IMPACT OF FOREIGN CONTRACTORS ON DEVELOPMENT OF SRI- LANKAN CONSTRUCTION INDUSTRY THROUGH TECHNOLOGY TRANSFER

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(09/8852)

Degree of Master of Science

Department of Civil Engineering

University of Moratuwa

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DECLARATION

"I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree of Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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…… ……

Signature of the supervisor: Date:

DEDICATION

This dissertation is dedicated to my beloved parents, mother in law, my charming wife Mahesha, and my three kids Thenuka, Menuka and Vihansa, who have always been with me, in every hurdle I encountered.

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Sarath Bandara Dissanayaka

February 2014

ABSTRACT

Technology Transfer has been a subject of considerable interest to many groups, because of the close relationship between technology transfer and economic growth. It has aroused the interest of academic researchers.

Discussions on technology transfer (TT) in construction in the past have mainly focused on technology acquisition during the execution of projects involving an overseas party. The discussions enclosed how effectively the projects were executed and any benefits that accrued to the contracting partners from the foreign contractors.

This paper attempts to extend this discussion to the problems and prospects of International Technology Transfer within the domestic construction sector in order to boost domestic capacity.

A comprehensive literature survey was conducted to highlight past and present situation of the construction industry in Sri Lanka. Questionnaire was primarily prepared in the firm of interviewing parties related to the construction industry, by visiting the advisory services and Industry Development division at ICTAD, and interviews with senior officials at ICTAD registration rank C1, C2 and C3 contractors within the Colombo District.

The development of a construction industry of a certain country can be enhanced through the involvement of foreign construction firms. However, authors' initial investigations raised question is, whether the Sri Lankan construction industry is ready to acquire the possible construction technology through foreign firms. This paper identified enablers and barriers of technology transfer and suggested local construction industry to create a suitable condition to acquire construction technology more dynamicaly through foreign firms.

Keywords: *Technology Transfer, Contractor, Construction Industry*

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CHAPTER 01
INTRODUCTION

1.1 General

Technology, Innovation and Research and Development are widely recognized as the most important factors in eradication poverty which is the prime objective of economic growth and development in any developing country (Dissanayaka, October, 2003).

With the complication of peoples' needs, it is very difficult for a country to survive only with the existing resources. Therefore it needs help from other countries to fulfill its requirements. This leads to the inter collaboration between countries to exchange their needs and services. A developing country needs support from various developing or developed countries to catalyze its development process. The literature on construction in developing countries suggests that to provide a basis for their socio-economic development, these countries need a large volume of new constructions. However, most of the said requirements are beyond the capacity and the capability of the local construction industries, (Ofori et al, 2002).Thus these countries must engage foreign firms in their infrastructure and other construction projects.

The historical development of Sri Lankan construction industry is closely linked with the political changes that took place during last four decades. The significant economic changes can be categorized in to pre- and post – economic liberation periods (Devapriya and Ganesan,2002)

received substantial aid for urban and rural (irrigation) infrastructure which created a number of opportunities for joint ventures (JVs) and subcontracting arrangements (Ganesan and Kelsey,2006).During this period, public investments were channeled into major infrastructure projects such as the accelerated Mahaweli programme, Greater Colombo Economic Commission and Urban Development programmes with a view to creating a capital base in the country. private and foreign capital was boosted through the provision of incentives and infrastructure support (Devapriya and Ganesan ,2002).

Involvement of foreign construction firms in the Sri Lankan construction industry has a history of a few decades. It is evident that most of the large scale development projects such as Mahaweli project, Southern Highway project, Colombo Harbor Expansion project, Hambantota international airport project, and Hambantota port are constructed with the involvement of foreign contractors from various countries like Germany, Norway ,United Kingdom, and China. Table 1 illustrates a few of the large scale projects which are sub projects and the foreign firms involved with those projects. These construction firms engaged in Sri Lankan construction industry by undertaking projects on their own or in collaboration with local counter parts.

Previous studies on the impacts due to involvement of foreign contractors revealed that these foreign firms have both positive and negative effects on the host country's construction industry irrespective of the entry mode (Ofori ,2000).It is evident that the involvements of foreign construction firms in Sri Lankan construction industry had both positive and negative impacts in the recent past. With the end of three decades of prolonged destructive war in Sri Lanka, a large number of large scale building and infrastructure projects are initiated for the benefit of the people. According to the Ministry of Finance and Planning in Sri Lanka, construction related projects over Rs.700 billion is planned for the next two to three years although certain contracts may be awarded to foreign principals, a substantial part of the work would be reassigned (by way of sub contracts) to local contractors. With this huge investment on construction industry involvements of foreign construction firms in Sri Lankan construction industry have increased enormously.

Technology transfer (TT) and knowledge transfer can be considered as major benefits of foreign contractors' invlovement.TT covers all the forms of physical assets, knowledge and human capabilities that enable a more efficient organization of construction projects and services. TT reduces the sharp differences in technological competence between different countries (Genesan and Kelsey,2006).It is evident that the involvement of foreign construction firms in Sri Lankan construction industry is a cause for TT process to some extent in the recent past. It is viable to investigate whether the level of TT and Knowledge transfer is

adequate to develop the construction industry of Sri Lanka. Moreover finding the weaknesses of existing TT process may be worthy to propose some suggestions to enhance the current level of Technology and knowledge transfer between foreign firms and their counterpart local contractors. This study may be helpful to the governmental organizations to make their policies to acquire a considerable amount of foreign technological knowledge from foreign construction firms.

It is evident that with past studies, Sri Lankan construction industry is developed during last few decades and it will undergo huge development with the expected huge investment on infrastructure development in next few years .According to the studies carried out by researchers from various countries revealed that the foreign contractors involvement in the host country construction industry is a factor that influence the development of host country construction industry along with some other factors such as Government incentives, support of other local construction firms, support from various authorities, public and private sector client's help,…etc.(Ofori et al.2002). Investigation on relative importance of those factors may be worthy to take initiatives for the further development of local construction industry by providing necessary actions to influence the above factors.

During the last few decades local construction firms undertook various types of work within the host country as well as outside the country for their own growth. Moreover that work can be categorized accordingly, as general construction work in host country as well as overseas, specialist construction work in host country and overseas, design and build projects, diversifying into other businesses which are not related to construction, forming joint ventures with foreign companies as well as local construction companies,….etc. The importance of work undertaken should be investigated to find the most suitable types of work that should be undertaken by the local firms for their own development. It will also reveal the relative importance of forming joint ventures between foreign construction firms with the other projects undertaken by the local firms. It will reveal the importance of foreign firms on the growth of local construction industry. In addition to that, it is necessary to find the area in which local construction industry firms have developed in the past few decades. According to the studies they may have developed in areas such as

managerial expertise, technical expertise, financial resources, plant and equipment, quality of work, construction safety, application of information technology…etc.

With the present condition of foreign contractors' involvement, some of the local construction firm laments that they are not getting any large scale projects since a dominant part of large scale projects are under taken by foreign firms. Moreover they suspect that if this situation continues they would not get only the large scale projects but even small projects. The question that arises is "why do clients tend to engage foreign Contractors for their projects?". We should pay more attention on the areas in which local construction firms are lagging behind. According to the literature those foreign firms can be better than their local counter parts in few areas such as managerial expertise, technical expertise, financial expertise, plant and equipment, quality of work…etc. A comprehensive study should be done to find out the areas in which local firms are lagging behind and support should be given to them to upgrade their abilities in order to compete with their foreign counter parts.

It is obvious that to transfer the construction technology and knowledge ,foreign construction firms have a responsibility up to some extent .When a foreign construction firm and a local construction firm form a joint venture, the foreign firm can have an influence on their local partner by means of several procedures such as training programmers, transfer of managerial skills and systems, transfer of corporate policies and attitudes, demonstration of construction techniques, inspiration as role models…etc. The most effective vehicles, through which foreign contractors have an influence on their local joint Venture partners, need to be found in order to propose appropriate procedures to get maximum usage from foreign firms' construction resources.

Development of local the construction industry depends on the policies of the government as well as the incentives and support schemes offered by the government. Financial incentives, advisory services, providing market information, training of skilled workers, training of supervisors, organizing national awards can be considered as the types of incentives and support schemes that can be provided by the government. A study is essential to check whether those incentives and

supporting schemes are functioning in considerable amounts and the need to propose some suggestions to the government to develop local construction industry. Moreover existing government procurement policies, contract documents, contractual terms and method of registration and classification of firms need to be investigated to find their weaknesses and to propose solutions to overcome existing weaknesses.

Encouragement of local firms is a factor which may crucially effect the development of local construction industry. The measures that can be initiated by local construction companies on their own to develop themselves and providing basics for them may be an advantage for the development process of the local construction industry. Forming joint ventures with foreign construction firms is one of the activities that can be adopted by local firms to develop by learning from foreign construction firms. The importance of having joint ventures and strategic alliances for developing the local construction industry should be investigated in order to study the current situation of existing joint ventures and strategic alliances to be propose methods to adopted by local construction firms to enhance the conditions of existing joint ventures and to enhance the condition of joint ventures in the future.

The responsibility of the Chamber of Construction Industry of Sri Lanka to develop Sri Lankan construction industry is evaluated by the initiatives taken by this institute to improve the performance of local construction companies. This may be an influencing factor which helps the institution to continue its initiatives in a fruitful manner. The importance of local clients is investigated in order to get their active participation for the development process of local construction industry.

1.2 Objectives

Main objectives of the research work are the following:

i. To identify the level of technology transfer to the local construction industry through foreign contractors' involvement in the local construction projects

ii. To propose guidelines to mitigate existing shortcomings to enhance technology transfer to the local construction industry through foreign contractors' involvement.

The sub objectives of the study are to:

i. Trace the development of the construction industry in Sri Lanka since 2002

ii. Determine the factors contributing to the growth and improvement of the construction industry and construction enterprises in Sri Lanka.

The objectives of the study are to identify the factors which have been instrumental in the growth of local contractors, highlight their order of importance, establish relationships among them and recommend action by relevant key organizations.

1.3 Methodology

In order to fulfill above objectives, the following detailed research work was carried out:

1.A detailed literature survey was carried out to find out the following:

i. The factors that influence the development of the construction industry in countries around the world

ii. Incentives provided by the government as well as the support provided by the institutions which are related to construction to develop host country construction industry

iii. Factors that influence to enhance the TT to various countries from foreign construction firms
iv. Probable vehicles of Technology Transfer
v. TT models developed by various researchers all around the world
vi. Government policies regarding foreign contractors in order to control their actions.

2. A structured questionnaire was developed to get the opinions of professionals who are a part of construction industry about the following

i. The factors that have influenced the development of the Sri Lankan construction industry during the last few decades
ii. The types of projects undertaken by the local construction
iii. firms to develop during the last few decades
iv. The areas in which local construction firms are lagging behind when compared with foreign construction firms
v. The areas in which local firms improved their ability
vi. The vehicles through which foreign contractors had an influence on their joint venture partners and counter parts
vii. Types of government incentives and support schemes offered by the Sri Lankan government to help local construction firms to upgrade
viii. The measures taken by the local firms on their own to develop themselves
ix. How the guidance of the Chamber of Construction Industry, Sri Lanka has helped local companies to improve their performance
x. To which extent have the professionals from construction industry helped local contractors to develop
xi. The most appropriate measures which could be adopted to enable local companies to derive direct benefits from foreign firms operating in Sri Lanka

xii. Finally, the most appropriate actions which can be taken to improve the performance of the local contractors

1. A structured postal Questionnaire was held with prominent personnel of local contractors to find out the current level of technology and transfer from foreign contractors and the barriers to the transferring process. It also found the measures that can be adopted to enhance the technology transfer process. The questions were formulated after reviewing the literature.

2. Collected data was entered to the computer and analyzed by using Relative Important Index (RII) data analyzing methods

1.4 Structure of the Report

This dissertation comprises of the following five chapters.

Chapter 01. : Depicts the introduction of the report, highlighting the background, objective, frame work and the summary of the report.

Chapter 02. : Contains the literature studied on the technology transfer on the construction industry.

Chapter 03. : The Methodology of the research and mechanism of data collection are described.

Chapter 04. : Presents the data analysis based on the Questionnaire.

Chapter 05. : Contains conclusion, recommendation and further research area.

CHAPTER 02
LITERATURE REVIEW

2.1 Introduction

This chapter provides a description on the reviewed literature in Technology Transfer (TT), International Technology Transfer (ITT) & ITT experience in different situations.

As the first step of this study this literature review was carried out in order to gain a better understanding of concepts, tools and models adopted by other researchers on ITT and the experiences of other countries. Also the literature review provides the basis which is essential in formulation of the conceptual model in order to review the success and failures of the ITT project in Sir Lanka and to identify the factors that affected the success of the project.

The past experiences in Sri Lanka and other developing counties in ITT have been taken into consideration in framing the guidelines for future ITT project.

TT is an important business strategy today because the technology provides the ways and means of producing goods and services. Competitiveness of a firm or country, which engages in producing goods and services, depends on the technology they use. Pietrobelli (2000) states that the economic activities have become global and that technology is playing a central role in all economic activities. Feature of globalizing of economic activities means that the transfers and interchanges of technologies have increased tremendously while becoming vital to their development.

However, Offiri, (2001) indicates that the introduction of technology effectively into the organization and reaping the benefits is more complex. It points out the need of technology in the economic development of a country or a firm and

the needs for being vigilant in purchasing and implementing technology, specially for the developing countries.

Therefore, an in depth study of the implications of ITT is necessary.

TECHNOLOGY → **COMPETITIVENESS**

2.2 Technology Transfer

Technology Transfer (TT) is a crucial and dynamic factor in social and economic development. Abbot (1985) defined TT as "the movement of the science from one group to another, such movement involving its use". Simkoko (1992) defined the TT for construction industry as "the planned conveyance and acquisition of technical knowledge and techniques of construction firms". This implies that there is no true TT until the technical knowledge received from the donor has been put into effective use. Technology Transfer involves a two way process which can succeed only when both the donor and the recipient work together in deciding what needs to be transferred and implemented (Sridharan, 1994, Moavenzadeh and Hagopian, 1984) suggested that foreign contractors' involvement is a key requirement for the development of local construction industry and have shown that local contractors progressively enhance their capability by working with foreign contractors, until eventually they become able to export their services. It is evident with the Singapore construction industry, that the local contractors' capacity and ability have been enhanced as a result of their involvement with foreign firms.

United Nations Conference on Trade and Development (UNCTAD, 1990) suggested that effective transfer occurs when the technology is requested, transmitted, received, understood, applied, diffused widely and improved. Construction technology may be transferred through joint ventures between foreign and local companies which may either be project specified or of a long-term nature (Ofori, 1994). International joint ventures and subcontracts employed in building material

and construction can be serious vehicles of TT provided it contributes to provide high quality inputs into the wider industry (Ganesan and Kelsey, 2006). Kumaraswami (1997) show that technology transfer can take place in various ways, such as direct use of technology, use of technology with modification, and the reverse use of technology.

TT has advocated as a catalyst of the change or improvement required in many construction industries; however free transfer of technology from one country or region or firm to another has been restricted by various barriers (Shrestha and Kumaraswami, 2000). Organization culture, Lack of time, Capacities of individuals, Attitude of individuals, Lack of clear policy, Lack of clear agreements Lack of clear procedures, lack of funding provisions, are some of major barriers.

2.3 Technology Transfer for Enhancement of Capabilities

Akubue, (2002) indicates that, in a present study technology transfer is defined as the transmission of technical knowledge through commercial contracts involving the provision of goods and services. Included in this definition of technology transfer are many types of contracts ranging from the delivery of equipment and the acquisition of production rights to the training of persons the temporary provision of management with the transfer of responsibility. Complete technology transfers are there for package deals including a whole variety of goods and services. Some contracts are usually referred to as technology transfers, such as licensing or turnkey contracts, which are in the above definition only partial technology transfers or elements of such transfers, since the actual transmission of technological knowledge may be minimal. It is a also clear that complete technology transfer is longer processes, the number of years required depending on the complexity of the technology and the technological capabilities of the transferee.

2.4 Technology Capabilities & Assessment

Since the technological capability enhancement can be considered has a measure of determining the success of TT, it is important to study further what specific

capacities are required for a particular firm with respect to their comparative environment.

Sexton and Barrett, (2003) indicate that Technological Capability as the capacity to gain an overview of the technological components on the market, assess their value, select which specific technology is needed, use it, adapt and improve it and finally develop technologies oneself. This is a skill possessed both by direct producers (farmers, workers) and also decision-makers (in companies, in state agencies). Technological capability is not only the prerequisite for independent technological developments but also for successful technology transfer. For us the term technology also involves organization and know-how, and a country's own independent technological efforts and technology transfer are not alternative options but complement each other. A common feature of both organization and know-how is that they can only be partially transferred.

Further they pointed out that there are four pillars on which technological capability is based:

1. The skill of the producers to imitate and innovate;

2. The economic, political, administrative and legal framework conditions, which determine whether incentives to develop technological capability exist. In the past, it was often not recognized that these incentives do not exist in many developing countries, especially if an import substitution policy relieved companies of all pressure to be competitive or to innovate;

3. Direct support by technology-oriented state institutions or specific types of service companies - depending on the given development level, the competition situation and the characteristics of a technology branch in the given country;

4. Indirect support by the educational system; in addition to a sound basic education it is important that technical training of a suitable quantity and quality is available at the secondary-school level and also in the universities.

The close interaction between these four pillars creates technological capability: If framework conditions are not conducive to innovations, learning processes are very arbitrary and take place with a time lag. Successful innovation systems are characterized by close networking between producers, technology institutions and training institutions.

It should be stated that every business does not require all these capabilities at the highest level. Even though the capabilities have been there for the productive sector, they can be applied to the technologies related to the infrastructure sector as well.

It is also important to maintain that "self learning' which is an outcome of commitment, plays a vital role in enhancement technological capacities. A recipients' commitment cannot be ignored in successful TT.

The marking system maintained in the 'Technology assessment score sheet for management to technological capabilities' is used for the assessment of the accumulation of capabilities of a firm. Similarly, the same method can be applied with modification to assess the enhance capabilities of a firm after a particular TT focus.

2.5 Technology components

Purchasing hardware alone is not sufficient to gain these types of capacities, but the different levels of capabilities need different technology components at different levels. Also capabilities need different technology components at different levels.

Enhancement of technological capabilities levels of a recipient also depends on needs and capabilities. For example Malik, (2002) stated that hardware alone is not enough to solve the problems of our societies. Technical problems must be properly recognized and solutions must be properly recognized. Solutions must be developed and once such solutions have reached the production stage, the user will often require specialized knowledge and skills to exploit them efficiently. Knowledge and skills are embodied in people.

The findings of Malik, (2002) stress the necessary of transferring the

knowledge and skills to people along with the hardware, but it depends on the technological requirements of the recipient.

Some authors pointed out the need for acquiring all useful knowledge by the recipient, because the technology can be refined and optimized only with the understanding of the related science even though the technology can be developed without the thorough knowledge of the related science. Understanding of the related science is essential to refining and optimizing the acquired technology. This indicates that knowledge is required for operation and maintenance. However the different levels of knowledge required will have to be decided by the receiver, according to capacities & expectations.

While Malik, (2002) stresses the need of transferring the knowledge along with hardware, some authors indicates the importance of related scientific knowledge for successful Technology Transfer.

2.6 Important Factors in International Technology Transfer

Technology and its choice

As described by De Wit, (1988), there are two approaches for choosing technology and can be mentioned as follows.

Pure Techno –Economic Approach

This is based on technical criteria and well established economic analyzers such as cost benefit analyzers. Using this method one can select the technology that satisfies the stipulated technical criteria and delivers the highest economic efficiency or highest net benefits.

When the chosen technology is utilized in surroundings similar to the area in which it was developed and then successfully commercialized for a similar purpose.

Contingency approach

Considers the other factors like technological capacity to the potential user, nature of supertitle and raw material used when the surrey of the potential adopter of T & T objective functions differs.

2.7 Brief History of Technology Development of Sri – Lanka.

As described by Dissanayaka (2003) Sri Lanka technology can be divided into two major periods.

One, pre – Independence period. In ancient times there existed advance knowledge of technology, and practical geometry and astronomy were well known in Sri Lanka. In the health sector, a number of hospitals were built by several kings, and therefore most writers report that Sri Lanka was very advanced in respect to cotemporary Aurvedic medicine technology. Some writers report that in the Sri Lankan 12th century ancient technology was unique and such technology could not be seen in the rest of the world till the 17th century (Goonathilaka, 1976; Mandis, 1974).

Although Sri Lankan technology was bit an advance in the 16th century it was a dark clement that came after Portuguese incursion from the 16th century. Portuguese introduced their own technology neglecting Sri Lankan unique technology. The Roman Dutch too introduced some technologies. Technological era began from the 19th century with the British colonization. In order to facilitate their agricultural base market they developed irrigation, road sector, Colombo seaport and the rail sector etc. Consequently, Ceylon the Government Railways (CGR), Public Works Department (PWD) were developed. This had created various implications for construction technology transfer.

Two, post- independence period. In order to develop Sri Lankan Science & technology, Ceylon Institute of Science and Industrial Research (CISIR) was the first of such kinds of institutions. But this institution failed to deliver its objectives as reported by many publications (Wijesekera, 1976).

In 1976, United Nations Conference on Trade and Development (UNCTAD) mission came to Sri Lanka and they reported that Sri Lanka has the machinery for screening imported technology but complete and considerable Research& Development (R&D) is required. This mission recommended that a Center for

Transfer and development of Technology be established as a focal point to link R&D institutions with national economic planning apparatus.

During 1960- 1977 period, R&D work did not take place in the in the field of construction sector due to heavy state involvements in the economy. During this period, most of the TTs occurred as donations as mega factories from the Soviet Union. Development in science and technology did not happen after 1983, due to the increase of the ethnic problem in the country.

Not ever the above brief history Sri Lanka of Research & Development (R&D) shows that it was successful. Most of the significant reasons for the failure were lack of high level political commitment and support for the R&D activities. But after the post – war in 2009, reconstruction and rehabilitation efforts and the general economic revival are expected to trigger a construction sector boom in Sri Lanka over the next 5 years. Figure1 exhibits Sri Lankan construction industry growth. It is indicate that the construction industry drastically increased from 2009 to 2013.

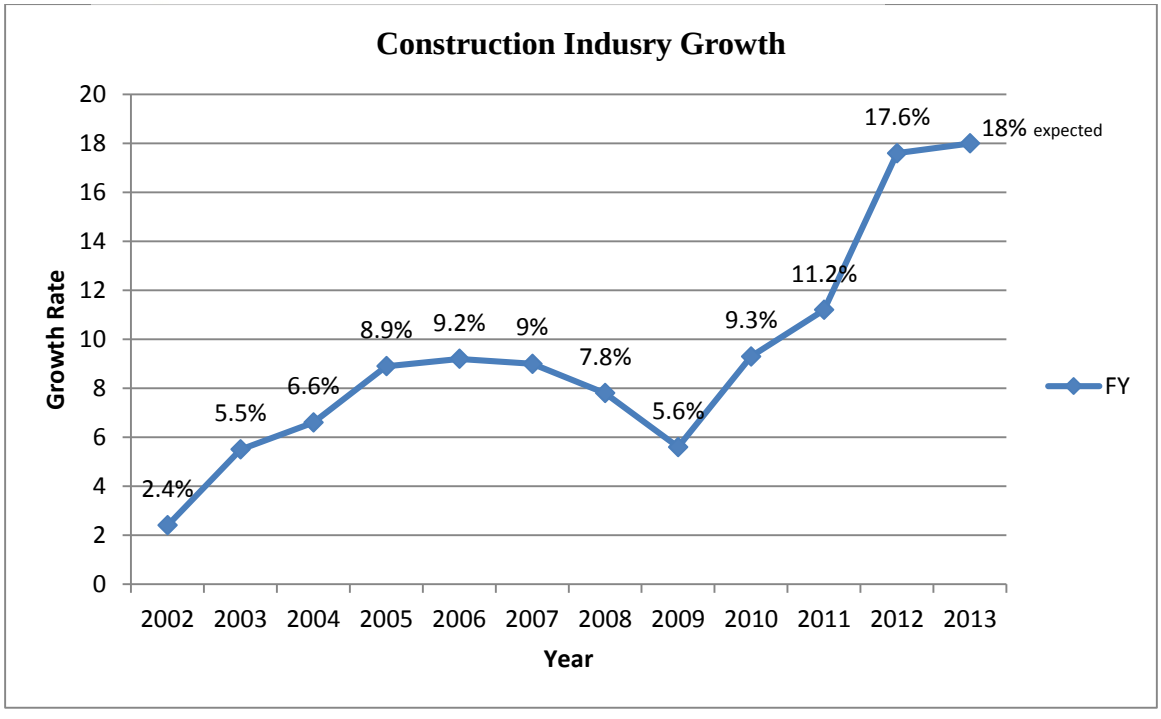

Figure 1: construction industry growth
Source: Central Bank SL IMaCS Analysis

Some of the key areas, which are expected to generate significant demand in the budget 2013 for construction, include power, roads, ports, water supply, sanitation, tourism, and health sector. The budget proposal 2013, the government of Sri Lank has introduced several schemes targeted at the construction industry. This significant demand for construction it will need significant technology and skill, either from foreign or local contractors.

Considering the outlook for the present Sri Lankan construction industry, it is expected that the value of construction projects awarded to local contractors, including sub constructors, will increases annually be approximately 50-60 per cent over the next three years.

According to the Ministry of Finance and Planning, over LKR 700 billion worth of construction related projects have been planned by the Government between 2010 and 2015. Considering massive completed projects such as express ways, Hambantota port further development, Mattala Air port, Norochcolai power plants etc., Government plan has being successes. Although the projects where successful, Government has not measured how much technology was transferred to the Sri Lankan Construction industry or what gained through these projects.

Sri Lanka's construction sector professionals recently called to cut down the number of foreign contractors, consultancies, and labour employed in mega infrastructure projects taking place in the country, stressing the practice has proved harmful to the local construction industry. Unfortunately, it has not happened and as a result, most of the infrastructure projects are handled by the foreign counterparts at a huge cost to the government. The neglect of this matter is that when we check with the donor countries or multilateral development banks, they maintain that it is not their fault but that of the Treasury for not negotiating for the involvement of the local construction industry when funding is sourced for projects.

In the proposed construction and development scenario, developing the road and rail way network takes precedence. The Government is now seriously looking at improving the railway network in addition to roads

From the above outlook once again can say that there will be a significant demand for construction and it should be provide significant technology and skill either from foreign or local contractors.

Less than 5 per cent workers in Sri Lanka have been systematically trained and carry certificates that are indicative of their skill. Due to the high demand for professionals in many countries and the low level of salaries in Sri Lanka, has resulted in a flight of skills. If the construction sector aspires to grow at the rate of 9 per cent in coming years it would require thousands of skilled workers. According to the Industry of Construction, Engineering Servile Housing and Common Amenities the number of skilled construction workers in Sri Lanka is 300,000. It is imperative that the Government and the industry join hands and initiate a skills development programme.

2.8 The role of the technology transfer in innovation within the construction industry.

Performance improvement based on technology absorbed in to construction firms through TT does occur successfully. However firms need to understand and manage technology transfer activity to ensure consistent success. De Wit, (1988) identified the following variables as affecting the degree of success in the process and results of technology transfer.

- person – to – person contractors
- Knowing whom to contract
- Variety of communication channels
- Increase in awareness of transfer
- A sense of common purpose

However, present construction industry technology transfer endeavors are being severely hampered by a lack of proper understanding of such TT issues and their interrelationships to both company capabilities and processes, and the knowledge characteristics of the technologies being transferred in particular (Barrett and Sexton, 1999).

First, current approaches tend to view technology transfer as a mechanistic "pick and – mix" exercise. Indentifying new technologies and trying to insert them in their existing form into unreceptive construction firms.

Second, current TT mechanisms are not sufficiently informed by or engage with, company strategic direction and organizational capability and processes necessary to enable them to absorb technologies and turn them into appropriate innovation. Finally, current TT mechanism does not fully appreciate both the ability and motivation for construction firms to absorb and new technologies are significantly influenced by knowledge characteristics of the technologies.

2.9 Factors influencing the development of Sri Lankan construction industry.

Even though the Sri Lankan contraction industry is in an upward trend since 2009, some barriers are present. The Sri Lankan Government has much more to do to bring their technological status to some satisfied level. One of the major drawbacks is the lack of proper technology policy framework integrated with an industrial development framework.

Devapriya &Ganesan (2002) pointed out that the following are some points that are barriers facing the Sri Lankan construction industry.

- Technological and marketing forces changes and necessary Construction Industry Act are also most important the educate to public and business enterprises.
- There is no due recognition to build Sri Lankans own Science & Technology capacity.
- Another important role is creation of a Science & Technology culture. Sri Lankan government at ministry level should take necessary initiatives.
- Lack of opportunities for domestic industries professionals in foreign funded projects. Very few private sector consultants and contractors have work in infrastructure projects.
- The prevailing tax structure for the construction industry is a deterrent for the development of the industry. As the cost of building materials, bank interest transport and labor cost are still very high.

- Tender awarding procedure also is one of the factors preventing the development of Sri Lankan construction industry.

Most important influence for the development of Sri Lankan construction industry is the prevailing practice of foreign constructions and contractors being given the lead role in government and government aided projects while the local counterpart is given a sub – contracting role. This has to be changed to be the other way, where the local consultants or contractors shall take the lead role and mobilize any expertise necessary from foreign sources.

Other key challenges to the rapid development of the industry include a possible increase in prices of raw materials such as steel, cement, and sand. In addition the skilled labour force in Sri Lanka may be insufficient considering the expected growth in the construction projects.

2.10 Government Incentives

According to the Mahinda Chinthana vision the 10 year development framework for the period of 2006-2016 Sri Lanka's strategy for infrastructure development includes public sector investment through direct budgetary allocation or foreign donor support. Programmes have been designed to channel investments through a consolidated fund, private and foreign direct investment, and public private partner ships. Roads, energy, water supply and sanitation, ports and aviation etc…are main areas of to focus. Creation of a separate ministry for construction in 2007 has enabled to focuse policy development for the industry. A new parliamentary act is being proposed to transform ICTAD (Institute of Construction Training and Development) into Construction Development Authority giving it much wider power and coverage to govern the construction industry.

Some of the incentives are

- Incentives for minimum investment of Rs. 2 million in small scale infrastructure in housing, tourism and water supply, income tax for five years, followed by 10% rate for two years and 20% concessional tax thereafter

- Income tax holidays of 6-15 years for large –scale infrastructure projects. Land acquisition facilities for foreign investors
- land available on lease for 35-50 years, the National Housing Development Authority (NHDA) to provide planning and technical assistance for low-income households to build or improve quality housing
- State banking facilities and internally generated income of NHDA to be used to promote low- income housing.
- A construction technology power to be established to popularize skills and low cost housing technology.
- Training skills for construction as well and research and development to bring down the cost of construction to be treated as an allowed expenditure against income tax.
- Encouraging foreign contractors to establish working partnerships with local construction companies.
- Customs duties on a few construction raw materials have been reduced.

2.11 Foreign Contractor's Involvement

The Sri Lankan government intends to develop stronger economic ties with other countries such as Qatar, Singapore, Jamaica, and Spain. Indirectly, a part of these investments will flow into the country's construction sector. So that foreign contractor's involvement is high.

The exchange control relaxations effected by the central bank in November 2010 have facilitated foreign exchange transactions and business activities during the past few months. The relaxation measures which enables companies to borrow foreign loans. Resulted in 20 new foreign companies commencing business in Sri Lanka year 2013.Sri Lanka's entire mega projects business has been formed out of four Chinese companies and seven Indian companies, with over 30,000 semi- skilled and unskilled Chinese workers, throughout the country.

Chinese companies are currently engaged in the Norokcholai power plant, Colombo Katunayaka expressway, Kankasantura rail – line, Jaffna housing complex for the army and a host of other projects. The entire Hambanthota project is expected to cost about US$ 1.5 billion and a consortium of Chinese companies lead the project construction.

China's Huuichen investment will provide US$ 28 million and manage a special economic zone at Mirigama for Chinese investors. In addition China has provided US$ one billion as humanitarian aid and for internally displaced persons and technical assistance for de-miming operations in Northern and Eastern province. Some 332 km of road inclusive of the Kandy – Jaffna Highway will be developed and modernized with Chinese funding of US$ 355 million India is also stepping into Sri Lanka's mega project business in a big way by entering into building construction in the North and East. A Mumbai –Based Company will manage the project to build 12,500 houses in the Kilinochchi district and similar number in the Mullatitivu district, 10,000 houses in Vavuniya and 15,000 in Jaffna and Mannar, under the supervision of the Government of India. Indian companies have won bids in railway expansion projects in the North and the South as well as in the proposed coal power project in Saampurni in Trincomalee. President of Chamber of Construction Industry Sri Lanka (CCISL) has been appealing on a regular basis to the Treasury to include in their contracts with donor funding organizations a substantial portion of the work to the local construction industry. Unfortunately, the Treasury is not thinking out of the box. The question is, why the local contractors unable to do at least two or three story building projects?. Don't they have the technology? The treasury is still adopting old models of economic theory, which is ineffective in today's technology advanced world.

The Chinese influence is gradually changing the community in Hambanthota and the agriculture industry in the area is providing Chinese – type green vegetables to around 350 Chinese workers at the harbor construction site as these vegetables are not available in the Sri Lankan market. The Project has been funded by the JICA Livelihood improvement programme. It focused on agriculture and institutional

development and income generation among the villagers in Hambanthota. Hence agriculture sector (irrigation) technology transfers are taking place.

2.12 Foreign Contractors Entry Modes

2.12.1 Foreign Direct Investment (FDI)

Foreign Direct Investment and trade has grown in an unprecedented fashion. FDI has rocketed from 2009 in to being the Sri Lankan government's, largest recipients of foreign investment received to the country. In terms of growth in FDI, the most remarkable increase was registered by Sri Lanka with an impressive 70 per cent between the years 2010 to 2012. In 2011, a record high level of investment poured in to Sri Lanka.

While generally the effect of FDI on growth has been viewed as positive with FDI raising the welfare level of the recipient country,

Researchers have found significant improvements in the local contractor's ability as a result of Foreign Direct Investment and Participation. It is related to the Technology Transfer.

2.12.2 Joint Venture, Partners

Kumaraswamy (1997) proposed a basic model for appraising potential partners in terms of their short and long term objective, resource pools and compatibilities.

Sri Lankan construction industry is in talks with a top Indian infrastructure finance company on setting up a fund to support the Island's post war construction activity, said Surath Wikramasingha, president of the Chamber of Construction Industry.

This statement reveals that India and Sri Lanka attempt to start joint ventures in the construction industry. It is the most popular foreign contractor's entry mode in any country.

2.12.3 Sub contractor

The sub contracting arrangements as a vehicle for Technology Transfer , involving different parties from a part of a joint venture itself , during its operation. Local contractors who are disqualified from bidding for a project in their own capacities, often end up as sub contractor (Kumarassamy, 1995) Reducing the size of the work packages, formed by increased opportunities for local bidders and thereby promote technology acquisition process.

2.13 Impact of Foreign Contractors

Recently, several major projects, such as power plants, ports, express way, are constructed by the foreign funds technology and contractors.

Most of the Sri Lankan firms do not have sufficient funds and expertise for such projects. Table 1 exhibits how the foreign contractors are involved in the Sri Lankan construction industry. Development projects are heavily funded by international entities, particularly originating from the People's Republic of china.

85% of the Colombo- Katunayaka highway is funded by a loan provide by China with engineering carried out by the China Metallurgical Corporation.

The foreign firms are not keen on effectively transferring their technology since they believe that it means they would be nurturing their future competitors. Both local and foreign firms will benefit if systematic efforts are made by the latter to develop the former.

Table 1: Involvement of Foreign Contractors in Sir Lankan Constriction Industry

	Major initiatives	**Time Duration**	**Estimated Total Project Value**	**Major Constructor and Suppliers**
Roads and highway	MAGA NEGUMA Highway and expressway	2007- 2017	$ 6.2 billion	Access Engineering Maga Engineering MTD Walkers China Harbor Eng.
Ports and Aviation	Colombo and Hambantota Ports, Mattala and Katunayaka Aviation projects, Funded through China and JICA and separately	2010- 2016	$2.5 billion in ports and $660 million in airports	MTD Walkers, China Harbor Engineering (China) Zhenhua Airport consultant (Japan)
Energy, Telecom, and related infrastructures	Norochcholai and Sampur coal and Termal projects, Telecom upgrade of over 1000 towers	2009-2016	$ 500 million line of credit for Sampur $375 million for Norochcholai	MTD Walkers, China Machinery Engineering
Commercial and Residential construction	Tourism and Housing projects	2009- 2020	$375 million in hotels constriction	Various suppliers and constriction

Source: Sri Lanka Commercial Construction Business opportunity 2006-2012- May, 2011

Thalgodapitiya says, Sri Lanka is deeply involved with the Chinese but they have a particular system of work . They fund projects, and then recover all of that funding in 4-5 months by selling machinery, consultant, systems and software etc. They

Also bill for the engineer who does not have the working knowledge of Sri Lankan labourse. At the end, having to pay their salaries that are highly inflated. So it's a bit like double taxation, they recover their investment.

Projects which are large and complex are undertaken by foreign contractors but it is the responsibility of the State to use available construction work to support the growth and development of the indigenous contractors enabling eventual replacement of foreign contractors.

Provision of international finance for implementation of major infrastructure projects, particularly when local construction companies lack finances and sometimes expertise to participate in the sponsorship of privatized projects. Nevertheless, foreign direct investment in projects could lead to an increase in construction demand creating opportunities for domestic companies.

It is observed that, the objective of foreign construction enterprises and host developing country governments differ. In the long- term, the gap between local construction firms and their foreign counterparts in technology, finance and management know-how could be filled through technology transfer, for example, via joint venture among the two groups of firms.

However, several authors have mentioned the difficulties involved in technology transfer, including the tendency of foreign contractors to adopt strategies which do not support host countries efforts to develop their industries.

The foreign firms are not keen on effectively transferring their technology since they believe that it means they would be nurturing their competitors. Both local and foreign firms will benefit if systematic efforts are made by the latter to develop the former.

2.14 The Role of the Technology Consultant

Effective transfer of technology, as applied to Consulting Engineering and related professions, comprises the transfer of knowledge and experience from an

organization, or individuals, to those not possessing such skills. This policy statement deals with the transfer of technical and management skills of developed countries' professionals to their colleagues in developing countries. It should be emphasized that knowledge of local political, social and environmental conditions, and on indigenous techniques and materials, is equally important to ensure that the acquired knowledge and experience can be put to effective and lasting use by the receiving party. The principle of appropriate transfer of technology in the terms of this policy statement. Technology transfer as an essential element in the process towards sustainable development on a global scale. Accordingly, the transfer of technology, and how it should become a necessary element of projects undertaken in the developing world. In some cases, such transfer could even comprise the entire scope of a project.

Consulting Work as a Channel for Transfer

The transfer of know-how is a continuous process taking place in all sectors of society. However, an obvious and effective channel for accomplishing this transfer is professional consulting work, which generally starts with the conceptualization, planning and development of capital projects, and then continues through design, implementation, operation, maintenance and rehabilitation. In professional consulting work, the transfer of know-how usually involves the passing of knowledge and experience from consulting organizations or individual consultants of the industrialized countries to the local consultants, or the staff of clients, in developing countries.

Working in Mixed Teams

There are many ways to achieve transfer of knowledge and each method has a particular advantage or disadvantage depending on many factors. It is very important to carefully select the appropriate method in view of the local circumstances and objectives. Notwithstanding the method of approach, however, an effective transfer of knowledge through development projects will hardly be possible unless the receiving party plays a meaningful role in the project. A passive counterpart system has proved not to be the answer. Integration of clients' and consultants' teams, or of local and foreign consultants, will ensure the local input necessary to make transfer of knowledge work.

Classroom type of instruction and on-the-job participation

The transfer of know-how can take place in the client's country or in the country of the foreign consultant, or possibly in both places. It can be achieved through formal classroom type instructions, and/or on-the-job participation and training in the planning, design, implementation and commissioning of projects. Ideally, the recipient personnel should receive formal classroom type instruction and also be required to apply the knowledge thus acquired by working on projects.

Comprehensive scope of skills to be transferred

The transfer of know-how should be aimed not only at passing on technical skills, but also at teaching the overall aspects of project development, environmental concern and project management, as well as company administration and finance. The full integration of project teams should be recognized as an important requirement for achieving the optimum transfer of technical, ecological, administrative and financial know-how from foreign to local consulting firms.

This comprehensive skill is often overlooked with the result that the transfer of skills to individuals may be successful, but the receiving party may not be able to benefit because of the failure of the local business unit. Accordingly, the strengthening of the consulting industry should be an objective to enhance the survival rate of local firms.

2.15 Impact of Globalization

Globalization of construction industry will greatly affect the Sri Lankan construction industry and also improve the economy. Adaption of new equipment, infrastructure, advent of Information technology and safety measures, will be the order of the day. Experts in technology have come forth, with vision of the future growth and given their views on the subject and construction vision 2020 from their futuristic eyes. Recently, several major projects, such as Keraverapitiya power plant, Hambantota port, are constructed by using foreign funds, technologies and contractors. Sri Lankan construction firms have no funds or expertise in such projects, but direct foreign investment in projects leads to increase in construction demand, creating

work opportunities for local contractors. Table 2 exhibits advantages and disadvantages of globalization.

Table 2: Advantages and Disadvantages of Globalization Considering Construction Industries in Developing Countries

Advantages	Disadvantages
Involvement of international finance makes possible the implementation of several projects, such as those of major infrastructure	Local construction firms have no funds or expertise to participate in the sponsorship of privatized projects.
Direct foreign investment in projects leads to increase in construction demand, creating work opportunities of local firms	Local construction companies lack of technical and managerial capability to undertake most of the foreign funded projects
Competition among foreign firms lowers the costs of projects to developing countries	It is possible that local firm will be deprived of the opportunity to grow
Presence of large number of international firms offers scope for technology transfer and the industry. The large numbers of such firms also means that technology transfer can be for competition	Foreign construction firms play lip service to technology transfer, or take measures to avoid it. Moreover, local companies may not be in a position to benefit from technology transfer, or to subsequently utilize the acquired

Sources: Raftery et al (1998)

Even though it is argued that presence of a large number of international firms offers scope for technology transfer, upgrading of the domestic industry and development of local companies, more often than not in actual fact very little technology transfers have taken place. Globalization should cause competition among overseas contractors hopefully lowering the Project Cost, but it may result in curtailing opportunities for growth of domestic companies. However, several authors have mentioned the difficulties involved in technology transfer, including the technology

of foreign contractors to adopt strategies which do not support host countries, efforts to develop their industries.

2.16 Summary of the Key Issues in Technology Transfer

- The business model of Technology Transfer has been used to suggest development paths of technology transfer based on mutual advantage for the acquirer and the supplier.
- The framework identifies technology transfer routes for countries with a limited industrial base that have been slow to gain revenues from supplying the technology, but again careful consideration is needed in managing the arrangement and valuing the technology.
- Prevailing practice of foreign contractors being given the lead role , while the local contractors given a sub contracting .
- More consider about Government Intensive to improve technology.
- Foreign construction firms play lip service to technology transfer, or take measures to avoid it. Moreover, local companies may not be in a position to benefit from technology transfer, or to subsequently utilize what is acquired
- Local construction firms have no funds or expertise to participate in the sponsorship of privatized projects.
- Considered Role of Consultant for the technology transfer
- Impact of globalization for the technology transfer.

CHAPTER 03

METHODOLOGY OF STUDY

3.1 Introduction

This chapter explains the framework which was set for the research process. Since the main objective is to find out new technology for the Sri Lankan construction industry and how to improve such technologies using domestic skills. Research methodology was set to achieve the aforementioned goals. Therefore it consists of procedures to absorb information from various levels of the construction industry managerial persons and current trends of international construction industry via literature review.

3.2 Methods of Data Collection

A survey was carried out on the sample targeting construction companies' employees who were involved in technology transfer processes. TT processes were defined as some form of knowledge, material or equipment transferred on the construction industry from one foreign party (such a person or organization) to another local party(as a person or organization) that arrange to receive it. Thus, respondent from Sri Lankan construction industry were considered the best respondents to evaluate the learning environment factors and their effect on variables pertaining to the TT process and the performance it can potentially generate.

The questionnaire provides several options for the respondent for answering the questionnaire and provides enough time for respondents provide the correct information required for the questionnaire. The objective of the questionnaire is to concentrate on all research questions. Each question in the questionnaire signifies a factors or number of sub factor that need to be measured in the population.

The questionnaire consists of a set of questions written to the very meaning of what is required of the query. This study is aimed at to investigating only the Sri Lankan construction industry and ICTAD registered ranked , C1 twenty numbers and C2 twenty numbers and C3 and ten numbers (all together fifty) respectively. The

reason of selection of CTAD registered ranked C1, C2, C3 was that, it was realized during the preliminary discussion with the contractors, that they have sufficient resource, educated staff, financial strength and other requirements and are involved in technology transfer processes but they only haven't modern and high technology for development of local construction industry in Sri Lanka. In the mean time, other contractors like (or are willing) to upgrade their skills (or technology) through feign contractors. However, for this questionnaire, I selected ICTAD ranked C1, C2 and C3 local contractors only.

To achieve the objective of the questionnaire, the selected sample for this study included employers and engineers in the construction organizations.

3.3 Questionnaire Survey

Based on the literature survey and interviews, key issues were identified for the questionnaire. Actually this is most important part of this research. Hence several discussions were held with the project supervisor and several revisions were made to suit the requirements and be user friendly.

The questionnaire consists of two parts. The First part is used to identify the back ground of the respondent. Under the first part, respondent's information such as name, organization and designation were asked. However the respondent was allowed to refrain from answering some quarries such as address, to keep confidentiality.

Part two consists of ten questions of general information of respondent's (or Contractor) regarding various aspects of foreign and local contractors.

Those fifteen questions "Agreed" on a scale of 1 to 5. Each equation carried out with few sub questions.

3.4 Method of Data Analysis

Accordingly the responses obtained for the questionnaire were analyzed using Relative Important Index (RII) method, in order to recognize the effect of each factor identified in Technology Transfer.

RII was calculated as follows

$$\text{Relative Important Index} = \frac{\sum \mu}{A \times N}$$

Where,

"μ" is the constant expressing weight given to each response, (ranging from 1 to 5)

"A" is the highest weight (i.e. 5)

"N" is the total number of respondents

RII value had a range from 0 to 1. Highest value gives the highest significance for the case.

CHAPTER 04

ANALYSIS OF DATA AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter focused on a thorough analysis of the responses received from the respondents. The responses were received by post and by hand. Fifty questionnaires were distributed. Forty Seven were received. When analyzing the responses, it was identified that three questionnaires were not fully completed. Since they were not fully completed, we assume that respondents had not taken good care to fill the questionnaire and their responses cannot be accurate. Therefore, those partly filled questionnaires were not taken in to the analysis. Forty four completed questionnaires were taken for the analysis.

4.2 Specimen calculation for Relative Important Index (RII)

$$\text{Relative Important Index} = \frac{\sum \mu}{A \times N}$$

Consider table number 3,

μ_1=1*1=1, μ_2=2*36=72, μ_3=3*5=15, μ_4=4*2=8, μ_5=5*0=0

$\sum \mu$=1+72+15+8+0 = 96

A = 5

N = 44

$$\textbf{Relative Important Index} = \frac{\sum \mu}{A \times N}$$

$$= \mathbf{0.44}$$

Similarly all the RII were tabulated and according to the responses, relative important index of each query are as follows.

Table No 3: Relative Important Index (RII)

Scale of 1 to 5 as follow:		*1=Totally disagree;*		*2= Disagree;*		*3= Neutral;*		*4= Agree;*				*5= Strongly agree*
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**$\sum\mu$**	**RII**
E1	Indicate the extent to which each of the following were the vehicles through which foreign contractors influenced their local counterparts (in general)												
	Inspiration as role models			7	32	5			21	128	25	174	0.79
	Targets for corporate benchmarking				40	4			0	160	20	180	0.82
	Transfer of construction techniques			4	35	5			12	140	25	177	0.80
	Transfer of managerial skills and systems			2	38	4			6	152	20	178	0.81
	Transfer of corporate policies and attitudes			2	36	6			6	144	30	180	0.82
	Demonstration of construction techniques		15	9	20			30	27	80		137	0.62
	Offering of competition		1	1	37	5		2	3	148	25	178	0.81

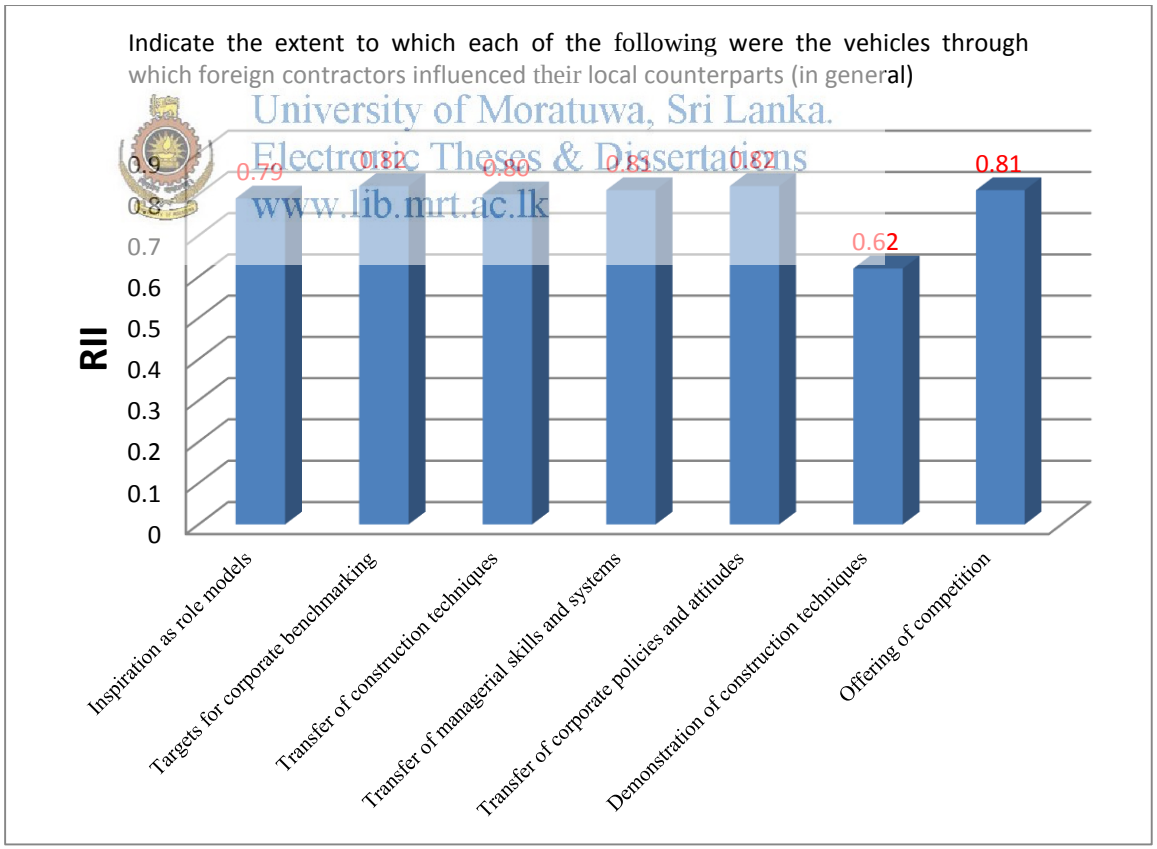

Figure 2: Graphic for performance of the last ten years (In general)

Effects due to project performance can be ranked as follows.

1. Targets for corporate benchmarking
1. Transfer of corporate policies and attitudes
2. Offering of competition
2. Transfer of managerial skills and systems
3. Transfer of construction techniques
4. Inspiration as role models
5. Demonstration of construction techniques

In general, the all important index is almost 80 present. It is noted that foreign contractors influenced their local counterparts in above mentioned vehicles. Corporate policies and attitudes, target for corporate benchmarking and the highest important index among them.

The policies and attitudes of foreign contractors have highly affected the transfer of technology. 82% of local contractors agree on it, . Similarly, foreigners are not willing to transfer their managerial skills and systems to the local contractors. It is seems they create competition between them and local contractors.

Similarly in this quarry, foreign contractors are not willing to Transfer and Demonstrate their techniques. Due to that once again they create a competition between them. For example, “Malaysians Miwan system formwork” (ready made Formwork) is a highly technological formwork system, but when they used it in Sri Lanka they did not even demonstrate about it. However, MAGA engineering company purchased such a set of formwork.

Hence we can conclude that foreign contractors are not only not willing to transfer and demonstrate their techniques, but are not willing to target corporate benchmarking and transfer of corporate policies and attitudes.

Table 4: RII for performance of last ten years

Scale of 1 to 5 as follow: *1=Totally disagree;* *2= Disagree;* *3= Neutral;* *4= Agree;* *5= Strongly agree*													
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**∑μ**	**RII**
E2	Over the Past 10 Years, local contractors have improved in the following areas (performance):												
	Ability to apply complex technologies		7	3	32	2		14	9	128	10	161	0.73
	Ability to provide design-and-build services		2	4	29	9		4	12	116	45	177	0.80
	Track record of large and complex projects				39	5				156	25	181	0.82
	Application information technology			2	36	6			6	144	30	180	0.82

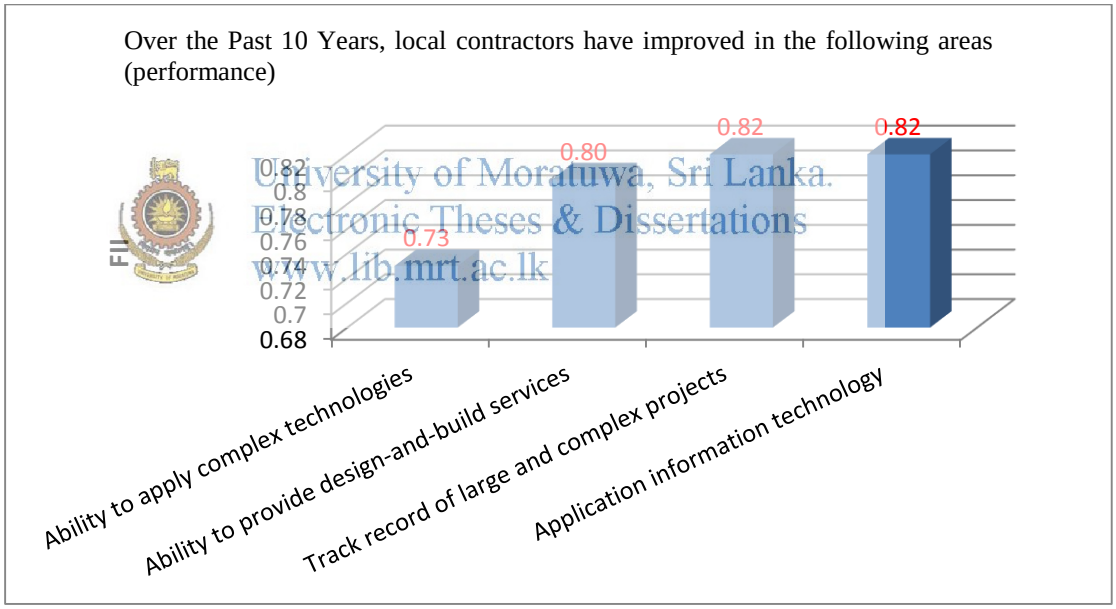

Figure 3: Graphic for performance of last ten years (In performance)

Effects due to project performance can be ranked as follows.

1. Application information technology
1. Track record of large and complex projects
2. Ability to provide design-and-build services
3. Ability to apply complex technologies

Discussion

Modern information technology is the highest most important index in this query. Actually in the past ten years the Sri Lankan construction industries improved their information technology through various ways. For example, a client can see the current progress through Skype without visiting the site. Even foreign contractors can share information with their parent office through it. Presently local contractors use it. With the help of information technology they can got more benefits for the construction field.

Most of the Local contractors in the Sri Lanka do not have a proper record system. It is very effective, when applying transferred techniques for the good performance of a project.

Table 5: RII for vehicle through joint venture

Scale of 1 to 5 as follow:	*1=Totally disagree;*	*2= Disagree;*	*3= Neutral;*	*4= Agree;*	*5= Strongly agree*								
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**$\sum\mu$**	**RII**
E3	Indicate the extent to which each of the following were vehicles through which foreign contractors had an influence on their joint venture partners,												
	Training of local partner's staff				39	5				156	25	181	0.82
	Structured programmed for development of local Partner's company		2	14	25	3		4	42	75	15	136	0.83
	Transfer of construction techniques		2	3	34	5		4	9	136	25	174	0.89
	Transfer of managerial skills and systems			2	37	5			6	148	25	179	0.92
	Transfer of corporate policies and attitudes		20	13	11			40	39	44		123	0.62
	Transfer of relationships with subcontractors		20	18	6			34	48	24		106	0.63
	Transfer of relationships with suppliers			16	27	1			39	100	5	144	0.61

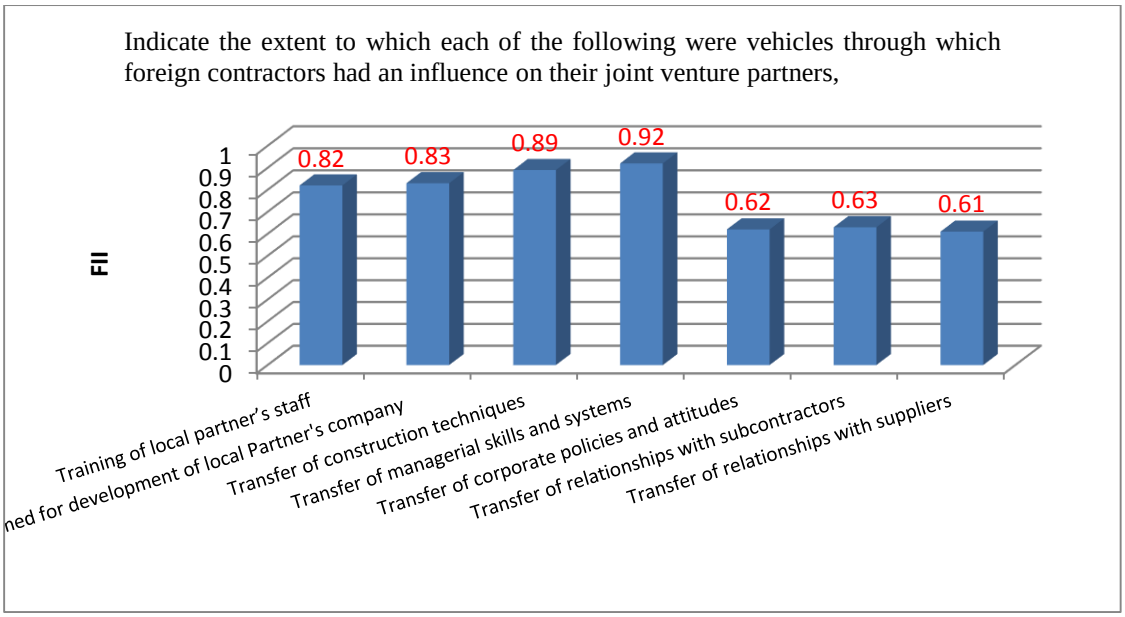

Figure 4: Graphic for vehicles through joint venture

Above query can be ranked as follows.

1. Transfer of managerial skills and systems
2. Transfer of construction techniques
3. Structured programmed for development of local Partner's Company
4. Training of local partner's staff
5. Transfer of relationships with suppliers
6. Transfer of corporate policies and attitudes
7. Transfer of relationships with subcontractors

Discussion

According to this effective important index, Managerial skills must be developed in local contractors through joint ventures. Actually this is the most important factor for the domestic contractors, but it is not happening. Most of the mega projects which include ports, highways and airports that are being undertaken by the Government. Also such mega projects funded as "Built, Operate and Transfer" (BOT) system projects. Hence, foreign firms are not keen on effectively transferring their technology since they believe that it means they would be nurturing their future competitors. Both local and foreign firms will benefit if systematic efforts are made by the government policy makers. They should include in their contract with donor funding organizations a substantial portion of work to the local construction industry. Unfortunately it's not happening.

Table 6: RII for Incentive and support by the government

Scale of 1 to 5 as follow:		*1=Totally disagree;*		*2= Disagree;*		*3= Neutral;*	*4= Agree;*	*5= Strongly agree*						
Question NO	**Query**	**No. of Respondent**					**μ**							
		1	2	3	4	5	μ_1	μ_2	μ_3	μ_4	μ_5	∑μ	**RII**
E4	Indicate the extent to which each of the following types of incentive and support schemes offered by the Sri Lankan government has helped local firms to upgrade:												
	Financial incentives				39	5				156	25	181	0.82
	Advisory services				35	9				140	45	185	0.84
	Market information				37	7				148	35	183	0.83
	Training of skilled workers				39	5				156	25	181	0.82
	Training of site supervisors			2	37	5			6	148	25	179	0.81
	Short courses for professionals and technicians				39	5				156	25	181	0.82
	Seminars and workshops			1	39	4			3	156	20	179	0.81
	Improvement of business environment				38	6				152	30	182	0.83
	National awards				37	7				148	35	183	0.83

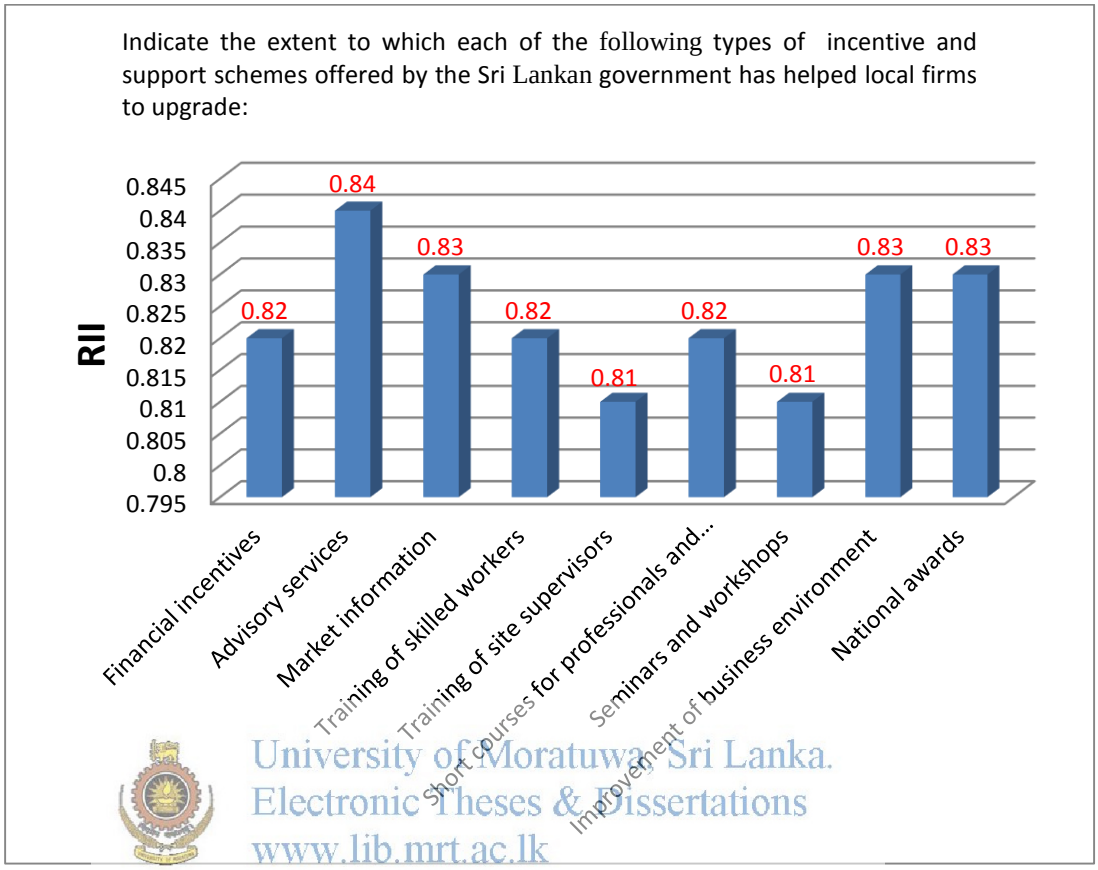

Figure 5: Graphic for Incentive and support by the government

Effects due to project performance can be ranked as follows.

1. Advisory services
2. Market information
2. National awards
2. Improvement of business environment
3. Financial incentives
3. Training of skilled workers
3. Short courses for professionals and technicians
4. Seminars and workshops
4. Training of site supervisors

Discussion

In this query, adversary is the highest RII. But others also are almost the same. For upgrading local firms through adversary services. The Sri Lankan government established various institutions such as ICTAD, NHDA etc. In the literature review too revealed that the Sri Lankan government much more to bring their technological status to some satisfactory level. Actually it has been happening since four year back. ICTAD, NHDA organizing some training programs for site supervises, short courses for professionals, national awards, seminars and workshops etc; to assist enhance local firms.

The national responsibility of the construction industry has been assigned to the Ministry of Construction, Engineering Services, Housing and Common Amenities. Secretary to the Ministry Gotabaya Jayaratna stated (*Sun Day Observer, 26 February 2012, Business Volume page 15*) that they are developing the Construction Industry Development Authority, hence local contractors should have been given more advisory services, market information etc;

Table No 7: Relative Important Index (RII)

Scale of 1 to 5 as follow:	***1=Totally disagree;***	***2= Disagree;***	***3= Neutral;***	***4= Agree;***	***5= Strongly agree***								
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**$\sum\mu$**	**RII**
E5	The most appropriate measures which could be adopted to enable local companies to derive direct benefits frame foreign firms operating in Sri lank are:												
	Make formation of joint ventures mandatory for												
	all their projects.			5	35	4			15	140	20	175	0.80
	Impose floor/financial limits on projects which									0	0	0	0.00
	Foreign firms can tender for limited amount				38	6				152	30	182	0.83
	Specify technologies to be transferred on each												
	project and monitor progress towards it				40	4				160	20	180	0.82
	Exclude foreign firms altogether				35	9				140	45	185	0.84

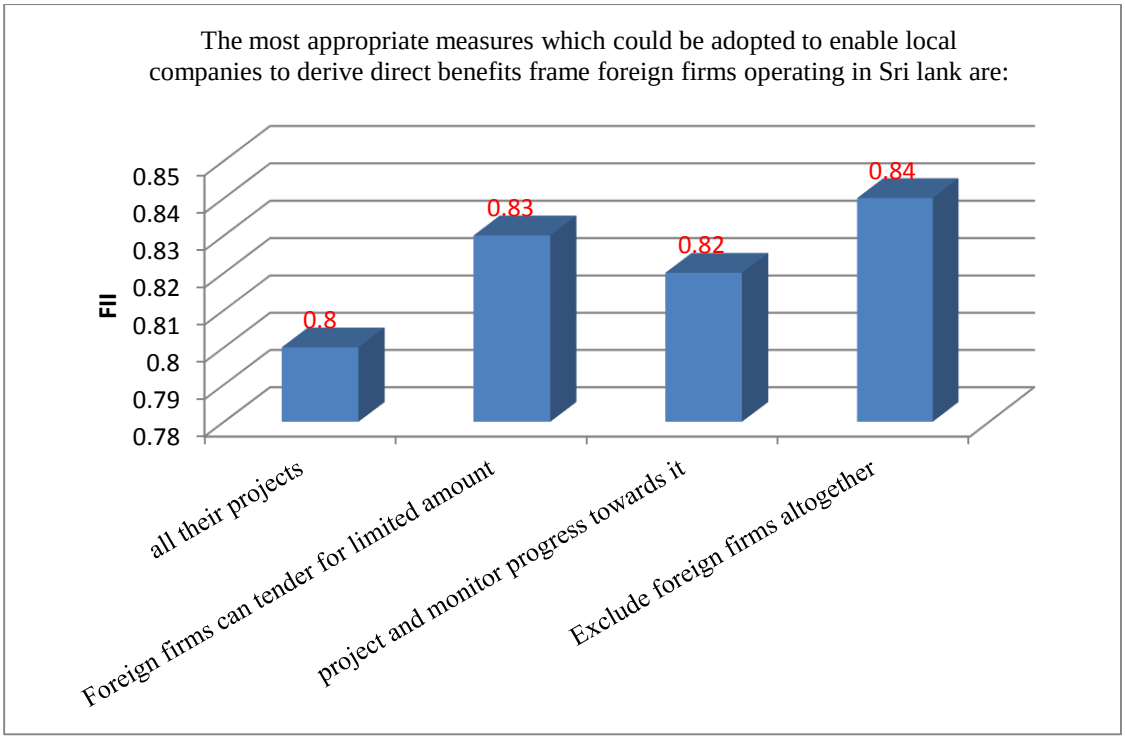

Figure 6: Graphic for direct benefits

Effects due to project performance can be ranked as follows.

1. Exclude foreign firms altogether
2. Impose floor/financial limits on projects which Foreign firms can tender for Limited amount.
3. Specify technologies to be transferred on each project and monitor progress towards it.
4. Make formation of joint ventures mandatory for all their projects.

Discussion

In this query also almost all the measures are same on Important Index. When local contractors and foreign contractors work together, it is the most appropriate method for technology transfer. 0.84 percentage of Important Index on it.

If they apply a special financial management systems or an uncommon construction method (like Miwan form work system), it should be transferred to local contractors through work together.

Even if the formation of joint ventures is mandatory for all projects it is the fourth in the relative important index, it is the easiest way for technology transfer.

Table 8: RII for local firms has helped them to upgrade:

Scale of 1 to 5 as follow:	*1=Totally disagree;*	*2= Disagree;*	*3= Neutral;*	*4= Agree;*	*5= Strongly agree*								
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**$\sum\mu$**	**RII**
E6	. Indicate the extent to which each of the following measures adopted by local firms has helped them to upgrade:												
	Employment of professionally qualified persons				40	4				160	20	180	0.82
	Adoption of human resource management policies				21	23				84	115	199	0.90
	Institution of quality management system				11	33				44	165	209	0.95
	Joint ventures with foreign companies			2	40	2			6	160	10	176	0.80
	Strategic alliances with foreign companies			2	37	5			6	148	25	179	0.81
	Strategic alliances with other local contractors				40	4				160	20	180	0.82
	Strategic alliances with forms outside construction				37	7				148	35	183	0.83
	Establishment of better relationships with clients				39	5				156	25	181	0.82

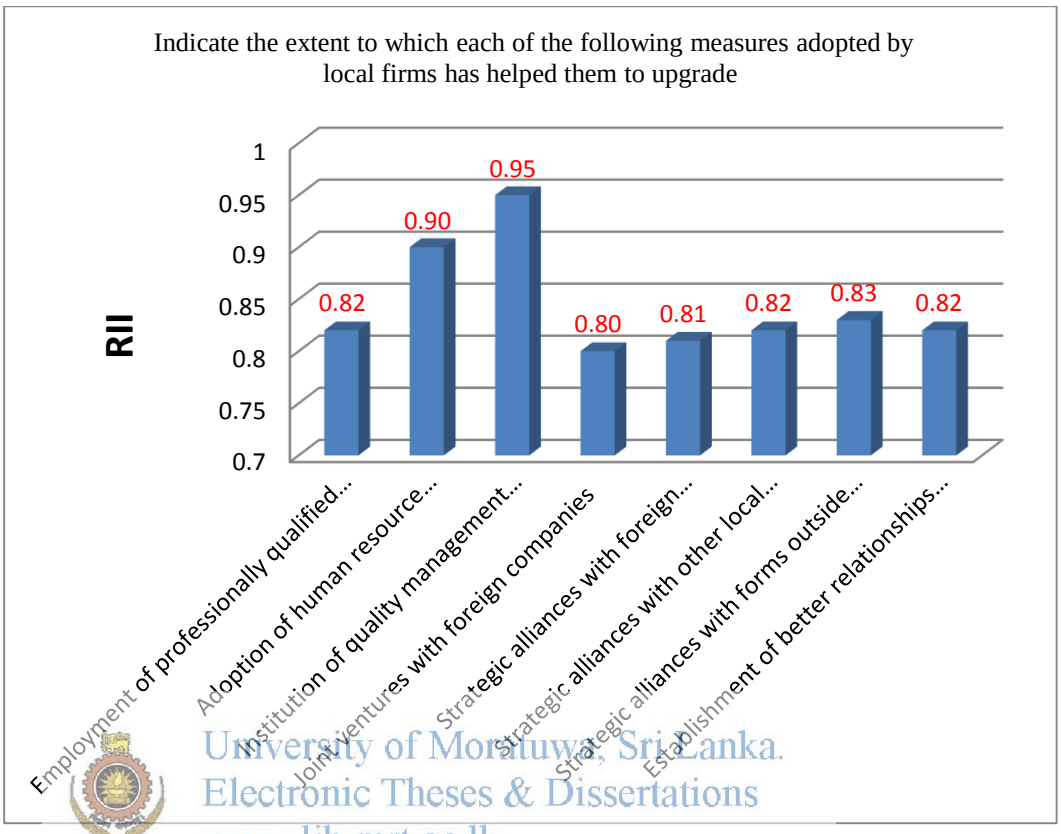

Figure 7: Graphic for local firms has helped them to upgrade:

Effects due to project performance can be ranked as follows.

1. Institution of quality management system
2. Adoption of human resource management policies
3. Strategic alliances with forms outside construction
4. Establishment of better relationships with clients
4. Strategic alliances with other local contractors
4. Employment of professionally qualified persons
5. Strategic alliances with foreign companies
6. Joint ventures with foreign companies

Discussion

Compared with foreign firms most of the local contractors do not consider high the quality of the product. The most relative important index of this query is "institution of quality system" and 75% strongly agree and 25% agreed to improve their quality of product. The Institution of Quality Management is formulating and implementing its plan, in order to upgrade. Local firms against the foreign contractors to achieve that target through joint ventures with foreign companies local contractor, can adhere to their quality management systems through technology transfer. Strategic alliances with foreign contractors is the most important factor for upgrading the local contractor.

Table 9: : RII for initiate by the CCISL has helped companies to improve upon their performance:

Scale of 1 to 5 as follow:	***1=Totally disagree;***	***2= Disagree;***	***3= Neutral;***	***4= Agree;***	***5= Strongly agree***								
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**$\sum\mu$**	**RII**
E7	Indicate the extent to which each of the following initiate by the Chamber of Construction Industry Sri Lanka has helped companies to improve upon their performance:												
	Running training courses for contractors' personnel				4	40				16	200	216	0.98
	Organizing seminars for members				5	39				20	195	215	0.98
	Lobbying government on members 'behalf				6	38				24	190	214	0.97
	Offering networking opportunities at home				6	38				24	190	214	0.97
	Offering networking opportunities overseas				4	40				16	200	216	0.98
	Construction Industry Information Network				6	38				24	190	214	0.97
	Continuing professional development				6	38				24	190	214	0.97
	Sri Lankan List of Trade Subcontractors				4	40				16	200	216	0.98
	Safety consultancy				3	41				12	205	217	0.99

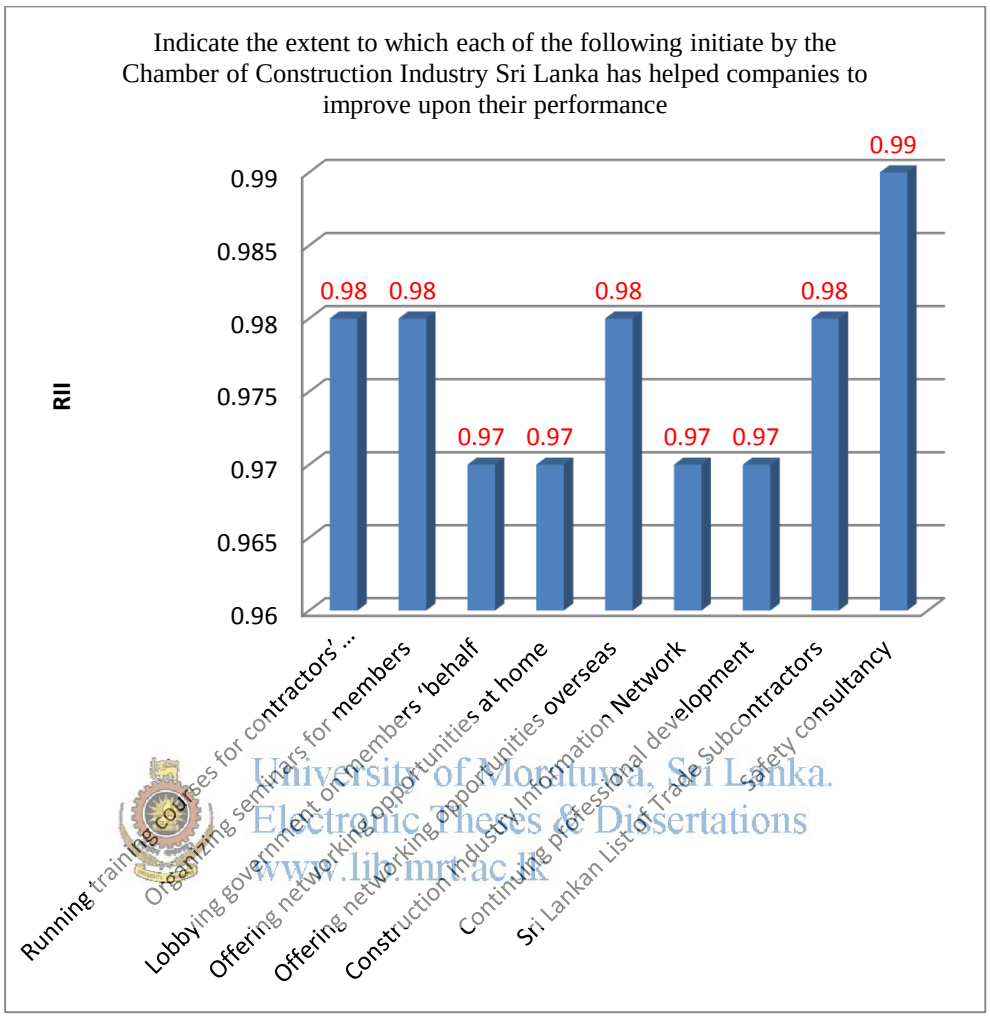

Figure 8: Graphic depicting initiatives how by the CCIS has helped companies to improve upon their performance:

Effects due to project performance can be ranked as follows.

1. Safety consultancy
2. Running training courses for contractors' personnel
2. Organizing seminars for members
2. Offering networking opportunities overseas
2. Sri Lankan List of Trade Subcontractors
3. Continuing professional development
3. Construction Industry Information Network
3. Offering networking opportunities at home
3. Lobbying government on members 'behalf

Discussion

One of objectives of this research is "how improve or modify such technologies using domestic skills". The Chamber of Construction Industry, Sri Lanka is a vital institute for that. The highest RII of this query is safety consultancy. In query E4 (see Appendix-2,) indicates the local contractor.

In this query, according to RII, CCILS has helped companies to improve their performance in every direction, because all of them are more than 98% important.

In order to achieve that CCI recently organized a seminar on ocean resources to educate local contractors and related industries. Actually it is an important step that the CCI has taken as mensioned in the literature review; the foreign contractors sell most of their equipment to the local contractors. Therefore such seminars are very important to domestic contractors.

The CEO of the chamber, Talgodapitiya says the chamber has recognized the vast potential for exploitation of ocean resources and the need to ensure its optimum utilization practically at a time when Sri Lanka is going through an economic growth. This is very good opportunity for local contractors to test their capabilities regarding technology that was transfer from foreign contractors.

Moreover CCISL is to host a seminar on "procurement practice in the construction industry" under its continuous technical upgrading program to benefit consultants and contractors attached to the construction industry.

In order to Train sub contractors, CCI has helped companies to improve their performance, it's president has been appealing on a regular basis to the Treasury to include in their contracts with donor funding organization a substantial portion of the work to the local construction industry.

Table No 10: Relative Important Index (RII)

Scale of 1 to 5 as follow:	*1=Totally disagree;*	*2= Disagree;*	*3= Neutral;*	*4= Agree;*	*5= Strongly agree*							
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**$\sum\mu$**	**RII**
E8	Indicate the extent to which each of the following measures adopted by clients has helped local firms to improve upon their performance:												
	Short listing opportunities				40	4				160	20	180	0.82
	Alternative design possibility			5	37	2			15	148	10	173	0.79
	Favorable contractual terms				39	5				156	25	181	0.82
	Design and build opportunities				3	41				12	205	217	0.99
	Bonus for quality performance				4	40				16	200	216	0.98

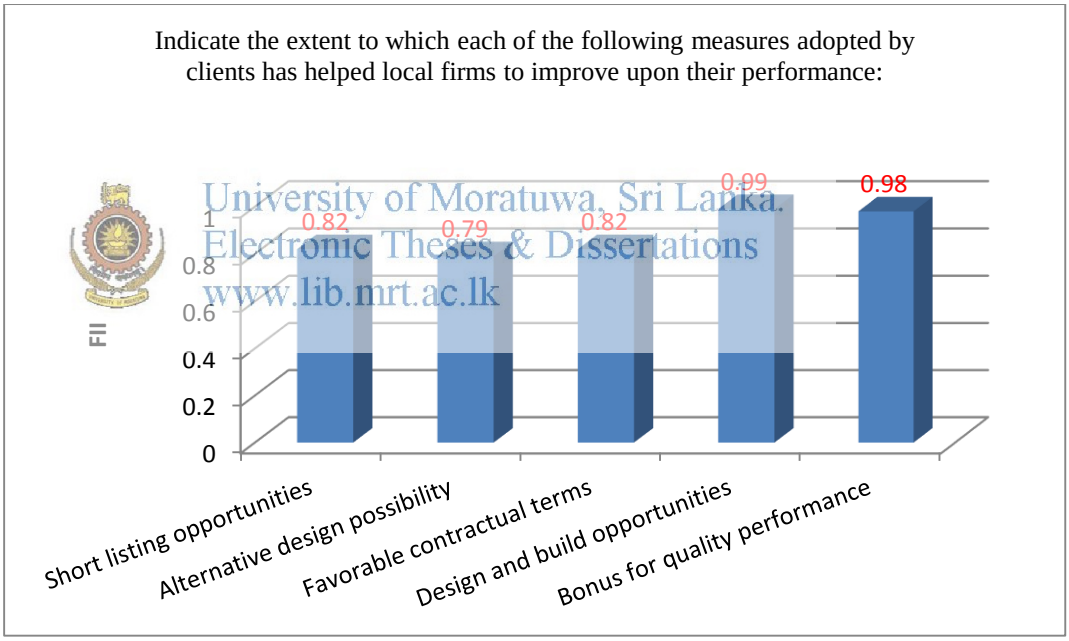

Figure 9: Graphic depicting clients have helped local firms to improve upon their performance

Effects due to project performance can be ranked as follows.

1. Design and build opportunities
2. Bonus for quality performance
3. Short listing opportunities
4. Favorable contractual terms
5. Alternative design possibility

Discussion

Most of the local contractors are insolvent due to the financial crisis. Payment delay is first factor for that. Most Important Index of that query is also it. 100% of local contractors strongly agreed to it. Hence they are unable to improve their technology due to the financial crisis. Most of the clients have delayed their payments.

Table No 11: Relative Important Index (RII)

Scale of 1 to 5 as follow: *1=Totally disagree;* *2= Disagree;* *3= Neutral;* *4= Agree;* *5= Strongly agree*													
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**$\sum\mu$**	**RII**
E9	Indicate the extent to which each of the following participants in the construction industry has helped local contractors to develop:												
	Architects				1	43				4	215	219	1.00
	Structural Engineers					44					220	220	1.00
	Mechanical and Electrical Engineers					44					220	220	1.00
	Quantity surveyors					44					220	220	1.00
	Subcontractors				4	40				16	200	216	0.98

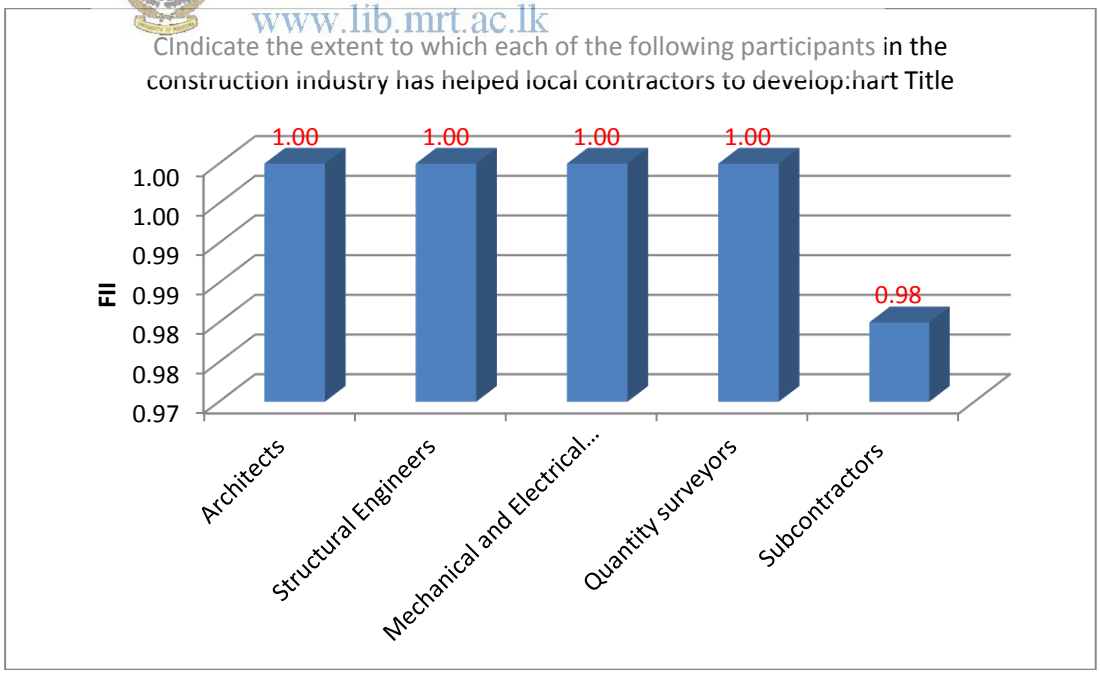

Figure10: Graphic for has to helped local contracts to develop

Effects due to project performance can be ranked as follows.

1. Architects
1. Structural Engineers
1. Mechanical and Electrical Engineers
1. Quantity surveyors
1. Subcontractors

Discussion

How can professional bodies develop strategies to ensure their continuing relevance and contribution to the construction industry? .The highest Most Importance Index in this query is all the relevant professionals in the construction industry. It is highlighted that proactive strategies are essential for professionals' to face challenges to retain and enhance their current roles.

In order to improve local contractors technologies, professional bodies are divided into the following areas

- Strategic direction
- Regulation
- Education and training
- Technical and other servicers

Table No 12: Relative Important Index (RII)

Scale of 1 to 5 as follow:	***1=Totally disagree;***	***2= Disagree;***	***3= Neutral;***	***4= Agree;***	***5= Strongly agree***							
Question NO	**Query**	**No. of Respondent**					**μ**						
		1	**2**	**3**	**4**	**5**	**μ_1**	**μ_2**	**μ_3**	**μ_4**	**μ_5**	**$\sum\mu$**	**RII**
E10	The most appropriate actions which can be taken to improve the performance of local contractors are:												
	Appropriate procurement methods				40	4				160	20	180	0.82
	Co-operation among local contractors					44				0	220	220	1.00
	Stronger and better Contractors' Association				1	43				4	215	219	1.00
	Help from firms in other sectors of the economy				41	3				164	15	179	0.81
	More effective Chamber of Construction Industry				1	43				4	215	219	1.00
	Additional government incentive schemes					44				0	220	220	1.00

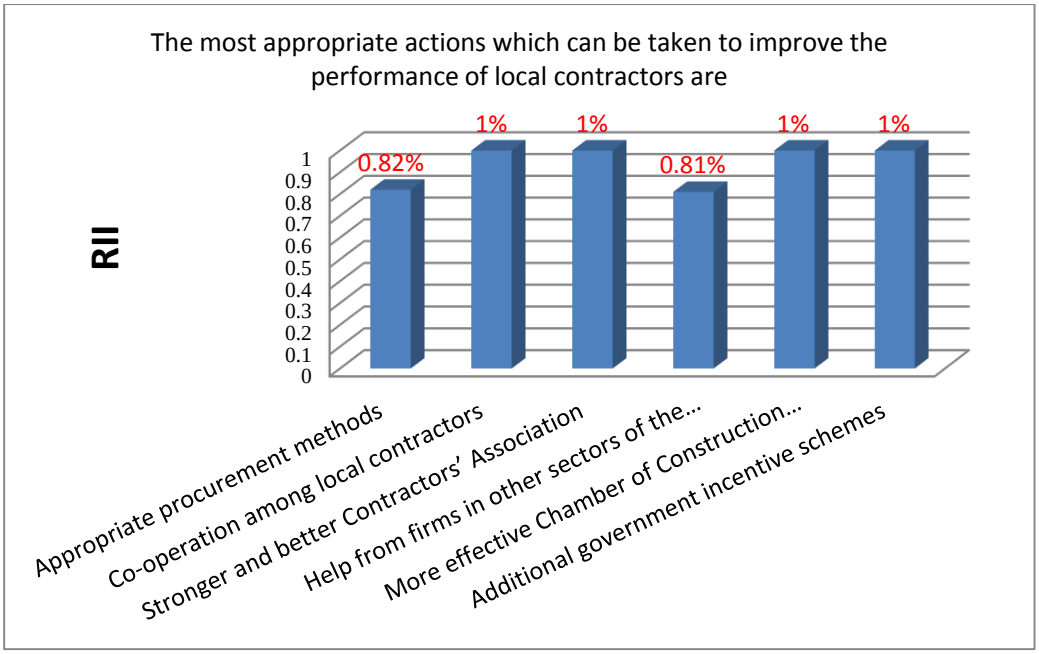

Figure 11: Graphic for the most appropriate actions which can be taken to improve the performance

Effects due to project performance can be ranked as follows.

1. Co-operation among local contractors

1. Stronger and better Contractors' Association

1. More effective Chamber of Construction Industry

1. Additional government incentive schemes

2. Appropriate procurement methods

3. Help from firms in other sectors of the economy

Discussion

In this query, all questions relative to the important index is the highest ranked. Hence we can say that local contractors should link with each other. They should close with CCI, and creatively link with it. Hence local contractors can improve both their technology and other performances. The other fist rank relative important index is the government intensive schemes. Actually, some initiatives taken by the government highly influenced the technology transfer of the country.

Establishing a national register of contractors and of construction projects to systematically regulate, monitor and promote the performance of the industry for sustainable growth, is one of them.

CHAPTER 05

CONCLUSION & RECOMMENDATION

5.1 Conclusion

During this research the author could identify that Sri Lankan construction industry has increased in the last decade (2002-2012). After the post war in 2009 it has drastically increased from year 2009 to 2013. Based on that, one can argue that the Sri Lankan construction technology also increased.

After the 1977 economic reforms, the government has made considerable effort to develop the country as a newly industrialized country based on science & technology (S&T). Due to matters such as lack of improvement of the conditions of S&T community, non development of proper S&T policy framework, lack of a S&T culture and uncertainties brought about by the ethnic conflict, the effort for S&T development was not very successful. Based on this, though the Sri Lankan construction industry was increased, its technology is growing too slowly. Due to lack of advanced technologies foreign consultants, contractors and laborers employed in mega infrastructure projects taking place in the country.

Through this questionnaire, it is revealed that when foreign funded contracts are negotiated with the Sri Lanka government, a new industry act, including with how technology transfer through foreign contractors to the local contractors should be included.

However, Sri Lanka's construction industry recently drafted a Construction Industry Authority Act. By this proposed law no priority has been given to local construction companies in granting government contracts and also reflects the continuous perpetuation of privileges to foreign contractors in foreign funded projects. According to the memorandum sent to the Secretary, Ministry of Housing and Construction by the president of CCI, he has been slammed this draft Act.

It indicates the extent to which the following initiatives by the Chamber of Construction Industry Sri Lanka has helped companies to improve their performance. Really, it is one of objects of this research.

Working towards a vision where Sri Lanka does not depend on either foreign technology or foreign material is important. Improving indigenous technologies to a high standard as well as boosting local production of high quality construction material should be given priority. In addition effective steps toward this would be to provide incentives for high quality oriented research projects as proposed by national technology policy guidelines.

Not only enhancing in the foreign participation in the industry, it is also required to adopt measures to absorb their practice. Therefore certain measures need to be implemented to improve interactions between local and foreign counter parts originating from the design stages.

The responses to the question E1 were interesting because more than eighty percent of the contractors indicated that foreign contractors influence their local counterparts in general. They indicated that when they worked with foreign contractors in one form or another, they can transfer construction techniques, (80% response).

Overall, the response to these questionnaires is that, the presence of foreign contractors in Sri Lanka assists to enhance the capability of local contractor's technologies by sharing their knowledge. But some contractors believed that foreign construction firms play lip service to technology transfer, or take measures to avoid it.

However, today the local construction industry has significantly advanced their expertise (Question E8 and E9) in both consulting and contracting in several sectors such as roads, highways and high-rise buildings. Therefore both government and non government organizations give more incentives to them. So that the CCI is fully supportive with the massive development projects.

Actually the literature on technologies is abundant. It is changing day by day because technology also changes day by day. Some of Sri Lankan construction firms are not only doing construction in Sri Lanka but within Asia they are active. Companies like MAGA, SIERRA have brought international knowledge to Sri Lanka. The government is not in a position to bring international knowledge. These companies pay higher salaries and they hire international skilled personnel and also they bring technology to Sri Lanka. The construction industry really depends on the technological development. Then the Sri Lankan construction industry will be happy to join the modern era. Modern era means the new technology they have adopted. With that knowledge also Sri Lankan personnel can develop their capabilities not fitting only to the Sri Lankan standards but also fitting to the international standards.

5.2 Recommendations

- In this context it should be noted that in Sri Lanka the percentage of technological skilled personal that have undergone formal training is less. Therefore, it is recommended to increase the intake to training institutions, develop the existing training institutions and establish new centers at suitable locations where there is a severe shortage. To increase the number of new entrants to the skilled market, the existing unskilled persons can be motivated to undergo training program for skilled personnel and an acceptable attractive minimum salary scale should be established. Then transferred technology can develop such skilled personnel.
- Technology acquisition should be given priority, and specific goals set in all instances including sub contracting assistances(Carrillo, 1994, p.47). This may include work opportunities and training facilities for local personnel in specified areas of project execution.
- When large domestic contractors are employed as subcontractors, the gap between foreign and local firms is relatively smaller, facilitating technology transfer. For those firms, lack of regular work opportunities and particular access to technologically complex project, are among the most serious obstacle in developing countries, such as Sri Lankan construction industry

packaging of mega projects and employing improved procurements should be done in away to maximize local participation and promote technology transfer. Slicing of large work items can be done facilitate both venture and sub contracting assessment are and acceptable compromise when the donors are unwilling to adopt a Joint Venture of equal partner of design and construction projects.

- Minimum number of subcontractor's personal should be given joint responsibility for overall planning and management of the projects. That will virtually upgrade the cooperation to a joint venture status in this regard.
- Provide a convenient platform to mobilize both foreign and local resources in an appropriate manner.
- Government should take necessary initiatives for creation of a science & technology culture in the country. For that, elevate the quality of the educational experience and make it more attractive. The public university system in some aspects. Recruit/retain high caliber academics who are experts for technology creations. Provide more vocational training programs directly related to technology.
- Organizations such as ICTAD, CCI, IESL and Technical Institutes may actively participate to improve local professional's Technology.
- New Act should address issues such as to include in their contracts with donor funding organizations a substantial portion of the work to the local construction industry.
- Make efforts to bring back Sri Lankan experts in the construction industry employed overseas.

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QUESTIONNAIRE FOR SURVEY : LOCAL CONTRACTORS

IMPACT OF FORGEIN CONTRACTORS ON DEVELOPMMENT OF SRI LANKAN CONSTRUCTION INDUSTRY THROUGH TECHNOLOGY TRANSFER

Part one: COMPANY'S DETAILS

A1.Designation Of Person Completing This Questionnaire: …….

A2.Year of formation of firm: ……

A3.Firm's Current ICTAD Registration Category: ……

A4.Year Of Entry Of Firm Into Current Category: ……

A5.Firm's Turnover From Construction In 2010 RS: ……

A6.Value Of (5) Largest Projects Undertaken by the Company Since 2005:

	Value of project (RS)	year of award of project
i.		
ii.		
iii.		
iv.		
v.		

A7.Number of employees of company (by qualification):

Engineers: …….

Quantity Surveyors :……

Architects: ……

Technicians: ……...

Admin & secretarial staff: ……

Supervisory Staff: ……

Skilled Tradesmen: ……

Unskilled Site Workers: ……..

Part Two:

(Please answer each question by indicating the extent to which you" Agree", on a scale of 1 to 5 as follows: 5 = Strongly Agree; 4 = Agree; = Agree; 3 = neither Agree Nor Disagree

(i.e . your stand is Neutral) ; 2 Disagree; 1 = Totally Disagree)

E1. Indicate the extent to which each of the following were the vehicles through which foreign contractors influenced their local counterparts (in general)

Inspiration as role models	1	2	3	4	5
Targets for corporate benchmarking	1	2	3	4	5
Transfer of construction techniques	1	2	3	4	5
Transfer of managerial skills and systems	1	2	3	4	5
Transfer of corporate policies and attitudes	1	2	3	4	5
Demonstration of construction techniques	1	2	3	4	5
Offering of competition	1	2	3	4	5
Others (specify, indicating extent to agreement):					
……	1	2	3	4	5
……	1	2	3	4	5

E2.Over the Past 10 Years, local contractors have improved in the following areas (performance):

Ability to apply complex technologies	1	2	3	4	5
Ability to provide design-and-build services	1	2	3	4	5
Track record of large and complex projects	1	2	3	4	5
Application information technology	1	2	3	4	5
Others (specify, indicating extent to agreement):					
……	1	2	3	4	5

E3.Indicate the extent to which each of the following were vehicles through which foreign contractors had an influence on their joint venture partners,

Training of local partner's staff	1	2	3	4	5
Structured programmer for development of local Partner's company	1	2	3	4	5
Transfer of construction techniques	1	2	3	4	5
Transfer of managerial skills and systems	1	2	3	4	5
Transfer of corporate policies and attitudes	1	2	3	4	5
Transfer of relationships with subcontractors	1	2	3	4	5
Transfer of relationships with suppliers	1	2	3	4	5
Others (specify, indicating extent to agreement):					
……	1	2	3	4	5
……	1	2	3	4	5

E4. Indicate the extent to which each of the following types of incentive and support schemes offered by the Sri Lankan government has helped local firms to upgrade:

Financial incentives	1	2	3	4	5
Advisory services	1	2	3	4	5
Market information	1	2	3	4	5
Training of skilled workers	1	2	3	4	5
Training of site supervisors	1	2	3	4	5
Short courses for professionals and technicians	1	2	3	4	5
Seminars and workshops	1	2	3	4	5
Improvement of business environment	1	2	3	4	5
National awards	1	2	3	4	5
Others (specify, indicating extent to agreement):					
……	1	2	3	4	5
……	1	2	3	4	5

E5.The most appropriate measures which could be adopted to enable local companies to derive direct benefits from foreign firms operating in Sri Lanka are:

Make formation of joint ventures mandatory for all their projects.	1	2	3	4	5
Impose floor/financial limits on projects which Foreign firms can tender for limited amount	1	2	3	4	5
Specify technologies to be transferred on each project and monitor progress towards it	1	2	3	4	5
Exclude foreign firms altogether	1	2	3	4	5
Others(Specify, indicating extent of agreement):					
……	1	2	3	4	5
……	1	2	3	4	5
……	1	2	3	4	5

E6. Indicate the extent to which each of the following measures adopted by local firms has helped them to upgrade:

Employment of professionally qualified persons	1	2	3	4	5
Adoption of human resource management policies	1	2	3	4	5
Institution of quality management system	1	2	3	4	5
Joint ventures with foreign companies	1	2	3	4	5
Strategic alliances with foreign companies	1	2	3	4	5
Strategic alliances with other local contractors	1	2	3	4	5
Strategic alliances with forms outside construction	1	2	3	4	5
Establishment of better relationships with clients	1	2	3	4	5
Others (specify, indicating extent to agreement):					
……	1	2	3	4	5
……	1	2	3	4	5

E7.Indicate the extent to which each of the following initiatives by the Chamber of Construction Industry Sri Lanka has helped companies to improve upon their performance:

Running training courses for contractors' personnel	1	2	3	4	5
Organizing seminars for members	1	2	3	4	5
Lobbying government on members 'behalf	1	2	3	4	5
Offering networking opportunities at home	1	2	3	4	5
Offering networking opportunities overseas	1	2	3	4	5
Construction Industry Information Network	1	2	3	4	5
Continuing professional development	1	2	3	4	5
Sri Lankan List of Trade Subcontractors	1	2	3	4	5
Safety consultancy	1	2	3	4	5
Other (Specify, indicating extent of agreement):					
……	1	2	3	4	5
……	1	2	3	4	5

E8. Indicate the extent to which each of the following measures adopted by clients has helped local firms to improve upon their performance:

Short listing opportunities	1	2	3	4	5
Alternative design possibility	1	2	3	4	5
Favorable contractual terms	1	2	3	4	5
Design and build opportunities	1	2	3	4	5
Bonus for quality performance	1	2	3	4	5
Others(Specify, indicating extent of agreement):					
……	1	2	3	4	5
……	1	2	3	4	5

E9.Indicate the extent to which each of the following participants in the construction industry has helped local contractors to develop:

Architects	1	2	3	4	5
Structural Engineers	1	2	3	4	5
Mechanical and Electrical Engineers	1	2	3	4	5
Quantity surveyors	1	2	3	4	5
Subcontractors	1	2	3	4	5
……	1	2	3	4	5
……	1	2	3	4	5

E10.The most appropriate actions which can be taken to improve the performance of local contractors are:

Appropriate procurement methods	1	2	3	4	5
Co-operation among local contractors	1	2	3	4	5
Stronger and better Contractors' Association	1	2	3	4	5
Help from firms in other sectors of the economy	1	2	3	4	5
More effective Chamber of Construction Industry	1	2	3	4	5
Additional government incentive schemes	1	2	3	4	5
Others(Specify, indicating extent of agreement):					
……	1	2	3	4	5
……	1	2	3	4	5
……	1	2	3	4	5
……	1	2	3	4	5