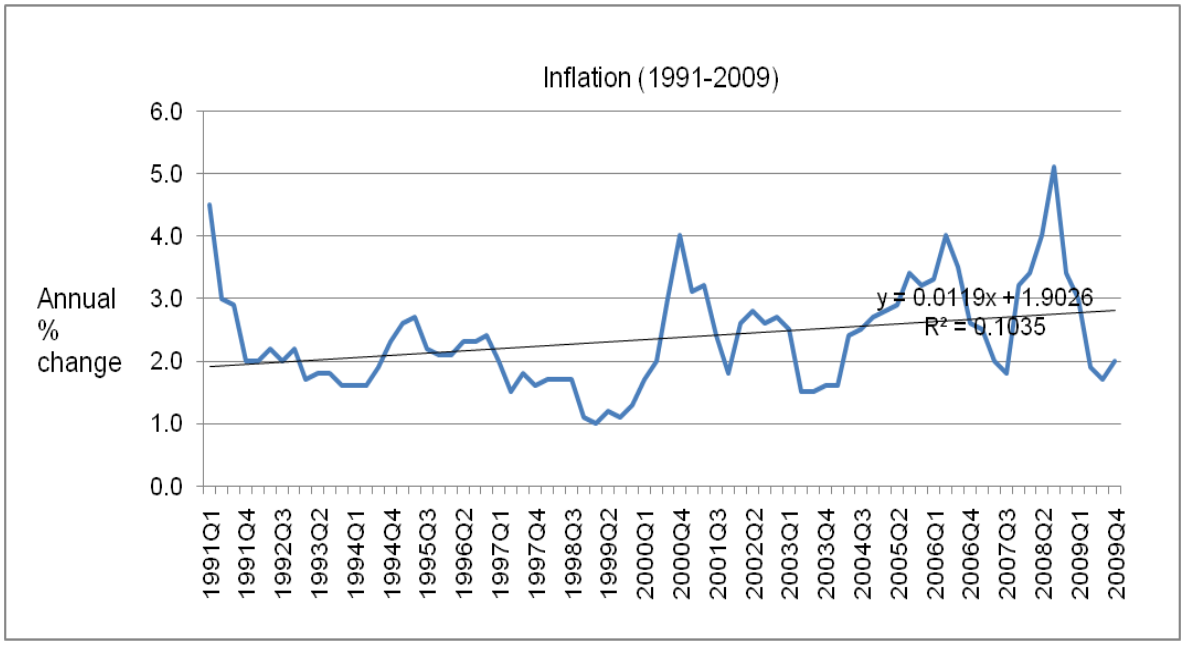
This part of this report aims at addressing areas that have significant influences on the overall performance of labour productivity in the NZ construction industry. These include, but not limited to, inflation (both at the aggregate and industry levels), construction employment, average earning per hour, Building Consent Issued, Elemental Cost of Building, House price and construction GDP (as well as measured sector GDP). Data presented here were collected from various sources and they will provide a platform for analyses in subsequent sections. Visual profiles of these data are constructed to represent the corresponding performance of each factor over time.

4.2. Inflation

Inflation has a significant effect on labour productivity. As the cost of labour increases, productivity goes down. As the selling price of the built product increases relative to labour cost, labour productivity goes up. The inflation series in NZ are publicly available on SNZ website. These series date as far back as the first quarter of 1920. However, the official SNZ series do not include inflation figures for every year. As such, the Reserve Bank of New Zealand (RBNZ) estimated the annual percentage change in NZ inflation for a number of years. But since 1991, thanks to the consistency of these series, RBNZ has used data published by SNZ.

Since the introduction of Goods and Services Tax (GST) in October 1986 and the subsequent GST changes in June 1989, NZ inflation growth in a number of quarters were impacted, specifically, quarter 4 of 1986 to quarter 1 of 1988 and quarter 3 of 1989 to quarter 4 of 1990 respectively. However, since 1991, the impact of GST on inflation in NZ is almost non-existent(see Figure 21).As can be seen from Figure 21, the linear regression line is almost flat (with regression coefficient being 0.0119 and the R-squared value is 0.1035). As can be seen here, the linear regression line is almost flat. An estimate of inflation growth averaging 3% p.a. is reasonable for the time period.

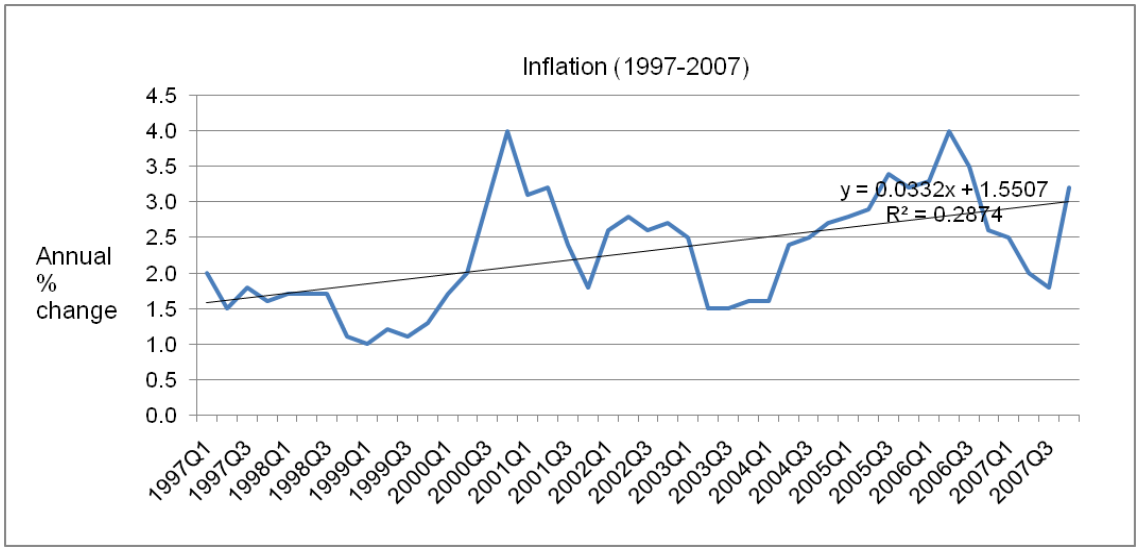
Figure 24: NZ Inflation growth (1991-2009)



Source: SNZ, RBNZ. Note: Interest rates are excluded

However, in the period from 1997 to 2007, this time profile changes quite dramatically, as illustrated in Figure 25.Here both regression coefficient and R-squared result show greater values than those in the previous case. These changes may happen due to the shorter time frame considered (10-year period as oppose to 18-year period previously). Nevertheless, the two graphs show that there seems to be a degree of volatility in inflation. And this volatility may have certain implications on the performance of labour productivity in NZ construction in the period 1997-2007.

Figure 25: NZ Inflation growth (1997-2007)



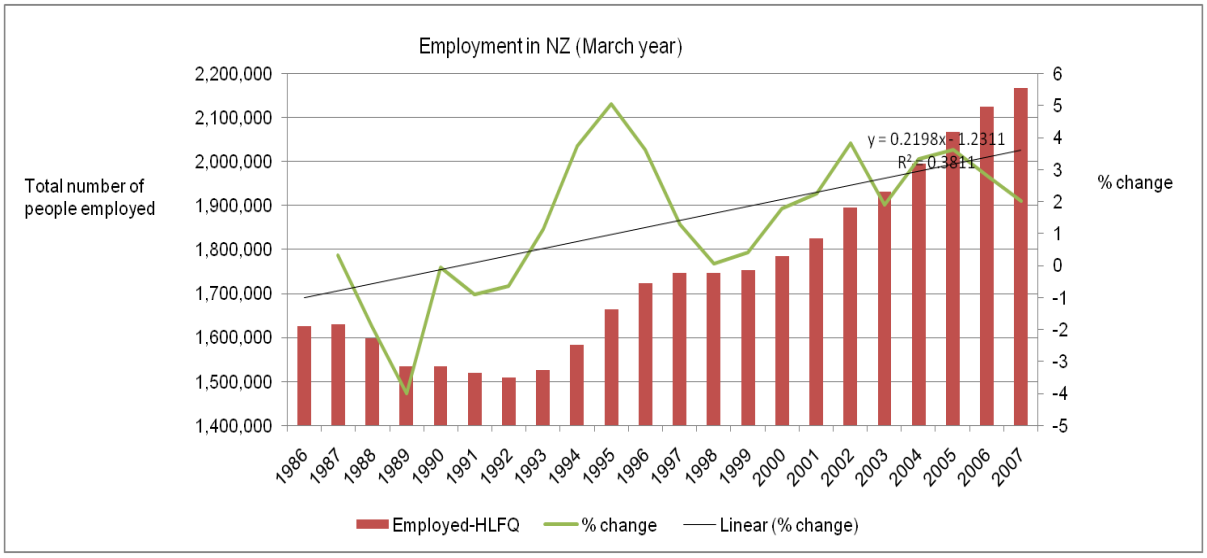
Source: SNZ, RBNZ. Note: Interest rates are excluded

4.3. Employment

The NZ employment data for all sectors and industries have been extracted from the Household Labour Force Survey and are seasonally adjusted. The series date back to 1986 and are available every March year to 2007.

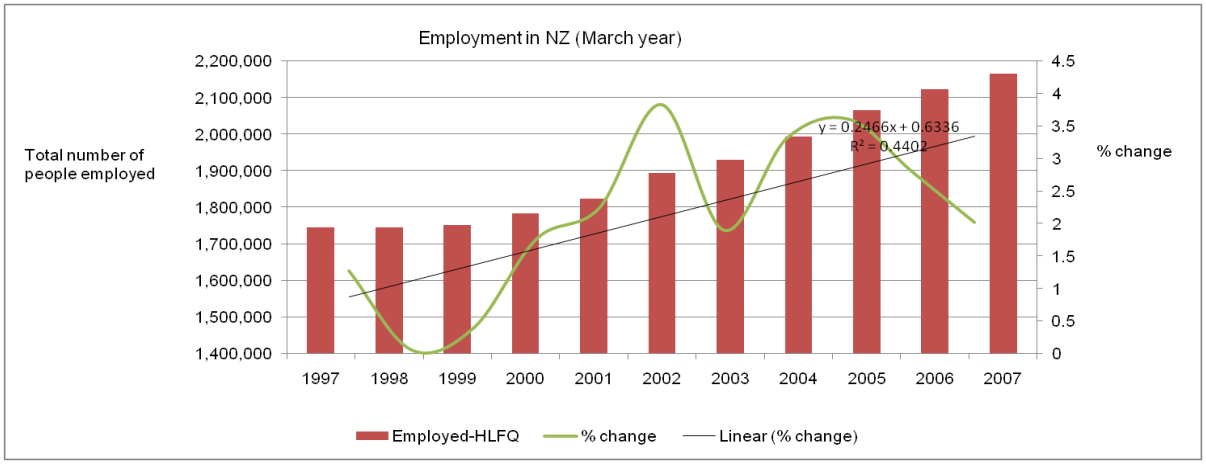
Since 1992, number of employed individuals in NZ in all industries increased significantly (from 1,509,000 in 1992 to 2,167,000 in 2007). In the 10 year period to 2007, employment in NZ grew by 24%. Comparison of the trend lines in Figures26 and 27 showed growth in the latter period was much stronger than that of the former.

Figure 26: Employment in NZ (1986-2007)



Source: SNZ

Figure 27: Employment in NZ (1997-2007)

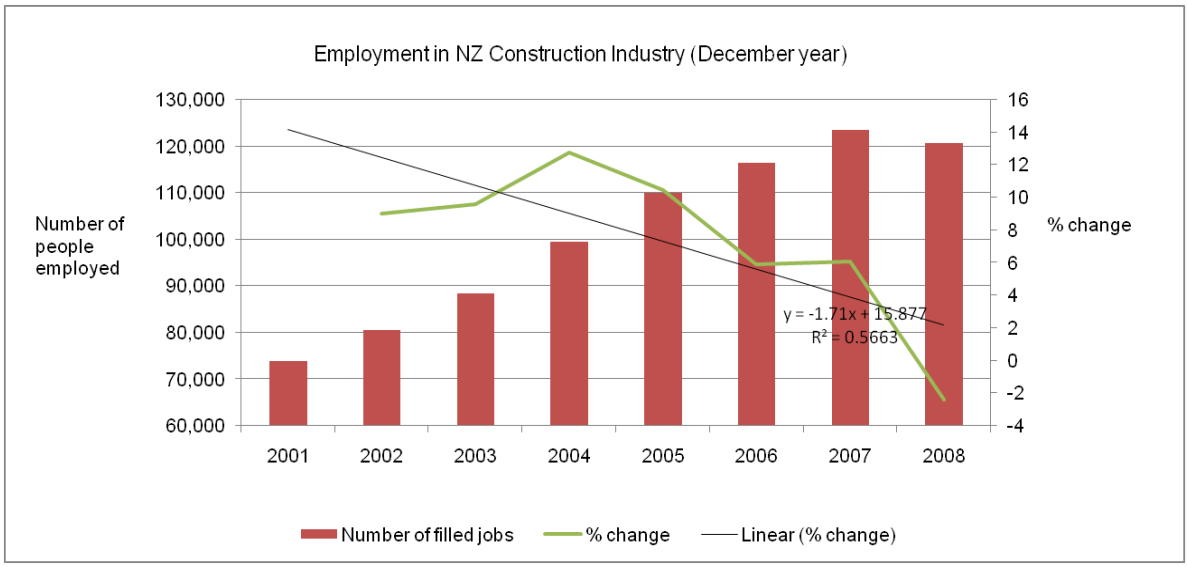


Source: SNZ

Figures 26 and 27 show employment in NZin general grew consistentlyand strongly over time. By contrast, employment in NZ construction is apparently quite volatile. Despite a strong growth of employment in construction between 2001 and 2007 (63% in comparison to the 18.8% employment growth in NZ over the same period), year to year growth rates in construction showed a greater degree of variation. After a period of sustained growth (2001-2004), NZ construction experienced a slow-down in employment growth, even though the number of employed individuals in the sector was still increasing. Employment in construction peaked in 2007 with the number of filled jobs in the industry growing to 123,580. However, by December 2008, the

industry had lost some 3000 jobs. Trend line in Figure 28 shows a steep decline contrasting the increasing trend lines in two previous graphs.

Figure 28: Employment in NZ Construction Industry (2001-2008)



Source: SNZ

Table 13 shows the numbers of wage and salary earners identified by being directly involved in various trades in the NZ construction sector between 2001 and 2006.

Table 13: Wage and Salary Earners in Construction Industry

Wage and Salary Earners in Construction Industry

March years

Sub-industry	2001	2002	2003	2004	2005	2006	Change between 2001 and 2006	
	Number of people						Absolute	%
Building construction	15,672	16,056	18,117	21,003	24,666	27,102	11,430	72.9
Non-building construction	17,547	17,928	18,189	19,170	22,164	24,717	7,170	40.9
Site preparation services	4,854	5,112	5,622	6,225	7,470	8,103	3,249	66.9
Building structure services	4,191	4,305	4,956	5,769	6,543	7,107	2,916	69.6
Installation trade services	16,605	17,322	18,468	20,148	21,396	23,718	7,113	42.8
Building completion services	10,272	10,251	11,247	12,459	13,917	14,529	4,257	41.4
Other construction services	4,512	4,455	5,460	6,126	7,221	8,610	4,098	90.8
Total	73,656	75,426	82,062	90,903	103,374	113,889	40,233	54.6

Source: SNZ

The overall employment growth in all sub-industries considered here was quite substantial in this period (54.6%). The greatest change in employment between 2001 and 2006 happened in the “Other Construction Services” category (90.8%). On the other hand, the “Building Completion Services” category had the lowest growth rate

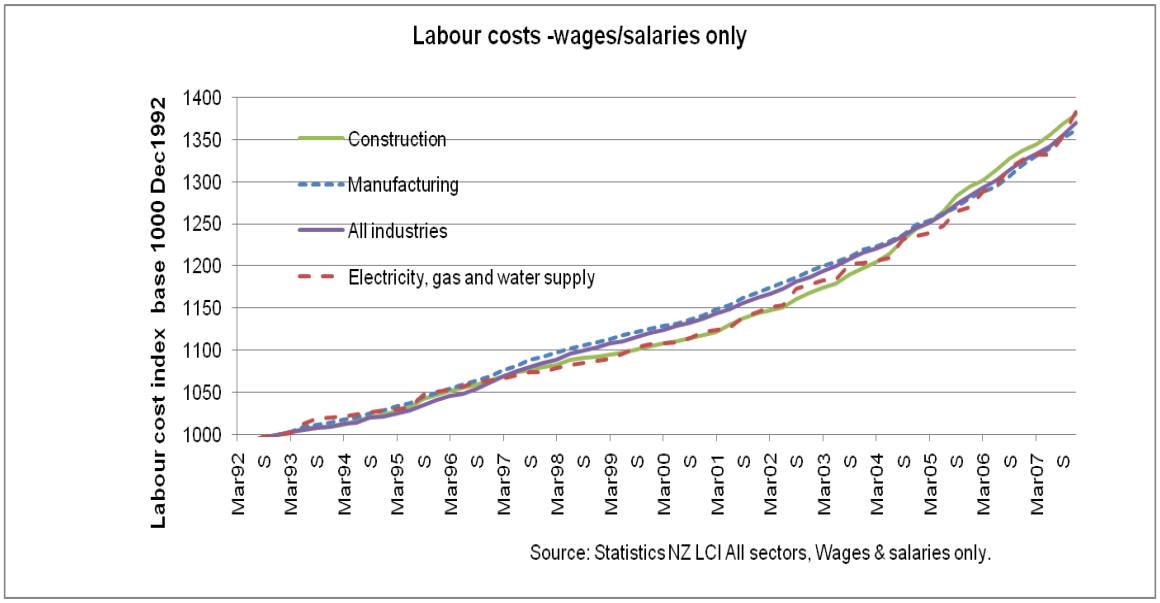
among these sub-industries (41.4%). However, employment growth in this sub-industry was still 2.5 times higher than that of the whole economy over the same period (16.4%).

It is apparent that the sustained growth in employment in construction 1997-2007 was accompanied by an almost continual decline in labour productivity. The causes of this apparent strong correlation are moot. However, a number of potential candidates for this decline have been posited education, training, declining skills, declining popularity of apprentice schemes etc (Taskforce, 2009). One has to be careful in interpreting the results presented here because certain sub-industries are actually more “productive” in term of labour than others. For instance civil construction has always been a machinery-dominated sub-industry. Personnel in this sector are few but most (if notall) are highly specialised. As the result, civil construction has always had significantly higher output per man hour compared to other sub-industries.This in turns means that labour productivity in this sub-industry is much higher than that of the overall industry. In spite of the skewing effects of civil construction, and the expanded amount of civil infrastructure works of recent years, construction labour productivity is still declining. This is extremely concerning for the NZ construction sector.

4.4. Labour Costs

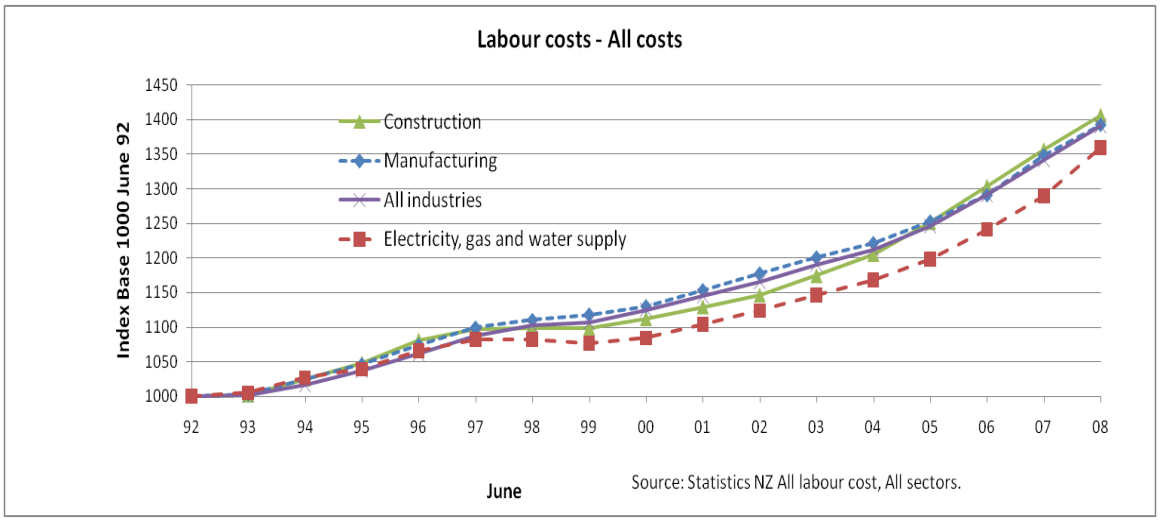
The labour cost series in this research was provided by BRANZ (Page, 2010). Labour cost index in the construction industry was compared with labour cost indices in other sectors (manufacturing; electricity, gas and water supply) and with those in all industries.

Figure 29: Labour Costs-Wages/Salaries only



Source: SNZ, BRANZ

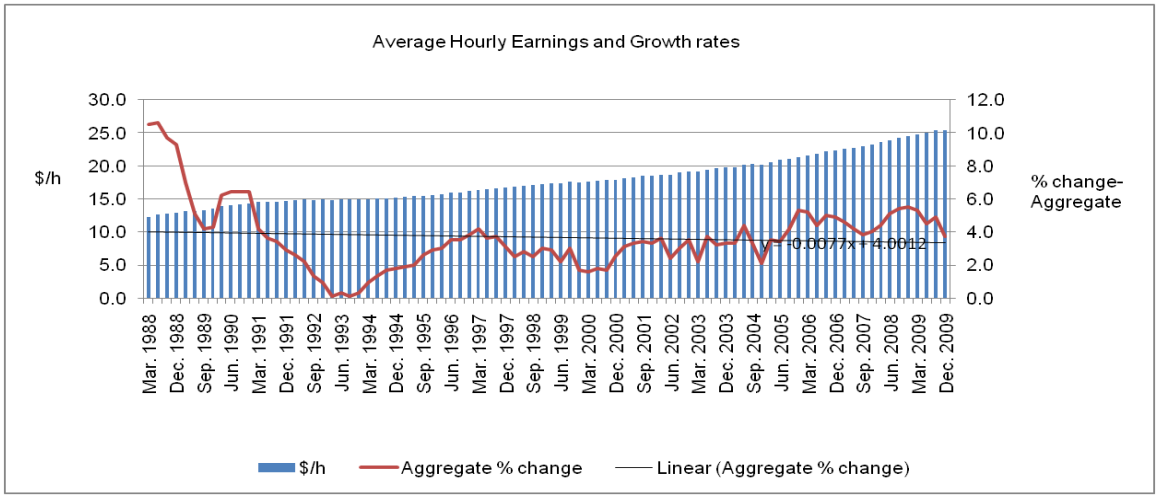
Figure 30: Labour Costs-All Costs



Source: SNZ, BRANZ

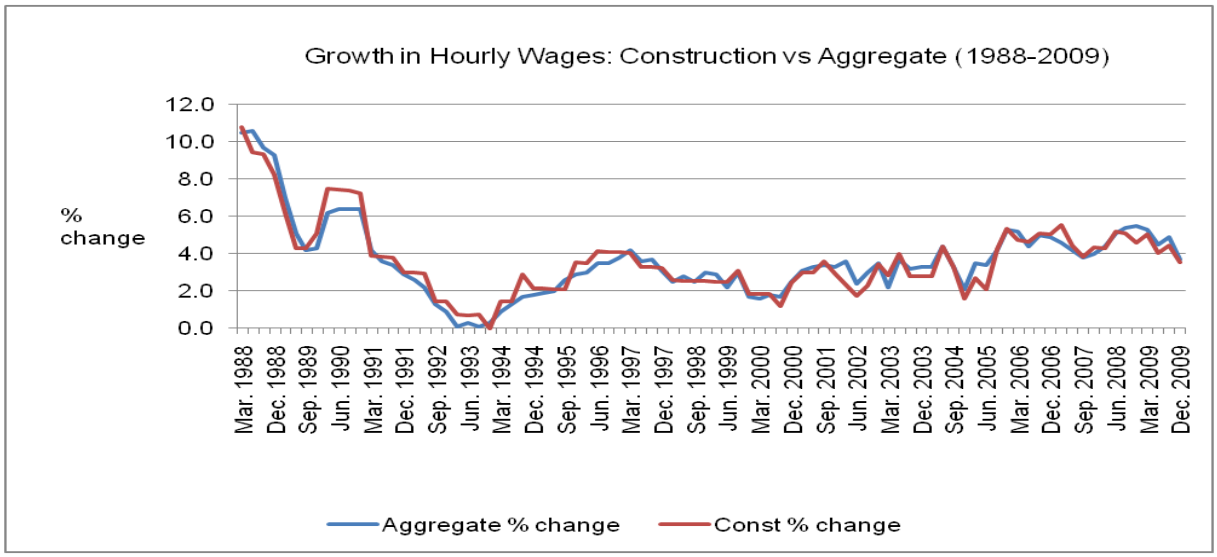
Overall, labour costs in construction behave much like those in the wider economy and in general performed better than labour costs in some other major industries (Electricity, Gas and Water Supply).In terms earnings in NZ,the average for a working person in the country did improve significantly in the 21-year period (from $12.2/hr in 1988 to $25.4/hr in 2009), but the rate at which this improvement takes place is sluggish (see trend line, Fig. 31), averaging 3% over the period. In effect, wage growth tracked inflation almost exactly. Growth rates in NZ construction in general follow the same patterns as those in the aggregate economy (Figure 32).

Figure 31: Average Hourly Earnings



Source: SNZ, RBNZ

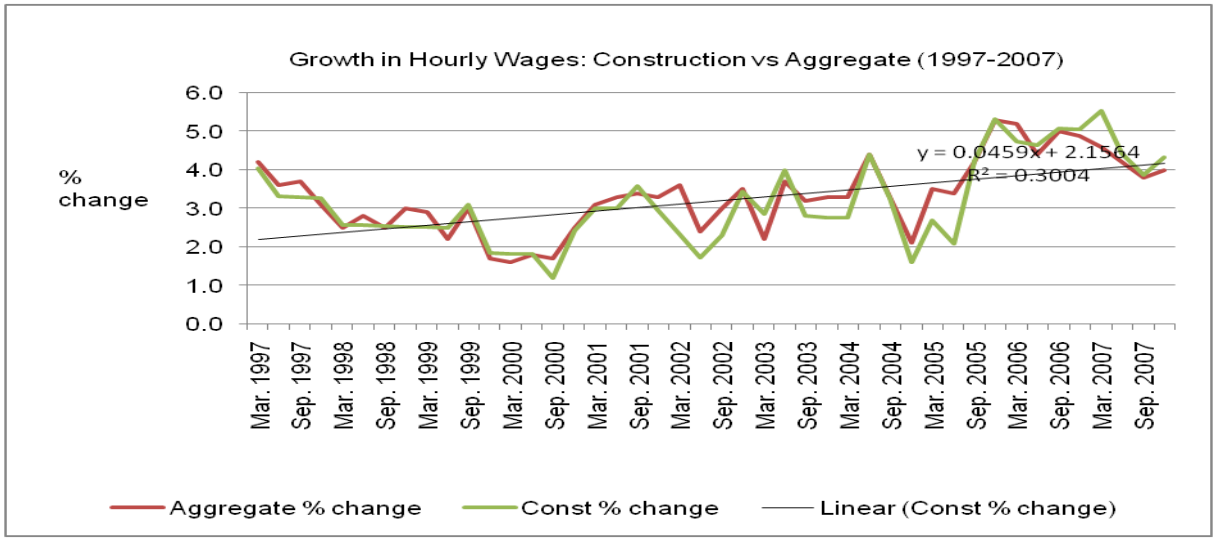
Figure 32: Growth in Hourly Wages: Construction v Aggregate (1988-2009)



Source: SNZ, RBNZ, DOL

From 1997 to 2007, both series show strong growth (41% or 3.7% p.a.), with actual wages increased from $16.4/hrto $23.2 respectively. This strong performance might have been due to the favourable economic conditions in NZin this period, in which the construction boom from 2001-2004 might have played a major part. It is interesting to note that despite of the strong growth, the labour costs in both the NZ construction and the wider economy in effect grew at almost the same rate as inflation over the periods considered. This means the labour costs in the construction industry have actually remained flat (and stable) if we are to take inflation into consideration. This finding may have significant implications on our analysis later in relation to labour productivity.

Figure 33:Growth in Hourly Wages: Construction v Aggregate (1997-2007)



Source: SNZ, RBNZ, DOL

Often an understanding of the earning potential of those involved in an industry helps in understanding the economic power of that industry. In this study we concentrate on the construction sector; it is therefore important to have a representation of earnings of those professions in the NZ construction industry instead of just having the Average Hourly Earnings series alone.In 2009, Hays Construction & Property published a report containing a profile of basic salaries among various professions involved in the construction sector in Australasia (Australia and NZ only). Section of this report concerning the salary levels in NZ construction is included here for an illustration of the earnings diversification in the industry.

Table 14 show a great income disparity in the sector: salary levels vary from as little as $30,000 per annum to unlimited earnings, as in the cases of a Graduate Architect and of the Principle of a firm respectively. Generally, those with limited industry experience (the newly Graduates in Architecture/Engineering) or limited authority (Leading Hands) will earn much less than the people with more experience or authority. However, as these individuals obtain more work experience and/or as they assume more responsibilities, they become more valuable to their organisations. Their salaries grow accordingly as a consequence because they can contribute more to their firms and to the industry as the whole.

Table 14: Income by Profession in NZ Construction

Profession in Construction	Salary by Region ('000)	
	Auckland	*Christchurch/Wellington*
ARCHITECTURE		
Graduate Architect	35-45	30-50
Architect 2-5 yrs	55-80	50-70
Architect 5-10 yrs	75-90	60-90
Graduate Interior Designer	35-45	30-35
Interior Designer 2-5 yrs	45-55	40-50
Interior Designer 5-10 yrs	60-90	50-80
CAD Drafter	35-90	35-70
Landscape Architect	45-90	40-75
Town/Urban Planner	65-90	45-70
BUILDING SERVICES: DESIGN CONSULTANCY		
CAD Drafter-Design Drafter	40-70	35-55
CAD Manager	70-100	55-80
Graduate/Entry-level Design Engineer	40-70	40-70
Intermediate -Senior Design Engineer	75-95	55-90
Associate/Senior Associate	100-120	100-120
Principle/Director	110+	110+
BUILDING SERVICES: CONTRACTOR		
Foreperson/Supervisor	50-70	50-70
Estimator-Senior Estimator	50-70	50-70
Project Manager	75-90	70-90
Senior Project Manager	85-120	80-100
Operations Manager	90-120	90-120
Building Service Manager	100-160	100-140
CIVIL AND STRUCTURAL		
Drafter	45-70	35-60
Civil Designer Drafter	50-75	40-65
Civil/Structural Engineer	65-110	50-110
Client Side Representative/Resident Engineer	75-120	60-110
Structural/Civil Project Engineer	60-110	50-100
Associate	100-150	90-130
Group Manager/Principle	115+	100+
CONSTRUCTION CIVIL		
Leading Hand	40-55	40-55
Foreperson/Supervisor	55-65	50-70
Site Engineer	45-65	45-65
Project Engineer	65-85	65-80
Project Manager	80-120	80-110
Estimator	70-120	60-100
Construction Manager	90-160	85-140
Contract Administrator/Quantity Surveyor-Entry level	45-60	45-60
Contract Administrator/Quantity Surveyor-Senior	75-120	80-110
Design Manager	90-130	90-120
CONSTRUCTION BUILDING		
Leading Hand	45-55	44-60
Foreperson/Supervisor	55-75	55-70
Site Engineer	60-75	55-75
Project Engineer	65-90	60-80
Project Manager	85-130	90-120
Estimator	60-120	80-110
Construction Manager	120-160	110-150
Contract Administrator/Quantity Surveyor-Entry level	40-60	35-55
Contract Administrator/Quantity Surveyor-Senior	80-120	75-120
Design Manager	85-120	80-115
Site Manager	65-95	70-110
FACILITIES MANAGEMENT		
Building Manager	55-80	50-70
Facilities Co-ordinator	40-60	40-55
Facilities Manager	65-90	60-80
Facilities Service Manager	70-100	60-90
Contract Manager	70-100	65-90
Operations Manager	85-120	70-110
Engineering Manager	70-100	70-90
Bid Manager	70-120	65-105
General Manager	100-190	90-160

Overall, personnel and professionals employed in this industry enjoy better earnings than those involved in other sectors in NZ such as Service and Hospitality Industries or Manufacturing. This shows the importance of the construction industry in the NZ economy (accounting for nearly 15% of total GDP). Therefore the health and performance of this industry have significant effects on the NZ economy as a whole and the “poor” performance of labour productivity of NZ construction is a worrying sign indeed.

4.5. Construction Materials and Construction Works Indicators

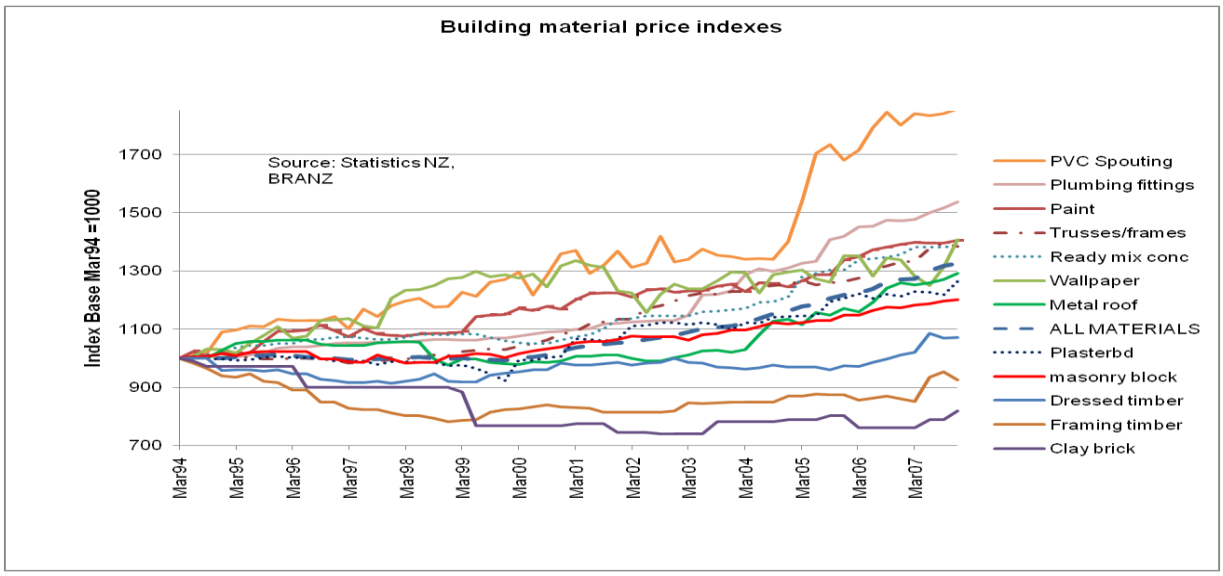
A number of factors in the Residential and Non-Residential construction sub-industries will be explored in this section. They include the Material Costs and the Building Cost per Square Metre for various building types. The latter series include material and labour costs. Indicators of construction work such as Building Consent Issued will also be looked at. These series provides an indication of the overall demand for construction work in NZ, which then allows for more discussions in detail later.

4.5.1. MaterialCosts in Residential/Non-Residential Construction

The materials index series was developed by BRANZ using collections of data obtained from SNZ, including materials prices for their Consumer Price and Producer Price Indexes (PPI). All materials have been re-based to 1000 in 1994.The time profiles of these indices are presented, along with their corresponding year over year growth rates (Figures 34 & 35).

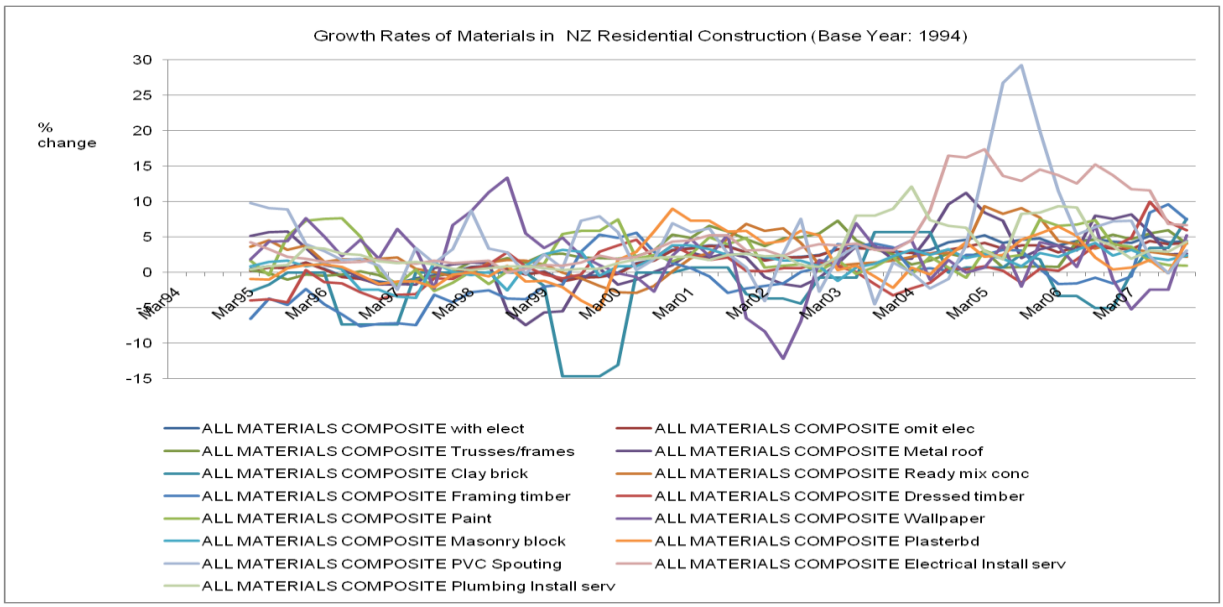
Over the period considered, material costs increased significantly. However, the rate of growth of the series averaged at 3% per annum. This finding means that the materials in NZ residential construction tend to grow at a uniform rate in line with the more general inflation rate in the country. The result of the analysis above is similar to findings in the analysis of the labour costs series and it may have certain implications on the analysis of labour productivity of NZ construction. Details will be discussed later.

Figure 34: Material Price Index (All Materials)



Source: SNZ, BRANZ

Figure 35: Growth rates of Material Price Index (All Materials)



Source: SNZ, BRANZ

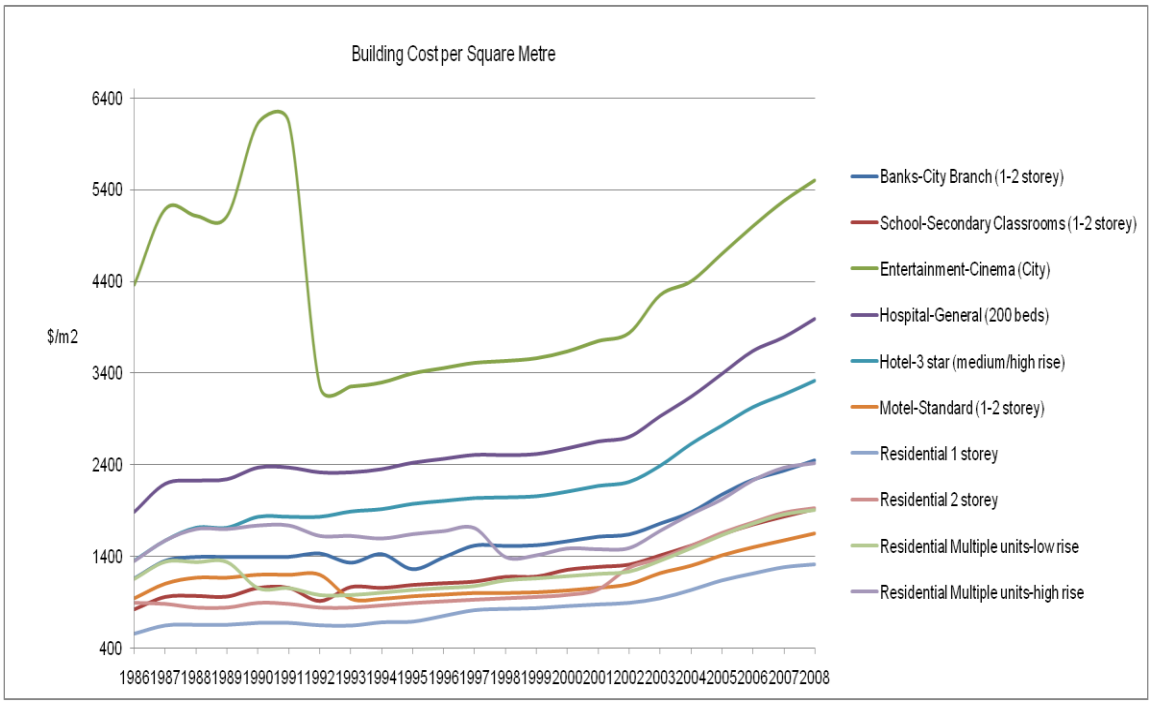
4.5.2. Building Cost per Square Metre

The Building Cost per Square Metre (BCSM) data were sourced from Rawlinson's NZ Construction Handbook. The Handbook provides a comprehensive reference work on NZ building costs and other related information.

BCSM indicates the price range of construction cost in each of the four main cities in New Zealand, namely Auckland, Wellington, Christchurch and Dunedin. Cost of

construction in each city is obtained by averaging these corresponding price ranges. These costs are then averaged again in order to obtain the Elemental Cost of Building in NZ. These data are measured in dollar per square metre and include all associated costs(labour and material costs) for each type of construction work. Here we consider 7 different types of building construction. Within the Residential category, we again sub-divided it into further 4 types. The idea behind categorisation of buildings is to obtain a perspective on the distribution of costs for different building types. This in turns serves as the basis for a generalisation on the performance of construction cost in NZ over time. These data series are shown below:

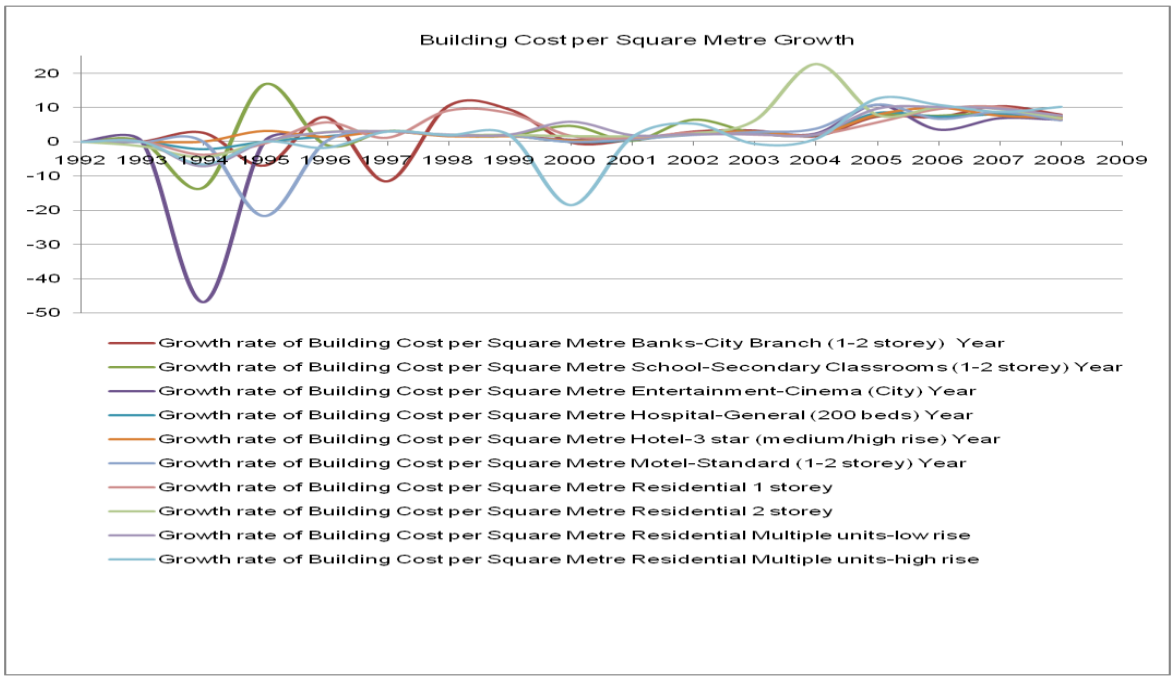
Figure 36: Building Cost per Square Metre



Source: Rawlinson's Construction Handbook

Figure 36showthe cost of building has increased quite significantly since 1986, in some cases (hospital, 3-star hotels), these increases almost doubled. An exception is the Cinema category. After the steep decrease in 1992, the Cost of Buildings of this category has not yet fully recovered despite a strong growth since. As of 2008, the cost per square metre in this category is still lower than levels in the 1990/1991 period.In spite of the strong increases over the 22-year period, the rates of growth howeverhave remained low. This is consistent with the behaviours previously observed in labour and material costs.

Figure 37: Growth of Building Cost per Square Metre

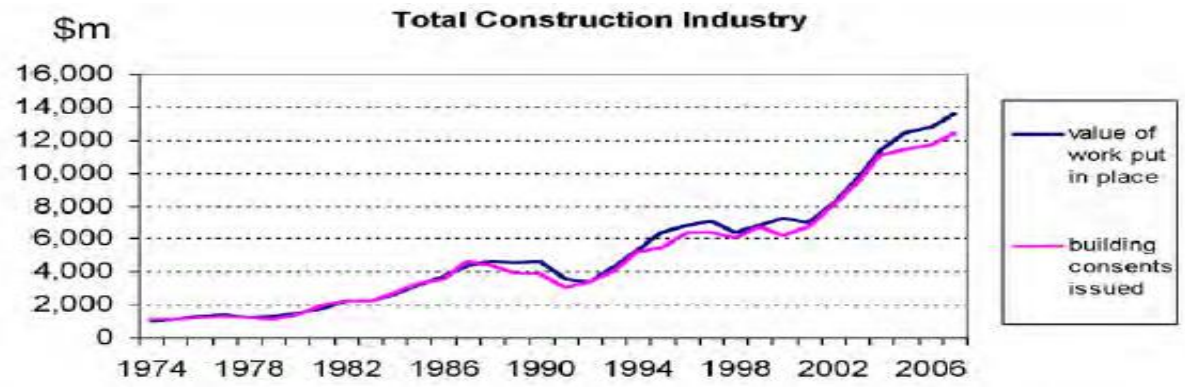


Source: Rawlinson's Construction Handbook

4.5.3. Building Consent Issued (BCI)

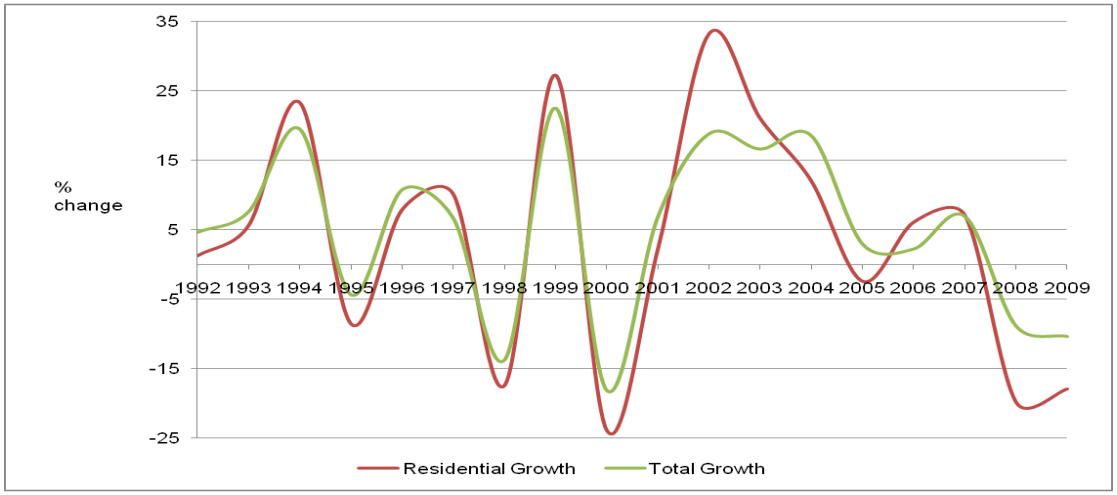
It is essential to explore the supply side as well as the demand side in NZ construction in order to obtain a full understanding of the nature of this industry). The supply side was discussed earlier (employment, labour costs and material costs. Discussions of the demand side are offered here. The BCI series serves as indicators of demand of construction work in NZ. Figure 38 shows the relationship between BCI and the Value of Work Put in Place series. Generally, the two series follow each other very closely and bothseries increased significantly over time.

Figure 38: Building Consent Issued and Value of Work Put in Place



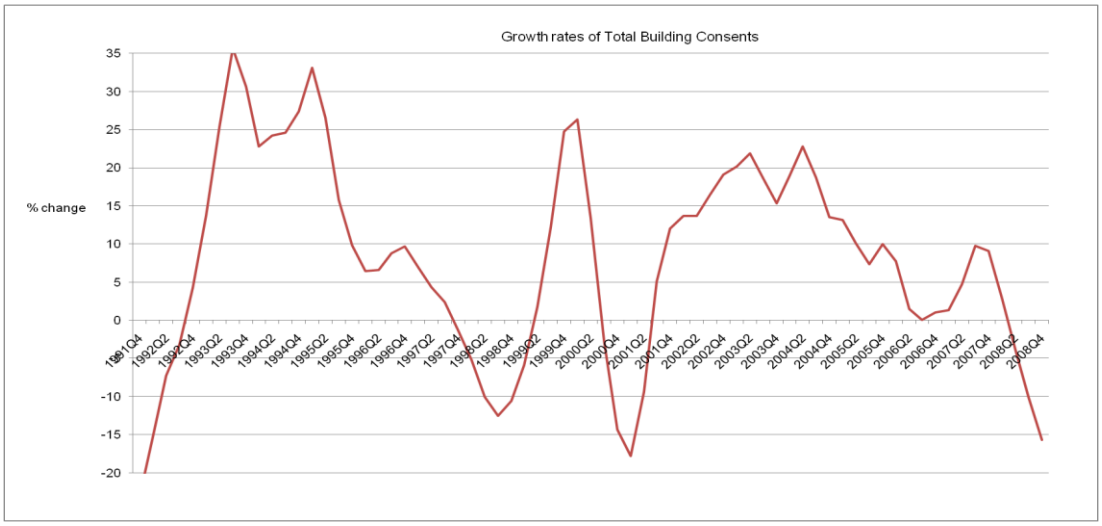
Source: CAENZ (2008)

Figure 39: Growth of Building Consent Issued (Yearly growth)



Source: Statistics New Zealand

Figure 40: Growth of Building Consent Issued (YOY growth)



Source: SNZ

Figures 39 and 40 show the performance of Total Building Consent Issued (including both Residential and Non-residential) between 1992 and 2008. Overall, the year over year growth rate series showed more significant fluctuation in comparison to the yearly series. Nevertheless, they show the volatile nature of the construction industry. As cautioned by Grimes et al (2006), one must take note that BCI should only serve as indicators, rather than a comprehensive measure of supply responsiveness in residential building since:

a) They may over-state the responsiveness - some consents are not followed by building

b) They may under-state responsiveness to the extent that unauthorised building takes place
c) They take no account of demolition

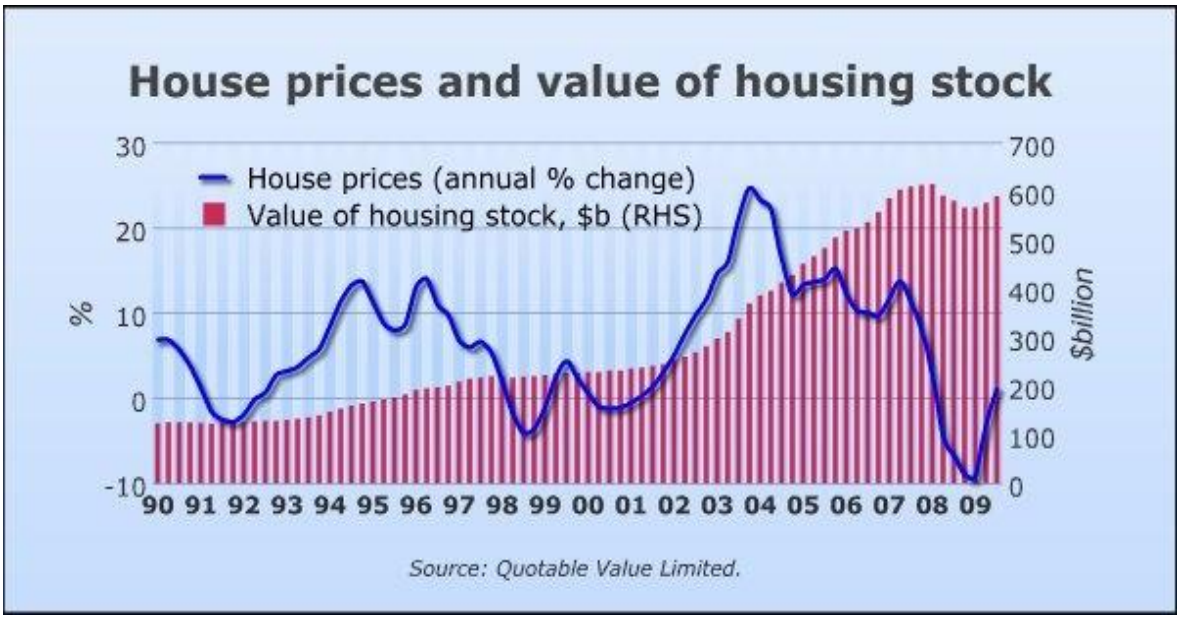
BCI showed demand for construction works in NZ was significant between 1997 and 2007. However this demand is not continuous and is subjected to economic conditions which might have caused the volatile behaviours of NZ construction as observed.

4.6. Residential Construction: House and Land Prices

Unlike previous investigations into the area of labour productivity in NZ construction, here we look into an important driver of the demand of construction work, the housing market, and the changes happening in it over the period 1997-2007. The purpose of this inclusion is to identify whether the growth in this market had any effects on labour productivity and if they did, to what extent they influence the performance of productivity of the whole industry. Another reason for this consideration is that the house prices collectively include all associated costs (labour and material costs). This means in effect the housing market should be a real reflectionof all factors discussed earlier.

House price data in this research is obtained from RBNZ. From 1990-2010, value of NZ housing stock increased from NZ$123 billion to NZ$591 billion (Figure 41). These official figures show that NZ housing is a highly inflated market in the NZ economy, with the annual inflation rate averaged at 7.5% in comparison to the rate of 3% in the wider economy over the same period.

Figure 41: House Prices and Value of Housing Stock

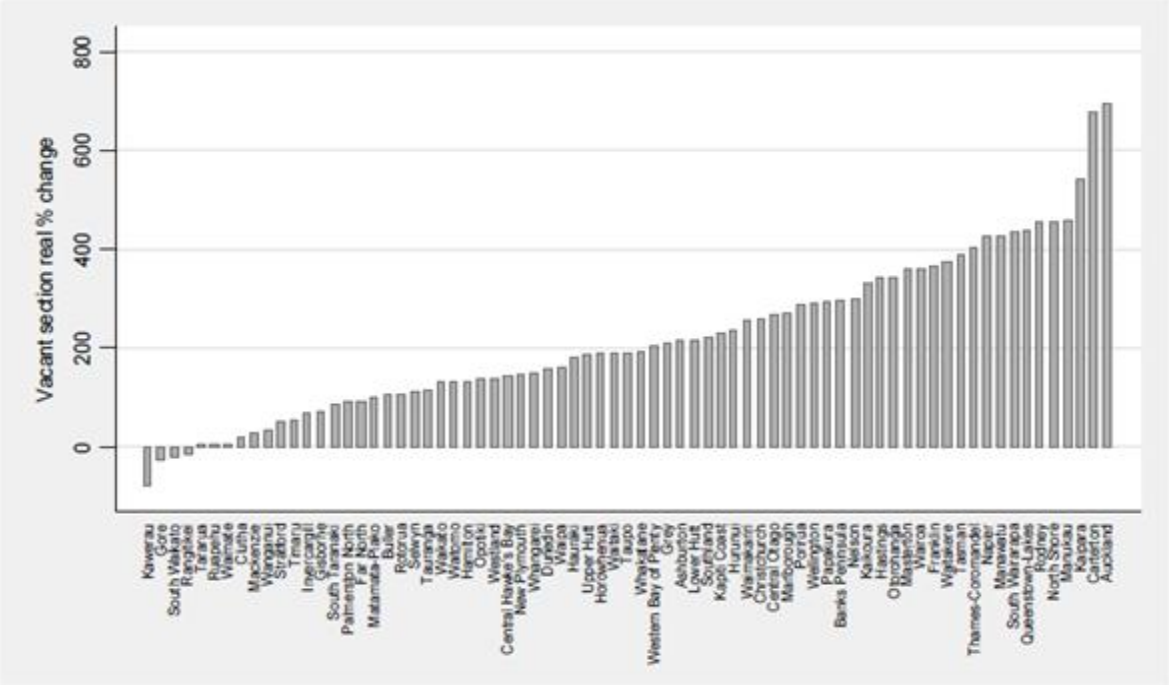


Source: QV, RBNZ

According to a number of studies by Motu Economic& Public Policy Research, the increase in NZ house prices were mainly driven by the increase in land prices across New Zealand. These studies found that land prices in New Zealand increased significantly in the period from 1981 to 2004, with the real (inflation or CPI-adjusted) price of vacant residential sections rose by 286% on average across the country (Grimes et al, 2006). These increasesare most significant in metropolitan areas such as Auckland City (700%), Manukau, North Shore City (both 460%) or tourist areas such as Queenstown-Lakes and Thames-Corromandel(over 400% each) (see Figure 39).

These studies found that on average across the country, a 1% increase in real residential land prices translates into an estimated 0.27% in real house prices; statistically, the effect is highly significant. In the absence of real land price increases, Motu predicted that real house prices would have increased by just 16.4% (or by roughly 0.7% p.a.) over the 23 year period (Grimes et al, 2006).

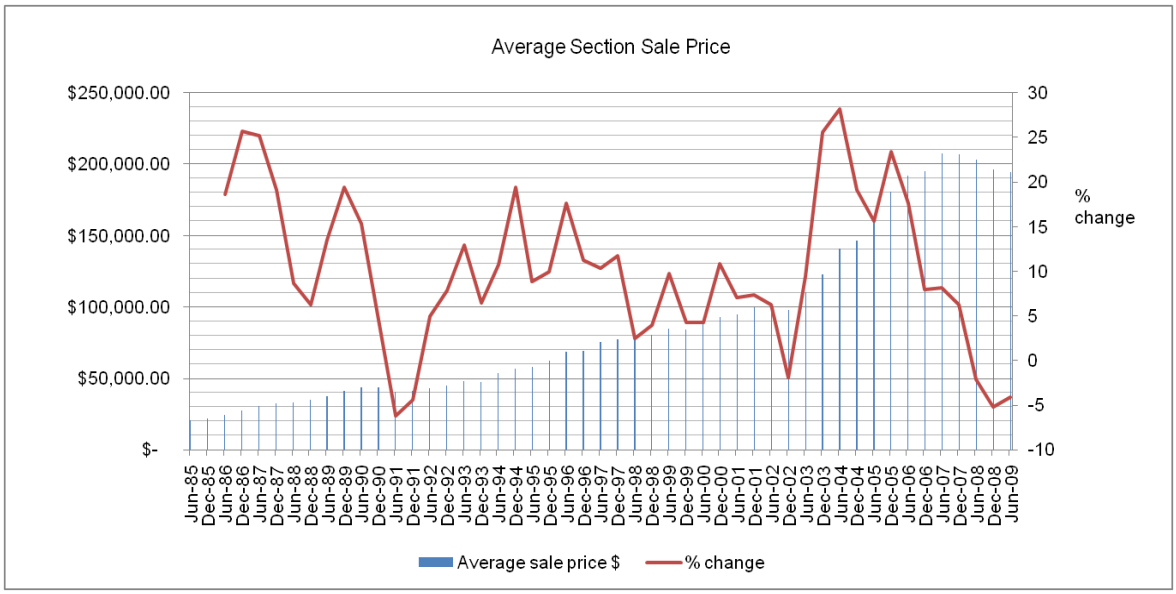
Figure 42: Vacant Section Real % Change (1981-2004)



Source: Motu

The average section sale price and the corresponding growth in NZ are shown in Figure 43. The movement of the section price series resembles that of the value of housing stock series but section prices seem to be more volatile than house prices, as the growth rate series of the former series fluctuate at much greater rates than those of the latter.

Figure 43: Average Section Sale Price



Source: QV

On average, inflation of Residential Land Price in the period between 1985 and 2009 is 6.5% p.a. Combine with results found in Motu's studies, land prices might have played a major role in the increase of house prices in NZ as observed. Note that inflation rates of both house and land prices are much higher than the inflation rate of the whole economy over the same period. This is highly significant. Property and built product prices are increasing (6.5% and 7.%5 p.a., respectively) at a little over twice the rate that material and labour costs are (an NZ economy average of 3% pa). Thus rationally it could be expected that construction labour productivity should increase more rapidly than any of its comparable other industries. However, this is not the case. The skewing effect highlighted actually creates an artificially positive result in comparison to other industries. This is highly significant for the industry and needs further understanding in order to be rectified.

4.7. Non-Residential Construction

Data for non-residential construction in NZ are sourced from SNZ. These series date as far back as 1999 only. However, they should be sufficient in illustrating the performance of this sub-industry over the period considered in this research.

As can be seen from Figures 44-46, the Non-Residential sector has enjoyed a strong growth over the 10-year period to 2009. However, since the second half of 2006, demand for this sector seems to have decreased from the strong growth in previous years. Number of Building Consents in this period grew at slower pace and Value of Work Put in Place showed a flat lining behaviour.

Figure 44: Annual Non-Residential Building Work Put in Place

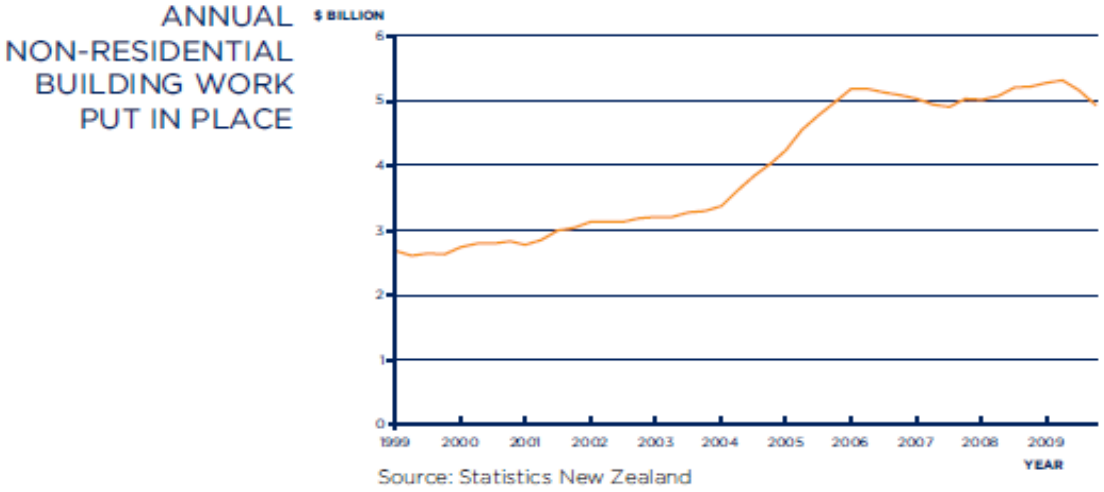


Figure 45: Annual Non-Residential Building Consents

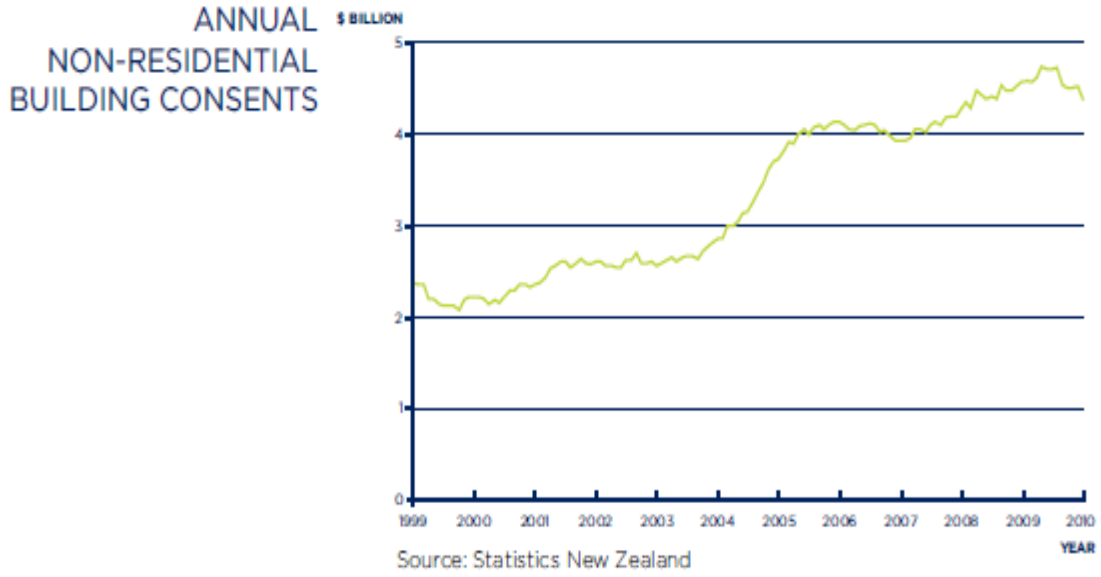
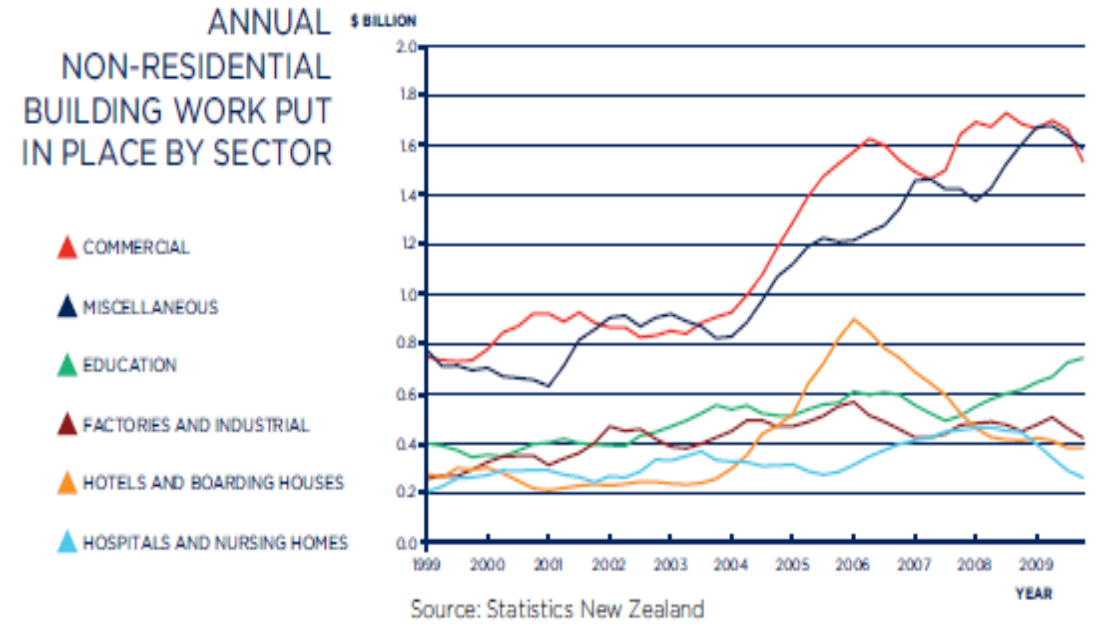


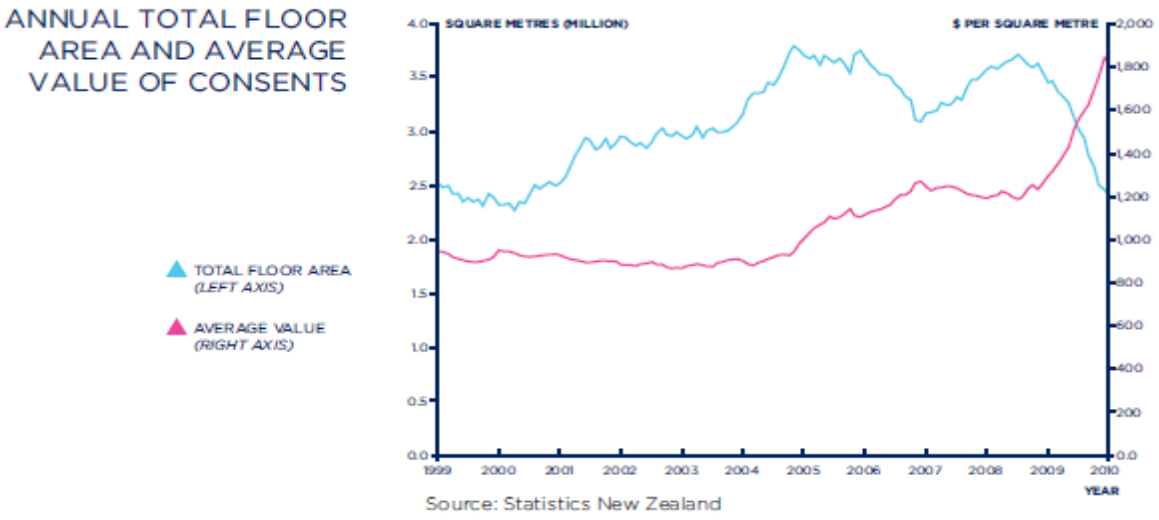
Figure 46: Annual Non-Residential Building Work Put in Place by Sector



Demand for Commercial construction is of greatest between 1999 and 2009. Given the prosperous period that the NZ economy had from 1999-2007, this fact comes with no surprise. But with the recession in 2008 and the current economic climate, this demand has dwindled. The recession squeezed firms' profits and has left them with low reserves for investing in new buildings. Moreover, demand for new commercial buildings tends to lag economic growth. Therefore,the non-residential building sector was later to enter a downturn than the residential building sector and

will also be later to see an upturn, as there is plenty of vacant office and retail space available before needing to build more. As for non-residential construction in other sectors, work on hospitals and nursing homes recorded the sharpest drop, down 39% in 2009. Work on hotels and boarding houses declined 7%, factories and industrial buildings 5% and miscellaneous buildings 11.6%. The only exception to this trend was of the education buildings, in which the growth of 21% in 2009 was observed. This growth may be due in part to government spending in this sector. The overall result is that value of non-residential building Work Put in Place fell 9.0% in the last quarter of 2009. According to the RLB study, in the short run, the sector faces regulatory uncertainty over the government's tax reforms (RLB, 2010). The outlook for the non-residential sector is grim with the total value of non-residential building investment is expected to fall a further 17% over the next 12 months, before solid growth of 16% and 12% over the following two years (RLB, 2010).

Figure 47: Annual Total Floor Area and Average Value of Consents



In the period considered (1997-2007), performance of the non-residential construction sector was generally good. Value of work in the sector was consistently increasing (see Figures 44 and 46). This trend was a reflection of the economic prosperity in NZ in this period. But, with construction labour productivity performance in this time was in general lower than that in other sectors; one may speculate that the rapid expansion in labour pool of the industry and the quality of these trade personnel as well as training provided to them might have been a major factor.

However, at this instance, there is no data or study available to verify this speculation. A more rigorous investigation into this may be necessary.

4.8. Infrastructure Construction

Data for infrastructure construction are provided by the New Zealand Transport Agency (NZTA). Whilst not responsible for all infrastructure provision, NZTA is the largest single entity responsible for such, and therefore acts as a significant indicator of infrastructure provision. Data provided include amount of investment and numbers of completed projects in areas which NZTA considers priorities.

Table 15 show the breakdown of investment in infrastructure work in NZ. They are cumulative sums of investments in each category over the financial years (July 1st- June 30th) from 1997/1998 to 2009/2010. The base unit is givenin thousands of dollar. Table 16 show the distribution of investment into various Activity Classes across the board by NZTA.

Table 15: Value of Infrastructure works in NZ

Value of Infrastructure work in NZ								
FinancialYear	Maintenance	Renewals	Traffic Management	Bridge Renewals	New Roads/Structures	Road Reconstruction	Seal Extension	Grand Total
1997/98 Total	221747.9	42592.1	865.4	13501.5	46860.5	119310.4	1359.4	446237.2
1998/99 Total	247109.6	50458.6	2890.2	6490.3	84154.2	100093.7	3321.4	494518.0
1999/00 Total	269704.1	76798.3	6551.8	7293.4	72581.9	130420.8	5451.4	568801.7
2000/01 Total	264921.7	75541.1	5362.2	10900.3	44684.5	114402.7	6602.8	522415.4
2001/02 Total	252804.6	110849.3	7112.3	3896.1	59687.9	93052.8	5365.7	532768.7
2002/03 Total	273506.8	88280.4	1277.9	7543.9	84244.9	87331.7	363.4	542548.9
2003/04 Total	279457.0	118794.2	3549.9	6921.5	125028.3	109004.6	171.9	642927.4
2004/05 Total	318633.9	127416.9	6279.6	8128.8	155401.4	150754.6	518.0	767133.3
2005/06 Total	332061.5	168758.5	10404.4	14519.1	275300.1	158517.2	304.0	959864.8
2006/07 Total	368114.3	253648.6	54698.3	24560.0	282368.6	163197.6	500.2	1147087.5
2007/08 Total	405916.5	184282.4	65625.9	30506.0	303748.3	248638.3	4776.8	1243494.3
2008/09 Total	441858.7	285294.4	66766.5	100929.3	323851.2	277663.5	6677.1	1503040.8
2009/10 Total	339845.9	154697.0	41045.7	148709.6	224397.3	150546.9	6947.6	1066190.0
Grand Total	4015682.6	1745833.7	272474.3	389598.0	2177221.2	2024341.3	57412.4	10682563.5

Source: NZTA

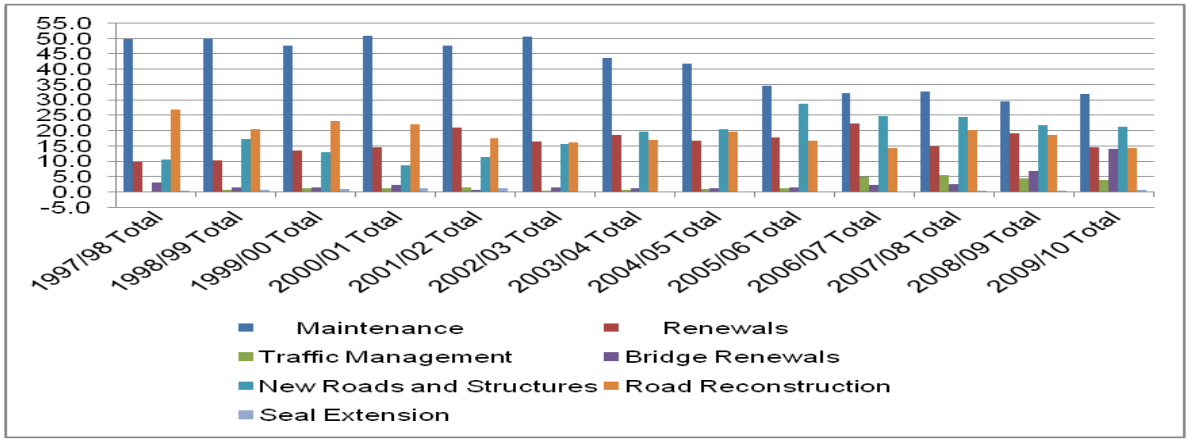
Table 16: Contribution of each Activity Class

Contribution of Activity Classes								
FinancialYear	Maintenance	Renewals	Traffic Management	Bridge Renewals	New Roads/Structures	Road Reconstruction	Seal Extension	Grand Total
1997/98 Total	49.7	9.5	0.2	3.0	10.5	26.7	0.3	100.0
1998/99 Total	50.0	10.2	0.6	1.3	17.0	20.2	0.7	100.0
1999/00 Total	47.4	13.5	1.2	1.3	12.8	22.9	1.0	100.0
2000/01 Total	50.7	14.5	1.0	2.1	8.6	21.9	1.3	100.0
2001/02 Total	47.5	20.8	1.3	0.7	11.2	17.5	1.0	100.0
2002/03 Total	50.4	16.3	0.2	1.4	15.5	16.1	0.1	100.0
2003/04 Total	43.5	18.5	0.6	1.1	19.4	17.0	0.0	100.0
2004/05 Total	41.5	16.6	0.8	1.1	20.3	19.7	0.1	100.0
2005/06 Total	34.6	17.6	1.1	1.5	28.7	16.5	0.0	100.0
2006/07 Total	32.1	22.1	4.8	2.1	24.6	14.2	0.0	100.0
2007/08 Total	32.6	14.8	5.3	2.5	24.4	20.0	0.4	100.0
2008/09 Total	29.4	19.0	4.4	6.7	21.5	18.5	0.4	100.0
2009/10 Total	31.9	14.5	3.8	13.9	21.0	14.1	0.7	100.0
Grand Total	37.6	16.3	2.6	3.6	20.4	18.9	0.5	100.0

Source: NZTA

Figure 48 provides a visual representation of Table 15. Of all classes considered, NZTA constantly invested a significant amount in maintaining of its existing infrastructure portfolio. The maintenance portfolio alone accounts for about 37% on average of the investment committed by NZTA. New Roads and Road reconstruction are some other classes that have received some attention from this organisation (approximately 20% of investment each). The main reason for developments in these areas may be due to the intention of the Government in boosting economic growth and keeping people employed in the economic down turn such as the one currently being experienced, by means of the stimulus packages offered .But demand for up-to-date infrastructure in order to support of such external event as the Rugby World Cup might play a crucial role as well.

Figure 48: Contribution of Activity Classes



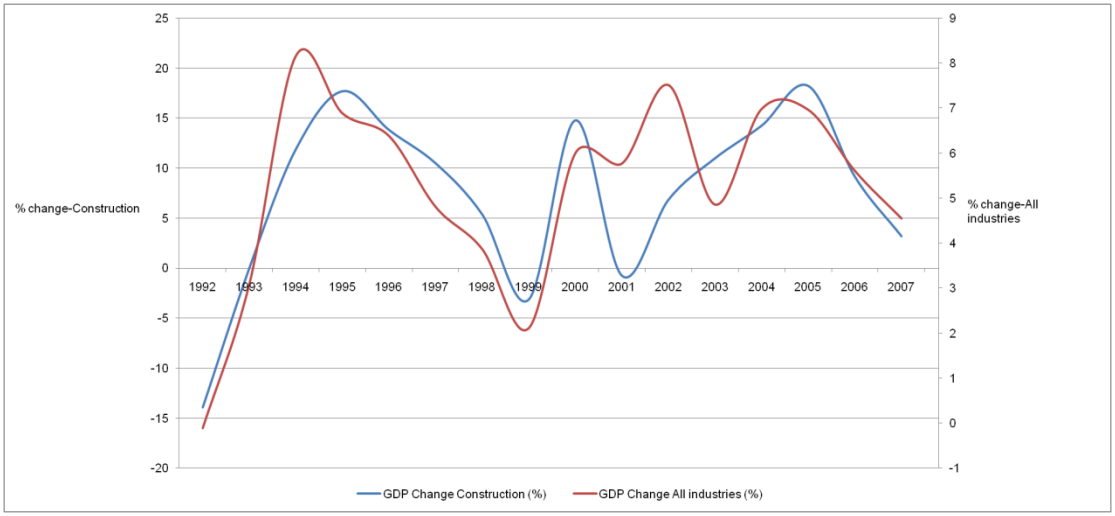
Source: NZTA

Performance of infrastructure sector may therefore have significant implications on the performance of NZ construction labour productivity. However, at present it is not possible to get a measure of building productivity versus infrastructure productivity. All construction activity is quoted in a consolidated industry output figure. However, as has been previously noted, labour productivity from the civil sector is likely to be significantly higher than for the building sector. This is due to the different degrees of mechanisation inherent in each sector. However, this "probability" needs to be confirmed through research and/or through improved reporting. At present the compilation of the sector is not fully recognised in its effect.

4.9. Construction GDP and Underlying Economic Trends

Data for construction GDP series are measured in the current prices ($ million) dating as far back as 1972. However, in this research, the data series have been truncated and limited to the period from 1992-2007. This is to be consistent with other data series considered in term of time frame. Growth rates of these series have been derived from the available data and are shown in the Figure 49 below.

Figure 49: Construction GDP growth

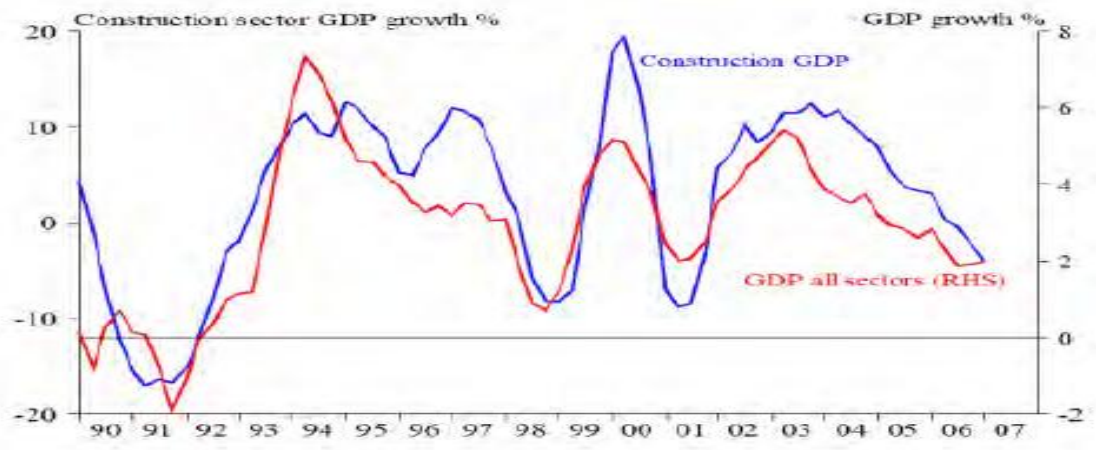


Source: Statistics New Zealand

Observation shows that the annual growth rates of construction GDP vary more significantly than those of the measured sectors in NZ: growth rates of the former often consist of two digit numbers while those of the latter mostly remain in the one digit region. Peaks and troughs in the two series seem to match, except for those between 2001 and 2003. This indicates a close relationship between NZ construction

and the wider economy. Comparison with CAENZ'sconstruction GDP graph shows that there seems to be some differences between the two. For instance, in 2000, while construction GDP growth in the CAENZ graph peaked at 20%, that of our case was measured at merely 15%. Despite these minor differences (perhaps due to the measurement methods rather anything else), the overall theme of two series is very much the same: outputs in the construction sector vary at greater rates than those in the aggregate market.

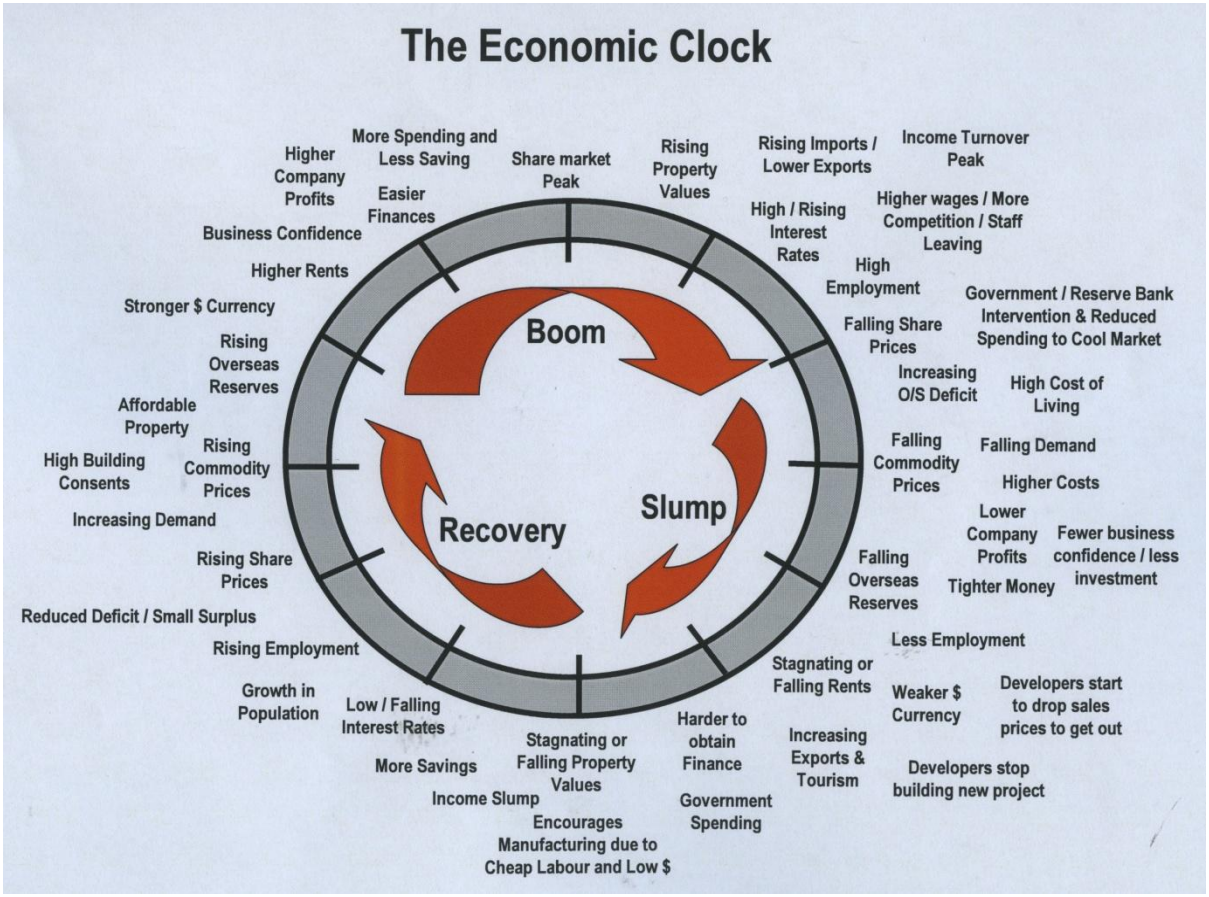
Figure 50: Construction GDP growth v NZ GDP growth (Reproduced based on CAENZ)



Source: Reserve Bank of New Zealand

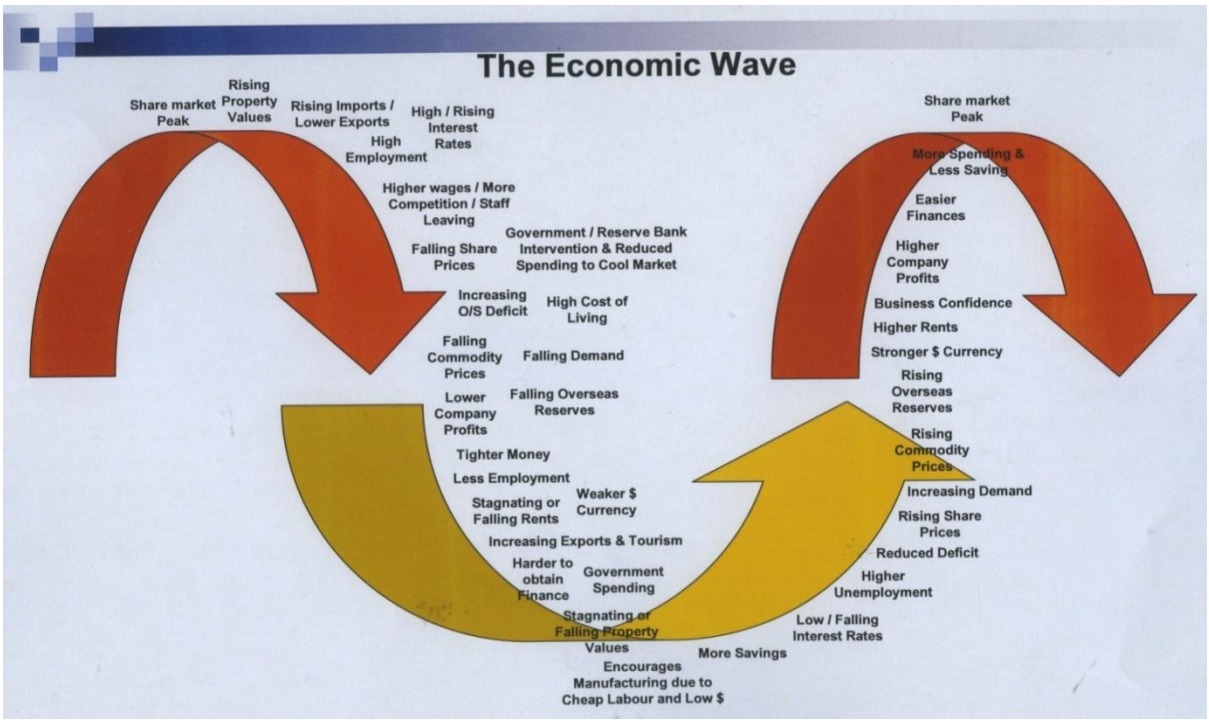
Discussions in previous sections have established that three main sub-industries in New Zealand construction indeed have significant contribution to GDP or value of output of the industry. However, as Allan et al (2008) found, these sub-industries together with the construction industry on the whole are subjected to the underlying economic conditions they operates within. As a result, construction seems to behave in accordance to the NZ cyclic economic "waves". The cyclical nature of the construction industry and its relationship with the economy is best represented by Figures 51 and 52. These figures summarise the results of a study into a 20-year cycle in the NZ construction sector (RCP, 2005). A number of economic features (share market performances, currency and commodity prices, and import-export trends) were included and summarised here to illustrate their effects on all factors discussed above (interest, house prices and associated costs, investments in the sector). Overall, the RCP study demonstrated consistency with the CAENZ study.

Figure 51: The Economic Clock



Source: RCP

Figure 52: The Economic Waves



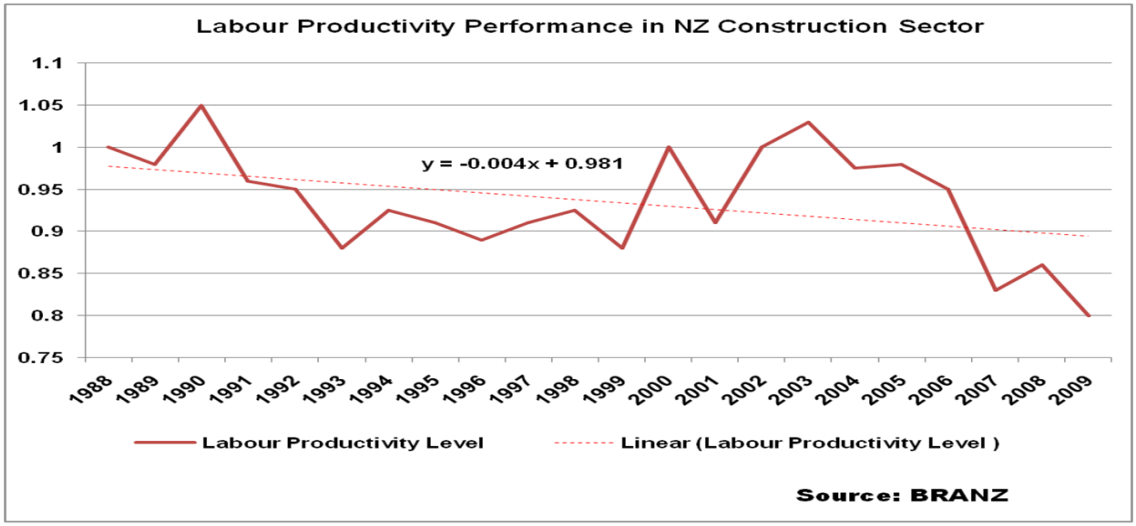
Source: RCP

Analyses of these sub-industries showed construction have significantly higher output values than many industries in NZ in the period between 1997 and 2007.This finding should have had positive impacts on labour productivity of NZ construction, given the positive relationship between output and labour productivity as per established. However, the fact that labour productivity of NZ construction has underperformed in comparison to that of other industries seems counter-intuitive. There may be other factors that influence this performance and more research need to be carried out.

4.10. Labour Productivity Performance

The Labour Productivity Index series shown here was constructed by BRANZ. The series dated back to 1988 and covers the period to 2009. Overall, labour productivity in NZ construction has experienced a continual decline in spite of some major corrections at the beginning of the recent construction boom (1999-2003). This behaviour is illustrated by the red trend line. Moreover, the annual growth rates of construction labour productivity fluctuated quite significantly over the period 1988-2009. For example: the growth rate series peaked at 13% in 2000, but declined to -9% in the following year. Relationships between labour productivity and factors considered above will be explored further in the following section by means of statistical testing.

Figure 53: Labour Productivity in NZ construction



Correlation Tests

Statistical tests in this part serve as the confirmation of results found in this chapter. Due to the fact that data series in this research are available in different time frames, i.e. some series are given on the yearly basis while others on quarterly basis; results of correlation tests of a number of factors yield some degrees of variation. However, these variations are insignificant and as such can safely be ignored. Correlation tests for the two types of data will be considered separately in this section.

4.11. Correlation tests on the quarterly series

Data series of this type include Material and Labour cost series, Inflation series, Total Value of Building Consent series, Employment series and House Price series. Overall, labour and material costs have significant effects on house prices in NZ. Statistical tests show positive correlations between growth in house prices and growth in all basic construction costs (labour and material). The only exceptions are with timber products. Correlation tests also confirm the close relationship between house prices and BCI (with correlation coefficient value of 0.6). This seems logical enough because, BCI have been used as one of the leading indicators in the housing market; i.e. whether it is worthwhile to invest in the market (Allan et al, 2008). It is therefore a consequence of supply and demand in the sector, i.e. as construction outputs grow, more confidence is restored in the industry and people are willing to invest more in the housing market. This leads to an increase in both house prices and housing demand. As the latter goes up, speculations start to develop in this market, as developers and many private investors alike try to maximise their profits, which in turns leads to an increase in BCI. Conversely, as house prices fall, investors tend to respond accordingly by pulling out of this market. Their actions consequently are reflected on the number of BCI. However, one must note that all this postulation is just one possible explanation to observed test results and it will need to be verified by further research.

4.12. Correlation tests on the yearly series

We consider three distinct periods in this part: 1992-2007, 1997-2007 and 2002-2007. This disaggregation allows us to have a full understanding of the relationship between NZ construction labour productivity growth and that of other factors over the

time frames listed above. Total Building Consent Issued encompasses both Residential and Non-residential construction. One interesting finding is that there is an inverse relationship between Building Consent Issued (BCI) and the output (GDP) in construction. This seems to be counter-intuitive because it was said that the former often acts as the indicator of the performance in the industry while the latter is the direct result of this performance. One possible explanation to this phenomenon is that this may be the result of the "lag effect" between the two series, i.e. the GDP series may be behind the BCI series. In other word, the BCI serves as the indicator for possible changes in the sector. Once these changes materialise (i.e. works commence), it takes time for the end results (buildings, infrastructure etc) to be directly observed. Further research is required to verify this hypothesis. Finally, statistical analysis reveals a strong correlation in growth between the construction labour productivity and the GDP series. Furthermore, these tests also show labour productivity growth in NZ construction is indeed affected by performances of all other factors considered above.

4.13. Chapter Summary

An overview of the main results in the study of labour productivity performance in NZ construction was provided in this chapter. Numerous extraneous factors were investigated thoroughly. These are national inflation rates, construction employment, construction costs (labour and materials) as well as a number of main sub-industries in NZ construction such as the Residential, Non-Residential and Infrastructure construction sectors.

Key findings are construction costs have remained stable for a period of time since 1992 while the industry on the whole has enjoyed a higher-than-average growth in terms of value of outputs (construction GDP) over the same time. GDP in construction is subjected to the performance of the underlying national economic conditions and as such fluctuates in “waves”, each of which would normally lasts for about 5 years in NZ. This finding may have significant implications on the overall performance of NZ construction and they will be discussed in detail in Chapter 5.

Statistical analysis tends to suggest that such factors as output of the industry (GDP); employment and wages in the sector; building costs may have significant

effects on the performance of construction productivity growth. Moreover, investigations into areas such as house and land prices (i.e. areas which were over-looked in previous studies) reveal strong relationships between house prices and such factors as material and labour costs; as well as with the traditional indicators of the sector (BCI). The implication of these results is that these extraneous factors may have some significant influences on labour productivity growth in NZ construction. Some possible explanations to the observed phenomena were offered. In particular, the inverse relationship between the BCI and the GDP series may be due to the “lag effect” of the two; and the close relationship between the former and the house price series may be due to supply and demand in the sector.

CHAPTER 5

5. INTERPRETATION AND DISCUSSION OF THE RESEARCH RESULTS

5.1. Introduction

Chapters 4 presented and discussed the data collected of this thesis project. The initial analysis conducted in this chapter was designed to establish a basic understanding of the dynamics of labour productivity in the NZ construction industry using these data. The objective of this chapter is to develop this understanding and demonstrate the relationship that exists between the data and the research questions and objectives of the study.

Finally, a series of mathematical equations will be presented to illustrate the relationships of all variables mentioned in this study and labour productivity. They may then serve as the basis for further research in this area.

5.2. Restatement of the Objectives

For purposes of making fully explicit the research findings from this study, it is necessary to correlate the findings of the study with the objectives that were originally laid out to guide the study process. Consequently, the following sections address each objective in turn. The summary of all of these findings is given in tabular form in section 5.4.

5.2.1. Objective 1

To re-examine existing studies on labour productivity in NZ construction

This objective was achieved in Chapter 2. Relevant literature in areas concerning labour productivity and important factors affecting it was analysed thoroughly. The overall conclusion of these studies is that labour productivity in NZ construction has been poor comparing to labour productivity performances of other industries in New Zealand. Moreover, labour productivity of NZ construction has been in decline over time. This trend might have been as a direct consequent of the rapid expansion of labour pool in the industry over the period considered (1997-2007), due to the significant increase in demand for construction work during the construction boom 2001-2006. However, when a longer time period was considered (1992-2009), this trend still persists which suggests this is a real problem in the industry. A solution is therefore urgently needed in order to resolve this issue.

Being one of the major industries in NZ (accounting for nearly 15% of total GDP), the construction industry affects the economy in many facets. Hence the (poor)

performance of labour productivity of this sector may affect the growth of the NZ economy significantly. This was shown in the CAENZ study. In it, the cyclical nature of NZ construction was thoroughly discussed. The conclusion of CAENZ study is that this behaviour tends to create a significant amount of waste and uncertainty in the industry and does affect productivity.

On the other hand, the construction industry has provided a significant amount of support to the NZ labour market, with number of individuals employed by this industry accounts for nearly 10% of the NZ workforce. However, construction employment has suffered from a cyclical pattern of skills shortages in times of peak demand, and surplus workers when demand is low. Department of Labour found that construction employment tends to expand rapidly during the boom periods (23% on average), with the appearance of many individuals in many construction trades. But, this expansion tends to dampen growth of labour productivity because these individuals often need time to be productive in their work. This labour pool however also tends to shrink fast during recessionary times like the one currently experienced, principally within the trade workers occupational group. Employment of professionals in construction, such as architects and engineers, and employment of labourers often hold up well. The report also notes that any loss of skilled workers and trainees would likely to impair the productivity of the industry when demand picks up again.

5.2.2. Objective 2

To identify factors that may affect performance of construction labour productivity

Chapter 4 has attempted to achieve this goal. A number of factors such as the national inflation rates, construction employment and construction costswere explored and discussed in detail. In addition, three main sub-industries in NZ construction (Residential, Non-Residential and Infrastructure Construction) were also included in the investigation. These factors, as well as their associated extraneous variables, have provided some useful information in relation to the “real” performance of NZ construction labour productivity. This is in contrast to previous

productivity studies in NZ, where observed performances were presented by facts and statistical figures without having their causes properly identified.

Results from analysis in Chapter 4 show that since the early 1990's, while factors influencing outputs (house and land prices) have increased significantly, factors impacting inputs (labour and material costs) have remained relatively stable. Given the relationships between outputs and labour productivity established in Chapter 2 and the statistical results from Chapter 4, one would expect labour productivity in the New Zealand construction sector to perform exceptionally well in comparison with other industries. However, despite this logical belief, labour productivity in this industry has remained flat throughout and actually was in decline during the construction boom (2003-2007). Moreover, from discussions in Chapter 4, factors that affect value of construction outputs most significantly are land and house prices, because the period considered (1997-2007) was mainly driven by demand for construction work in the residential area. Unlike this research, previous studies into NZ productivity seemed to have ignored effects of their increases in their calculations. Despite this omission, their conclusions have been consistent, i.e. productivity in NZ construction has been poor. Therefore, when these factors, together with value of output from Non-Residential and Infrastructure Construction, are taken into consideration, labour productivity performance of construction might actually have been much worse than that reported in previous studies.

5.2.3. Objective 3

To set up a platform for future research in this area in NZ

5.2.3.1. Verification of the influences of factors presented

Traditionally, productivity researches in NZ, including those which investigate labour productivity of the construction industry, are often done by economists (Black et al, 2003; Janssen et al, 2008). As such, macroeconomic factors are often considered in these studies. Data for these studies often come from Statistics New Zealand. The problem with these data series is that they tend to bundle all variables together for the sake of simplicity in representation. However, in doing so, results of these studies often become dubious because they do not explain what factor(s) cause these series to behave in certain ways. Further, they may not be the true reflection of

the “real” performance in some cases offer little help in explaining what has gone wrong.

In this research, a number of factors were investigated; their detailed discussions were offered. These factors were largely ignored or over-looked in previous studies. However, it would appear to be necessary to explore and have a good understanding of these factors, their behaviours and their impacts on labour productivity performance of NZ construction, so that appropriate actions can be taken to resolve the perceived problem. Once this understanding is achieved, appropriate actions can then be taken by appropriate authorities to resolve the perceived problem. Careful analysis of factors investigated found a significant influence they have on the performance of labour productivity. The overall result is that when these factors are taken into consideration, performance of construction labour productivity may actually have been much worse than that previously reported. However, this is just a speculation and further research is needed to verify this hypothesis.

5.2.3.2. Verification of hypothesised mathematical relationship

Based on statistical tests which have been obtained in Chapter 4, a set of mathematical relationships between labour productivity and related factors can be established as follows:

$$L \sim P_h \qquad GDP_{const} \sim \frac{1}{BCI}$$

$$L \sim P_l \qquad P_h \sim C_{labour}$$

$$L \sim GDP_{const} \qquad P_h \sim C_{material}$$

$$L \sim E_{const}$$

$$where\ L: Labour\ Productivity;\ P_h: House\ Price; P_l: Land\ Price;\ GDP_{const}: Construction\ GDP$$

$$E_{const}: Construction\ Employment; BCI: Building\ Consent\ Issued;\ C_{labour}: Labour\ Cost$$

$$and\ C_{material}: Material\ Cost.$$

$$The\ sign\ "\sim"\ indicates\ the\ proportionality\ between\ two\ variables$$

Again, more research is required in the future in order to verify this hypothesis. Once it is confirmed, one can be reasonably confident in predicting the behaviours of labour productivity in the New Zealand construction industry.

5.2.3.3. Research on solutions to the problem

This research has perhaps provided a more in-depth understanding the "real" performance of NZ construction labour productivity. A range of factors were investigated and their effects on labour productivity of NZ construction were explored. Analysis has shown these factors may affect construction's productivity performance significantly. Performance of the whole construction industry is a collective result of performances of many related (or unrelated) sub-industries. A number of sub-industries included in this investigation perform exceptionally well. However, the aggregate performance of NZ construction is bad at best and might actually have been worse than we had expected. This is a serious problem and it may have significant implications on NZ economy, given the importance of the construction industry in this country. To this end, urgent actions are therefore needed in order to make the sector more productive. With this in mind, the next step is to perhaps formulate a set of solutions so that appropriate actions can be taken. This task should be carried out diligently and carefully so that each solution must be achievable and applicable.

5.2.3.4. Research on skills-productivity relationship

One key issue that was repeatedly emphasised in literature is the seasonality of skill base and the adequacy of skill levels of personnel in the construction industry. The labour pool of experienced and skilled personnel changes drastically in accordance to the underlying economic conditions, i.e. during the boom period, employment in construction tends to grow exceptionally high (mainly in the unskilled occupation categories) while during slow periods, the reverse is true (Allan et al, 2008; DOL, 2009). Therefore, this fluctuation in labour availability makes it hard for firms in the NZ construction industry to operate efficiently because they tend to experience skill shortages during prosperous periods but difficult to hold on to their experienced staff in hard times due to the availability of work and to each firm's financial health. The direct consequence of this unpredictable nature of NZ construction is on the performance of labour productivity, where it tends to exhibit a choppy behaviour as

observed. It can be argued that a well-equipped skilled workforce may be a backbone for any future growth in labour productivity if the industry decides to take actions to mitigate this chronic problem. However, this hypothesis must be verified before any resources are committed. Hence, a research into the relationship between skills and productivity in NZ construction is needed.

5.3. Interview Results: Practical Opinions

As expressed in Section 3.5.2, the aim of Elite Interview is to obtain opinions of experienced managers of major organisations in the NZ construction industry. This form of interview is suited to this research due to its nature, i.e. reviewing past performance of construction productivity; and as such these interviews serve primarily as the confirmations of results obtained in this research. A number of persons of interest were contacted. However, perhaps due to their other commitments, only one manager was available for the interview.

Overall, the views of the interviewee align with results found in this research. They are summarised below:

- NZ construction is subjected to the national and international economic conditions
- Boom-Bust cycles exist in construction; they tend to happen every 7 years
- Firms tend to find work outside of their traditional areas (moving to other parts of country or countries and/or diversify their portfolios) during hard times in order to retain their staff
- Skilled workforce is often hard to find and retain in NZ construction due to the attractiveness of other sectors (mining for instance)
- Legislations and Regulations in construction may have adverse effects on productivity of the industry
- More innovative approaches are needed to lift the productivity performance of the construction industry (streamlining of consent and procurement process)

The results of the interview show there are many problems facing the construction industry. In order to make any improvements to this industry, there must be a collaboration between organisations at all levels (Government, Professional and Trades organisations as well as individual firms themselves). Fortunately, the

problem of labour productivity in this sector has been recognised in NZ and a Labour Productivity Taskforce, a joint initiative between a numbers of organisations, has been set up recently to address and overlook the issue. It is indeed a proactive approach by the authorities; one can hope that this issue will be resolved quickly and appropriately in a near future.

5.4. Limitation of Research

Results from this research are constrained to the available data and resources which the author has managed to obtain. As such, they may not be the “true” reflection of the “real” performance of the construction industry in New Zealand (in terms of labour productivity). This section offers some discussions on a number of limitations in this research. The most notable disadvantage of this research is time. In order to have a complete understanding of NZ construction labour productivity, more time is required. But given the nature of the qualification that the author is working towards (Master’s degree) and the time constraint imposed on it (1 year), it is not possible to do so. However, this understanding can be achieved with contribution from other researchers who are willing to continue researches on this topic matter. Recommendations suggested in section 5.2.3 can serve as guidelines to future researches.

A number of other areas can be explored but were omitted. For example: effects of innovation in the construction industry were omitted in the consideration of productivity. Other areas include the sub-industries other than those considered here(civil works, demolition and Building Services for example). Reasons for this exclusion may be due to the cross-over of practices in NZ construction. For instance civil work or any associated innovations are often considered as part of the Residential/Non-Residential or Infrastructure construction. Thus full investigations are needed in order to address their effects on productivity of the whole industry.

Finally, the availability of practicing professionals for interviews is another drawback to this research. Perhaps due to their busy schedules, all but one manager of a NZ construction company was available for interviews on this subject matter. As a result, the view expressed may not reflect the overall opinion of the whole industry and is

subjected to low statistical confidence. Nonetheless, it is still useful in confirming some findings in this study.

5.5. Chapter Summary

This chapter has discussed and interpreted the key findings of this study. Below a summary of the evaluation of the research problem, questions and objectives is given. The next chapter concludes with various suggestions for constructive solutions to the research problem.

Table 17: Resolution of research problems

Research Problem	Result
1	resolved
2	resolved
3	resolved

Table 18: Resolution of research questions

Research Questions Number	Result
1	Addressed
2	Addressed
3	Addressed

Table 19: Review of research objectives

Objective Number	Result
1	Achieved
2	Partially Achieved (due to the limitation in qualitative information)
3	Achieved

CHAPTER 6

6. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1. Overview of the Research

This thesis has endeavoured to contribute to the development of an understanding of labour productivity in the New Zealand Construction Industry. The thesis has explored all aspects of the subject matter, including all extraneous factors which were overlooked in previous studies but may have significant influences on the productivity performance of the industry. To establish the relationships between all factors considered and labour productivity, the thesis proposed a theoretic mathematical model that depicts their behaviours. It is intended that further research can be carried out to verify this model.

The purpose of this chapter is to provide a research overview and summarise the key findings and conclusions with reference to the specific research questions and objectives identified in chapter 3. It also states the research's contribution to knowledge, areas for further research and recommendations.

The New Zealand construction industry plays an indispensable role both directly and indirectly in the nation's economic growth. While construction has a huge contribution to the quality of life in this country, the industry's "productiveness" has decreased over time and may have significant adverse effects on the "quality of life". To this end, there is a need to investigate productivity of the NZ construction industry, particularly labour productivity and factors which affect it, in order to obtain a full understanding of the issue so that the standard of living offered by this industry can be maintained.

In achieving this goal, a number of macroeconomic variables were investigated. These variables were mostly ignored in previous productivity studies. It is contended that a good understanding of behaviours of these factors in the context of NZ construction can provide crucial information to why construction has performed so badly in comparison to other industries in NZ. Historical events were cross-referenced to highlight impacts of these factors on the NZ economy on the whole and on NZ construction in particular in the period 1997-2007. It is intended that information provided by this study will motivate academics, research organisations and the Government to undertake further research in construction labour productivity in order to achieve complete understanding of the dynamics of this industry.

6.1.1. Research Problem, Question and Objectives

Chapter 1 discussed this issue in detail. In spite of the fact that the construction industry is a major sector of the NZ economy, its productivity performance has been in decline in recent times. To address these deficiencies, efforts are underway to measure construction productivity at three levels: task, project, and industry.

The root of the problem is the ambiguity of data presented in recent productivity studies with much of the variability of the productivity components may be as a result of extraneous factors having a lag effect on productivity (Black et al, 2003; Davis, 2007; Janssen et al, 2008; Taskforce, 2009). Therefore, there is a need to understand the factors involved in order to address the true nature of this particular issue and get the best information we can from the data. Another issue at the present is the conflation of data and the selective citing of limited statistics. Their aim is basically to provide simplification of the issues for a wider readership (and at times to motivate the industry to perform better); but in return, they may have had adverse effects on industry itself because the real performance may not have been realised.

The primary aim of this research is therefore to deconstruct construction productivity figures in NZ and explain the patterns over recent years of 'poor performance' in comparison with other industries. As such the study examined the nature of the NZ construction industry and analysed the historic statistics related to its labour productivity. It then goes on to investigate factors which influence levels of productivity in construction from 1997 to 2008. The research would provide an overall understanding of NZ construction (and extraneous factors that may have significant influences on the sector) so that a platform for future planning in this industry can be built upon.

The formulated objectives for this thesis are stated as follows:

i) To re-examine existing studies on labour productivity in NZ construction;
ii) To identify factors which have significant effects on construction labour productivity;
iii) To set up a platform for future research in this area in NZ.

6.1.2. Methodological Framework and Technique

Chapter 3 tackled the issue of Research Methodology of this study. It set out the direction in which sequential tasks will be carried out for this research to reach fruition. Philosophical background of Research Methodology was introduced in the beginning of this chapter to give readers some understanding of the issue. Definitions of Epistemology and Ontology were given and their respective implication on this research was discussed in detail. Due to the nature of research of this type, both qualitative and quantitative methods have been employed here. This is to maximise the benefits of each method so that a meaningful result can be obtained from this investigation into construction labour productivity performance, which may then serve as a basis for future development in this area.

This research consisted of three main tasks: Data Collection, Interview and Analysis. Data used in this project are mainly sourced from Statistics New Zealand because they have provided valuable information to other studies in the past. It is therefore logical for the author to use the same data in this research. In addition, data that come directly from the industry's main reference sources such as those from Rawlinson's Handbook of Construction were utilised. These data will serve as the basis for the construction of wages data series and construction cost data series, which will then in turns act as catalysts for further investigation into, and help to answer the question of "what causes", the continual declination of labour productivity in the construction industry in New Zealand.

In terms of interview, a specialised form of qualitative interviewing called "Elite interview" was employed in this research based on its merits. Valuable information can be gained from participants because of the positions they hold in their respective organisations. An overall view of an organisation and their relationships to other organisations in the same industry as well as those in the wider economy can also be obtained. This is particularly useful in a study into labour productivity such as this one, because the performance of labour productivity of the construction sector needed to be put in the context of performances in the wider economy for comparative analysis. However, one major disadvantage of this form of interview, as the author experienced in this research, is the difficulty in gaining access to these individuals because they are often busy people.

Finally, both Qualitative methods and Quantitative methods were employed in the Analysis phase of this study. This arises from the fact that there is a need for confirmations on results published in previous studies in this area.

6.2. Summary of Key Findings

6.2.1. Results from Current Literature

This objective was achieved in Chapter 2. Relevant literature was looked at thoroughly. The overall theme of all these studies is that NZ construction has performed poorly in comparison to other industries in terms of labour productivity. Moreover, it has been in decline over time which suggests this is a real problem in the industry alone and the economy as a whole, given the significance of construction to the NZ economy (accounting for nearly 15% of total GDP). A solution is therefore urgently needed in order to resolve this issue. The cyclical nature of NZ construction was thoroughly discussed in the CAENZ study (Allan et al, 2008). The conclusion of CAENZ study is that this behaviour tends to create a significant amount of waste and uncertainty in the industry and does affect productivity.

Effects of the cyclical nature of construction is visible in the construction employment market (which itself accounts for nearly 10% of employment in NZ) with the sector has continually suffered from patterns of skills shortages in times of peak demand, and surplus workers when demand is low (DOL, 2009). The report also notes that any loss of skilled workers and trainees would likely to impair the productivity of the industry when demand picks up again (DOL, 2009).

6.2.2. Construction Labour Productivity in perspective

6.2.2.1. Objective 2

To identify factors that may affect performance of construction labour productivity

Chapter 4 attempted to achieve this goal. A number of factors were explored and discussed in detail. They include the national inflation rates, construction employment and construction costs as well as three main sub-industries in NZ construction (Residential, Non-Residential and Infrastructure Construction sectors).

These factors, and their associated extraneous variables, have provided some useful information in relation to the “real” performance of the NZ construction industry and labour productivity in this sector. In contrast, previous productivity studies in NZ only presented the observed labour productivity performances by facts and statistical figures without having their causes properly identified. However, in spite of this omission, their conclusions have been consistent, i.e. productivity in NZ construction has been poor. Therefore, when these factors, together with value of output from Non-Residential and Infrastructure Construction, are taken into consideration (as in this research), labour productivity in NZ construction actually might have been much worse than performances found in those studies.

6.2.2.2. Objective 3

To set up a platform for future research in this area in NZ

6.2.2.2.1. Verification of influences of factors presented

As stated in Chapter 5, traditionally studies on construction productivity are often done by economists in NZ; and their conclusions are often vague and offer little help in explaining what has gone wrong in terms of productivity in this industry. Moreover, any suggested solutions derived from results may not be appropriate for the mitigations of problem(s). With this in mind, this research took a different approach where a number of factors which were largely ignored or over-looked in previous studies were investigated and their detailed discussions were offered. Upon analysing these factors, it was found that they actually have significant influences on the performance of labour productivity. Again, further research is needed to verify this hypothesis.

6.2.2.2.2. Verification of hypothesised mathematical relationships

Based on statistical tests which have been obtained in Chapter 4, a set of mathematical relationships between labour productivity and related factors were established.

However, more research is required in order to verify these propositions. Once they are confirmed, one can be reasonably confident in predicting the behaviours of labour productivity in the New Zealand construction industry.

6.2.2.2.3. Research on skills-productivity relationship

One of the key issues which has been repeatedly emphasised in literature is the seasonality of skill base and the adequacy of skill levels of personnel in the construction industry. The labour pool of experienced and skilled personnel changes drastically in accordance to the underlying economic conditions. The direct consequence of this unpredictable nature of NZ construction is on the performance of labour productivity, where it tends to exhibit a choppy behaviour as observed. It can therefore be argued that a well-equipped skilled workforce may be a backbone for any future growth in labour productivity if the industry decides to take actions to mitigate this chronic problem. However, this hypothesis must be verified before any resources are committed. Hence, a research into the relationship between skills and productivity in NZ construction is needed.

6.3. Overall Conclusion

This research established through literature that while the construction industry has a substantial contribution to the standard of living in NZ, its “poor” labour productivity performance may have detrimental effects on the wider economy. To address the problems, urgent actions have been undertaken by the industry. A number of studies have been carried out in an attempt to investigate this issue. However, review of recent literature revealed that the issue of labour productivity is not well understood in the construction industry. Further, these studies seemed to have relied on published statistics to construct their productivity series without trying to fully understand the underlying dynamics of NZ construction. As a result, their findings are subjected to biases and any recommendations tend to be limited in scope. This is what gave impetus for the research and is the basis on which the thesis hinges. The aim of the research was therefore to establish a base level of understanding in the area of construction labour productivity and provide a platform for further research in this area in NZ.

The research questions formulated focused on the need to understand the nature of NZ construction labour productivity. The objectives primarily sought to identify factors which have significant effects on the performance of productivity level and its growth in the construction industry. The research therefore attempted to apply this understanding to the current knowledge of the subject matter. Investigations reveal that extraneous factors such as construction costs, values of works in areas such as residential, non-residential and infrastructure indeed have significant influences on level of labour productivity of NZ construction. These factors were largely ignored in previous studies. Between 1997 and 2007, the basic construction costs (material and labour) remained stable while values of works in the mentioned sub-industries grew at significantly higher rates. This result suggests that theoretically the NZ construction industry should have perform exceptionally well in terms of labour productivity. However, statistics showed the overall productivity performance of NZ construction was actually in decline. This contradiction suggests that when extraneous factors above are taken into consideration, labour productivity might have performed much worse than we had expected. However, investigations need to be carried out to confirm this hypothesis so that a concrete foundation for further work in this field can be achieved.

6.4. Contribution to Knowledge

This research has contributed to the body of knowledge considering that currently, little effort has been directed at research in the area of construction productivity, particularly labour productivity. In this regard, the following insights have been provided:

i) The research has developed a bespoke methodology to achieve the research objectives.

ii) The research has increased the understanding of labour productivity in construction context and factors which may have significant influences on its performance.

iii) The research has established potential areas for future research in order to improve labour productivity in NZ construction.

6.5. Critical review of Methodology used

This Thesis adopted a research strategy that utilised the explorative approach in conjunction with the explanatory approach in order to gain a full understanding of the performance of labour productivity in the New Zealand construction industry. These approaches comprise two main steps: the research seeks to first, widen the investigation bases (i.e. areas considered to be significant) and second, to break them down to individual components (i.e. what factors contribute to or affect labour productivity growth the most). This strategy has been noted as reducing the generalisability of research since the chosen areas of investigation may seem arbitrary and the scale of the study may not provide the minimum data set required for statistical testing due to the relatively small sample considered. Therefore, at this stage, the findings are only “hypotheses”.However, it is contended that the results of the research can be generalisable if these hypotheses can be confirmed. It means further research in this topic matter is needed.

6.6. Recommendation for further Research

Further work in the following areas will enable a better understanding of the performance of productivity in NZ construction. There are a number of urgent requirements:

- To collect and construct data series for Building Services/Civil sub-industries and thus complete the picture of labour productivity in NZ construction
- To interview more leading industry practitioners who are directly involved in the industry to get their opinions on the issue of labour productivity in NZ construction
- To research on the interaction between the industry and the communities; for example construction education at schools in a range of subjects or projects
- To research on the relationship between skills and labour productivity and training incentives offered to apprentices
- To research on the turning points of the observed boom-bust cycles in NZ construction and what drives them in order to get an in-depth understanding of the subject matter; and its influence on productivity

7. APPENDICES

7.1. Appendix 1: Research Questionnaire

Q1: In your opinion, what was the major cause for the steep decline in construction output in 1996/1997?

Q2: This period is the followed by a strong growth in construction GDP from 1999-2001. In fact, the growth in construction GDP out-performs the GDP growth in all sectors over the same period. From your experience, what do you think stimulated this strong performance of the construction sector?

Q3: There seem to be an inverse relationship between GDP growth and employment growth during the construction boom. What is your opinion on this issue?

Q4: What strategies does your organisation have in place to retain personnel in recessionary times such as in the current period? And why is it important?

Q5: How has employment influenced labour productivity growth in the construction sector?

Q6: Various studies have suggested that labour productivity in the New Zealand construction industry has performed poorly in comparison to that of the aggregate market sector as well as to that of Australia. What do you think of these results? And can you give an insight into this based on your own experience?

Q7:In your opinion, what is the main source for the decline in labour productivity in the construction industry in New Zealand? Elaborate as much as possible, as this is important to us. What other major factors may contribute to this decline?

Q8: Is there anything else you would like to add that you think is important and we should have asked you?

Many thanks for your time and insights!!!

7.2. Statistical Results

7.2.1. Results on the Quarterly Series

	Wood-Trusses/frames	Sheet-Metal roof	Clay brick	Ready mix conc	Framing timber	Dressed timber	Composite materials	House prices	Labour Cost	Aggregate Costs	Const Cost	Total Building Consent	Employment	Inflation
Wood-Trusses/frames	1													
Sheet-Metal roof	0.14079315	1												
Clay brick	0.131688737	0.34612608	1											
Ready mix conc	0.074096879	0.433219669	0.2785912	1										
Framing timber	0.531763119	0.275048825	0.2490521	-0.058492701	1									
Dressed timber	0.65087614	0.158762508	0.1058268	-0.097674772	0.636740057	1								
Composite materials	0.736899189	0.631836894	0.6009056	0.481458719	0.607645059	0.545656887	1							
House prices	-0.057714594	0.516265102	0.3631187	0.351406329	0.200374433	-0.26231341	0.34004499	1						
Labour Cost	0.04981085	0.295496613	0.1143287	0.281026557	-0.110226545	0.152050858	0.213217106	0.40130479	1					
Aggregate Costs	0.039086938	0.337989922	0.2321976	0.494755545	-0.101527793	0.074177553	0.311818072	0.451197281	0.899925093	1				
Const % change	0.04981085	0.295496613	0.1143287	0.281026557	-0.110226545	0.152050858	0.213217106	0.40130479	1	0.899925093	1			
Total Building Consent	-0.087900394	0.251471886	-0.101214	0.090608027	0.286646745	-0.24004629	0.046938388	0.587688303	-0.088505283	-0.093545148	-0.0885053	1		
Employment	0.003285103	0.492744955	0.0535523	0.423948958	0.095448487	-0.26234882	0.258652317	0.513682335	-0.053823788	-0.008900101	-0.0538238	0.5633926	1	
Inflation	0.283931874	0.443823251	0.2082411	0.472621243	0.072142316	0.198793125	0.485114335	0.117467365	0.280167622	0.348163801	0.28016762	-0.12919944	0.43311108	1

7.2.2. Results on the Yearly Series

	Const Employment % char	mployment % cha	Residential % change	Total % change	Construction GDP % change	Total GDP % change	Productivity %	ast % char
Const Employment % change	1							
NZ Employment % change	0.452788774	1						
Residential % change	0.099153798	0.105239327	1					
Total % change	0.566061718	0.108848769	0.818336436	1				
Construction GDP % change	0.730746071	0.443856031	-0.415505147	-0.085324367	1			
Total GDP % change	0.633344797	0.969004947	0.206911026	0.308431063	0.494444537	1		
Labour Productivity % change	0.280649035	0.507013585	0.652940751	0.425695099	0.221792056	0.544709092	1	
Infrast % change	0.341660559	-0.043814907	-0.720662987	-0.430446756	0.811954644	-0.054833622	-0.195849382	1

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