

## CHAPTER 6 - CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

This study revealed that there are many popular methods available to estimate TFPG in an industry or an economy. These include Index Number Theories, Growth Accounting Method together with Tornqvist Index Method which are explained in Chapter 2.

This research used the Tornqvist Index Method, which is generally called as Transcendental Logarithmic formula to estimate the TFPG in the Sri Lanka Building Construction Industry for the study period 1995-2001. Out of the available methodologies, the Tornqvist Index method is the most suitable and the simplest method to estimate TFPG in the building construction sector, when the required data availability is limited, incomprehensive and incomplete which is the case in Sri Lanka.

The TFPG results indicated in the Table 4.4 and in the Fig. 4.1 do not show a negative or positive trend during the study period, i.e. from 1995 to 2001. The TFPG in the building construction industry in Sri Lanka remains almost zero in the recent past but with very high fluctuation in many years. In ideal situations, TFPG in an industry or in a national economy should give a particular trend to explain clearly the reasons for that trend.

However in reality, obtaining TFPG results with a particular trend would be a difficult task due to the reasons such as not having a very accurate database showing the actual situation of the sector, and also since the sector does not behave according to the assumptions that have been stated to use the above methodology and the capacity utilization rate.

This study gives all of the stakeholders involved in the construction industry a new vision on the productivity enhancement in the construction sector in general (specially in the building construction sector), methodologies of assessing TFPG, importance of the TFPG and its determinants, and importance to have a better data set to estimate TFPG for the sector in the future more effectively.

## 6.2 Recommendations

1. Tornqvist Method is the most suitable method to estimate TFPG in the building construction sector in Sri Lanka considering its validity, simplicity and limitations of available data.
2. The output figure required for the Tornqvist Method can be considered as the component of GDP for the construction sector. At present, this data is available in the Annual Accounts Report published by the DC&S. If the study is limited to a specific section such as Building Sector, then there should be a reliable cost values of building constructed annually and the total output in the form such as floor area.
3. The inputs: There are two inputs required to estimate TFPG using Tornqvist Formula, namely Labour (L) and Capital (K). In general, labour input is measured in labour hours, which is involved in the annual construction (for building, road, and other sectors separately). This also could be represented by the total salary paid for the labourers engaged in the sector. This construction labour data should have the compositional and quality changes such as gender, educational levels, age, experience, skills, etc. Ideally, the capital input should be the capital services per unit time. However, this type of information is seldom in most of the countries. Therefore, it is recommended to have at least the data on the capital services such as the data on construction fixed assets (land, office buildings, office and construction equipment, construction machinery, transport vehicles, etc.).
4. In addition to the above, to carry out the adjustments on historic values of fixed assets it is necessary to have several price indexes such as Commercial Price Index for shops and offices and Domestic price Index for Machinery and Transport Equipment. Therefore it is important DC&S to publish this information related to building and overall construction sector quarterly or annually.
5. To obtain a reliable and accurate data set to cover the above data requirement, it is recommended to use the same data collection procedure carried out by the DC&S of Sri Lanka. However, the present construction data collection system and the questionnaire used by the DC&S should be improved to eliminate or reduce the deficiencies described in the Discussion Chapter. The research

emphasises that when improving the construction data collection survey in Sri Lanka, it is important to give priority to obtain reliable and accurate data required to estimate TFPG in the entire construction and sub sectors of the construction industry.

6. At present, there is no priority given to this survey and therefore data compilation and publishing is prolonged. This is mainly due to lack follow up from ICTAD and lack of resources available with DC&S of Sri Lanka. Therefore, it is recommended to deploy suitable and skilled personnel to process this database in a sensible manner to have a reliable and complete construction database, which can be used for variety of studies and decision making activities.
7. Several occasions in this report, it was highlighted that there is a poor response rate to collect construction data from the contractors in Sri Lanka. To improve this response rate of feedback, it is suggested that DC&S and ICTAD to have more follow up strategies including the following.
  - To have a confidentiality agreement between the contractor and DC&S, and buildup a strong understanding between the two parties.
  - ICTAD to have effective awareness sessions on importance of such reliable and strong centralized database related to the construction industry and its usefulness for the contractors, construction industry and to the whole country. This will improve the contractors' attitudes on this data collection survey.
  - ICTAD to impose strict rules in contractor registration to submit true and reliable data, to form a computerized data base and support DC&S to formulate their comprehensive database. It is important not to collect duplicate data and information by DC&S and ICTAD.
  - Bring the laws related to this data collection into effect and penalize those who do not send their business information to DC&S and ICTAD.
  - ICTAD should follow up to check regularly whether the registered contractors are maintaining actual records and information with related to their construction activities. ICTAD could conduct seminars and training sessions on this and encourage them to store data in computers.



7. It is strongly recommended to use Tornqvist method to assess again the TFPG in the Sri Lanka entire/ building construction industry when the above data collection system being improved in future.
8. It is also recommended that ICTAD, Central Bank of Sri Lanka, DC&S of Sri Lanka and other construction related organizations to focus their attention to develop a reliable data base including the input and output requirements mentioned in the above table to assess TFPG more accurately in the construction sector in future studies. This will also help to use different methodologies to estimate TFPG and compare the results in future.



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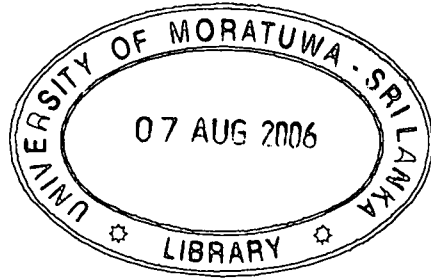
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## LIST OF APPENDICES

1. DC&S construction survey procedure and the format of the questionnaire
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## Appendix 1

### Methodology of Survey Of Construction Industry – Sri Lanka

Source: Report Published by Department of Cencus and Statistics in 2001

#### Scope and Coverage

In this survey, all construction activities undertaken in year 2000 by the contractors registered with ICTAD, other organizations in the government and semi-government are considered. However the construction activities carried out by the foreign contractors, contractors who are not registered in the above organizations and unauthorized construction activities are excluded from this survey.

The following sectors of construction are covered in this survey.

1. Building construction
2. Highway construction
3. Bridge construction
4. Water supply and drainage
5. Irrigation and land drainage
6. Dredging and reclamation
7. Other construction activities not mentioned above



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#### Methodology of Survey

A total number of 1097 sample units (contractors) were considered for the survey carried out in 2000. The contractor sample was selected to cover the whole island excluding the North and East provinces. The questionnaire prepared by the DC&S of Sri Lanka was posted by mail to these contractors to obtain the required information. A field follow up for non-responding contractors was carried out by a panel of trained statistical officers attached to respective Divisional Secretary Division.

## Sample Design

Stratified Systematic Sampling technique was used for designing the sample for this survey. Since the major portion of construction activities carried out by the large contractors registered at ICTAD, all contractors registered as grade 1-5 were considered for this sample. The breakdown of the sample considered in year 2000 is as follows.

No.	Sample Frame	Strata	Sample Fraction/(%)	Sample Size
1	List of contractors registered with ICTAD as at December 1999	Grade 1-5	100	84
		Grade 6-10	25	113
2	List of contractors registered in other organizations	Over 5 Mn	100	69
		2Mn – 5Mn	25	31
		1Mn – 2Mn	15	25
		Less 1Mn	10	775
Total				1097

It is important to note that this survey not covered the large scale construction activities carried out by foreign contractors and the contractors not registered in the above organizations.





Appendix – 2

**Sample of Raw Building Construction Data Extracted  
From DC&S of Sri Lanka**

# SRI LANKA BUILDING CONSTRUCTION INDUSTRY

Source: Department Of Census And Statistics

Sri Lanka

Year: 1995

No.	Name Of The Contractor	Total Cost Of Building Contracts Obtained During The Year /Rs.	Floor Area /Sq.ft	Raw Material /Rs.	Labour Cost /Rs.	Cost Of Services and Other Expenses /Rs.	Cost Of Work Carried Out During The Year /Rs.	Unit Cost Rs./Sq.ft
1		12,000,000	14,525	7,447,500	1,500,000	2,852,500	11,800,000	826
2		5,800,000	6,300	3,770,000	900,000	1,130,000	5,800,000	921
3		9,300,000	10,475	6,200,000	1,350,000	2,650,000	10,200,000	888
4		2,109,656	2,400	1,390,000	300,000	510,000	2,200,000	879
5		6,500,000	9,500	2,900,000	625,000	1,350,000	4,875,000	684
6		3,560,000	4,000	2,360,000	400,000	910,000	3,670,000	890
7		2,200,000	1,800	1,400,000	300,000	640,000	2,340,000	1,222
8		8,393,601	8,200	4,052,000	925,000	1,363,000	6,340,000	1,024
9		7,571,930	7,590	2,586,540	250,000	363,460	3,200,000	998
10		4,400,000	5,500	1,250,000	200,000	350,000	1,800,000	800
11		1,766,000	2,200	1,085,000	225,000	565,000	1,875,000	803
12		13,000,000	15,665	4,800,000	825,000	1,160,900	6,785,900	830
13		4,100,000	4,000	2,670,000	530,000	965,900	4,165,900	1,025
14		2,800,000	3,000	1,810,000	400,000	540,000	2,750,000	933
				<b>43,721,040</b>	<b>8,730,000</b>	<b>15,350,760</b>	<b>67,801,800</b>	
							Total	12,722
							Average Unit Cost Rs.	909
							Total Building Cost Rs.	1,884,427,173
							Total Building floor area.	2,073,689

# SRI LANKA BUILDING CONSTRUCTION INDUSTRY

Source: Department Of Census And Statistics

Sri Lanka

Year: 1996

No.	Name Of The Contractor	Total Value Of Building Contracts Obtained During The Year /Rs.	Floor Area /Sq.ft	Raw Material /Rs.	Labour Cost /Rs.	Cost Of Services and Other Expenses /Rs.	Value Of Work Carried Out During The Year /Rs.	Unit Cost Rs./Sq.ft
1		6,387,000	6,000	3,945,000	1,250,000	1,450,035	6,645,035	1,065
2		16,456,000	15,000	6,248,000	2,540,793	2,661,767	11,450,560	1,097
3		37,870,000	40,000	7,745,000	2,850,000	2,905,000	13,500,000	947
4		9,377,000	10,000	5,390,000	1,886,650	2,290,800	9,567,450	938
5		7,293,500	8,000	4,251,000	1,552,000	1,150,470	6,953,470	912
6		9,865,000	11,000	4,674,000	1,740,000	2,153,984	8,567,984	897
7		11,045,000	13,500	1,650,000	750,000	1,176,000	3,576,000	818
8		8,700,000	9,750	4,125,000	1,350,000	1,525,000	7,000,000	892
9		18,706,000	21,500	5,670,000	1,775,000	2,242,500	9,687,500	870
10		5,317,000	5,500	3,245,000	1,154,000	1,468,200	5,867,200	967
		3,734,000	4,000	1,800,000	800,000	1,057,000	3,657,000	934
		1,786,000	1,500	930,000	475,000	491,000	1,896,000	1,191
		9,600,000	9,500	4,786,000	1,078,000	919,050	6,783,050	1,011
				<b>54,459,000</b>	<b>19,201,443</b>	<b>21,490,806</b>	<b>95,151,249</b>	
							Total	12,536
							Average unit Cost Rs.	964
							Total Building Cost Rs.	737,238,829
							Total Floor Area (sqft)	764,499

# SRI LANKA BUILDING CONSTRUCTION INDUSTRY

Source: Department Of Census And Statistics

Sri Lanka

Year: 1998

No.	Name Of The Contractor	Total Value Of Building Contracts Obtained During The Year /Rs.	Floor Area /Sq.ft	Raw Material /Rs.	Labour Cost /Rs.	Cost Of Services and Other Expenses /Rs.	Value Of Work Carried Out During The Year /Rs.	Unit Cost Rs./Sq.ft
1		23,000,000	22,500	11,250,000	3,840,000	3,910,000	19,000,000	1,022
2		14,500,000	12,000	7,669,000	2,280,000	3,520,000	13,469,000	1,208
3		145,950,000	150,000	83,560,614	26,265,781	38,923,605	148,750,000	973
4		691,769,958	620,136	326,178,120	112,760,135	129,126,245	568,064,500	1,116
5		8,850,000	8,500	5,400,000	2,800,000	1,675,000	9,875,000	1,041
6		7,702,708	7,500	4,350,000	2,032,135	1,242,106	7,624,241	1,027
7		78,600,000	69,218	49,180,000	13,910,000	17,980,000	81,070,000	1,136
8		112,362,000	118,100	38,880,900	10,007,450	17,803,650	66,692,000	951
9		15,860,000	8,600	12,220,000	3,140,000	1,795,000	17,155,000	1,844
10		5,557,261	4,000	2,950,000	1,240,000	1,086,033	5,276,033	1,389
11		18,700,500	18,725	7,856,500	2,613,541	2,232,149	12,702,190	999
12		273,650,950	298,500	90,003,632	32,975,000	13,721,368	136,700,000	917
13		12,547,500	7,460	7,346,000	2,875,000	3,014,000	13,235,000	1,682
14		45,115,000	48,500	28,082,694	10,023,768	9,393,538	47,500,000	930
				<b>674,927,460</b>	<b>226,762,810</b>	<b>245,422,694</b>	<b>1,147,112,964</b>	
							Total	16,235
							Average Unit Cost Rs.	1,160
							Total Building Cost Rs.	7,914,023,790
							Total Floor Area (sqft)	6,824,387





# SRI LANKA BUILDING CONSTRUCTION INDUSTRY

Source: Department Of Census And Statistics

Sri Lanka

Year: 2000

No.	Name Of The Contractor	Total Value Of Building Contracts Obtained During The Year /Rs.	Floor Area /Sq.ft	Raw Material /Rs.	Labour Cost /Rs.	Cost Of Services and Other Expenses /Rs.	Value Of Work Carried Out During The Year /Rs.	Unit Cost Rs./Sq.ft
1		56,327,000	54,000	12,224,370	5,056,912	253,317	17,534,599	1,043
2		6,360,000	4,000	5,248,000	1,032,793	79,207	6,360,000	1,590
3		100,000,000	36,625	31,168,120	12,794,080	53,037,800	97,000,000	2,730
4		11,277,136	5,960	6,440,000	4,159,650	4,597,440	15,197,090	1,892
5		67,262,830	42,400	4,851,000	1,252,000	7,072,964	13,175,964	1,586
6		38,880,000	25,000	12,674,000	6,740,000	19,466,000	38,880,000	1,555
7		20,000,000	17,325	12,000,000	9,000,000	5,000,000	26,000,000	1,154
8		7,000,000	15,000	4,800,000	1,450,000	750,000	7,000,000	467
9		14,526,000	30,000	9,930,000	3,105,000	1,491,000	14,526,000	484
10		25,317,228	24,440	12,031,000	6,078,000	7,208,228	25,317,228	1,036
				<b>111,366,490</b>	<b>50,668,435</b>	<b>98,955,956</b>		
							Average Unit Cost Rs.	13,538
							Total Building Cost Rs.	<b>1,354</b>
							Floor Area in 2000	6,012,952,227
								4,441,421

# SRI LANKA BUILDING CONSTRUCTION INDUSTRY

Source: Department Of Census And Statistics

Sri Lanka

Year: 2001

No.	Name Of The Contractor	Total Value Of Building Contracts Obtained During The Year /Rs.	Floor Area /Sq.ft	Raw Material /Rs.	Labour Cost /Rs.	Cost Of Services and Other Expenses /Rs.	Value Of Work Carried Out During The Year /Rs.	Unit Cost Rs./Sq.ft
1		93,287,254	85,000	37,164,702	21,596,509	2,445,606	61,206,817	1,097
2		46,429,480	46,000	17,620,000	9,393,000	6,392,200	33,405,200	1,009
3		126,783,330	100,000	27,977,904	19,465,748	16,094,507	63,538,159	1,268
4		28,000,000	15,500	15,500,000	4,200,000	4,300,000	24,000,000	1,806
5		250,000,000	196,000	147,351,050	47,564,339	19,784,611	214,700,000	1,276
6		8,900,000	7,000	5,023,000	2,700,000	977,000	8,700,000	1,271
7		542,627,000	420,000	298,163,964	158,893,465	273,099,280	730,156,709	1,292
8		26,000,000	21,520	8,800,000	4,325,000	2,875,000	16,000,000	1,208
9		38,000,000	11,841	28,453,000	10,467,000	1,000,000	39,920,000	3,209
10		3,917,916	2,651	2,460,000	1,000,000	0	3,460,000	1,478
11		10,522,328	8,750	5,420,000	2,000,000	1,875,783	9,295,783	1,203
12		8,000,000	5,000	850,000	220,000	430,000	1,500,000	1,600
13		12,200,000	9,500	6,014,000	2,923,000	1,263,000	10,200,000	1,284
14		8,365,270	6,116	3,829,714	1,348,850	1,186,706	6,365,270	1,368
15		37,200,000	24,116	14,480,000	3,050,000	0	17,530,000	1,543
				<b>619,107,334</b>	<b>289,146,911</b>	<b>331,723,693</b>	<b>1,239,977,938</b>	
							Average Unit Cost Rs.	21,912
							Total Building Cost Rs.	1,461
							Floor Area in 2001	3,861,975,470
								2,643,696

# SRI LANKA BUILDING CONSTRUCTION INDUSTRY

Source: Department Of Census And Statistics

Sri Lanka

Year: 2002

No.	Name Of The Contractor	Total Value Of Building Contracts Obtained During The Year /Rs.	Floor Area /Sq.ft	Raw Material /Rs.	Labour Cost /Rs.	Cost Of Services and Other Expenses /Rs.	Value Of Work Carried Out During The Year /Rs.	Unit Cost Rs./Sq.ft
1	Prefab Engineering Pro	15,000,000	9,000	6,250,000	4,240,000	4,510,000	15,000,000	1,667
2	General Engineering S	12,500,000	7,200	2,669,000	280,000	520,000	3,469,000	1,736
3	Squire Mechanical Eng	101,360,900	56,500	33,560,614	1,265,781	13,882,769	48,709,164	1,794
4	Daya Construction	61,769,958	42,136	26,178,120	2,760,135	34,126,341	63,064,596	1,466
5	Sierra Constructions	690,702,708	542,325	167,000,000	20,532,135	152,092,106	339,624,241	1,274
6	Maga Engineering	918,880,000	694,218	391,180,000	117,910,000	307,280,000	816,370,000	1,324
7	Chathura Construction	7,863,185	4,600	4,220,000	2,140,000	796,000	7,156,000	1,709
8	Navoda Engineering	31,557,261	20,000	950,000	540,000	586,033	2,076,033	1,578
9	Sathula Builders	93,676,941	38,250	23,003,632	12,975,000	721,368	36,700,000	2,449
10	WW Contractors & Sup	12,547,508	6,450	2,346,000	475,000	414,384	3,235,384	1,945
11	SEC	363,116,698	212,500	130,082,694	137,023,768	280,450,538	547,557,000	1,709
12	Orient Cosntructions	42,890,000	22,500	24,830,000	8,060,000	0	32,890,000	1,906
13	Tudawa Brothers Ltd	88,880,000	61,000	49,250,000	3,698,000	32,932,000	85,880,000	1,457
14	SD & CC	132,000,000	94,660	12,000,000	6,000,000	2,000,000	20,000,000	1,394
				<b>873,520,060</b>	<b>317,899,819</b>	<b>830,311,539</b>	<b>2,021,731,418</b>	
								23,408
							Average Unit Cost Rs.	<b>1,561</b>
							Total Building Cost Rs.	0
							Floor Area in 2002	0