Policies to meet the future demand for science and technology workers in Sri Lanka

Draft paper

Written for
ADB-Asian Think Tank Development Forum 2018

Nisha Arunatilake
Institute of Policy Studies of Sri Lanka
13th August 2018

1.0 Introduction

Since the turn of the millennium countries have increasingly looked to innovation to stay competitive and drive growth. Human resources in science and technology are a key for generating new ideas and technologies and making them marketable and usable to the general population. (Organisation for Economic Co-operation and Development (OECD), 2015). Human resources in science and technology take long to create. With the start of the innovation driven economic growth strategies, more developed countries have looked to invest in training skilled workers as well as attract talent from across the world to ensure an adequate supply of skilled workers in their economies. Sri Lanka too has reiterated the need to move to a knowledge-based economy in order to be competitive in the global market.[1]

Science and technology workers are an essential part of a knowledge-based economy. However, training science and technology workers to meet the demands of the market are becoming more and more difficult; this is especially the case for developing countries. First, in order to supply a steady stream of science and technology workers countries need to plan well in advance. Second, globally there is a competition for talent. With the dawn of the new millennium many countries changed their immigration laws to attract highly skilled workers. Many such skilled workers are sourced from developing countries, which are unable to provide lucrative employment opportunities to the trained individuals. This makes planning for training skilled workers harder for developing countries, as now they need to take into account not only the changes to demand locally, but, also the changes to demand internationally. They also need to take into account the global trends in migration, to ensure that they train adequate numbers of skilled workers. Third, it is difficult to cater to the fast changing demands of the market as often developing countries do not have the human, financial and physical capital to keep up with the technological and managerial changes that are taking place in the market. Even if countries have the ability to change training programmes financial, human resource and other constants may be more challenging to overcome. Lastly, to create a knowledge-based-economy

[1] (Government of Sri Lanka, 2017)

just training workers alone are not sufficient. The trained individuals need to be fruitfully employed in the economy, in order for the country to benefit from the investments made in training individuals.

To be competitive in a knowledge driven global economy, it is essential to ensure that the country has an adequate supply of science and technology workers. Science and technology workers are essential to the effective functioning of occupations ranging from policy makers, to managers, to professionals such as doctors, engineers, teachers and technicians and academics. The main objective of this paper is to assess the availability of science and technology workers in Sri Lanka, and to assess how well they are used to create value in the economy.

The paper starts by defining skilled workers (section 2). It then assesses the demand and supply trends of skilled workers in the country (sections 3 and 4), and how well the tertiary educated workers are used in the country (section 5). Lastly the paper will conclude and make recommendations for improving the availability and use of skilled workers in the country.

2.0 Background and methodology

2.1 Who are Science and Technology Workers?

In this paper, following the Canberra Manual,[2] we refer to 'skilled workers' as Human Resources in Science and Technology (HRST) and define them as individuals with a *tertiary level education* in *science and technology* and/or are employed in a *science and technology occupation (S&T occupation)*, which requires a tertiary level education. Defining HRST using education is referred to as the *qualification approach*, while defining HRST using employment is referred to as the *occupation approach*.

Science and Technology (S&T) can be defined in different ways.[3] At its narrowest definition HRST covers only those with an education or doing a job which requires an education at the university level in natural sciences or engineering. At its broadest, HRST covers all with a tertiary level education or in employment that requires a tertiary level education. Given the difficulties in obtaining data for the narrower definition of HRST, this paper adopts the wider definition, where all individuals with a tertiary level education or working in an occupation needing a tertiary level qualification is considered to be HRST.

[2] Oganization For Economic Co-Operation and Development (1995).
[3] Oganization For Economic Co-Operation and Development (1995), page 8.

In the ***qualification approach***, tertiary education is defined using the International Standard Classification of Education (ISCED). The ISCED divides education into 8 levels. Of these the levels 5, 6, 7, and 8 are considered to be tertiary level education. Where ISCED level 5 is short cycle general or vocational training programs;[4] and, ISCED level 6, 7, 8 are Bachelor's degree or equivalent, Master's degree or equivalent and a Doctoral degree or equivalent, respectively (UNESCO Institute for Statistics, 2011). Henceforth all tertiary educated HRST is referred to as HRST-EDU (see figure 1). The education data collected in Sri Lanka are not usually classified according to ISCED. Of the tertiary level ISCED levels considered, levels 6, 7 and 8 are identifiable in the Sri Lankan data. In this paper, we use a proxy measure for ISCED level 5. We consider those who have passed the General Certificate in Education Advance Level (A-levels) plus have a vocational training to be those with tertiary level education in this paper.

In the ***occupation approach,*** S&T occupations are defined to be occupations in science and technology which are usually open to individuals with tertiary level education. We consider all occupations in level 2 (i.e., professionals) and 3 (i.e., associate professionals and technicians) of the International Standard Classification of Occupations (ISCO) as S&T occupations, and those working in those occupations as S&T workers.[5] Henceforth all employed as professionals, associate professionals or technicians (PAPT) are referred to as HRST-OCC (see figure 1).

The above definition of HRST takes into account both the supply of science and technology workers as well as the demand for science and technology workers. The qualification approach tells us the number of tertiary education qualified people available in the country. The occupation approach tells us the number of people required in S&T activities at required levels. The occupation approach assumes that there are no labour shortages. In the case of labour shortages, those doing jobs that require tertiary level education plus the vacancies for jobs that require tertiary level education will provide the estimate for the demand for HRST jobs in a country.

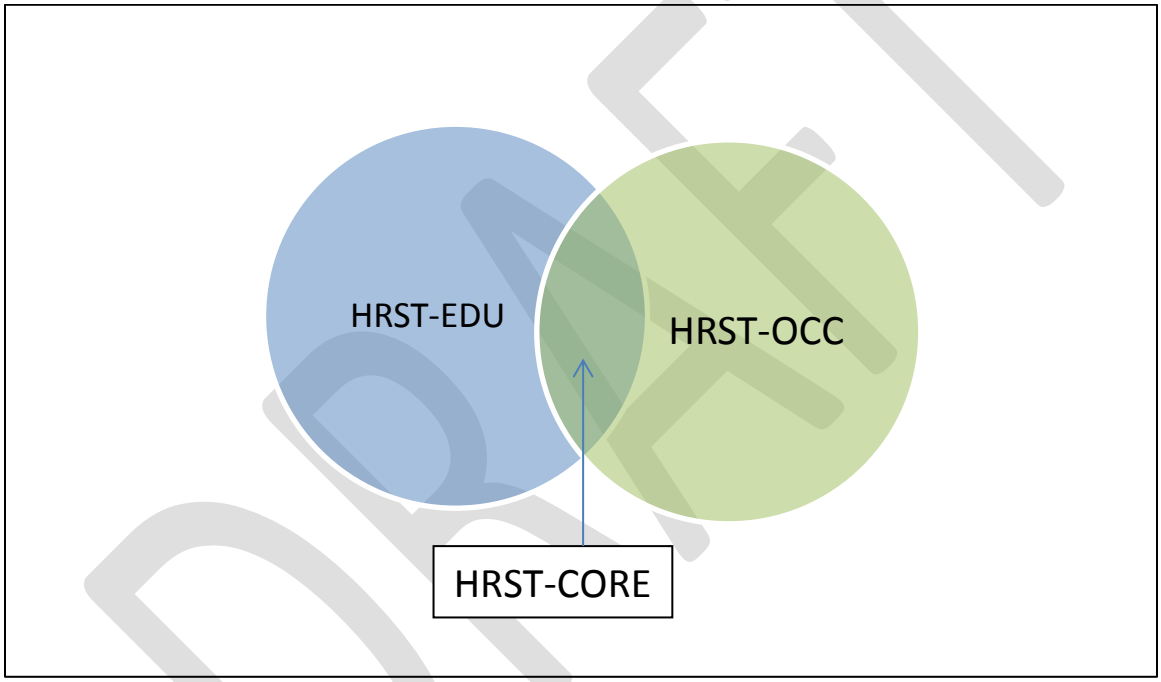
Ideally, those with a tertiary level education should be in employment that requires a tertiary level education. But, there are many with tertiary level education that are not doing jobs that require a tertiary level education (for example, an IT graduate who has quit the work force to raise a family), and then there are other who are doing jobs that require a tertiary level

[4] Usually these programmes are open only to those who have completed secondary level education, but they do not lead to a university degree. Examples of such programmes include diplomas and vocational training programmes.

[5] Professionals include: physical, mathematical and engineering science -professionals; life science and health professionals; teaching professionals; and other professionals. Technicians and associate professionals include: physical and engineering science associate professionals; life science and health associate professionals; teaching associate professionals; other associate professionals

education, but do not have a tertiary level education (for example, a high school graduate who is promoted to be an IT hardware engineer through experience). We refer to those that are both qualified as HRST as well as working as professionals and associate professionals and technicians as HRST-CORE (see figure 1).

Figure 1. Human resources in Sceience and Technology, by type



Source: Own construction

Note: HRST-EDU – Tertiary qualified individuals; HRST-OCC- Those working as professionals, associate professionals or technicians, HRST_CORE – Tertiary qualified working as professionals, associate professionals or technicians.

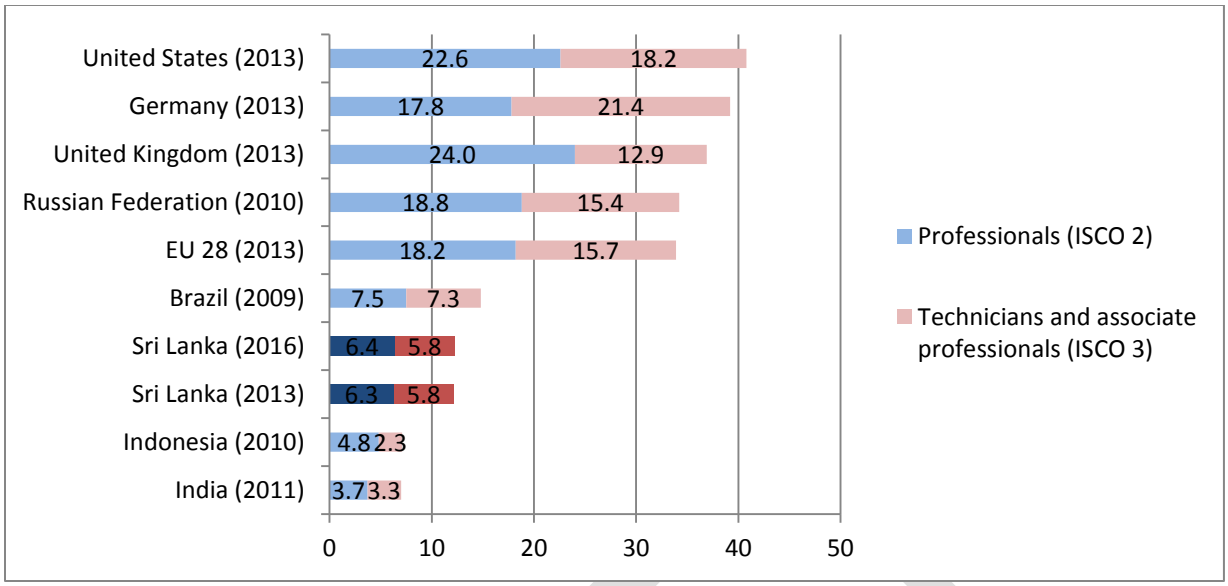
3.0 Employment in S&T Occupations in Sri Lanka

The share of HRST-OCC in Sri Lanka is low, and it is increasing very slowly. In 2013, 21.1 per cent of employed were HRST-OCC in Sri Lanka. This share has only marginally increased to 12.2 per cent by 2016, indicating the rate of growth of S&T workers in the country is very low compared to the growth of other types of employment in the country. In all advanced countries more than 30 per cent of employed were HRST-OCC in 2013. The share of HRST-OCC in Sri Lanka has increased by only 0.1 per cent from 2013 to 2016. Which suggests that to increase the share of HRST-OCC in Sri Lanka to 30 per cent of employed, will take the country more than 500 years given the current trends.

The data provided in figure 2 are for those employed. It is possible that there are S&T jobs in the country that are not filled. Even, not filled, vacancies for S&T jobs also reflect the demand for HRST workers in the country. A recent survey conducted by the department of Census and Statistics shows that the shortages for HRST-OCC in the country are very low.[6] According to this source, the main S&T occupations for which there were labour shortages were Secondary Education Teachers (9,558 vacancies), Information and Technology Technicians (8,128 vacancies) and Nursing Professionals (5,239 vacancies) and Nursing Associate Professionals (2,408 vacancies). All other vacancies were for non S&T jobs such as security guards, cleaners, etc.

Figure 2. Professionals, Associate Professionals and Technicians (HRST-OCC) as a per cent of total employment

[6] (Department of census and Statistics, 2017)

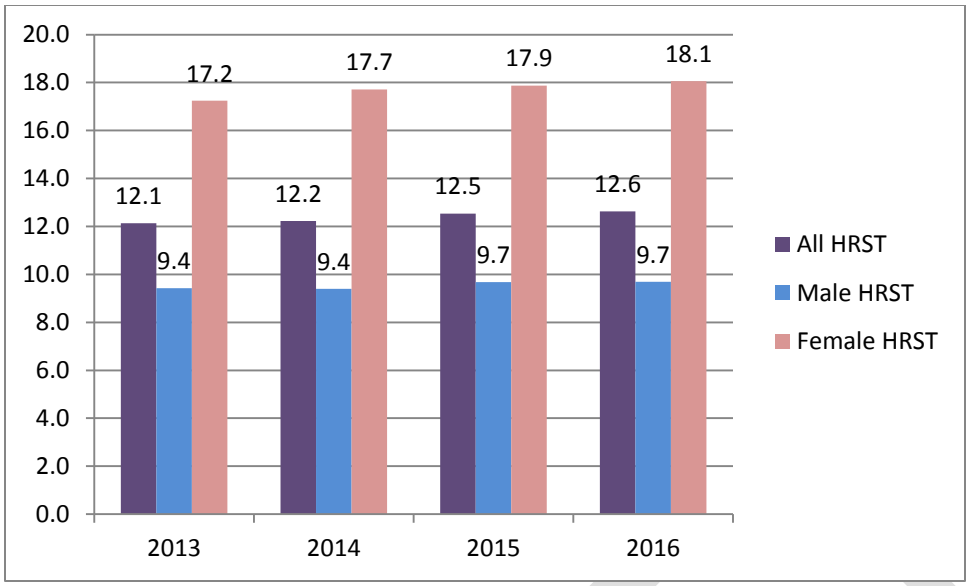


Source: Sri Lanka – Constructed using Labour Force Survey 2013 and 2016 data; other countries - OECD, based on European Labour Force Surveys, Eurostat; ILO Laborsta Database; and national sources, July 2013 (OECD, 2013).

Note: "Professionals" and "Technicians and associate professionals" are defined according to the International Standard Classification of Occupations 2008 (ISCO-08) major groups 2 and 3 respectively, except for Brazil, India, Indonesia, and the Russian Federation, for which the corresponding ISCO-88 groups are reported.

A higher proportion and number of females are HRST-OCC (see figure 3). For example, in 2016, 18.1 per cent of all female employees were S&T workers, while only 9.7 per cent of male workers were S&T workers. In 2016 in Sri Lanka, 498,905 males were HRST-OCC while 505,093 females were HRST-OCC. The higher incidence of females working as S&T workers, is partly explained by the quality of S&T jobs available in the country. Majority of female professionals are working as teachers.

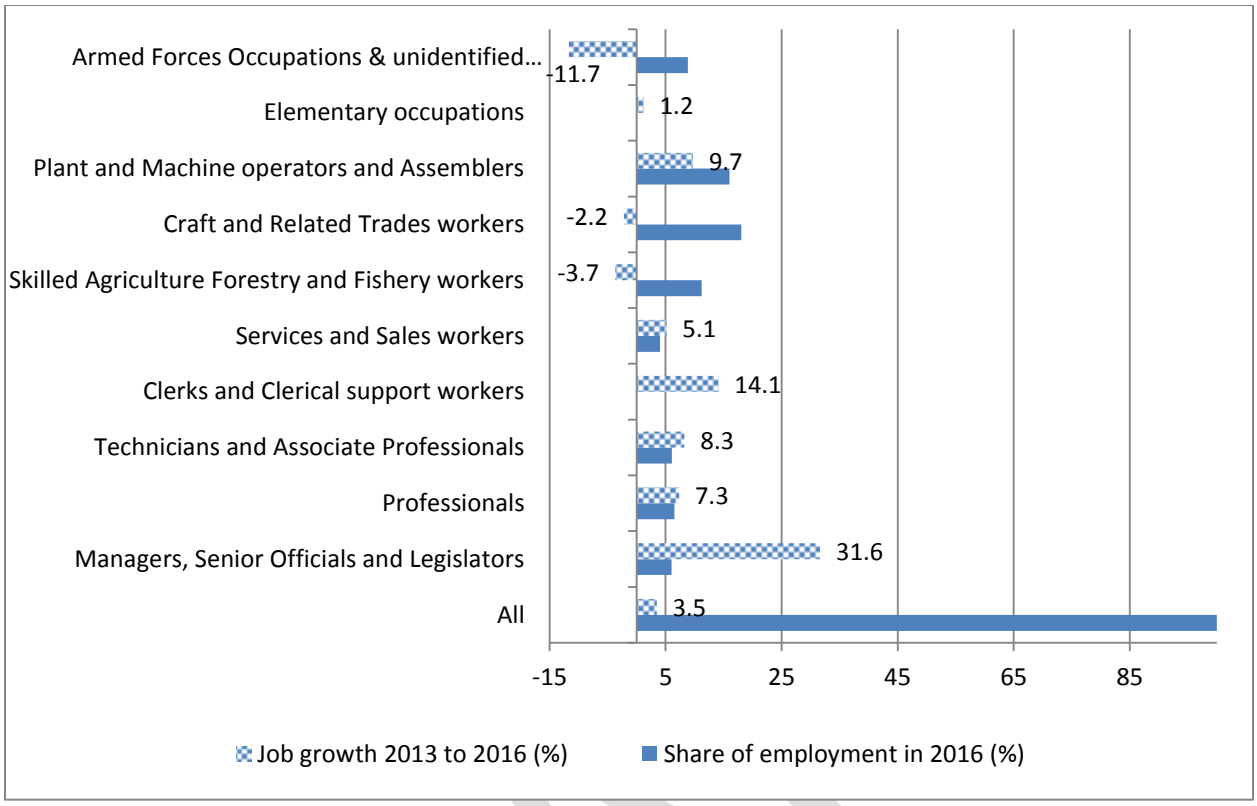
Figure 3: Share of human resources in Science and Technology, by gender (%)



Source: Own calculations using Labour Force Survey Data 2016.
Note: Human Resources in Science and Technology are defined to be professionals, technicians and associate professionals (International Classification of Occupation levels 2 and 3).

Encouragingly, the growth in science and technology types of employment is greater than the overall job growth (See figure 4). For example, the overall job growth from 2013 to 2016 was 3.5, while the professional and technical and associate professional job growth was at 7.33 per cent and 8.26 per cent. However, as the share of S&T workers in the country is low, the increase in the number of S&T workers is also low. For example, from 2013 to 2016 the number of professionals in the country increased by only 35,445 and the number of associate professionals and technicians increased by 37,000.

Figure 4: Job growth 2013 to 2016 by occupation category



Source: Own calculations using Labour Force Survey Data 2016.

4.0 Tertiary educated individuals (HRST-EDU) in Sri Lanka

Comprehensive information on tertiary level educated individuals is available only from the Census 2012 data source. The household income and expenditure survey (HIES) also collects information on the education attainment of individuals, but HIES do not contain information on the technical level tertiary educated. As such, although a little dated, we mainly use the Census 2012 data in this section.

As seen in figure 5, the share of tertiary level educated in the country in 2012 was very small. Only 13.3 per cent of the 15 and above population were having tertiary education (**Figure**). Of this the proportion with a university degree was only 3.3 per cent (or 499,563), while the rest (about 1,527,001) were with technical level tertiary education. Majority (86.7 per cent) were without a tertiary level education.

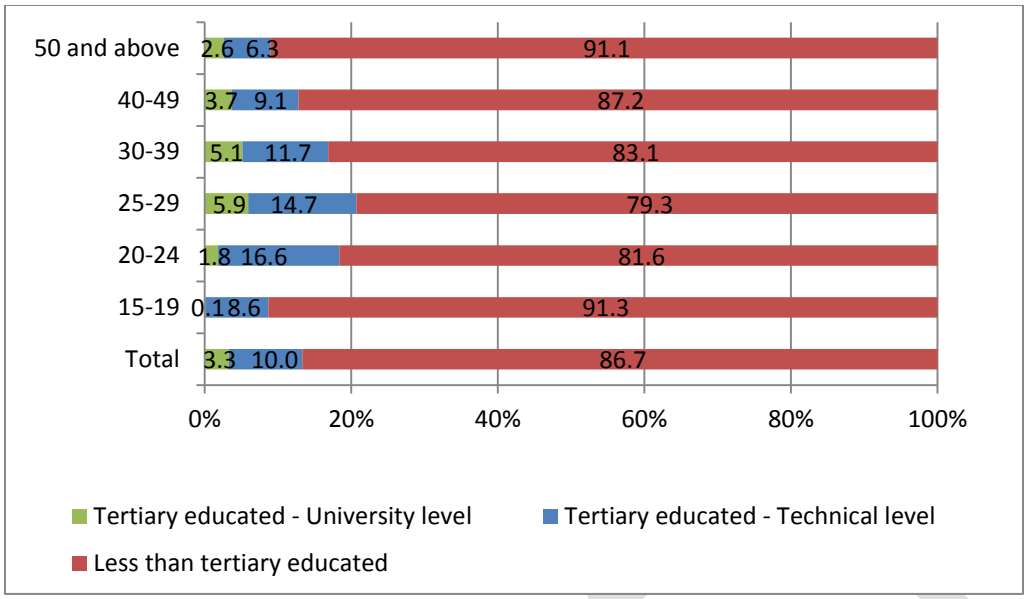
However, as also seen in figure 5, a higher proportion of those in younger age cohorts are tertiary educated, indicating that the incidence of tertiary educated individuals is likely to increase in future.

There are several reasons for the low prevalence of tertiary educated in the country. First, only a limited number of individuals are able to enter university due to lack of capacity in the university system in the country. The gross tertiary enrolment rate in Sri Lanka in 2014 was 21 per cent (The Institute of Policy Studies of Sri Lanka, 2017, page 82). The corresponding statistic for middle income countries was 22 per cent, while in upper middle income countries the gross tertiary enrolment rate was 44 per cent.

A third reason for the low prevalence of tertiary educated is the education dropout at the lower secondary level. Although primary education is near universal in Sri Lanka, only a small share of individuals advance to upper secondary and tertiary level education in the country. For example, in 2014 30 per cent of 15 to 19 year olds and 80 per cent of 20 to 24 year olds were not in any form of education or training programme. (The Institute of Policy Studies of Sri Lanka, 2017, page 83). Dropout at the upper secondary level is partly the result of the poor quality of education and the failure of nearly a half of the individual's at the Ordinary Level exams (Abayasekara & Arunatilake, 2017). As a pass in O-levels are needed to advance in to collegiate level education or to obtain high quality vocational training, many stop their education at the lower secondary level.

A third reason for the low prevalence of tertiary educated in the country is the emigration of a large share of tertiary educated to other countries. Following (Barro & Lee) 2000, we define the emigration rate of those born as Sri Lankans to be those (born as Sri Lankan) living abroad as a share those (born as Sri Lankan) living anywhere in the world, By restricting the statistics to tertiary educated, we get the emigration rate for the tertiary educated Sri Lankans. According to \Barro and Lee (2000) in 2000, 19.4 per cent of the tertiary educated Sri Lankans were living abroad in 2000. (Barro & Lee, 2000). This number could have only increased over the last two decades.

Figure 5. Population aged 15 and over, by level of education and age

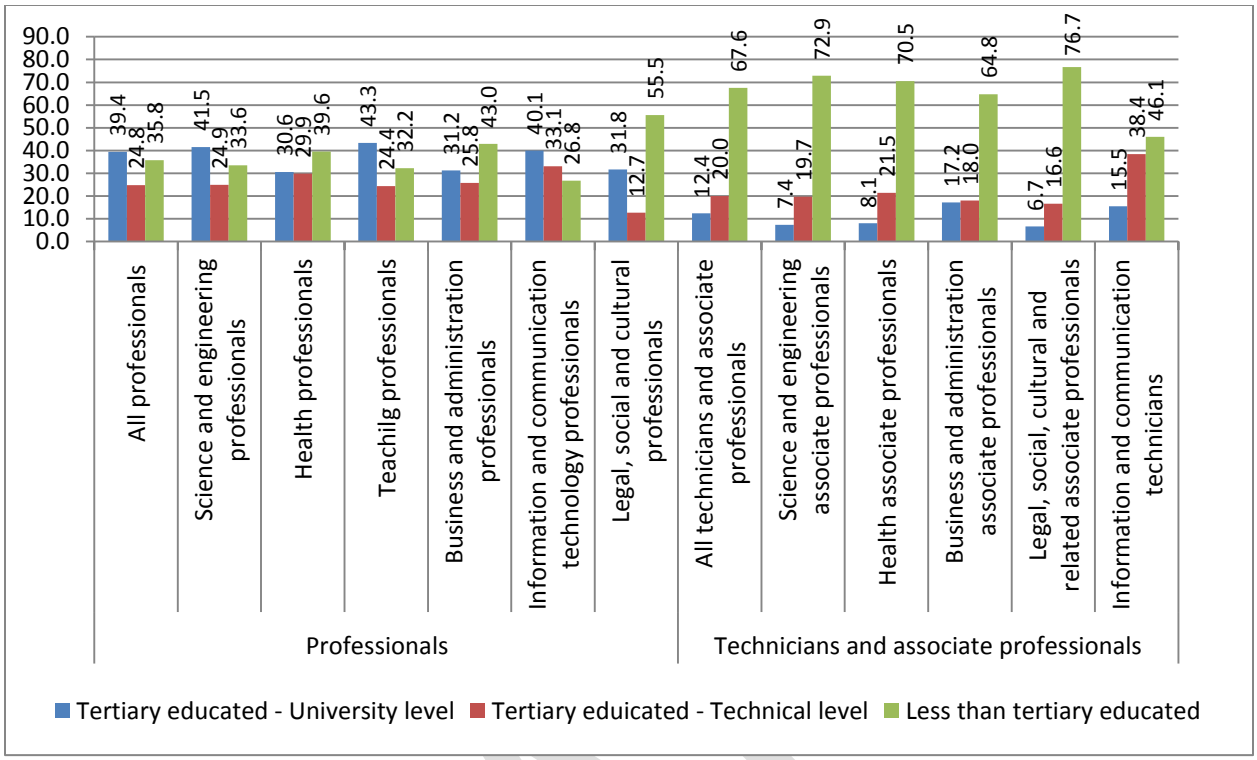


Source: (Arunatilake, 2016) calculated using Census and Population and Housing 2012 data.

5.0 Tertiary educated working in S&T occupations (HRST-CORE) in Sri Lanka

A large share of S&T workers were without a tertiary level education in Sri Lanka (see figure 6). More professional category S&T workers were tertiary educated both at the university and the technical level. However, even amongst professionals about 36 per cent of the employed were without a tertiary level education. This was the case in all professional categories, except in the information and communication profession. The share of tertiary educated amongst the technicians and associate professionals were even lower. Around 65 per cent or more of technicians and associate professionals were without a tertiary level education in each category of technicians and associate professionals, with the one exception of the information and communication profession (see figure 6).

Figure 6: Distribution of S&T workers by type of profession and level of education

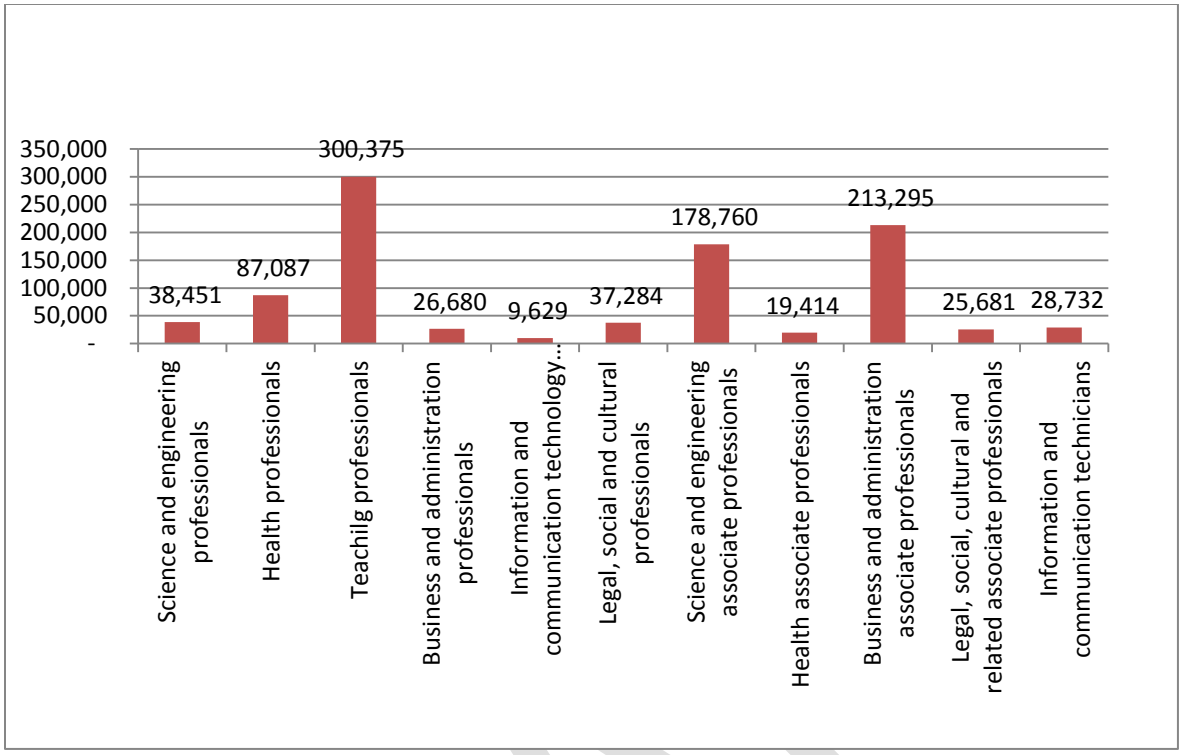


Source: Source: Calculated using Census and Population and Housing 2012 data based on analysis done for (Arunatilake, 2016).

The diversity of S&T workers in the country was low (see figure 7). The professional level employment was largely concentrated in teaching professionals. For example, in 2012 there were close to 500,000 professionals in Sri Lanka, of this, more than 300,000 (or 60 per cent) were teaching professionals. The next highest category of professionals was health professionals (17.4 per cent). The concentration of teachers was the apparent at all levels of education. Further, a large proportion of professionals who were not tertiary educated were also teachers. In most advanced countries a teacher is required to have a degree. But, in Sri Lanka only 43.3 per cent of teachers had a degree or higher qualification.[7] Further, 32.2 per cent of teachers did not have any tertiary level qualification, while the rest has technical level tertiary education. The technicians and associated professionals were largely concentrated in business administration and science and engineering associate professions, irrespective of the level of education.

[7] Calculations conducted for (Arunatilake, 2016) using census 2012.

Figure 7. Total employed, by type of occupation (no.)



Source: Source: Calculated using Census and Population and Housing 2012 data based on analysis done for (Arunatilake, 2016).

The low quality of S&T occupations in the country a reason for the low prevalence of tertiary educated in S&T jobs in the country (see table 1). The available information suggests that only 51 per cent of tertiary educated at the university level and 14.2 per cent of tertiary educated at the technical level are in S&T occupations. About a fifth of university level tertiary educated and 42 per cent of technical level tertiary educated have chosen to work in jobs that are not S&T. Further, a large share of both university and technical level tertiary educated were out of the labour force. This could be due to the lack of good quality S&T jobs in the country.

The unavailability of tertiary level educated individuals in the relevant fields may be one reason for the low prevalence of tertiary educated in S&T jobs. According to the University Grants Commission, in 2014/15 nearly one third of those entering universities enrolled for arts subjects. The employment prospects for arts graduates are low in the country. According to the Graduate Employment Census 2012, only 52 per cent of art graduates were employed.[8] Even of this, 20 per cent were under employed, while only the rest (32 per cent) were gainfully employed. In comparison, more than 90 per cent of gradutes in the engineering, information technology and medicine fields were gainfully employed.

The low quality of tertiary education in the country a reason for the low prevalence of tertiary educated in S&T jobs. A recent survey obtained information on the employers perception on the preparedness of first time job seekers for employment by level of employment.[9] According to this survey, around a third of employers interviewed felt that the preparedness for work of individuals with only a university or higher level education were 'poor'. According to the same survey, a third of the employers also felt that the preparedness of those with a secondary level education and vocational training (i.e., technical level tertiary educated) for work was also 'poor'. However, according to the same survey, only 5.4 per cent of the interviewed felt that the preparedness of those with at least a university degree and technical and vocational training were 'poor'. Indicating that those with both a tertiary level university plus a technical training were the best prepared for work. According to the same survey, the main reason for 'poor' preparedness of university graduates to work was the, lack of job specific skills and the poor attitude, personality and motivation. The main reason for citing the 'poor' preparedness of those with secondary level education and technical training were, 'lack of job specific skills' and the lack of work life work/life experience and maturity.

Table 1. Population by type of activity and level of education

	15 and above population	Tertiary educated - University level	Tertiary eduicated - Technical level	Less than tertiary educated
All employed	48.2	71.8	56.2	46.3
S&T occupations	6.3	51	14.2	3.7
Professionals	3.3	39.4	8.1	1.4
Associate professionals and	3.1	11.6	6.1	2.4

[8] (The Institute of Policy Studies of Sri Lanka, 2017, page 88)
[9] (Department of census and Statistics, 2017)

technicians				
All other occupations	41.8	20.9	42	42.6
Unemployed	3.4	6.4	5.8	3
Out of the labour force	48.4	21.7	38	50.6
Total	100	100	100	100

Source: Calculated using Census and Population and Housing 2012 data based on analysis done for (Arunatilake, 2016).

6.0 Conclusion

The above analysis highlights several issues with the employment market in the country that needs to be addressed in order to move the country towards a knowledge based economy. First the share of S&T workers amongst the employed in the country are low, and this share has not improved much over time. The share of S&T workers in Sri Lanka is around 12 per cent, and this share has not changed much over the last several years. Most advanced countries have more than 30 per cent of their employed in S&T occupations. In the United States the share of S&T workers in total employment is as much as 40 per cent. Sri Lanka needs to create more S&T jobs in the country to innovate and be competitive in the global market.

Second, the share of tertiary educated individuals in the country is low. This is partly due to the limited access to tertiary education in the country at the university level. It is also due to many dropping out of school before completing secondary education due to the low quality of secondary education in the country. Lastly, a large share of tertiary educated are leaving the country for employment abroad.

Third, the existing S&T jobs are concentrated in a narrow spectrum of occupations. Majority of professional jobs are teachers, while majority of technical and associate professional jobs are for business associates and science and engineering associates. In order to introduce innovation in different sectors of the economy, S&T jobs needs to be created in diverse economic sectors.

Fourth, a large share of S&T jobs is done by individuals without a tertiary level education. In order to improve the productivity of these professions, the training and education sector in the country needs to be developed, so that more tertiary educated are directed to S&T jobs. This could be due to the skills mismatched between skills of the tertiary educated in the country and the skills demanded by S&T occupations. Evidence from the Information and Technology (IT)

shows that not all IT graduates are employable as they lack soft skills that are also required to do the job effectively (Information and Communication Technology Agency of Sri Lanka (ICTA), 2013).

Fifth, the market is not fully using the available tertiary educated human resources in the country. The under employment of tertiary educated could be due to several reasons. The quality of the available S&T jobs in the country may not be attractive to the tertiary educated. As shown in the paper, about 60 per cent of professional jobs in the country are for teachers. Teachers are usually paid less, as they do not work full time. This could dissuade tertiary educated from taking up S&T jobs.

Lastly, the poor quality of S&T jobs available in the market may compel tertiary educated individuals to seek employment abroad.

7.0 Policy Recommendations

The above analysis shows that Sri Lanka needs to work on several fronts to improve the share of tertiary qualified science and technology workers in the country.

The country needs to expand and improve the tertiary education sector in the country. As shown earlier, only 13.3 per cent of 15 and above are tertiary educated in the country. Further, those educated at the tertiary level are educated in a limited range of subjects. In order to cater to the growing demand for different types of S&T workers in the market, the tertiary education sector needs to expand its scope.

Expanding access to tertiary education alone is not sufficient. The quality of the available tertiary education programmes need also to be improved and made more relevant. The education system in the country needs to be better aligned with the skill requirements of the market. This needs to happen from the general education level, so that children acquire the soft skills needed by the market.

The current tertiary education model in the country may not be able to cater to the changing demands of the market. In order to meet the demands of the market, the government will need to think of ways to improve the quality of existing largely traditional tertiary education institutions in the country, while opening the tertiary education market to other players, such

as private sector education providers, foreign affiliated education providers and on-line education providers. The tertiary education is provided by a diverse set of institutions in globally.

The available S&T jobs in the country are limited, and those that are available are concentrated in a few professions. The country needs to find strategies to create more jobs in diverse occupation categories. Policies for attracting foreign direct investment (FDI) can be helpful in creating S&T jobs in the country. But, FDI must be strategically targeted to attract investment that would create good quality S&T jobs in the country.

Creating good quality S&T jobs in the country will also be a means of retaining the tertiary educated in the country. Good quality S&T jobs can also result in brain gain, that is provide incentive for those who left the country to return back to the country.

Lastly, the country needs to better match available tertiary educated with the available S&T jobs in the market, so that investments in educating individuals at the tertiary level are not wasted.

Bibliography

Abayasekara, A., & Arunatilake, N. (2017). *Better Schools for Better O-Level Results in Sri Lanka.* Colombo: Institute of Policy Studies of Sri Lanka.

Arunatilake, N. (2016). *Labour Market Characteristics-Thematic Report based on Census of Population and Housing 2012 .* Colombo: United Nations Population Fund, Sri Lanka.

Barro, R., & Lee, J. W. (2000). *International Data on Educational Attainment: Updates and Implications.* Cambridge, MA: Centre for International Development at Harvard.

Department of census and Statistics. (2017). *Sri Lanka Labour Demand Survey 2017.* Battaramulla: Department of census and Statistics.

Government of Sri Lanka. (2017). *Vision 2025 - A Country Enriched.* Colombo: Government of Sri Lanka.

Information and Communication Technology Agency of Sri Lanka (ICTA). (2013). *National ICT Work Force Survey 2013.* Colombo: ICTA.

OECD. (2011, November 10). *OECD Science, Technology and Industry Scoreboard 2011*. Retrieved from OECDiLibrary: http://www.oecd-ilibrary.org/sites/sti_scoreboard-2011-en/02/03/index.html?contentType=/ns/Chapter,/ns/StatisticalPublication&itemId=/content/chapter/sti_scoreboard-2011-14-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html

OECD. (2013). *OECD Science Technology and Industry Score Board 2013 - Innovation for Growth.* Paris: OECD. Retrieved from http://dx.doi.org/10.1787/sti_scoreboard-2013-en

OECD. (2013, October 23). *Professionals and Technicians, 2012: HRST as a per cent of Total Employment.* doi:10.1787/sti_scoreboard-2013-en

Organisation for Economic Co-operation and Development (OECD). (2015). *OECD Innovation Stategy for 2015 - An Agenda for Policy Action.* Brussels: OECD.

The Institute of Policy Studies of Sri Lanka. (2017). *Sri Lanka State of the Economy 2017.* Colombo: The Institute of Policy Studies of Sri Lanka.

UNESCO Institute for Statistics. (2011). *International Standard Classification of Education 2011.* Paris: United Nations Educational, Scientific and Cultural Organization (UNESCO) .