STUDY REPORT

SR 266 (2012)

Construction Industry Segmentation

IC Page

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Preface

This report has been prepared to target potential productivity improvements in the construction industry. The aim is to identify the significant segments by size and importance for productivity.

Acknowledgments

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Abstract

The construction industry does not perform well in productivity trends over time. While most industries have a slow but steady improvement, the construction industry's productivity has at best remained static or declined in recent years. This project examines the various clients and processes in the industry, and allocates costs to each. The aim is to identify the larger segments for further investigation of their potential for productivity improvements.

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1. INTRODUCTION

This report examines the types of work done by the construction industry and provides a segmental breakdown. The aim is to identify which segments have significant value and are possible candidates for productivity improvements. Two main approaches are used.

First, a client by process matrix was developed with costs as the metric. Second, company tax data was used to calculate labour productivity for each sub-industry group in construction.

The first approach is more comprehensive because it identifies costs associated with processes outside the construction industry. The second approach looks only at the sub-industries within construction, but it identifies which parts have the lowest productivity.

2. SUMMARY

The main findings are:

- The largest client (or work type) segments by cost are new detached and low-rise dwellings, alterations and additions to dwellings, Central Government-funded roads, private sector mining, industrial buildings and education buildings.
- The most significant process by cost is the design stage, excluding construction and ongoing costs.
- Maintenance and operations costs are a significant proportion of the initial cost even when these future payments are discounted back to present values.
- In addition, the business occupancy costs in non-residential buildings (as represented by wages and salaries), is significantly larger than the construction, maintenance and operations costs. This indicates the importance of designing the structure to facilitate business efficiency and adaptability.
- The alternative method of segmentation, by construction sub-industries, found the lowest labour productivity in bricklaying, carpentry, painting, plastering and tiling/carpet laying.

3. MAIN RESULTS

3.1 Client by Process Matrix Segmentation

The main segments by client and work type are summarised in

Table 1. They are housing (new and A&A), roading, mining, industrial and education buildings, and rail. These are the top 20% by number of segments and represent about 51% of the value of work.

The production of capital assets have many other costs associated with them than the construction cost, see Table 2. The table indicates that ongoing maintenance/operating costs and occupancy costs are very large. The maintenance and operations costs (power, rates, insurance etc) have been discounted over 25 years and add up to about 37% of the construction/commissioning costs for buildings. If discounting is ignored then the total cost of maintenance and operations over 25 years is between 10% and 40% greater than the construction cost for buildings.

Table 1 Main Segments by Value of Work Placed

Construction work 2011 Value of work placed			
	Segment	$million	Segment
New house /low-rise units - small builders		2701	RB
Dwelling alterations/ additions		1309	RB
	Central Govt roads	1185	OC
	Priv sect mining/gas/oil	954	OC
New house/low-rise units - group builders		900	RB
	Industrial bldgs	876	NR
	Education	867	NR
	Rail	741	OC
	Local Govt roads	741	OC
	Retail bldgs	738	NR
Central Govt power gen & transmission		716	OC
	Local Govt water/waste	716	OC
Priv Sect power gen & distribution		716	OC
	Central Govt mines	636	OC
	Office bldgs	593	NR
	Health	460	NR
	Housing (mid,hi-rise)	406	RB
	Recreation/ civic bldgs	370	NR
	Forestry/farm roads/bridges	289	OC
Local Govt power gen &distribution		239	OC
	Farm bldgs	231	NR
	Ports infrastructure	148	OC
	Air transport infrastructure	148	OC
	Hotel/motels	144	NR
	Corrections	104	NR
Transport bldgs (road/air/rail/ sea)		78	NR
	Courts	30	NR
	Central Govt housing	25	RB
	Local Govt housing	25	RB
	Housing trusts	25	RB
	Religious bldgs	16	NR
	Sports clubs	16	NR
	Cultural bldgs	16	NR
Totals		17160	
	Residential buildings (RB)	5391	
Non-residential buildings (NR)		4541	
	Other construction (OC)	7228	

Occupancy costs are the business costs for the enterprise occupying the building and are proxied by the value of wages and salaries of the staff. These costs are many times

the other costs for non-residential buildings and indicate any refinement in the design that saves on occupancy costs is well worth investigating at an early stage in the process. The other two asset types, housing and civil structures, also have occupancy costs associated with the asset use. However, these are difficult to quantify for many structures and have been nominally assessed as being 5% of the initial cost per year. Even at this low percentage the occupancy costs are a significant proportion of the totals for housing and civil structures.

The Appendix shows a change in the discount rate from 5% to 10% and does not significantly change the ranking of operating/maintenance costs and occupancy costs. However, the total does drop significantly, by about $24 billion, going from a 5% to a 10% discount rate.

Table 2 All Costs Associated with Putting Capital Assets in Place

Life time costs summary for projects constructed in 2011 5% discount rate					
		$ million PV for one year of construction			
	Initial costs	Constructn, commission	Maintenance/ operations	Occupancy cost	Total
Residential building	469	5465	2347	3799	12081
Non-residential buildings	616	4649	2243	51228	58736
Other construction	1348	7445	1889	5583	16266
All construction	2434	17559	6479	60611	87082
Initial costs includes investigation, financial analysis, design,consents,and procurement.					
Construction costs include construction, re-design, re-work and commissioning.					
Maintenance / renovation/ operations costs are present value discounted over 25 years.					
Occupancy costs are the discounted wages/ salaries of occupants of non-residential buildings					
For housing and civil engineering structures a nominal 5% x initial cost per year					
was used as the annual occupancy cost.					

3.2 Sub-Industry Labour Productivity

The second approach to segmentation was the labour productivity by sub-industry. Tax data was used to develop a proxy for labour productivity, based on gross profits per worker employed. Statistics New Zealand (SNZ) carried out this work for BRANZ and provided it in aggregated form to preserve confidentiality. The main results are shown in Figure 1 which is taken from a previous study report (Page, Curtis, 2011).

It indicates the comparatively labour-intensive and low-skilled sub-industries have lower productivity – namely bricklaying, plastering, carpentry, tiling/carpet laying and painting/decorating. The sub-industries with high productivity are mainly plant-intensive sectors such as non-residential construction, road and bridge construction, site preparation services and hire of construction machinery.

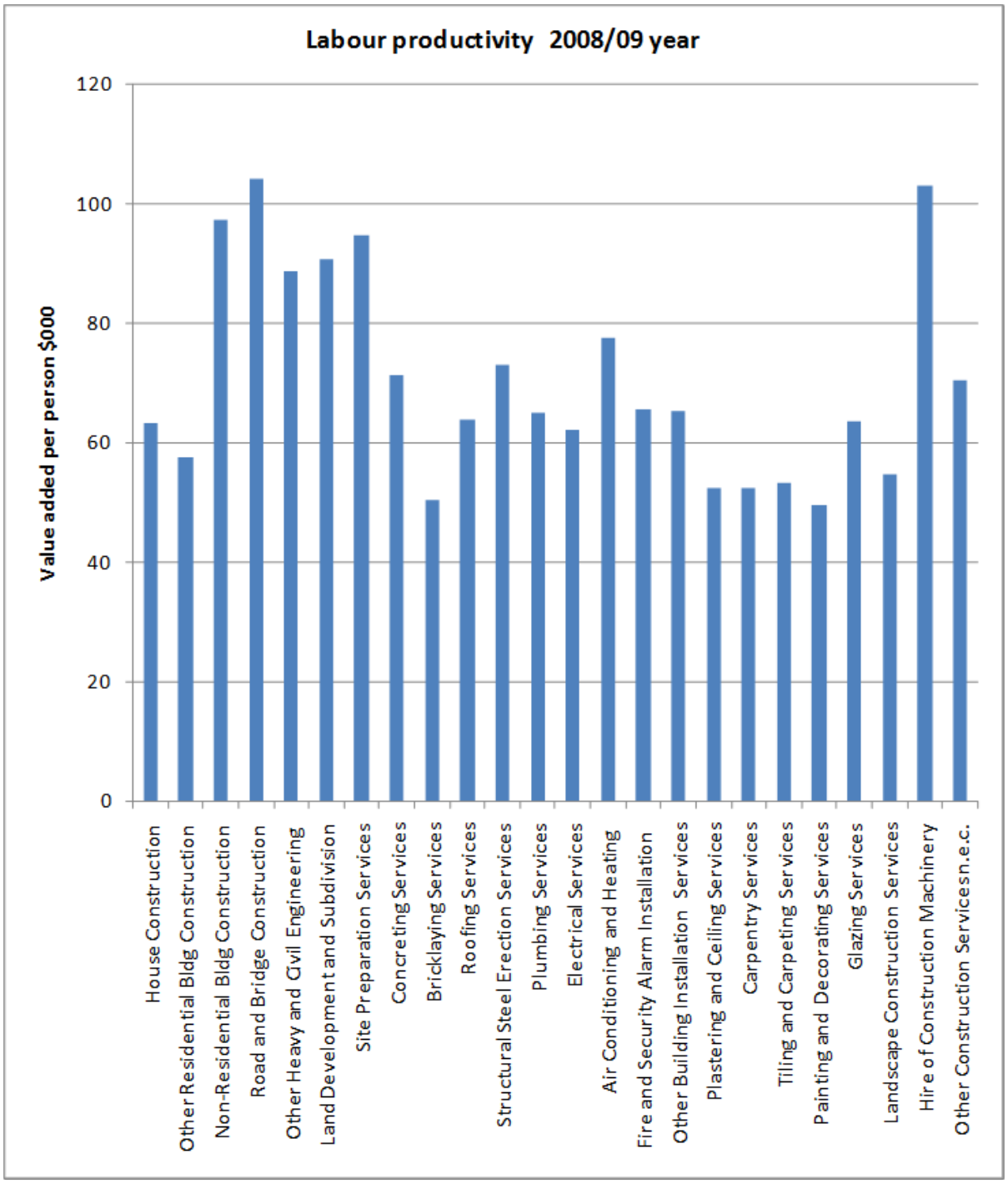

Figure 1 Labour Productivity by Sub-Industry Group

4. METHOD

SNZ's Building Activity Survey (BAS) was used to obtain the value of work placed in buildings. Building consent data was used to further breakdown buildings into smaller segments. We do not have an equivalent BAS for "other construction" work so we need to use the capital formation data, also from SNZ.

The main problem with the capital formation data is that it includes transaction costs, namely design and other professional costs, legal fees and consent costs, as well as the construction costs. There is an approximate 7% difference in value between capital formation and BAS data for non-residential buildings. We need to estimate the percentage of transaction costs in other construction capital formation. They are likely to be a larger percentage than in non-residential buildings because the legal and consenting processes for civil structures are usually quite complex. So it was decided to reduce other construction fixed capital formation by 10% to get the actual construction costs. See Table 10 in the Appendix for the difference between the building activity survey and fixed capital formation.

An additional problem with other construction capital formation is that it is not broken down by industry beyond 2009. However, we used data in the National Infrastructure Plans of 2010 and 2011 (Treasury 2010, 2011) to derive a BRANZ estimate of other construction by industry for 2011. The detailed breakdowns are in the Appendix.

Maintenance and operating costs were obtained from a Property Council New Zealand (2010) publication on building expenses. These include rates, insurance, administration, WOF, cleaning, fire protection, HVAC, lifts and escalators, repairs and maintenance, security, energy and water charges.

The initial processes include preliminary investigations and scoping, financial analysis, project management, designers, resource management processes and building consents, tendering and procurement. These costs were estimated as a percentage of the construction cost. Designer costs were obtained from architects' and engineers' agreement for services documents. Typically their fees range from 4% to 15% of the construction cost, depending on the scope and complexity of work. Consent costs were obtained from two territorial authorities for typical projects. The other percentages are BRANZ estimates of the work involved.

The approximate number of persons in the various professions involved with construction is known from the 2006 Census. A dollar-per-person year-rate was assumed for each process step and work type. This enabled total employment demand to be calculated and checked against supply, see Table 3.

The table indicates a demand for professional services of about 20,500 persons and in the 2006 Census 22,600 persons in the required professions were available. So the numbers approximately balance, allowing for the different timeframes (i.e. between 2006 and 2011). Professionals in the actual construction stage have not been included because this work is mainly carried out by the trades. However, some project management expertise would be required during construction (one or two thousand persons), bringing the demand into balance with supply.

Table 3 Costs and Labour Numbers by Work Type and Process Step

					Costs $ million									Discounted	Discounted		
					Prelimary scope	Financial	Designers	Consents	Tender or	Constructn	Re-design	Call-	Commission/	maintenance	occupancy		**Total**
					/investigation	economic	& Project	obtained	negotiations		as required	backs	hand-over	& renovations	(staff costs)		
					(by client)	analysis	managers		(procuremt)					over life	over life		
	Residential building			RB	34	9	341	84	3	5391	23	49	2	2347	3799		12081
	Non-residential buildings			NR	133	48	331	64	40	4463	89	63	33	2243	51228		58736
	Other construction			OC	360	191	486	238	73	7306	70	15	54	1889	5583		16266
		Number at			527	248	1158	386	116	17161	182	127	89	6479	60611		87082
Key	**Profession**	2006 Census			**$/person involved (incl overheads)**												
AA	Architects	3590		RB	70,000	100,000	120,000	120,000	100,000	95,000	100,000	95,000	120,000				
AD	Arch designers	1150		NR	140,000	160,000	140,000	140,000	140,000	110,000	140,000	110,000	140,000				
CC	Cost consults, QS	1690		OC	140,000	200,000	140,000	180,000	140,000	160,000	140,000	160,000	140,000				
EC	Economists	na			**Number of persons**												
EN	Engineers/ tech	9210		RB	485	89	2,838	696	25	56,747	228	519	17				
LS	Legal services	na		NR	949	301	2,362	457	286	40,575	638	576	238	Total persons			
PM	Project managers	4720		OC	2,572	955	3,474	1,322	522	45,665	501	91	383	(excl Construction)			
TA	TA bldg inspectors	620			4,006	1,344	8,674	2,475	833	142,987	1,367	1,185	638	20,522			
RP	Resource planners	1630	**Persons**		AA,AD,CC,	CC,EC	AA,AD,EN,	AA,AD,TA,	AA,PM,		AA,AD,EN,		AA,EN				
		22610	**involved**		EC,RP.		PM, RP.	RP,LS,PM.	LS, CC.								

A breakdown for Table 3, with detailed work types is in the Appendix.

5. DISCUSSION

The approximate value of all construction in 2011 was $17.2 billion. However, data in Table 2 indicates that total costs including maintenance, operations and occupancy are at least $87 billion for the work put in place in 2011. The latter number includes occupancy costs which are available for non-residential buildings, but more difficult to derive for housing and civil structures. For example, with housing it is likely new buildings reduce social and health costs. To allow for this effect we have inserted a value estimated as a nominal 5% of the initial cost per year. For civil structures the new infrastructure has costs associated with its use, though the overall effect is to improve the economic performance of the whole economy. In the absence of a detailed analysis for each type of structure (which is beyond the scope of this project), a value of 5% of the construction cost is allowed per year as the costs associated with using/occupying civil engineering assets.

What this indicates is the construction cost is a small part of the overall economic implications of the built environment. In the stages before construction it is apparent the effort spent on financial analysis and design has a large multiplier effect on the structure's performance. For example, if another 10% was spent at the design stage for non-residential buildings (i.e. another $33 million) on refining/improving buildings for efficient occupant use then we would need to see at least a 0.06% ($33 million/$51 billion) improvement in occupancy costs. This small percentage improvement in occupant efficiency seems to be well within grasp using improved design.

At the present time "other construction" is slightly larger than residential building work. However, in *normal* times "residential buildings" is the largest segment. Even so, new low-rise housing is currently the largest single work type, followed by housing A&A. Productivity improvements in the industry need to put some emphasis on these two segments.

An examination of the labour productivity by sub-industry groups indicated a quite wide range in performance between them. We would not necessarily expect all sub-industries to have similar labour productivity because some groups are plant-intensive and other groups employ relatively unskilled labour. One lesson is that elimination of some groups (or reduced use of these groups) would improve overall industry productivity. For example, more prefabrication which reduces the need for some of the finishing trades would lead to a productivity improvement.

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7. APPENDIX

This Appendix contains the detailed model from which Table 3 is derived. The details are in Table 4, Table 5 and Table 6 below. The first of these shows costs during the process stages as a percentage of construction cost. The larger percentages arise in the maintenance and occupancy columns. The traditional way to express these is as a ratio of construction cost to operating/maintenance cost to occupancy cost. A ratio of 1:0.4:12 was derived in a United Kingdom study (Hughes et al 2004) for office buildings, where occupancy costs are the wages and salaries of the staff occupying the building. The authors note that there are large variations in the literature for these ratios. A similar exercise was done for New Zealand office buildings as shown in Table 7 and a ratio of 1:0.7:20 was found.

We have derived an annual maintenance/operating cost of between 1% and 5% of the initial cost, see Table 6. This is based on the Household Expenditure Survey for households and the Property Council New Zealand publication of operating costs of commercial buildings (offices and retail centres).

Occupancy costs are more difficult to define and it was decided to use occupant worker wages and salaries as the metric in non-residential buildings. The derivation is in Table 7 and is based on person densities from the New Zealand Building Code and an assumed average wage rate plus overheads of $80,000 per worker. Not all occupants are counted, only persons for whom the building is their place of work. Some densely-occupied buildings such as education buildings have a quite low rate when expressed as paid persons per square metre, because value placed on the students is ignored.

It is acknowledged that this approach fails to acknowledge the value associated with all occupants and users of a building or asset, but it is a conservative approach for allocating costs associated with physical assets over their life. There are difficulties in ascribing user value to housing and “other construction” so we have used a nominal 5% of initial value as the user cost per year for these assets.

Table 7 and Table 8 below show local data on operating costs and on building consent fees. These examples are used to derive the percentages used in Table 4.

In Table 9 the discount rate was changed to assess the sensitivity of the lifetime costs to this parameter. The base case uses a 5% discount rate and the change to 10% affects the future costs, namely for operating and occupancy. Even at a 10% discount rate the occupancy costs remain significantly larger than the other costs.

Table 10 has an analysis of the two methods SNZ uses to measure building work, namely the building activity survey and fixed capital formation. The problems in using the latter measure are identified.

Table 4 Process by Client Matrix Model – Percentage of Construction Cost

					Process								
			2011		Prelimary scope	Financial	Designers	Consents	Tender or	Constructn	Re-design	Call-backs	Commission
			work placed		/investigation	economic	& Project	obtained	negotiatns		as required		/ hand-over
			$M per year		(by client)	analysis	Managers		(procuremt)				
Households		**Client**			**Percent of construction cost in the Process step**								
	New house /low-rise units - Small builders		2701	RB	0.5	0	7	1.5	0	100	0.5	1	0
	New house/low-rise units - Group builders		900	RB	0.5	0	5	1.5	0	100	0.5	0.5	0
	Dwelling alterations/ additions		1309	RB	0.5	0	5	1.5	0	100	0	1	0
Central Govt		Health	460	NR	3	0	10	2	1	100	2	2	1
		Education	867	NR	3	1	7	1	1	100	2	2	1
		Corrections	104	NR	3	2	10	2	1	100	2	2	1
		Courts	30	NR	3	2	10	2	1	100	2	2	1
	Central Govt Roads		1185	OC	5	3	6	3	1	100	1	0.5	0.5
		Rail	741	OC	5	3	6	3	1	100	1	0.5	1
	Central Govt Housing		25	RB	1	1	6	3	1	100	1	1	0
	Central Govt Power gen & transmission		716	OC	5	3	7	4	1	100	1	0	0.5
	Central Govt Mines		636	OC	5	3	7	4	1	100	1	0	1
Local Govt	Local Govt Water/waste		716	OC	5	1	7	2	1	100	1	0	1
	Recreation/ civic bldgs		370	NR	3	2	10	2	1	100	2	2	1
	Ports infrastructure		148	OC	5	3	7	2	1	100	1	0	1
	Air transport infrastructure		148	OC	5	3	7	2	1	100	1	0	1
	Transport bldgs (road/air/rail/ sea)		78	NR	5	2	9	2	1	100	1	0	1
	Local Govt Roads		741	OC	5	2	6	3	1	100	1	0.5	0.5
	Local Govt Power gen &distribution		239	OC	4	3	7	4	1	100	1	0.5	0.5
	Local Govt Housing		25	RB	2	1	7	2	0.5	100	1	1	0
Private Companies		Hotel/motels	144	NR	3	1	10	2	1	100	2	1	1
		Retail bldgs	738	NR	3	1	8	2	1	100	2	1	1
		Office bldgs	593	NR	3	2	10	2	1	100	2	2	1
	Industrial bldgs		876	NR	3	1	4	0.5	0.5	100	2	0.5	0
	Priv Sect Power gen & distribution		716	OC	5	3	7	4	1	100	1	0	0.5
	Priv Sect Mining/gas/oil		954	OC	5	3	7	4	1	100	1	0	1
		Farm bldgs	231	NR	3	0	1	0.5	1	100	2	0.5	0
	Housing (Mid,Hi-rise)		406	RB	2	2	9	2	0.5	100	1	1	0.5
	Forestry/farm roads/bridges		289	OC	4	1	7	2	1	100	0	0	0.5
Voluntary Assocns		Religious bldgs	16	NR	1	0	7	2	0.5	100	2	1	0.5
		Sports clubs	16	NR	1	0	7	2	0.5	100	2	1	0.5
	Cultural bldgs		16	NR	1	0	7	2	0.5	100	2	1	0.5
	Housing trusts		25	RB	2	1	5	2	0.5	100	1	0.5	0

Table 5 Process by Client Matrix Model – Process Cost

				COSTS $ million											
				Prelimary scope /investigation	Financial economic	Designers & Project	Consents obtained	Tender or negotiatns	Constructn	Re-design as required	Call-backs	Commission / hand-over	Maintenance & renovations	Occupancy (staff costs)	**Total**
Households				(by client)	analysis	Managers		(procuremt)					over life	over life	
New house /low-rise units - Small builders			RB	14	0	189	41	0	2701	14	27	0	1142	1903	6030
New house/low-rise units - Group builders			RB	5	0	45	14	0	900	5	5	0	381	634	1987
Dwelling alterations/ additions			RB	7	0	65	20	0	1309	0	13	0	553	922	2890
Central Govt		Health	NR	14	0	46	9	5	460	9	9	5	324	2962	3842
		Education	NR	26	9	61	9	9	867	17	17	9	489	7332	8844
		Corrections	NR	3	2	10	2	1	104	2	2	1	59	470	657
		Courts	NR	1	1	3	1	0	30	1	1	0	17	406	460
	Central Govt Roads		OC	59	36	71	36	12	1185	12	6	6	334	835	2592
		Rail	OC	37	22	44	22	7	741	7	4	7	313	522	1728
	Central Govt Housing		RB	0	0	2	1	0	25	0	0	0	14	18	60
Central Govt Power gen & transmission			OC	36	21	50	29	7	716	7	0	4	202	504	1575
	Central Govt Mines		OC	32	19	45	25	6	636	6	0	6	90	448	1314
Local Govt	Local Govt Water/waste		OC	36	7	50	14	7	716	7	0	7	202	504	1550
	Recreation/ civic bldgs		NR	11	7	37	7	4	370	7	7	4	209	4172	4835
		Ports	OC	7	4	10	3	1	148	1	0	1	21	104	303
	Air transport		OC	7	4	10	3	1	148	1	0	1	42	104	324
Transport bldgs (road/air/rail/ sea)			OC	4	2	7	2	1	78	1	0	1	33	490	617
	Local Govt Roads		OC	37	15	44	22	7	741	7	4	4	209	522	1613
Local Govt Power gen &distribution			OC	10	7	17	10	2	239	2	1	1	67	168	524
	Local Govt Housing		RB	1	0	2	1	0	25	0	0	0	14	18	60
Private Companies	Hotel/motels		NR	4	1	14	3	1	144	3	1	1	102	2035	2311
		Retail bldgs	NR	22	7	59	15	7	738	15	7	7	416	6245	7540
		Office bldgs	NR	18	12	59	12	6	593	12	12	6	334	16049	17113
	Industrial bldgs		NR	26	9	35	4	4	876	18	4	0	247	9872	11095
Priv Sect Power gen & distribution			OC	36	21	50	29	7	716	7	0	4	202	504	1575
	Priv Sect Mining		OC	48	29	67	38	10	954	10	0	10	134	672	1971
	Farm bldgs		NR	7	0	2	1	2	231	5	1	0	33	1305	1587
	Housing (Mid,Hi-rise)		RB	8	8	37	8	2	406	4	4	2	229	286	993
	Forestry/farm roads/bridges		OC	12	3	20	6	3	289	0	0	1	41	204	578
Voluntary Assocns	Religious bldgs		NR	0	0	1	0	0	16	0	0	0	5	93	116
		Sports clubs	NR	0	0	1	0	0	16	0	0	0	2	103	124
	Cultural bldgs		NR	0	0	1	0	0	16	0	0	0	7	186	211
	Housing trusts		RB	1	0	1	1	0	25	0	0	0	14	18	60
		$ million		527	248	1158	386	116	17161	182	127	89	6479	60611	87082

The above lifetime maintenance/operating costs and the lifetime occupancy costs are obtained from Table 6 next.

Table 6 Maintenance and Operating Costs, and Occupancy Costs for New Zealand Buildings

Maintenance and operating costs, and Occupancy costs. $ Million									
			2011	Maint/operating	Present value	Worker density	Construction	Occupancy cost	Present value
			work placed	costs as % of	Maint/operate	persons/sqm	cost	as % of constructn	Occupancy
Households			$M per year (1)	initial cost per yr (2)	costs $M (3)	(4)	$/sqm (5)	cost/yr (6)	costs $M (7)
New house /low-rise units - Small builders			2701	3.0%	1142			5%	1903
New house/low-rise units - Group builders			900	3.0%	381			5%	634
Dwelling alterations/ additions			1309	3.0%	553			5%	922
Central Govt	Health		460	5.0%	324	0.02	3500	46%	2962
	Education		867	4.0%	489	0.015	2000	60%	7332
	Corrections		104	4.0%	59	0.01	2500	32%	470
	Courts		30	4.0%	17	0.03	2500	96%	406
	Central Govt Roads		1185	2.0%	334			5%	835
	Rail		741	3.0%	313			5%	522
	Central Govt Housing		25	4.0%	14			5%	18
Central Govt Power gen & transmission			716	2.0%	202			5%	504
	Central Govt Mines		636	1.0%	90			5%	448
Local Govt	Loc Govt Water/waste		716	2.0%	202			5%	504
	Recreation/ civic bldgs		370	4.0%	209	0.02	2000	80%	4172
	Ports		148	1.0%	21			5%	104
	Air transport		148	2.0%	42			5%	104
Transport bldgs (road/air/rail/ sea)			78	3.0%	33	0.01	1800	44%	490
	Local Govt Roads		741	2.0%	209			5%	522
Local Govt Power gen &distribution			239	2.0%	67			5%	168
	Local Govt Housing		25	4.0%	14			5%	18
Private Companies	Hotel/motels		144	5.0%	102	0.015		100%	2035
	Retail bldgs		738	4.0%	416	0.02		60%	6245
	Office bldgs		593	4.0%	334	0.06	2500	192%	16049
	Industrial bldgs		876	2.0%	247	0.01	1000	80%	9872
Priv Sect Power gen & distribution			716	2.0%	202			5%	504
	Priv Sect Mining		954	1.0%	134			5%	672
	Farm bldgs		231	1.0%	33	0.005	1000	40%	1305
	Housing (Mid,Hi-rise)		406	4.0%	229			5%	286
Forestry/farm roads/bridges			289	1.0%	41			5%	204
Voluntary Assocns	Religious bldgs		16	2.0%	5	0.01	2000	40%	93
	Sports clubs		16	1.0%	2	0.01	1800	44%	103
	Cultural bldgs		16	3.0%	7	0.02	2000	80%	186
	Housing trusts		25	4.0%	14			5%	18
				19993	6479				60611
(1) Work value is from the Building Activity Survey and fixed capital formation for "other construction", both from Stats NZ.									
(2) Maintenance/ operating costs based on Stats NZ Household Expenditure Survey, and NZ Property Council Operating & Expenses Handbook.									
(3) Present value is the discounted cost over 25 years at 5% discount rate.									
(4) BRANZ estimate based on Occupant Densities NZ Building Code clause C/AS1 Table 2.2. Only employed occupants are included.									
eg patients in health buildings are ignored, also students in education buildings are ignored (i.e no value is placed on their occupancy.)									
(5) Construction costs from Rawlinson NZ Construction Handbook.									
(6) Occupancy costs as % of initial cost = col (3) x $80,000/ Initial cost . For segments where worker density is not given insert a nominal 5%.									
(7) Present value of occupancy costs = Col 1x Col6 x discount factor over 25 years, at 5% discount rate (14.1).									
Analysis period	25	years	USPFW =	14.1	Average worker cost incl overheads $/yr			80000	
Discount rate	5%								

Table 7 Construction Cost, Maintenance and Staffing Cost Ratios for New Zealand Buildings

Ratios of construction cost to on-going costs									
Housing									
Initial cost. Rawlinson New Zealand Construction Handbook									
		Medium quality, two-storey, initial cost $1,700/sqm							
Maintenance / operating costs.									
		3% per yr of initial cost for energy, maintenance , rates, insurance .							
		Assume major refurbish at 15 years @ 20% of initial cost.							
Analysis period	25	yrs	5%	discount rate	USPWF=	14.1		not discounted	
		Present value of maintenance and refurbishment=				882	$/sqm	1615	$/sqm
		Ratio Initial cost: Operating cost =			1700:882 =	1: 0.5			
Non-residential buildings									
Initial cost. Rawlinson New Zealand Construction Handbook									
		Grade A office building, initial cost $3,500/sqm							
Maintenance / operating costs. From New Zealand Property Council Operations Expenses Benchmark									
		$120/ sqm for energy, maintenance , cleaning, rates, insurance, blding management, HVAC,							
		Assume major refurbish at 15 years @ 35% of initial cost.							lifts, etc.
Use 25 year analysis period			5%	discount rate.				not discounted	
		Present value of maintenance and refurbishment=				2281	$/sqm	4225	$/sqm
Occupancy costs. Salaries/ benefits of staff only.									
		Persons say 16 sqm/person @ $80,000 /person				5000	$/sqm per year		
				Present value 25yrs =		70470	$/sqm		
Ratio Initial cost: Operating cost :Occup cost=					3500:2281:70470				
			Ratio =	1: 0.7 : 20	with future cost discounted to present values.				

Table 8 Territorial Authority Consent Fees

Consents fees							
Wellington CC			$20-100k	$100-500k	$500-1000k	$1000-1500k	>$1500k
Cat1		NZS3604	825	900	2100		
Cat2		2-3 level NR	825	1350	2400	2800	+$720/$500k
Cat3		>3 levels	875	1350	2700	2800	+$720/$500k
Plus inspections $150/hr				non-	limited	fully	
			prelim	notified	notified	notified	
Resource consent			$1,040	$1,500	$8,000	$15,000	
Tauranga CC							
		New house	$1,000				
		Multiunits	$1,500				
		A&A >$10K	$500				
		Commercial	$1,500				
		Plus inspections $120/hr					
200sqm hse = $300,000					% of construction cost		
Say 6 inspections @1.5 hrs =				1,350			
Building consent =				900			
Resource consent, PIM				2,000			
				4,250	1.4%		
Commercial $5 million							
Say 12 inspections @2.0 hrs =				3,600			
Building consent =				8,560			
Resource consent PIM				15,000			
				27,160	0.5%		

Table 9 Change in Discount Rate

Life time costs summary for projects constructed in 2011				5% discount rate		
				$ million PV for one year of construction		
			Initial	Constructn,	Maintenance/	Occupancy	
			costs	commission	operations	cost	Total
	Residential building		469	5,465	2,347	3,799	12,081
	Non-residential buildings		616	4,649	2,243	51,228	58,736
	Other construction		1,348	7,445	1,889	5,583	16,266
	All construction		2,434	17,559	6,479	60,611	87,082
Initial costs includes investigation, financial analysis, design,consents,and procurement.							
Construction costs include construction, re-design, re-work and commissioning.							
Maintenance / renovation/ operations costs are present value discounted over 25 years.							
Occupancy costs are the discounted wages/ salaries of occupants of non-residential buildings							
For housing and civil engineering structures a nominal 5% x initial cost per year							
was used as the annual occupancy cost.							

Life time costs summary for projects constructed in 2011				10% discount rate		
				$ million PV for one year of construction		
			Initial	Constructn,	Maintenance/	Occupancy	
			costs	commission	operations	cost	Total
	Residential building		469	5,465	1,512	2,447	9,893
	Non-residential buildings		616	4,649	1,444	32,993	39,702
	Other construction		1,348	7,445	1,217	3,596	13,606
	All construction		2,434	17,559	4,173	39,036	63,201
Initial costs includes investigation, financial analysis, design,consents,and procurement.							
Construction costs include construction, re-design, re-work and commissioning.							
Maintenance / renovation/ operations costs are present value discounted over 25 years.							
Occupancy costs are the discounted wages/ salaries of occupants of non-residential buildings							
For housing and civil engineering structures a nominal 5% x initial cost per year							
was used as the annual occupancy cost.							

Table 10 Building Activity Survey Versus Fixed Capital Formation Data

BAS versus FCF values							
	March year	07	08	09	10	11	average
		$ million					5 years
Residential buildings							
	BAS	7,690	8,621	6,846	5,843	6,188	
	FCF	10,953	11,865	9,400	8,277	8,665	
	Ratio	0.70	0.73	0.73	0.71	0.71	0.72
Non-residential bldgs							
	BAS	5,042	5,024	5,287	4,710	4,834	
	FCF	5,370	5,352	5,610	5,056	5,206	
	Ratio	0.94	0.94	0.94	0.93	0.93	0.93
BAS = Building Activity Survey							
FCF= Fixed capital formation							

Statistics New Zealand carries out a building activity survey every quarter. It uses building consent data to identify builders doing work and asks them to record the value of all work done on buildings in the quarter. The survey results are scaled up using consent data (which is a 100% record of building activity over $5000 in value), to give the total value of building work. There is no similar survey for “other construction” work.

Capital formation is obtained from business surveys in which the acquisitions less disposals of physical assets are recorded each quarter. The values recorded include transaction costs which are the design, legal and land agent outlays associated with the purchase and sale of asset. The physical assets can be either new or existing assets.

For housing, a significant proportion of the total stock is traded each year and while the purchases and sales values of existing buildings “nett-out”, the transaction costs, primarily land agent and legal fees are included in capital formation for each transaction (for both the buyer and seller). We know that existing sales are approximately six times the sales of new housing, though this ratio various between four and eight times in any one year, depending on the state of the two markets. Assuming the land agent and legal costs are 4% of the sale price, then we would expect FCF to be approximately 6 x 4% = 24% greater than the BAS value of house building work. This accounts for most of the difference in Table 10 between BAS and FCF values for housing.

For non-residential, the sale of existing buildings occurs much less frequently than for housing and hence the difference between BAS and FCF is smaller than for housing, as shown in the table.

This analysis illustrates that care is needed in the use of FCF data as a measure of new building and construction activity.