Report on
Industry - Academia Linkages

THE KERALA STATE
HIGHER EDUCATION COUNCIL

EXECUTIVE SUMMARY

The higher education system in Kerala has found its comparative advantage in education eroding over time, and the majority of its students ill-equipped to deal with globalized market demand. There is also an endemic concern expressed by industry that the output of the higher education system is ill-trained and needs considerable remedial training before they can be productive. Given relatively low levels of industrialization, Kerala has been troubled by educated unemployment in the past; if there is a slowdown in out-migration, we may again see unemployment and under-employment rising.

It is in this context that the Kerala State Higher Education Council constituted a Committee on Industry-Academia Linkages. As per the Terms of Reference (see Appendix 0), the Committee has considered various approaches towards creating mechanisms to induce students, industry and academia to engage meaningfully with each other.

After holding six meetings, the Committee has arrived at a series of recommendations in several broad categories. They also held one interaction with the IT industry. It is felt that further interactions with other sectors, within the framework of the recommendations, may be done as a follow-on activity, to get more direct feedback from various sectors.

The general thrust of the recommendations focus on the following:

1. Creating conditions that improve the interactions between industry, academia, research labs and students as well as skill upgrading.
2. Creating mechanisms that will increase the level of structured innovation and entrepreneurship so that more students from Kerala become job-creators rather than job-seekers, especially in sectors where the state has a comparative advantage.
3. Using the fast-moving technology of education in ways that can make it feasible to update students with the latest course

content, custom-created courseware, and localized materials with minimum expenditure of time and effort.

The Committee has made detailed recommendations in the enclosed report. The Committee requests that the Higher Education Council consider the recommendations, approve and refer them to the Kerala Government for further action.

The Committee and I would like to thank Ambassador (Rtd.) T. P. Sreenivasan, Vice-Chairman of the Kerala State Higher Education Council for having given us this opportunity to contribute. I would like to thank every member of the Committee for sparing their valuable time and providing stimulating ideas. In particular, I am grateful to Smt. Shakila Shamsu for thoughtful comments and suggestions, and for referring the Committee to the substantial prior work in this area done at the Central Government level and by international agencies. I am also grateful to the industry participants for their valuable insights, and to the academic participants for their perspectives.

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1. Introduction

1.1 The Changing Global Higher Education Scenario

An academic revolution has taken place in higher education in the past century and a half. The changes have not just been radical in terms of breadth and scope, they have also enabled the higher education sector to carve out a niche for itself in reshaping economies and societies worldwide. Tertiary education has become critical for knowledge generation, knowledge dissemination and knowledge application. The sector has also become crucial for developing the professional and technical capabilities needed for creating a knowledge-economy[1].

The failure to develop a tertiary education system capable of leveraging advances in science and technology could result in a situation where developing and transition economies become even more peripheral to the global economy. Now, more than ever before, Governments need to ensure that the tertiary education sector develops the capability to innovate and respond to changes in market demand for highly-skilled manpower.[2]

1.2 Problem Statement

With this background, the question to be posed is as follows: Is Kerala providing the right kind of education to its tertiary level students?

There is the coming 'Asian Century'[3] and the students successfully completing various academic courses in Kerala must be

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[1] Altbach, Philip et al, Trends in global higher education: Tracking an academic revolution, Report of UNESCO 2009 World Conference on Higher Education, 2009

[2] Constructing Knowledge societies, New Challenges for tertiary Education, World Bank Report,2006

[3] Some observers call it the 'Asia-Pacific' Century, and others have called it the 'Indo-Pacific' Century, reflecting perceptions about the leading role of the Asian continent and the Indian Ocean in this century

provided relevant education that will help them not only to survive but also thrive in this new world order. Such an education would enable them to effectively participate in the new economic system which is witnessing changes in the Indian (and world) economy as the result of technology, globalization and demographics.

At the moment, it can be stated that Kerala is not providing globally relevant higher-education. One of the major reasons for this is the absence of adequate linkages between academic institutions and industry. This has resulted in a disparity between education and workplace requirements, raising serious concerns about the employability factor of the graduates. There is an urgent and imperative need for appropriate interface between academic institutions and industry that could result in a win-win partnership benefiting all stakeholders and the nation at large.

Kerala used to have a comparative advantage in education, which has been leveraged by the large number of migrant skilled workers who currently form a large diaspora in other parts of India, the Middle East, Europe and America. But this comparative advantage has eroded despite the oft-repeated claim of the most literate state in the Union. There are practically no higher education institutions in Kerala that feature in the top rankings of Indian educational institutions. (This is made even worse because Indian educational institutions are, in general, falling behind those in East Asia and Southeast Asia's developing countries, not to mention those in developed countries.)

On the other hand, Kerala's industries are varied and dynamic, with a significant service sector, a limited manufacturing sector, and a declining agricultural sector. The need of these industries for innovation and also for acceptable graduate intake is not shared with the academia, whereas there could be considerable synergy between them. Equally important is the need to make our graduates competent to exploit the vast employment opportunities outside Kerala.

The Kerala State Higher Education Council (KSHEC) has put together a Committee to consider this problem and to produce a roadmap for the future; this Report being the output. The Terms of Reference is in Appendix 0: Terms of Reference.

The objective of this Report is to explore the strategies of positive and pro-active interface between academic institutions and industry. It suggests ways to improve the mutual understanding between industry and academia and to set in place mechanisms that could ideally bring long-term and fruitful collaboration between the two.

1.3 Plan for Report

The Main Report at the end of 2012 will provide the general recommendations of the Committee, both short-term and long-term. Since the Committee would like to provide sector-specific inputs, it proposes to hold sector-based workshops and thereafter submit an Addendum to the Main Report by August, 2013.

1.4 Target Audience

It is hoped that the Report will be of interest to different audiences and stakeholders:

- Academic institutions
- Faculty/Deans/ Heads of Departments
- Industry and Industry associations
- Students
- Parents
- Government and government bodies (especially the Higher Education Department and the Higher Education Council)
- Media

The Report has attempted to present an objective view and has not been written from either the industry's perspective *per se* or the academic institutions' perspective.

1.5 Focus

Though the focus is to some extent on engineering and technical education students, as they are the ones usually hired by industry, it is equally targeted to cover students of liberal education. It would be pertinent to note that currently there are as many as 14 lakh students in the disciplines of arts and science who should be made more aware of and capable of succeeding in industry jobs.

The goal is the development of appropriate skills and knowledge, over and above the standard curriculum: for instance dual degree programs, such as those that the Govt. of Kerala has considered in collaboration with NASSCOM.

1.6 Concerns

A number of concerns have been expressed about the intent of this Report, and we attempt to address these below:

- Is there an intent to make higher education subservient to industry needs?

Ans. Not at all. The purpose of university education is to create enlightened citizens, and it would be appropriate to create graduates who are competent with the current trends and technologies that are suited to the industrial and economic needs. There are two reasons for this: on the one hand, the requirements dynamically change with time, and it is not possible to anticipate what these specifics are; on the other hand, if graduates become proficient at continuous learning, they will be able to keep themselves up to date and adapt to changing requirements.

- Are higher education institutions producing students with the skills that industry needs?

Ans. Apparently not. A McKinsey-NASSCOM survey said a few years ago that only 25% of engineering graduates in India were immediately employable without much remedial training (this is for the IT industry). The situation may be similar for other sectors and industries.

- Are there any structural reasons why industry does not wish to involve academia?

Ans. Probably not; it is just that existing systems may not have given scope for such an interface. As such, there is very little interaction between the two. Once there are platforms, mechanisms and forums for them to interact, it is likely that they will reach out and find constructive ways to collaborate.

- Can industry contribute constructively to academia?

Ans. Yes. This Report will attempt to suggest various ways in which this can be done for mutual benefit.

1.7 Basic Information about Kerala

Kerala, which lies on the south-western tip of India, is one of the smaller states of India, accounting for about 1.18 per cent of its territory and 2.8 per cent of its population (2011 census). The State came into existence on November 1, 1956 consequent on the reorganization of states on linguistic basis.

Kerala forms a narrow strip of land along the Arabian Sea coast with the Western Ghats on its eastern border, sliding towards the west from the mountain ranges and having three distinct layers of land – the highlands, the midlands and the lowlands.

It has a total geographical area of nearly 3,900,000 hectares. Nearly 28 per cent of the land area is covered by forests; land used for non-agricultural uses comes to about 10 per cent. The net area sown is around 56 per cent.

Forests and dense tree growth in the midland and lowland areas give Kerala an affable climate and protect the region from soil erosion. Forests form the resource base for a variety of industries. Kerala receives copious rainfall of about 3000 mm a year, from the two monsoons which extend from June to November. There exist 41 westward flowing and three eastward flowing rivers, which originate in the Western Ghats.

A large number of lakes, backwaters, lagoons and estuaries along with the numerous rivers and their tributaries make Kerala a land rich in water resources and a great tourist destination. Groundwater resources are also rich and bountiful.

Kerala is the leading fish-producing state in India; the industry employs 12 lakh persons and produces on the average 7.5 lakh tones of fish. Kerala's mineral endowments are poor except for China clay, silica sand, lignite and lime shell.

Kerala has not been industrialized heavily, but has a stronger service sector than much of the rest of the country. In at least three sectors, there is considerable growth in the service sector: healthcare, tourism and education. Agriculture, the mainstay in past years (especially large-scale paddy and coconut cultivation), has fallen on hard times, with boutique crops (such as spices) and plantation crops being the silver lining.

2. Concept and Definition of Industry–Academia Linkages

The Industry-Academia interface can be described or defined as an interactive and collaborative arrangement between academic institutions and business corporations for the achievement of certain mutually inclusive goals and objectives. The successful products of our educational system, be they general education graduates or technical education graduates, will be better suited to industry needs if there are institutional mechanisms for promoting industry academy interaction within their curricula.

A strong Industry–Academia relationship is of key importance not only for producing technical graduates suited for industry needs but also for creating an ecosystem of innovation and entrepreneurship. The industry academia linkage is being advocated so that the relevant stakeholders, both institutions and individuals, gain from the partnership.

Academic institutions, such as, universities, colleges and technical institutions as well as research based institutions would immensely benefit from the projects and other academic tie-ups with industry and corporate houses. The individual stakeholders of this academic segment, namely, the students, faculty and researchers would have an enriched experiential learning advantage through their deeper interaction with industries and corporate houses.

As far as the industry is concerned, their research needs, creation of patents and other innovations can be propelled through the academic institutions and their faculty, students and researchers. Such a mutually beneficial arrangement has become more significant in the recent times particularly due to the constantly changing socio-economic needs of an industrialized and knowledge based society.

While promoting industry-academia linkages to enhance the quality of learning experience as also to improve the learning outcome of students, the goals could be varied. One end of the spectrum would be to enhance the employable skills of graduates, whereas, at the other end, would be to promote research & development, innovation and entrepreneurship. At the basic level, the industry could gain from equipping the undergraduate students with the right attitudes, skills and application based knowledge to suit their requirements.

2.1 The Need for Institutional Linkages with Industry

Some of major reasons often identified are:

- Constantly changing needs of the industry.
- Increasing criticality of human competence in creating and sustaining competitiveness.
- Increased competition for students placements.
- Growing need of industry to make their fresh recruits productive with all the right knowledge, skills and attitude thereby reducing the training costs.
- Increasing interdependence between academia and industry to satisfy need for sustenance and innovation in their respective areas.
- Promotion of research, innovation and entrepreneurship and development of intellectual property and patents.

Generally, there is a tendency to advocate industry academic partnership only for students in technical institutions. This is a very restrictive perspective as there is a critical mass of students who are pursuing their non-technical courses in arts, commerce, basic sciences, social sciences, humanities etc. and it is equally, if not more, important to ensure that these students are also properly attuned to the commercial business, industrial and economic employment markets.

Presently, India has a pre-dominant advantage over other countries, in so far as it has a substantial youth population. This so called demographic dividend is not confined only to students pursuing technical education, such as those in engineering, management, pharmacy, architecture, hotel management etc but other academic disciplines of tertiary education. Hence, to address the issue of industry academia linkages from the point of technical education alone would be highly myopic.

A recent study by the McKinsey Global Institute (The world at work: Jobs, pay and skills for 3.5 billion people, June 2012), suggests that there will be a skill shortage of as many as 16-18 million college-educated workers in developed economies as soon as 2020. Even China, which has hitherto been able to supply as much as 20% of the world's entire labour force growth between 1990 and 2010, will have a shortage of 23 million high-skill workers by 2020. India, however, is expected to increase its entire labour pool from 470 million today to 630 million by 2030, and should theoretically be in a position to supply a large portion of the college-educated skilled labour. But the question is whether they will be adequately trained and skilled to take on these roles.

To cite an example, students pursuing Bachelor of Arts have potential opportunities to take up jobs in the services and tourism sector. There is lot to be gained if such students, while pursuing their under-graduate degrees, are placed for summer projects or some other academic arrangement in relevant industry so that the relevant applications and skills, for instance, communication skills, personality development and soft skills are provided as value-added knowledge. This would facilitate their being job-ready as soon as their education is completed and employers will also be equally happy to pick up such candidates who would not need further training and thereby save their time and training costs.

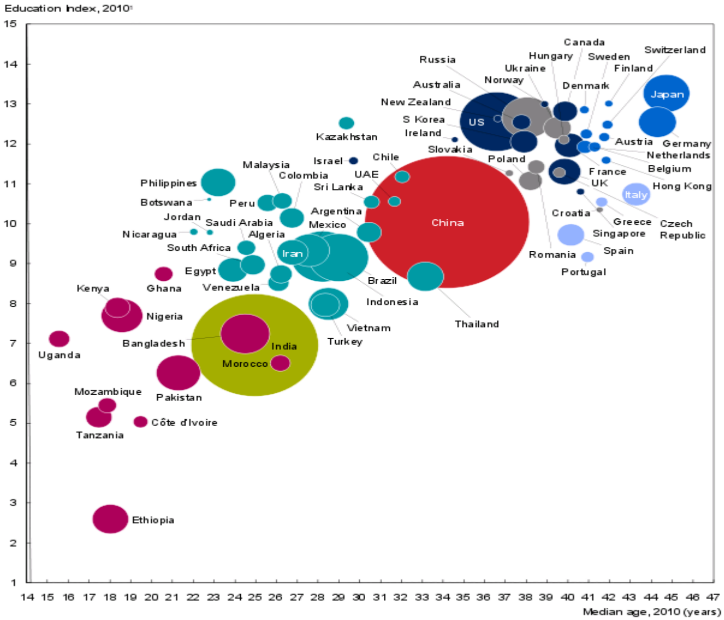
McKinsey Global Institute
The world at work: Jobs, pay, and skills for 3.5 billion people

Exhibit E3

Global labor markets fall into eight clusters, each distinctly positioned in terms of age profile and educational attainment

Size of circle represents total size of the labor force of the country in 2010

Cluster	Young Developing	Young Middle-Income	India	China	Young Advanced	Russia & CEE	Southern Europe	Aging Advanced
Workers Million	322	640	469	783	290	141	60	145
GDP per capita $	<3,000[2]	3,000–20,000[3]	3,000	7,000	25,000–50,000[4]	10,000–20,000[5]	20,000–30,000	30,000–45,000



1 Calculated based on attainment levels of working-age population, and relative weights for each attainment level—4 for no education, 6 for primary, 12 for secondary, and 16 tertiary.
2 With the exception of Morocco (GDP per capita of $7,100).
3 With the exception of UAE (GDP per capita of $28,500).
4 With the exception of South Korea (GDP per capita of $23,500).
5 With the exception of Czech Republic (GDP per capita of $22,300) and Ukraine (GDP per capita of $6,000).
NOTE: All money data in this report is expressed in US dollars ($) and at 2005 purchasing power parity (PPP) levels; for more detail on methodology for clusters, please see the appendix.
SOURCE: United Nations Population Division (2010 revision); ILO; IIASA; McKinsey Global Institute analysis

Figure 1 Global Labour Markets Fall into Eight Clusters

Detailed charts from the same McKinsey report suggest that India has relatively poor educational attainment even in comparison to its BRIC peers and other developing economies. The first figure below shows how India falls into a lower percentile of the world's clusters, where the educational attainment and per capita GDP are both relatively low. There is clearly room for improvement and this can make a real difference in the earning power of the students from Kerala and other parts of India.

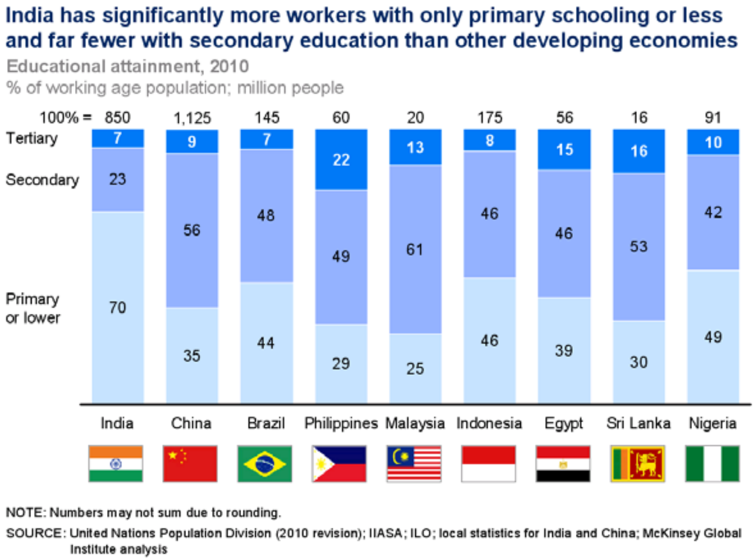


Figure 2 India's proportion of secondary/tertiary to primary education is skewed compared to other developing nations.

3. Educational Institutions in Kerala

To focus specifically on Kerala, the latest relevant data (Economic Review of Kerala 2011) about the number and types of higher and technical institutions is essential to understand the scope of the issue. Also, institutional industry linkages cannot eliminate polytechnics and other technical institutions though they are strictly out of the ambit of higher education. Since the skills deficit and skills enhancement are also included in the Terms of Reference (see Appendix 0), this data has also been covered to give a comprehensive picture.

The detailed breakdown of Kerala's educational institutions is provided in Appendix 1 (Kerala Educational Institutions)

4. Kerala: General Economic status

The general state of the economy (Kerala Economic Review 2011) would be a significant factor indicating employment trends and aligning the educational system suitably.

The global slowdown has had its adverse impact on the Indian economy. Deceleration in economic activity has been in evidence for quite some time now and seen across many sectors. The Reserve Bank has pegged growth during 2012-13 at 5.8 percent, a ten-year low, and that compares with 6.5% in 2011-12. The decline was spread across agriculture and most of the sub-sectors of industry, while the service sector preformed well. There was a fall in revenue collection, which, in turn, resulted in increased fiscal deficit. Corporate sector also reported a decline in profit. The fall in rupee value against the dollar by 20 percent in mid- 2011 pushed up the import bill.

The sector-wise distribution of gross state domestic product revealed that contribution from primary, secondary and tertiary sectors to the GSDP in 2010-11 at constant prices (2004-05) was 11.06, 20.13 and 68.80 percent respectively. At current prices, it was 14.94, 21.08 and 63.98 percent, respectively. Recent trends reveal that the contribution from primary sector has been decreasing while that of tertiary sector has been increasing. The contribution of the secondary sector has been almost stagnant.

Unemployment continues to be one of the basic problems of the State. The number of job seekers, as per the live register of employment exchanges in Kerala as on 31.08.2011 was 43.42 lakh, of which 25.68 lakh (59.1%) were females. However, there is doubt whether these figures reflect the actual unemployment position as many who have found employment continue to be retained on the live register for want of information.

The Kerala State Entrepreneurs Development Mission was a new initiative launched by the Government in 2011, aiming at providing self- employment to one lakh youth through 10,000 new ventures, over a period of 5 years. The Kerala Financial Corporation is the nodal agency and before launching self-employment ventures, all the beneficiaries are given training jointly with institutions like the Entrepreneurship Development Institute, KITCO, RSETI, and the Centre for Management Development etc.

It had been a satisfactory year for industry and allied sectors in Kerala. While the manufacturing sector in the country as a whole registered a growth rate of 8.2 percent in 2010-11, in Kerala it was a bit higher at 8.74 percent. The contribution of the manufacturing sector to GSDP at constant and current prices in 2010-11 was 8.2 percent and 9 percent, respectively. The performance of public sector undertaking was not commendable. Out of the 63 PSUs under the Industries Department, 17 remained closed. However, there was a significant increase in turnover and profits of the profit-making units in 2011 compared to the previous year.

Micro, Small and Medium Enterprises (MSMEs) sector played a vital role in employment generation at low capital cost, upholding entrepreneurial spirit and innovation, in the State. During 2010-11, there were 10882 SS/MSME units and the total investment made was Rs. 1453 crore. A total number of 84878 job opportunities were created through these units in 2010-11. Under the Prime Minister's Employment Generation Programme, a total number of 959 projects involving margin money of Rs. 11.84 crore had been sanctioned by various banks, in 2010-11. Similarly, in 2011-12, up to August, 259 projects at margin money of Rs. 392 crore had been sanctioned.

5. The Reality of Educational Attainment in Kerala

Here are some of the facts that all stakeholders should be aware of and concerned about:

- Gross Enrollment Ratio in higher education in India, which is the participation rate of the cohort in the age group of 18-23 years continues to be low and in India it is estimated to be nearly 15% as of 2010 (Selected Educational Statistics 2009-10(Provisional), MHRD). This is much below the world average of 24%, two thirds of that of developing countries (18%) and way behind that of developed countries (58%). Currently, data has estimated that our GER is around 17% as against 84% in US, 59% in UK, 55% in Japan and 28% in China. Kerala's higher education GER is only 13.1%as per MHRD SES 2009-10.
- None of India's educational institution is in the top 300 in the world in the Times Higher Education supplement (UK). Only 4-5 are in the QS survey and only 1 in the top 500 from Shanghai JiaoTong's list. The number of doctorates has grown only by 20% in India cf. 85% in China in 1991-2001.
- Funding availability: Higher education spending in India is 1.1% of GDP, US spends 3.1% of its GDP and South Korea 2.4% of its GDP. The Gross Expenditure on R&D (GERD) as a percentage of GDP is also not very encouraging as India spends an abysmally low 0.8 % on R&D as against 3.22% by Japan, 2.77% by USA , 2.68% by Germany and 1.77% by UK (UNESCO Institute for Statistics) (Figure 3).
- Of the top institutions in the country according to *India Today,* none are in Kerala.
- The quality of the incoming post-secondary students into higher education appears to be poor.
- In standardized tests, such as, PISA[4] (Programme for International Student Achievement, 2009) which measures the academic

[4] PISA 2009, Mathematics achievement, scores out of 600:
Shanghai, China 600
Singapore 562
Hong Kong 555
South Korea 546

achievements of 15 year-olds, Indian States perform dismally. For instance, Himachal Pradesh and Tamil Nadu (the only Indian states in the comparison), came in almost dead last, 73rd and 74th out of 75. Kerala's relative achievements compared to other Indian states are not particularly laudable.

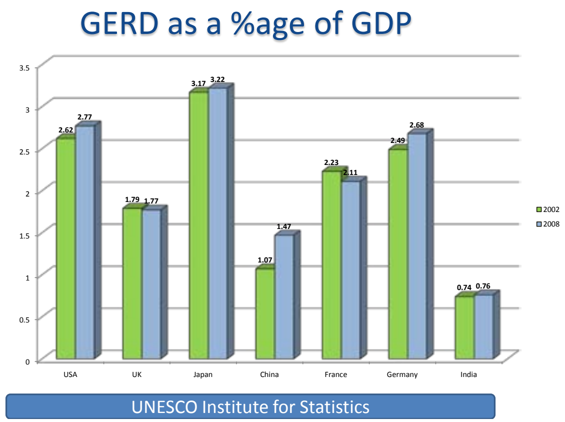


Figure 3 GERD as a percentage of GDP per capita, selected countries

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Taiwan 543
Finland 541
Liechtenstein 536
Switzerland 534
Japan 529
Canada 527 were the top ten.
Indian scores:
73. Himachal Pradesh 337
74. Tamil Nadu 325 and
75. Uzbekistan brought up the rear.

5.1 Thrust in the XII Five Year Plan:

It would be relevant to examine this issue as envisaged in the XII Five Year planning process. In Para 10.24 sub- section "**Enhancing Employability"** within the Chapter on **Education and Skill development** of the **Approach Paper to the XII Plan** states as quoted:

"…There is a need for a clear focus on improving the employability of graduates. Indian higher education is organized into 'General' and 'Professional' streams. General education which is an excellent foundation for successful knowledge based careers, often fails to equip graduates with necessary work skills due to its poor quality. On the other hand, professional education is often expensive, lengthy and usually imparted in narrowly specialized private institutions, with little emphasis on liberal arts, which is essential for the development of intelligent able-minded citizens. For both 'General' and 'Professional' education streams, integrated curriculum with greater flexibility in the choice of subjects and innovative pedagogic practices are needed to improve the quality and hence employability. Graduates now require the skills beyond the basics of reading, writing and arithmetic (the '3Rs'). Skills such as critical thinking, communication, collaboration and creativity (the '4Cs') are now important in more and more jobs. Accordingly, there is need to focus on the '4Cs'. Special emphasis on verbal and written communication skills, especially in English would go a long way in improving the employability of the large and growing mass of disempowered youth."

5.2 Approach Paper to the XII Five Year Plan of the State of Kerala

The following challenges faced by Kerala have been identified in the Approach Paper to the XII Five Year Plan of the State of Kerala:

- Poor Quality in Higher Education
- Both out and in migration
- Urbanization – 47% Urban Population

5.2.1 Education

- The XII Plan will attempt to identify and fill critical coverage gaps in education facilities.
- The state has achieved full retention both at primary and upper primary level, and dropout rates are negligible.
- The elementary education GER is 97.86.
- Kerala is the only state in India to have achieved female literacy above 90% (91.98%).The overall literacy rate is 93.9%.
- The state proposes to achieve 100 % literacy during the plan period.
- It is proposed to upgrade at least 10 nationally accredited colleges during the plan period and also it is proposed to set up 10 international schools for providing better education.

5.2.2 Unemployment

Unemployment continues to be one of the basic problems of the state. The number of jobless, as per the live register of employment exchange in Kerala as on 31.08.2011 was 43.42 lakhs of which 25.68 lakhs (55%) were females.

- Employment generation will be a focus area and will be secured through higher and more dispersed investment.
- Development of educational infrastructure; particularly vocational education at school and college level, and skill development.
- Considering the states special problems in the unemployment sector, high priority is given to skill development during XII Five Year Plan.
- A mission mode approach would be followed for addressing the unemployment problem for educated unemployed through skill development and other means.
- Students who complete 10th standard and beyond will be the target and suitable skill development activities will be ensured to them.

- Blueprint has been submitted to the National Skill Development Corporation and National Skill Development Mission.

5.2.3 Primary Sector

- High tech farming, precision farming etc are envisaged during XII Plan.
- Technology will be used to attract younger generation to Agriculture.
- The XII Plan growth target for Agricultural Sector is 1%.

5.2.4 Secondary Sector

- Infrastructure sector is given high priority during the XII Five Year Plan.
- The Approach Paper suggests to increase investments in the infrastructure sector through PPP.
- Construction sector to be given priority as this has very good contribution in the secondary sector.

5.2.5 Tertiary Sector

- The share of this sector to GSDP during 11th Plan was 69%.
- Tourism should be the growth engine in the XII Plan.
- As far as the economy of Kerala is concerned, service sector should be given top priority.

5.2.6 Power Sector

During the XII Plan, the target will be to double the installed capacity through installation of new gas based and super critical plants.

● Major components of capacity addition during XII Plan Period are the following viz.

1. LNG based plant at Kochi (375 x 3) MW.
2. Coal based plant (1000 MW) utilizing coal block at Baitarni allotted to KSEB.

6. An analysis of the Problem of Employment and Unemployment of the Educated in Kerala

The Kerala State Development Report 2008 has analyzed the aspect which is critical to this Report.

In particular, the state faces a serious problem of educated unemployment, which has been both persistent and endemic. Especially with the entry of large number of females into the workforce, unemployment and underemployment continue to be a major social concern in Kerala.

Details of this analysis are available in Appendix 2: The Problem of employment and unemployment of the educated in Kerala.

7. Planning Commission and World Bank Recommendations on Sectoral Opportunities and Skills in Engineering Students

The Planning Commission has made a number of recommendations about how to seize opportunities in different areas. The Manufacturing Plan has outlined Strategies of Accelerating Growth of Manufacturing in India in the 12th Five Year Plan and beyond. These are pertinent across the country and for the State of Kerala too and the State Government is encouraged to consider adoption of these strategies suitably.

Manufacturing must provide a large portion of the additional employment opportunities required for India's increasing numbers of youth. Agriculture cannot be expected to provide more jobs. On the contrary, it should be releasing labour which has very low productivity in agriculture, to be absorbed in other sectors. While the services sector has been growing fast, it alone cannot absorb the 250 million additional income-seekers that are expected to join the workforce in the next 15 years.

Details of the recommendations are provided in Appendix 3 (Planning Commission Recommendations for the Manufacturing Sector)

7.1 Survey on Skills Needed

The World Bank conducted a survey to identify the nature of skills needed by engineering students. The recommendations categorize three types of requisite skills, namely Core skills, Communication skills and Professional skills, which are important to employers of engineering graduates. The detailed summary findings and Policy Implications of Planning Commission are provided in Appendix 4 (Recommendations of the World Bank).

It is desirable that the suggested recommendations be considered for implementation in the Universities and colleges of Kerala as it would enhance the employability factor of engineering and non-engineering graduates. It is clarified that though the survey focused on engineering employers, the skills identified would be applicable to general education students also.

8. Focus Sectors

Given limited resources and time, this Report will focus on a few industry sectors that are likely to have the best immediate impact in Kerala. Such industry-specific Sub-Committees should be empowered to hold one-day workshops with relevant industry representatives in different parts of the state. The general intent is to get local industry in all parts of the State involved in providing feedback to the Committee. The objective of the workshops is not limited to information dissemination, but to create a sustainable interface in that domain for the next 4-5 years. The identified list of industries is not exhaustive and additional sectors can be added if a regular platform could be created as a sustained activity over a longer period of time. Expected outcomes from the workshops:

- 4-5 distinct actionable points.
- Ways of collaboration and cooperation between industry and academia.
- Some guidelines on the roles of each partner.

The industry sectors considered are:

- Information Technology

- Retail
- Infrastructure, including inland waterways
- Tourism/Hospitality
- Healthcare, including ayurveda
- Agriculture, including floriculture, pisciculture and horticulture.

It is suggested that the Banking and Finance sector could be added to this list, even though we had originally not considered it, because of its considerable growth potential in Kerala.

Some specific actionable items that have been considered include:

8.1 Curriculum-plus Certificate Programme

This topic is covered in some detail in section 3 in Appendix 4 (Recommendations of the World Bank). The intent is to provide, in addition to the normal curriculum, a mechanism whereby students can benefit from employment-related skill development.

8.2 Government of India National Vocational Education Qualifications Framework (NVEQF)

The National Vocational Education Qualification Framework tries to combine skill building and general education. This is done initially through certificate level courses which can be followed up later with diploma and degree programmes using the same framework. The NVEQF uses a localized approach which involves determining sectors and skills which would have the greatest local impact. This model is a flexible one that covers not only different sectors, but also involves courses of varying duration (half-day, one day or week-end programmes). These practical courses are delivered in the local language and allow participants to switch from formal and vocational education programmes to the job-market, and vice-versa, at different points of their careers.

Industry would be closely involved in the identification of skill-requirements at all levels; national, regional and local. There would also be a provision for "Recognition of Prior Learning" that would enable development of training programmes that would take into account knowledge and skills gained though non-formal education. Testing and certification would provide them an entry into the formal job-markets. Knowledge gaps would be covered through courses provided by organizations/institutions such as NIOS/State Open Schools, IGNOU/State Open Universities. A registration system for NVEQs, and accreditation of courses and programmes offered by them, would ensure that this framework translates into uniform standards for courses and programmes offered by different institutions. This would also bring greater uniformity in standards of vocational education nationwide.

8.3 Recommendations of the Narayana Murthy Committee on Corporate Sector Participation in Higher Education

The report by this Committee highlights the following activities:

- create enabling conditions to make the higher education system robust and useful to attract investments.
- improve the quality of higher education by focusing on research and faculty development with corporate sector participation.
- engage the corporate sector to invest in existing institutions, set up new institutions, and develop new knowledge clusters.

9. R&D

Figure 3 (in Section 5 above) indicates the low level of education spending on R&D in India as compared to other countries. It is a matter of concern that the quality of the research coming out of Kerala's higher education institutions is relatively poor, with a few exceptions. The experience around the world has been that high-quality research institutions bring significant dividends in terms of leading-edge work that might lead to the creation of new industries. The experience of the Silicon Valley cluster around the research universities of Stanford and the University of California, Berkeley is an example.

Despite the high physical quality of life, it appears at the moment that it is difficult to attract researchers to Kerala. This is in contrast to the situation a century ago, when Travancore University went so far as to offer Albert Einstein a position. A number of initiatives may be pursued to improve the research climate in Kerala.

9.1 Publishing Incentives

A strong mechanism for increasing the attractiveness of research may be in providing monetary incentives (partly funded by the institution and partly by the government) for publishing in prestigious journals listed as Class A or Class B according to a well-known entity such as Cabell's Directory. There could also be incentives based on the Citation Index.

9.2 Patenting R&D and IPR

At the moment, the existing mechanisms for converting intellectual property into usable patents are limited. A strong IPR cell, with support from lawyers, industry and other relevant functionaries, can be created within some major Universities. It would also be helpful to hold a series of seminars educating researchers about the process of creating defendable IPR, such as patents or copyrights or other forms of intellectual property.

9.3 Collaborations between Industry, Academic & Research Labs/Institutions

One of the reasons for the success of industrial clusters around the world is the constant interaction among industry, educational institutions and research laboratories. Given that there are many large centrally-funded research institutions in Kerala (e.g. ISRO, RCC, etc.) there should be mechanisms that encourage the productization and marketing of ideas from the labs, perhaps in collaboration with academia.

10. Innovation and Entrepreneurship

There is considerable entrepreneurship in Kerala, but most of this is in the service sector. There is little by way of the standard venture-capital backed model of technology startups as in the Silicon Valley, although the first IPO of a Kerala-incubated company, MobMe from the College of Engineering Trivandrum, happened recently. There is little awareness of the possibility of raising risk capital. However, a recent phenomenon has been the growth of companies focused on products in the mobile space, which looks like a sunrise sector, as the traditional IT services sector is beginning to mature.

One of the disadvantages of Kerala at the moment is the lack of risk capital available, for instance there is currently no Kerala-based VC fund. An experiment a few years ago with the Kerala Venture Fund (jointly created by SIDBI and KSIDC) with a small corpus, was only modestly successful. The ecosystem for entrepreneurship is missing, although the success of several home-grown IT companies in Technopark has created a sense of confidence among youngsters.

There is, however, not a systematic "demonstration of success" in entrepreneurship, and the incidence of business failures is high. A mechanism whereby success can be highlighted and best practices passed on to aspiring entrepreneurs will be helpful.

Private Equity managers may also play a significant role in the promotion of entrepreneurship, as this may also lead to business opportunities for them.

10.1 Creating an Ecosystem for Innovation

A major part of such an ecosystem will be finance. The other would be a pool of advisors who can bring their expertise to bear on the problems faced by small companies. Given the availability of retirees with rich experience, it would be useful to set up a mechanism, similar to those pursued by TiE (The Indus Entrepreneur) in Silicon Valley, where 'angel investors', experts, and entrepreneurs can meet and exchange ideas.

10.2 Setting up Innovation Platforms, Cluster Innovation Centers and Design Innovation Centers

The second linkage that may bear fruit is the creation of Innovation Platforms including the identification of promising areas where there might be significant potential in future. Based on these areas – for example, renewable energy, LED lighting, Big Data, biopharmaceuticals – an experimental facility may be set up at a central location, which can be used by would-be entrepreneurs. A simple example might be a mobile platform set up with the prevailing technologies such as Android, Apple and Microsoft, wherein an entrepreneur may rent time to test and customize his product.

10.2.1 Cluster Innovation Centers

In the Twelfth Plan, Universities are encouraged to set up Cluster Innovation Centers (CIC). One such CIC is functioning in the University of Delhi. This CIC provides a platform to the University of Delhi and all its partners to forge mutually beneficial linkages to initiate and assist innovation activities and act as a catalyst and facilitator. Its primary objective is to create an ecosystem that connects and facilities various stakeholders on all aspects of the innovation process including training and support. By promoting innovation, channeling various incentives that benefit the cluster, CIC acts as an incubating body managing the growth of innovation in this ecosystem.It is expected that CIC can act as a hub for innovation activities – facilitating and developing of ideas into innovation applications that can benefit society directly or can be marketed successfully.

10.2.2 Design Innovation Centers

Another initiative in the Twelfth Plan is the establishment of Design Innovation Centers (DIC) as recommended by the National Innovation Council. The model of DIC's set up by the Central Government is as follows: the structure, course content, course design, will be innovative and tailored to the objectives. The DICs should not be set up as regular schools/centers in institutions. The DICs are free to network and partner with other institutes depending upon their areas of work. The DICs can focus on Product Design, Industrial Design, Process or System Design with the outcomes aligned to the needs of the society. Each Center will offer courses in design and innovation which will be different from those offered by individual departments. The course to be offered by the Center will be multi-disciplinary and participatory in nature. Projects to be done in teams will consist of students from different specializations, who are expected to work under the mentorship of faculty from diverse departments/centers/schools to tackle social and industrial problems.

The courses offered from the centre will not have a specific science or engineering specialization focus but they will be allowed to have specific application focus such as bio-design, inclusive innovation, assistive technologies, sustainable energy technologies, etc. These courses would be available to students from very early stages of their programmes to imbibe design and innovation culture. Some of these courses will be primarily for undergraduate students and another set of courses are those which can be taken by both undergraduate and postgraduate students. The centre over a period of time is expected to run at least six courses of this nature to undergraduate and post graduate students with an enrolment of about 40 students per course.

The Design Innovation Centres will play a crucial role in promoting industry sponsored and community driven projects. Working closely with the community, the DIC can identify industry and community based needs/ideas which require multi-disciplinary problem solving skills and which can be addressed within an academic setup as a part of the course and projects to be offered by the centre. Depending on the nature of problem and deliverables, these can be multi-semester project courses each building over previous ones. They would adopt a 'Hub and Spoke' model with the Lead Institute acting as the mentor while synergizing and leveraging the potential of the institutes at the field level. Though Design and Innovation are concepts without boundaries as they are based on multi-disciplinary and open learning approach, however the DICs main endeavor is to specialize either in some broad sector orin their geographical areas of operation. The DICs over a period of time shall strive to be self-sustaining.

10.2.2.1. Creating an Eco-System for Translation into Business Venture

Presently many knowledge creating activities do not go beyond institute corridors. Taking an innovative idea from proof of concept stage to market/user/society/industry requires a compelling ecosystem which will be put in place as a part of centre activities. The DICs will try to fill the gap between a successful laboratory prototype and a committed business venture,by playing an active role in promoting an intermediate stage of translational research & development to bridge this gap. In other words the DICs will provide necessary eco-system and resources to students/faculty to take their ideas beyond a first successful prototype to a pre-production prototype.

10.2.3. Creation of CICs and DICS

Kerala may like to explore the possibility of setting up of CICs in some of its State Universities or State Technical Institutions which could double up as incubation centres. Similarly, it can co-locate Design Innovation Centres in a couple of major institutions which can be lead institutions partnering with other institutes around them. The National Innovation Council has recommended setting up of State Innovation Councils and Kerala may like to consider this for implementation.

10.3 Setting up Incubation Facilities

Along the lines of what is working at IIM Bangalore (the NS Raghavan Center for Entrepreneurship), incubation facilities may be provided at a regional level. There is already such a facility at Technopark. This could be augmented with others, where entrepreneurs are chosen through a business plan competition, and housed and counseled for a fixed length of time beyond which they will have to leave the incubator. They could pay for services rendered through a combination of equity and cash.

An existing incubator in the academic arena is the one at NIIT, Kozhikode, funded by the Department of Science and Technology, Government of India.

10.4 Encouraging Research in Social Sciences and Non-Technical Subjects

In addition to the physical sciences, research into the social sciences can also lead to new business models – for instance, the entire social networking arena, as well as the area of design thinking and creativity can be quite useful.

10.5 Intrapreneurship

In addition to starting new ventures, it would be useful to create new businesses within existing firms. Technical and business faculty can be involved in the process of creating intrapreneurial ventures.

10.5.1 Business plan competitions inside firms

One possibility is to create standard templates for business plan competitions within firms, which can then be judged by academic faculty on the technical and business merits and feasibility for further investigation.

10.6 X-Prize-Style Large Prizes for Solving Difficult Problems

It has been demonstrated that creating large prizes for reasonably well-defined, complex problems, may well cause creative ferment among those in that sector, leading often to breakthroughs. One example is the series of X-prizes in the US, one of which has been for the commercialization of space flight. Similarly, the US Department of Defense has funded prizes for self-driving cars, and after years of increasingly complicated requirements, now such cars are on the threshold of commercial viability.

11. Recommendations for Enhancing Industry- Academia Linkages

One of the endemic problems faced by research universities and research labs is that some of their inventions languish on the shelf, because those who might be able to commercialize them are simply unaware of the invention itself. A recent effort to increase what is called in the literature 'open innovation' has been the creation of mechanisms to link up inventors with potential users. 'Lead-user research' is one such initiative.

A newer initiative, which in essence is the opposite of the X-prize type mechanism, is a website named Marblar, where new inventions are posted, with a challenge to users to come up with potential new uses.

11.1 Incentivizing Faculty

- Provide consulting incentive such as % of consulting fee.
- Possibly additional matching grants from government (open to both public and private colleges), or from the institutions themselves.
- Incentives for publishing in listed journals (national and international) as well as for textbooks, also from the institutions.
- Establishment of sponsored chairs.
- Training in leadership and management from industry.
- New programmes and facilities.

11.2 Rotating Industry People into Academia

- Relaxing existing regulations to allow sabbaticals of 1 year for industry people to spend time in academic institutions.
- Creating more part-time Masters and Doctoral studies programmes such as PGSEM at IIM Bangalore.

- Bringing in retired industry people into academia for a second career in teaching.

11.3 Rotating Faculty into Industry on Sabbaticals

- Paid sabbaticals for faculty in industry to pursue PhDs.
- Post-doctoral programmes in industry.

11.4 Industry outreach programmes

11.4.1 Strategies

The Working Group on Technical Education for the XII Plan constituted a Sub-Group on Skills and Employability. Some of these suggested strategies which can be adopted by Kerala State could be considered for implementation on a pilot basis by a few government/government aided/private institutions. These pilots can be scaled up as regular programmes if positive outcomes have yielded.

Industry Institute Student Training Support

Objectives:

- To connect industry directly with students through training programmes.
- Such initiatives to operate in specific specializations
- Training to be imparted in every District Headquarters on regular and need based pattern.

Industry Institute Continuous Interaction Scheme (Student-Centric and Faculty Centric)

Objectives:

- To support 4-5 industrial interaction per month (one per week).
- Industrial expert spends two full days of activity in an institutional environment alongside faculty and students.

Intensive Interaction-Train the Teachers (Faculty Centric)

Objectives:

- To make faculty learn about the needs and environment of industry by spending a month in industry during summer vacation time.
- 5% of the staff encouraged and incentivized to take it up every year.
- Incentivizes could be honorarium and living expenditure.
- Periodic refresher courses or workshops to familiarize with changing needs.

11.4.2 Other General Suggestions that could be Adopted by all Institutions

Industry representation in Governing Councils and Board of studies:

- Industry inputs in curriculum designing
- Student mentoring
- Making regular college visits, a part of industry initiative (e.g. as per CII proposal)
- Non-summer student projects so that specific tasks can be handed off to them by industry (undergraduate and graduate)
- Designation of industry clusters and nodal academic institutions to spearhead contacts with these cluster representatives
- Regular programme of inviting industry people to academic institutions as guest faculty (also as per CII proposal)

11.5 Regional incubation centers

- Technology parks to twin with institutions for incubation (e.g. Technopark and its existing incubation mechanism)
- Top institutions to provide facilities for technology parks (as has been done, for instance, by IIT Madras and Stanford University)

11.6 New Knowledge Clusters

- Knowledge City in Trivandrum, Kochi, Kozhikode, Malappuram: knowledge ecosystem, urban scale and services, socio-cultural climate, faculty relocation preference.

The Narayana Murthy Committee Report has suggested clusters at various levels:

- National level: Bangalore, Chennai, Delhi, Hyderabad, Mumbai, Pune.
- Secondary: Ahmedabad, Chandigarh, Coimbatore, Gurgaon, Jaipur, Kolkata, Mysore, Raipur and Dehradun-Roorkee.

Along the same lines, Regional Hubs can be set up in various places, for instance in Trivandrum with Indian Institute of Science Education and Research, Indian Institute of Space Science and Technology, CET, University College and the Regional Cancer Center, the Sree Chitra Thirunal Institute of Medical Sciences & Technology, the Rajiv Gandhi Center for Biotechnology, and other research institutions.

12. Technological Solutions Investment

The year 2012 has seen a boom in the area of Massively Open Online Courses (MOOC), where a globally distributed audience of 10,000 or even 150,000 might take a course offered by an eminent faculty. Using this mechanism it is possible to dramatically improve the availability of teaching material and to leverage the work of eminent faculty in a way that does not require additional investments by industry.

Using recorded materials, students can learn at their own pace. It is also possible to create simulcast lectures with the possibility of interaction between the faculty and students, but this model has been proven expensive (high bandwidth requirements), unsatisfying (to both teachers and students, as compared to a face-to-face lecture) and too rigid (everyone has to learn at the same pace, by definition).

On the other hand, it will be possible to deliver high-quality teaching material to a wide audience with little difficulty and at low cost, essentially only the cost of bandwidth using basic tools such as

YouTube. The student can also consume material on relatively inexpensive smart phones. Since smartphones are predicted to be ubiquitous, they become a good delivery mechanism.

In addition, under the NMEICT mission, there is a proposal to provide Aakash tablets to every student, and also for teachers to be given adequate technical training. However, the primary interest we have here will be in the ability of the tablet (or smartphone) to deliver content. Further, IIT Bombay's 'A-view software' can be leveraged by institutions for undertaking capacity building programmes for faculty. Educational institutions may create studio facilities to beam training sessions conducted by IIT Bombay for the training of faculty.

Industry experts can be identified to create detailed content for students that will enable them to come to industry with a fair grasp of the things they will need to be familiar with. Localized content is another possibility – with experts providing information in Malayalam, or with specific local context (e.g. in tourism and hospitality, the way in which knowledge of history and culture may be a major value-add in offering a 'glocalized' product that appeals to high-value tourists.)

12.1 Leveraging Digital Content

There is much material already available free of charge on the internet. But some of the new entities are likely to charge.

- Using the vast amount of material available from various online 'Universities' like Udacity, Coursera, edX, Minerva, Khan Academy as well as IGNOU.
- A co-certification mechanism may be provided to give credit for classes taken under this mechanism (but this will require new ways of grading exams for remote students, with the attendant problems of plagiarism).
- Higher Education institutions to submit proposals under the NMEICT Mission of GOI.

12.2 Bridging the Digital Divide

How can students without internet access use this material? Based on smartphone and tablet availability (e.g. the Aakash 2 experiment by the Indian government) many students will be able to download video content. By providing facilities to view content in classrooms using projection systems, the entire class may be able to watch the course together.

13. Conclusion and Suggested Road Map

Based on the data considered in this Report, it is clear that some incremental and some radical innovations are necessary for the future well-being of higher education in Kerala. Here we consider a few steps, both short-term and long-term, for the consideration of the Higher Education Executive Council to recommend to the Kerala Government. Some of the recommendations do not have financial implications as they only require modifications in the structure of the curriculum.

Recommendations are in three categories, interaction/skill upgrade (INT), entrepreneurship/innovation (ENT), and technology solutions (TEC):

1. A Council for Industry in Higher Education to be set up (INT);
2. An ongoing process whereby this Committee's recommendations can be provided to stakeholders in different industry sectors, and followed up with Addenda to this report delivered with their recommendations included (target: August 2013, December 2013 for two updates) (INT);
3. A sandwich program for students with mandatory industry internships to be introduced (INT);
4. A soft skills programme with credits to be introduced in the curriculum (INT);
5. A mandatory programme of industrial visits, with experts coming to campus and students going to companies (both large

and entrepreneurial), with activities on a fortnightly basis (INT, ENT);

6. A student mentoring programme by the people in the industry to be set up (INT);
7. An empowerment fund for R&D to be set up, with a corpus, and matching grants by government towards specific research projects sponsored by industry (INT, ENT);
8. A technology-based initiative to create localized content, a studio to make these look professional, a projection system in every classroom, and Aakash-type tablets to be provided to students to take advantage of Internet-based delivery of course content (TEC);
9. A community college initiative that leads to a 2-year associate degree to be set up so that it responds to the demand for specific skills in the local economy (ENT);
10. Entrepreneurship initiatives including "My story" type programmes with successful entrepreneurs, lessons from failure, lectures on IPR and patenting, and incubation centers with the active involvement of venture capital and private equity players (ENT);
11. A design-thinking programme to encourage creativity and design innovation to include local non-technical perspectives and user-centric-ness (ENT);
12. Setting up of Cluster Innovation Centers and Design Innovation Centers in existing institutions (ENT); and
13. Creation of a State Innovation Council on the lines recommended by the National Innovation Council (ENT).

13.1 Implementation framework

Consequent upon the Kerala Government's acceptance of recommendations, a Task Force may be constituted. The Task Force can work out a detailed implementation plan with milestones and timelines to ensure effective and efficient outcomes. The Task Force can assess and monitor the progress and provide oversight to the industry academia linkages in the State. This Task Force can be dissolved either after a proper institutional mechanism of a State Council for Industry in Higher Education as suggested by this Committee or within a specified time frame as decided by the State Government.

We divide these into short (3 to 6 months), medium (6 months to 12 months) and long-term recommendations as follows and make the following estimation of financial requirements:

Sl.No & Item	**Timeframe**	**Estimated Cost**	**Comments**
1.Follow-on process to implement and monitor recommendations that are accepted by the government	**Feb 2013**	**Rs. 10 lakhs**	**The suggestions need to be taken forward with oversight.**
2. A Council for Industry in Higher Education to be set up, along the lines of CIHE in the UK	**Long-term**	**Rs. 10 crore corpus**	**A body to be set up with participation from industrialists, VCs /Principals, entrepreneurs, students, industry associations.**
3. A mandatory internship for students in industry	**Medium - term**	**TBD, as the cost can be shared by industry as part of CSR**	**Perhaps 3 months total as part of the course.**

4. A soft-skills programme in the curriculum	**Medium - term**	**TBD**	**180 additional hours of classes outside normal class hours.**
5. A mandatory industry visit/interaction program with frequency targets	**Medium - term**	**TBD**	**Both ways: students going to industry, and industry people visiting campuses.**
6. A student mentoring programme	**Medium - term**	**TBD, mostly borne by industry under CSR.**	
7. An R&D fund	**Long-term**	**Rs. 20 crore corpus, with industry funding specific projects.**	**Industry funds research; matching funds in 1:n ratio made available by government.**
8. A digital education programme with a state–of-the art studio for podcasts and videocasts and new content created regularly	**Medium - term**	**Rs. 20 crores for setting up a new Studio. Until that time rent can be factored in. Partial funds can also be leveraged under MP Local Area Development (MPLAD) Scheme.**	**Rent time in an existing studio, as technical requirements are not heavy. Content can be created by industry participants.**
9.Projection and Multimedia facilities in classrooms	**Medium - term**	**Rs.5 crores**	**All classrooms to move towards digital classrooms in a phased manner.**

10. Tablets to be made available to students	**Medium - term**	**Rs. 5 crores**	**Procuring Aakash tablet in a phased manner with students bearing part of the cost.**
11. A community college programme to meet local requirements	**Long-term**	**TBD**	
12.An entrepreneurship-oriented curriculum along with interviews with entrepreneurs.	**Long-term**	**Rs. 10 crore**	**Funding should also be available via an angel network, with collaboration from TiE**
13. A design-thinking programme to be held in different regions	**March 2013**	**Rs. 50 lakhs**	**To encourage creativity, innovation and out of the box thinking**
14. Setting up of Cluster Innovation Centres and Design Innovation Centres in existing institutions.	**June 2013**	**Rs. One Crore for each CIC and Rs. 2 crore for each DIC.**	**To promote industry sponsored and community driven projects and create a platform for multidisciplinary solutions.**
15. Creation of a State Innovation Council	**April 2013**		**As recommended by National Innovation Council.**

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Appendix 0: Terms of Reference

The Terms of Reference of the Committee are as follows:

- To examine various approaches for establishing institutional academic linkages with industry with specific reference to Kerala.
- To suggest various models of academic collaboration with industry, both in public and private sector, so as to encourage invention and innovation through research.
- To suggest introduction of modular skill based courses aimed at addressing the skill deficit in different industrial sectors of the economy.
- To assess the existing processes of placement of graduates in professional educational institutions, both in public and private institutions management and suggest improvements.
- To suggest new inter-disciplinary courses relevant to the changing needs of the globalized economy.
- To evolve guidelines for developing collaboration between academic institutions, research laboratories and industrial houses for promotion of research and development.
- To implement relevant skill based vocational courses proposed within the National Skill Development Mission (NSDM).

Appendix 1: Data on Educational Institutions in Kerala

University and Higher Education

There are a total of 9 universities functioning in the state. Out of these four universities viz. Kerala, Mahatma Gandhi, Calicut and Kannur are general in nature and are offering various courses. Sree Sankaracharya University of Sanskrit, Cochin University of Science and Technology and Kerala Agricultural University offer specialized courses in specified subject areas. Besides these, the National University of Advanced Legal Studies (NUALS) established in 2005 and the Central University established in Kasargode district are also functioning.

Inter University Centers within the Universities in Kerala were established in 2009. These centers provide academic support to the faculties and students of various universities and co-ordinate major projects undertaken in their respective fields. The Inter University Centre has the objective of developing post graduate programmes in the relevant discipline and serving as an Inter University Centre for research in the relevant discipline and strengthening the ongoing PhD programmes and research activity in the concerned areas of advanced study. The establishment of the Inter University Centers has a significant impact. The Inter University Centers are interdisciplinary centers for conducting cutting edge research programmes synergizing available academic expertise in the universities. A cluster of such centers has been established in the field of Bio Sciences. The centers are Centre for Bio - Informatics (Kerala University), Centre for Bio Science (Kannur University), Centre for Plant Biotechnology (Calicut University), Centre for Marine Biotechnology (CUSAT), Centre for Genomics and Gene Technology (Kerala University) and Centre for Bio Medical Science (MG University).

Arts and Science Colleges

Including 150 Private Aided Colleges and 39 Government Colleges, there are 189 Arts and Science Colleges in the State. Ernakulam district (25nos) has the largest number of Arts and Science colleges in the state followed by Kottayam (22 nos), Thiruvananthapuram (20 nos) and Thrissur (20 nos) districts. A new Govt. Arts and Science college has started functioning in Ambalapuzha, Alappuzha district with BSc Mathematics, BA Economics, and BCom during the academic year 2010-11. Thiruvananthapuram district has the largest number of Government colleges (8 nos) in the state.

Enrolment of Students

The total number of students enroled in various Arts and Science colleges (excluding unaided colleges) under the four general Universities in Kerala during 2010-11 is 1.82 lakhs. Of this 1.27 lakhs (69.78%) are females.

Out of the total 1.65 lakh students enrolled for degree courses, 45.10% are enrolled for BA degree courses, 39.63 % enrolled for BSc degree courses and 15.55% enrolled for B.Com degree courses. Girls constitute 69.05% of total enrolment for degree courses. 27 subjects are offered for BA degree courses. Among the subjects, Economics has the largest number of enrolment of students. 31 subjects are offered for BSc courses and Mathematics has the largest number of student enrolment. 15601 students are admitted to Post Graduate course in the state in 2010-11. 79.28% of those enrolled in PG courses are females.

Technical Education

Table Indicating Number of Technical Institutions under Directorate of Technical Education-2011

Sl. No.	Institutions	Nos
1	Government Engineering Colleges	9
2	Private Aided Engineering Colleges	3
3	Government Polytechnic Colleges	36
4	Government Women's Polytechnic Colleges	7
5	Private Aided Polytechnics	6
6	Fine Arts Colleges	3
7	Government Technical High Schools	39
8	Government Commercial Institutes	17

9	Tailoring and Garment making training centers	42
10	Vocational Training Centers	4
	Total	**166**

(Source: Directorate of Technical Education)

Engineering Colleges

There are 142 engineering colleges in the state with a total sanctioned intake of 45147 in 2011. Out of these engineering colleges, 128(90.14%) are self financing colleges, 11 (7.7%) are government colleges and 3 (2.11%) are private aided colleges. Mahatma Gandhi University has the largest number of engineering colleges affiliated to it. During 2011, 23 self financing engineering colleges started in the state. Comparing to 2010, the percentage of increase in the number of engineering colleges is 19.32% and the percentage increase of sanctioned intake is 18.8%. The University wise and District wise details of colleges are given below.

Table Indicating University-wise Engineering Colleges in Kerala 2011

1	Kerala University	39
2	Mahatma Gandhi University	40
3	Calicut University	33
4	Kannur University	8
5	CUSAT	20
6	Agricultural University	2
	Total	**142**

(Source: Directorate of Technical Education)

Table Indicating District-wise Engineering Colleges in Kerala 2011

1	Thiruvananthapuram	24
2	Kollam	15
3	Pathanamthitta	8
4	Alappuzha	9
5	Kottayam	9
6	Idukki	5

7	Ernakulam	26
8	Thrissur	15
9	Palakkad	8
10	Malappuram	7
11	Kozhikode	6
12	Wayanad	1
13	Kannur	6
14	Kasargod	3
	Total	**142**

(Source: Directorate of Technical Education)

Among the 11 Government Engineering colleges in the state, 2 Colleges are under the control of Kerala Agricultural University. These colleges are College of Dairy Science and Technology, Mannuthy and Kelappaji College of Agricultural Engineering and Technology, Thavanur, Malappuram.

Geographical Spread

Ernakulam district has the largest number of engineering Colleges in the state followed by Thiruvanathapuram, Kollam and Thrissur districts with an intake capacity of 9568, 7523, 4440 and 4795 respectively. Kollam, Pathanamthitta, Alappuzha, Ernakulam and Kasargode districts do not have Government engineering colleges. The sanctioned intake during 2011 of Govt. colleges was 2894 (6.4%), aided colleges 1550 (3.43%) and unaided colleges 40703(90.16%). The sanctioned intake of unaided colleges has increased by 21.12% during 2011 compared to the previous year.

Branch-wise Spread

Of the Engineering Colleges in Kerala, the largest number of branch wise seats was in Electronics and Communication (10200) followed by Computer Science (8280) and Electrical and Electronics (6900). 4564 students were studying in Government and Aided Engineering Colleges for graduate courses in the year 2011-12. Out of these 40% are girls. 906 students were studying in Government and Aided engineering Colleges for Post Graduate courses in the year

2011-12. Girl students constitute 55.3% of total students in Government and Aided Engineering Colleges studying for Post Graduate courses.

Faculty Development

The visiting faculty programme enables the teachers and students of the institution to share the experience and expertise of the eminent faculty from premiers Engineering institutions. Lectures were arranged in 9 Govt. Engineering colleges as part of this programme during 2010-11. Also 30 short term training programmes were organized in various Govt. Engineering Colleges for the knowledge enrichment of Engineering College teachers.

Training

Under capacity development, 42 training programmes were organized through various agencies for the teaching and non- teaching staff and more than 250 staff members participated in the programme. During 2011-12, 13 faculty members were deputed for M.Tech and 26 were deputed for Ph.D programme.

Infrastructure

More than 850 smart class rooms with all advanced teaching aids were established in all Govt. Engineering Colleges and polytechnics. Job oriented short term courses of 2 to 10 months for SC/ST students through engineering colleges, were conducted and 3190 students benefited through the programme.

Polytechnics and Technical High Schools

43 government polytechnics and 6 private aided polytechnics were functioning in Kerala during 2011. The annual intake of students in Government polytechnics and private aided polytechnics are 10378 and 1617 respectively. The total number of students in Government polytechnics during the year 2011 was 26583 and that of private aided polytechnics 4400. The female percentage in polytechnics in 2011 has increased to 32.59% from 27.34 % in 2010. Total number of teachers working in polytechnics of the state is 1879. Women teachers constitute 27.94% of the total teachers in polytechnics. SC/ST teachers constitute 8.41% of teachers.

Finishing schools

Finishing schools were established in 17 polytechnics including three women's polytechnics to make the polytechnic pass outs competent to meet the need of the industries in the country and develop their employment schemes.

Technical Schools

There are 39 government technical high schools functioning in the state. Total number of students in technical high schools in the year 2010-11 was 7488, out of which girls share has increased to 8.03% in 2011 from 7.77% in 2010. There are 905 teachers working in technical high schools of the state. Women teachers constitute 19.90% of teachers in technical high schools.

Institute of Human Resource Development (IHRD)

IHRD is an autonomous institution fully owned and controlled by Government of Kerala. IHRD was established in 1987 for imparting quality education especially in the Technical Education sector for development of manpower of the required level of competence to match the growing demand of the industry in the field of Electronics, Computer, IT and other emerging technologies. IHRD has a network of 94 institutions which include nine Engineering Colleges, seven Model Polytechnics, 35 Colleges of Applied Science, four model colleges, 26 Technical Higher Secondary Schools, six extension/ study centers, two model finishing schools, one skill development centre, one academic staff college, one information technology division and two regional centers. The college of applied science at Mananthavady in Wayanad has been set up to bring up the educational standards of the SCs and STs. 50% of the total seats have been reserved for ST students and 30% for SC students.

LBS Centre for Science and Technology

LBS Centre for Science and Technology was constituted in 1976 with the main objective of acting as a link between technical institutions, Universities and other professional bodies in the state and industry including public utility undertakings. For the last three decades, the centre is actively involved in consultancy services and its core capacity is Civil Engineering with emphasis on site surveying, preparation of architectural design, geo-technical investigation, foundation design, structural design, quantity survey and preparation of tender documents. Two Engineering Colleges one at Thiruvananthapuram and the other at Kasargode are functioning under the LBS.

Appendix 2: The Problem of Employment and Unemployment of the Educated in Kerala.

Unemployment has remained a characteristic feature of the Kerala economy right from the days of its inception 50 years ago. Workforce participation rates in Kerala have remained far lower than in all-India and even in the neighbouring countries of South India during all the years from 1951 onwards. While at the all-India level, work participation rates hovered around two-fifths of the population, and in the South Indian states of Andhra Pradesh, Karnataka and Tamil Nadu remained in the range of 40 to 45 per cent, the rates in Kerala remained at lower than one-third during the period. Work participation rate of women falls far short of that for men. As against 51.6 per cent for males and 22.7 per cent for females in 2001 at the all-India level, the corresponding work participation rates in Kerala were 50.6 per cent and 15.3 per cent respectively. While the rate was not far lower in Kerala in the Indian perspective for males, it was very much so in the case of females. Perhaps, Kerala is one among the major states in India in which the work participation rate declined; in some states, such as Punjab, Haryana and West Bengal, the rates were substantially increasing all along.

The factors that led to the decline in female work participation rate include the structural changes of employment in the state. For instance, several of the labour-intensive activities such as rice cultivation and traditional cottage industries have been declining or languishing in Kerala during the past three decades. These had been the two areas in which most of the women workers had found employment. The conversion of agricultural land to non-agricultural uses and of paddy fields to cultivation of commercials crops had reduced women workforce in the agricultural sector from 43.6 per cent in 1981 to 36.1 per cent in 1991. The crisis in the cottage industries led to a fall in women's workforce from 7.7 per cent to 5.9 per cent during the same period (Martin, 2005).

There are no significant differences in work participation rates between the urban and the rural areas in Kerala. In 2001, the respective rates according to the Census were around 32 to 33 per cent in both the areas. While it was agriculture that predominated in providing employment in rural areas, it was the tertiary sector which was predominant in the urban areas. The majority of the rural workers (accounting for about 84 per cent) were employed as casual labourers or were self-employed persons. It has been reported that 87 per cent of men workers and 85 per cent of women workers belonged to this category during 1999-2000. The proportion of the self-employed was higher among women, both in the rural and in the urban areas.

According to National Sample Survey Organization, Kerala had in 1999-2000, 22 per cent of its labour force unemployed; 20 per cent for males and 26 per cent for females. During the 1990s unemployed, reckoned in terms of current daily status, increased from 14.7 per cent in 1993-94 to 21.7 per cent in 1999-2000.

Unemployment is a multidimensional concept involving time, income and output dimensions. The concept of 'disguised' unemployment is used to signify employment that is not associated with commensurate output or income. Tertiary sector employment such as those of government officials does not ordinarily yield tangible results in terms of physical output or productivity. There may be also persons who have jobs and work to do, but who consider themselves unemployed, an aspect referred to as the 'recognition aspect'.

One of the widely used measures is the time dimension of unemployment. This dimension is sought to be captured through country-wide sample surveys by National Sample Survey Organization (NSSO). Owing to complex diversities existing in the intensity of employment among different sectors and over time periods, NSSO makes multiple measures of the time dimension of employment: Usual Principal Status (UPS), Current Daily Status (CDS) and the Current Weekly Status (CWS). UPS is the most widely used measure of unemployment, namely if the number of days of non-work come to more than 180 days in a year, the person is considered unemployed. According to this measure, the proportion of unemployed persons in the labour force was 11.4 per cent in Kerala in 1999-2000 as against 2.7 per cent for all India. Unemployment of women (21.5 per cent) was about three times the unemployment of men (7.4 per cent). Unemployment was higher in urban areas (12.5 per cent) than in rural areas (10.9 per cent). The difference in the unemployment rates between women and men was also the highest in urban areas: 12.1 percentage points in rural areas and 19.5 percentage points in urban areas (Table 3.5).

Information on the state of unemployment for the years since 2000 is obtained from surveys conducted under the auspices of Centre for Development Studies. During October-December 2003, a survey on the phenomenon of educated unemployed in Kerala was conducted in three districts of Kerala – Thiruvananthapuram, Ernakulam and Kannur. The respondents were persons with educational qualifications of Secondary School Leaving Certificate (SSLC) or above and belonging to the age group of 15 to 59 years. The specific objectives of the survey included an assessment of the magnitude and structure of human capital, the mismatch between education and nature of work of the employed (including the self-employed) and the waiting period for work.

The survey shows a significant increase in the supply of educated manpower in the state. The increase was mainly due to increase in the number of educated women.

It was also observed that while around 82 per cent of the educated men were employed, the corresponding proportion among women was only 71 per cent. The labour force participation rates were higher (88 per cent) for the less educated among men, but were far lower (20 per cent) for the less educated women.

About one-half the labour force of the age group 15 to 29 years, 42 per cent for men and 54 per cent for women, was unemployed. A significant proportion (3.7 per cent) of the educated labour force was of the secondary education level: persons who had the higher secondary level accounted for 19 per cent. Technically and professionally qualified persons came to about one-fifth of the educated manpower in Kerala. Nearly 24 per cent were degree (or postgraduate degree) holders.

Unemployment rates seem to have increased significantly among the educated during the early years of the new millennium. The proportion of the work-seekers among the educated constituted 45 per cent according to this survey. The educated unemployment rate was two and a half times higher among females than among males. Unemployment rate was the highest among the younger age group of 15 to 19 years for both men and women. For women the unemployment rate remained high until they reached the age of about 40 years, after which they seem to withdraw from the labour force.

Among the educated, the unemployment rate was the lowest for technically and professionally trained persons (such as diploma holders and professionals). It was much higher for females than for males for all categories of education and very high among unmarried females; about three-fourths of the unmarried females remained unemployed, according to the present survey. The rate was high among widows and divorced or separated women too.

Naturally, it is the less well-off sections of society that bear the brunt of the problem of educated unemployment. While 54 per cent of the poor sections (judged in terms of their housing conditions) among the educated remained unemployed, the corresponding proportion was only 37 per cent among the better-off.

The period of waiting for taking up the first job after completion of studies, is an indication of the duration of unemployment. It is estimated that an educated person in Kerala spent, on the average, about 5-6 years waiting for his/her first job. The United Nations study by CDS made in 1975 had calculated the waiting period for all categories of the unemployed as 2.9 years in 1972. Though this estimate is not strictly comparable to the results of the present survey which has been confined to SSLC holders and persons with higher qualifications and of the age group 15-59 years, the indications are that the unemployed among the educated have to wait for much longer periods than earlier to secure their first jobs.

But the waiting time for the educated seems to have been different for the different age groups. Persons in the age group 45-49 years are seen to have waited for much longer periods for their first jobs than persons in the age groups 30-44 years and 15-29 years. While on the average, a person in the age group 45-49 years had waited for 7.5 years, the corresponding figures for the age group 30-44 years was 6.5 years and that for those in the 15-29 years age group was only 3.3 years. The indications are that employment opportunities were much higher during the 1990s than had been the case earlier. Obviously these results do not necessarily and specifically reflect the situation in the early years of 2000. During the 1990s, the waiting period for the younger age groups varied among persons with different types of qualifications. For postgraduates and professionals, it was the lowest, at about 1.8 years as against more than 4 years for SSLC and HSC holders.

The waiting period varied also with the economic status of the persons concerned. It was lower for the relatively poor and the relatively rich, but longer for the middle-income groups. The low income group obviously would not have the ability to wait till appropriate job opportunities presented themselves. Persons of this category accept the job that comes first, irrespective of whether it is commensurate with the person's qualifications and expectations about conditions of work, terms of remuneration, etc. The relatively rich would have advantages of possessing educational qualifications in ready demand and of influence and contact with purveyors of jobs. It is the middle-income groups who are more punctilious about jobs, but who find themselves wanting in terms of influence or power. It is therefore this last group which remains the longest waiting for jobs.

About 90 per cent of the employment seekers come under the age group of 15 to 34 years. Except persons who do not have specialized skills but have only general education, such as SSLC and HSC, employment seekers look for security of jobs and jobs commensurate with their educational qualifications. This is true both for males and females, irrespective of economic status.

Among the educated employed, only about three-fifths were in regular or permanent employment. About one-sixth were casual labourers and one-fifth self-employed persons. Women in employment had a clear preference for public sector jobs: nearly 45 per cent of them were employed in the public sector as against only 34 per cent of men.

Men sought employment in a much wider range of occupations than women did. While men were found employed in manufacturing, construction, transport, trade, education and community and social services activities; women found employment in education, healthcare, trade and community and social services occupations. Persons with higher levels of education (e.g. postgraduates, professionals, diploma holders) were concentrated in education, healthcare and community and social services. Education does not seem to confer any significant advantage in earnings for persons having qualifications up to and including the higher secondary level. In fact, the salaries earned by these categories happen in most cases to be lower than the wage earnings of agricultural labourers. The difference between the two categories of jobs lies not in the earning levels, but in the nature of work, the former being white-collar, indoor and 'prestigious', 'jobs' are thus seen to carry a premium over 'labor'.

For the self-employed, who account for about 13.5 per cent of the labour force, trade and commerce appear to be the preferred areas for men (in which 37 per cent of the males in self-employment are engaged) and agriculture and livestock-rearing are the activities for nearly 35 per cent of the self-employed women. More than four-fifths of the employed persons among the educated found their employment through the agency of their friends and relations.

High rates of unemployment prevailing in the economy have not significantly affected the pursuit of employment opportunities, either for men or for women. About 10 per cent of the total labor force must have turned away from job search; but curiously enough, about

90 per cent of this group comprised women. One of the major reasons for the withdrawal of women must have been their relative lack of spatial mobility. Both men and women were, in general, reluctant to leave the places of their origin; but the reluctance was much greater in the case of women. Only about 5 per cent of the women job-seekers were willing to take jobs in places inconvenient to them.

An interesting question to ask is about the financial support that the educated unemployed receive; a condition that enables them to live a life of unemployment. According to a neoclassical economic theory, the labour market would find equilibrium at a price that clears the market of all excess supply and meets the total demand for labour in that market. If unemployment prevails, it implies that the market is in disequilibrium. Wage changes would continue to take place till the equilibrium wage is established.

In the context of Kerala, it is known that unemployment exists on a large scale, wage rates remain rigid and employment opportunities remain unfilled. The existence of widespread unemployment in the face of unfilled vacancies and unsatiated labour demand in general has produced a seemingly paradoxical situation. The explanation for the existence of this phenomenon has to be sought in the redoubled withholding power or staying power of the unemployed. It was noted earlier that the majority of the educated unemployed comprised young and unmarried persons. Most of them were not themselves the breadwinners of the households to which they belonged. They have found that their subsistence was being taken care of by their households, which had the required economic power. Zachariah and Irudaya Rajan (2005) have termed this type of unemployment phenomenon in Kerala a ‘social’ rather than an ‘economic’ problem.

The simultaneous existence of large-scale unemployment and of numerous unfilled job opportunities has led to a curious result in Kerala in recent years – the steady influx of labour from across the state borders, even from states as far away as Bihar, Assam and West Bengal, has resulted in a phenomenon known as ‘Replacement

Migration'. These in migrants work mainly in the household, agricultural and construction sectors at wages much lower than the prevailing rates. These in migrant workers are not given any legal rights on wages, working conditions and terms of service and are highly exploited. These hapless workers consider the conditions in Kerala much better than those at home and prefer to slog it away in Kerala. The pall of claim that covered this unsavoury practice has recently broken with the starvation deaths of a couple of these workers, allegedly suffering from 'malaria'. The stories of their ruthless exploitation have now begun to receive the attention of labour leaders, bureaucracy and political activists.

About 2.3 million persons were reportedly unemployed in Kerala in 2004 (Zachariah and Irudaya Rajan (2005). This number worked to about 19.2 per cent of the labour force – 41 per cent in the case of women. The unemployed have a waiting period of more than five years. Chronic unemployment involving much longer periods of waiting is experienced only by about one-fourth of the unemployed. The unemployment rate gets very small, nearly 6 per cent, among persons in the age groups above 30 years. Many of the unemployed persons are dependent members of well-to-do householders possessing strong withholding power.

One of the serious problems encountered in eradicating the unemployment problem in the state, particularly employment of the educated unemployed, is poor employability. As was shown earlier, employability is high among the technically and professionally qualified categories and among very highly qualified persons (e.g. postgraduate degree holders). However, the majority of the educated unemployed come from the general education stream – SSLC and HSC and first degree holders. The effective solution to the problem of educated unemployment in Kerala therefore lies in the promotion of technical and professional education programmes and retraining of the unemployed through appropriate vocational courses. Of course, a lasting solution is possible only if more investment opportunities are created within the state in agriculture and industry, overcoming the resistance of a variety of sociopolitical and economic interest groups.

Appendix 3. Planning Commission Recommendations for the Manufacturing Sector

The Manufacturing Plan has outlined Strategies for Accelerating Growth of Manufacturing in India in the 12th Five Year Plan and beyond. These are pertinent across the country and for the State of Kerala too and the State Government is encouraged to consider adoption of these strategies suitably. The recommendations on industry academia partnerships range from innovation and development of intellectual property, generation of jobs and employment, skill development and development of appropriate human resources to meet the demands of the manufacturing sector.

Given below is a table indicating skill deficit in various sectors of manufacturing as identified by National Skill Development Corporation (NSDC)

Table indicating skills gaps in the various sectors:-

India's Manufacturing Sector has a skill requirement of ~90M across different sub-sectors in 2022

Sectors	Expected Skills Gap in millions			
	2008	2012	2018	2022
Textiles	28.3	34.1	42.5	49.3
Food Processing	4.7	5.72	7.9	9.8
Auto & Auto Components	2.9	4.5	6.1	7.6
Leather & Leather Goods	2.5	3.6	5.3	7.1
Gems & Jewellery	2.2	3.1	4.8	6.1
Cons. Material & Building Hardware	0.7	0.9	1.6	1.6
Electronics & IT Hardware	0.3	0.5	1.0	1.5
Pharmaceuticals	0.4	0.6	0.9	1.2
Furniture	0.3	0.5	0.8	1.1
Chemicals & Petrochemicals	0.6	0.6	0.7	0.8
Total	42.9	54.2	71.6	86.1

Assumptions
- For the Auto Sector, proportionate growth rate assumed between 2012 and 2018
- Incremental increase in skilled manpower required in every period = CURRENT PERIOD – PREVIOUS PERIOD

Source: Sector Skills Reports- www.nsdcindia.org

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Figure 1 - Share of employment in manufacturing

Developing technology has been identified as an absolute imperative for Indian manufacturing. Technological capabilities for most manufacturing firms appear to be stuck at a basic or intermediate level and there is an absence of organized technology led development initiatives. India's R&D spend is 0.9% of GDP, whereas China, UK and Israel spent about 1.2%, 1.7% and 4.3% respectively. At present, about three fourth of the R&D expenditure India is in the public sector and only one-fourth is in the private sector. India needs focus on strategic investments in national, technological capabilities alongside development of institutional frameworks to ensure sustainability.

The key challenges faced by Indian industries are:

- The Indian industry has not given sufficient importance to the documentation of knowledge and creation of IP. As a result, not only were opportunities lost to create IP, but we lost IPs to other countries such as in traditional agricultural products. Our regulatory framework, speed of award of IPs and the enforcement of IP regulations needs improvement.
- Though there is an improvement in the industry-academia collaboration in creating patents / technologies, still there is a large scope for improvement.

Strengthen Partnership between Industry and Academia / Other Research Institutes to Create IPs Domestically

Industry-academia partnerships are relatively weak in India compared to many other countries. In the last few years, efforts have been made by various stakeholders including the Government, leadership of central / state research institutions, Industry and the Academia to develop stronger partnerships. However, we still have a long way to go. Some of the policy measures that Government can use to accelerate the development of Industry-Academia partnership are:

- Joint ownership of IP arising out of these collaborations.

- Align the goals and annual planning processes of central research institutions with that of industries through industry associations.
- Incentivize Central / State Research institutes to create joint IPs with Industry.
- Tying up a certain percentage of their budget to the number of collaborative IPs created.
- Incentivize University and industry for forging successful partnerships in University's governance, infrastructure, course curriculum design, faculty / students development and research.
- Create Cluster Innovation Centers at Universities with the aim to foster a favorable ecosystem and enforce industry-academia linkage.
- Consider passing a legislation which will provide a legal framework for active interface between funding agencies, academia and industry.

Human Resource Development

To exploit its demographic dividend, India must generate jobs to satisfy nearly 250 million additional income seekers that are expected to join the workforce in the next 15 years. A significant portion of these jobs will need to come from the manufacturing sector. In order to ensure that these jobs also lead to the targeted growth of the sector's contribution to GDP, human resource productivity will need to increase as well. Therefore, issues related to job creation and productivity of human resources are extremely important in the larger context of the manufacturing sector and the economic growth of the country.

One of the primary objectives of the plan is to increase the competitiveness of Indian manufacturing. Human resources are of critical importance for the growth of knowledge and technology, value addition, and improvement of competitiveness in manufacturing through processes of continuous improvement. In fact, the human resource is the only 'appreciating resource' in a manufacturing system. It is the only resource that has the motivation and ability to increase its value if suitable conditions are provided, whereas all other resources—machines, building, materials, etc—depreciate in value with time. The best enterprises view their people as their prime asset and the source of their competitive advantage.

Key Objectives

The key objectives for the manufacturing workforce in India are:

- Creating 100 Million additional good quality jobs by 2025.
- Developing skilled workers to meet the requirements of these jobs.
- Ensuring social protection for low income workforce (This objective is not relevant to this Report and hence strategies for this are not discussed.)

Status and Key Challenges

In India, the manufacturing sector employed 58 million people or just about 12% of the workforce in 2008[5]. This share is low compared not only to other developing countries, but even with more developed economies where there is a higher demand for services.

By 2025, an additional 100 million people are expected to join the workforce if the manufacturing GDP grows at the desired 12-13%. A large proportion of these employees should have access to social security benefits and they should be equipped for and incentivized to be more productive than the current workforce.

The high degree of informality in the workforce is a matter of great concern as well. Registered companies (also known as 'formal' sector) employ both formal and informal workers. According to the National Commission for Enterprises in the Unorganized Sector (NCEUS), the formal sector had 8.76 million formal workers and 16.71 million informal workers in 2009. The rest, approximately 32 million workers, belonged to unregistered units.

Given the current status of employment, skill development and social protection, it is clear that significant changes are necessary to meet the ambitious objectives. Currently, when most firms see the low cost of human resources as a source of

[5] CSO data

competitive advantage (albeit transitory), they understandably focus on minimizing labour costs rather than adding value to their human assets. If firms continue to look at reducing the cost of their workforce, they are less likely to invest significantly in training and skill-building. This is one reason why employment has not grown even as firms have become more competitive. Also, given the current state of labour laws, 'informalization' and 'casualization' of the workforce may continue.

Challenges in meeting the objectives lie broadly in three areas:

- From a skill development perspective, there is a significant gap between the existing training capacity and people entering the workforce. A very small proportion of total manufacturing workforce is currently skilled. Moreover, less than 25% of the total number of graduates is estimated to be employable[6] in manufacturing. The total training capacity in the country is about 4.3 million for all sectors including manufacturing. The Apprentice Training Scheme (ATS), which is supposed to provide a bridge from education to employment, has very low penetration and is suffering from significant administrative issues.
- For entrepreneurs and other employers, the perceived (or real) lack of flexibility of changing the size and nature of the workforce can act as a retardant in making investments that could lead to greater employment opportunities. Also, the complexity of labour laws and the administrative mechanism of the laws make it harder to do business in the country.

By 2025, an additional 8 million management workers (supervisors and above) are estimated to be required. Well trained management/supervisory staff are critical for improving the productivity and industrial relations in large as well as small manufacturing enterprises. Due to poor quality of educational institutes, brain drain and the relative unattractiveness of manufacturing for potential managerial workers, only a small

[6] According to NASSCOM – for all graduates, not only related to manufacturing

portion of the graduates from engineering and management institutes are joining the manufacturing sector. Therefore there will be a significant gap between demand and supply of management staff for manufacturing.

Strategy and Key Recommendations

For the manufacturing sector to meet its objectives of competitiveness along with employment growth, strategies of the firm must change. Human resources should be managed as a source of sustainable competitive advantage. Government policy changes should induce and support such firm level strategies. Currently only a small percentage of the total workforce is in the formal sector. However, as a larger proportion of the workforce formalizes, as they must if we want to meet our objectives of social protection, unions will become an even more important stakeholder.

Therefore the key stakeholders who will need to work together to make the necessary changes to the system in the key areas mentioned above are: Government (at the Centre and State level), Industrial organizations and the unions.

The strategies for meeting the objectives are in the following categories:

- Inducing job creation by reducing the cost of generating employment.
- Developing a supply of qualified human resources to meet the demand from additional job creation.
- Enhancing skill levels of current workforce to improve productivity.
- Improving the state of manufacturing management in the country
- Providing social protection to low income workforce.
- Improving Industry -Workforce relationships.
- Developing a supply of qualified human resources to meet demand from additional job creation.

As the manufacturing sector GDP grows and disincentives for job creation are removed, demand for human resources will increase significantly and therefore shortages of employable human resources will be exacerbated. The manufacturing sector may need more than 90 million people by 2022. This is an opportunity to ensure that a higher number of people are qualified to join the organized sector rather than being compelled to remain as unorganized workforce. However, the current capacity for skill development is ill-equipped to meet this demand. The capacity of the country's skill development infrastructure must be substantially increased and the quality of existing institutions involved in skill development has to significantly improve.

Role of Industry:

To ensure that the right kinds of skills are developed, industry must be involved in defining what is required. To enable the industry to play its role in defining the requirement of manpower both in terms of quality and quantity, Sector Skills Councils envisaged in the National Skills Policy are being set up. These councils will identify skill development needs in their sector, evaluate the gaps, create plans for skill development, and improve the quality of the training system. The councils are also expected to establish sector specific Labor Market Information Systems (LMIS) to assist in planning and delivery of training.

Private Sector Participation in Skill Development:

For the private sector to play a role in augmenting the skill-development capacity in the country, effective PPP models are needed. Existing ITIs should be clustered together in projects with total training capacity of at least 100,000 each to allow private sector service providers to leverage scale benefits leading to long term financial sustainability. For inducing the private sector to participate in creation of additional capacity, scalable and sustainable business models with direct linkages to employment should be deployed. The NSDC has created such models. They should be implemented across 20-30 projects specific to manufacturing in partnership with industry associations and from funding through NSDF.

Improving ITI:

The quality of the existing ITIs is seen as inadequate for the needs of industry. In addition to inducing private sector involvement in upgrading the quality of infrastructure in existing ITIs, the Department of Industrial Training should regularly monitor the performance of ITIs and their students either directly or through a monitoring agency. The faculty and staff as well as curriculum and content should be improved with industry involvement through sector skills councils.

Attracting Students:

In addition to improving the quality and the quantity of the skill development ecosystem in the country, it is also important to induce students to use this ecosystem to develop vocational skills. An unsecured loan scheme should be created for those who aspire to undertake vocational training. As a long term strategy, it is important to make acquisition and improvement of skills an aspiration for people, especially youth. This could be achieved by recognising high skill persons at the national and state levels along with recognition of other worthy citizens. Large enterprises could also provide special incentives and recognition for acquisition of high skills.

Overall Coordination:

A number of initiatives have already been taken by various Government ministries to tackle issues related to skill development both at the Central and the State level. Coordination between these initiatives should be improved. To ensure that skill development activities are aimed towards areas of maximum impact, it is important to put in place an information system that provides data on availability and requirement of skilled resources.

Enhancing Skill Levels of Current Workforce to Improve Productivity

Training and skill-building of the existing workforce is an important element of the strategy for increasing productivity of manufacturing in India. Training of employees can be incentivized by allowing tax deductions for expenditure incurred on training. Currently, skill building is predominantly achieved by in-house training of workers by each enterprise. However, clusters and National Investment and Manufacturing Zones (NIMZs) provide opportunities for shared infrastructure to provide training for skilled and semi-skilled workers.

Improving the State of Manufacturing Management in the Country

There were a total of approximately five million managers in the manufacturing sector in 2008. If the manufacturing sector grows at the targeted 12-13%, eight million more managers will be needed by 2025. Well trained managers are extremely important for improving the productivity of manufacturing enterprises and maintaining harmonious industrial relations. They form the backbone and provide the glue in a manufacturing enterprise.

Currently, only a very small portion of graduates from engineering and management institutes take up careers in manufacturing. Consequently there is a significant gap between supply and demand. Recommendations to improve the quantity and the quality of management in the manufacturing sector are:

- Increase collaboration between manufacturing companies and engineering/management institutes for joint projects in which staff and students of the institutes can get some hands-on experience.
- Encourage enterprises (especially larger ones) to run good graduate engineering programmes which can be a source of management talent for themselves as well as the manufacturing sector generally.
- Scale up programmes such as Visionary Leadership for Manufacturing (VLFM) at the national level. The VLFM programme is currently being implemented under an agreement signed by the Prime Ministers of India and Japan in December 2006 through a partnership between NMCC, Ministry of Human Resources Development, CII, Japan International Co-operation Agency, IITs Kanpur and Madras and IIM Calcutta.

- Set up centers of excellence for manufacturing management through MoUs between institutes, government bodies and industry partners. Business schools that focus only on manufacturing management should also be encouraged.
- Create a PPP model for engineering and management colleges with partnership with industry associations and employers with focus on manufacturing management.
- Launch a campaign focused on attracting management talent to the manufacturing sector.

A large source of potential managerial/supervisory staff is the current workforce. Support should be provided to enable deserving members of the workforce to be promoted to management positions.

Recent reviews with many sectors of industry reveal a crying need for better supervisors and foremen—the first and second levels of supervision—who are the backbone of productive and harmonious manufacturing enterprises. Development of supervisors and foremen, through suitable programmes, collaboratively designed and managed by industry and educational and training institutions must be ensured along with the emphasis on development of skilled workmen and good managers.

Appendix 4: Summary Findings and Policy Implications of Planning Commission Recommendations

Skills needed by Engineering graduates – Recommendations made by World Bank in Working Paper 5640 of Andreas Blom and Hiroshi Saeki.

An Employer Satisfaction Survey was carried out from September to November 2009 as part of preparation of the Second Phase of Technical Education Quality Improvement Program (TEQIP-II) initiated by the Government of India and financially supported by the World Bank.

1. Educating engineers with a comprehensive and deep set of skills that are in demand would be of tremendous importance for the employability of individual Engineers and for the country's development. Large economic sectors, such as IT, infrastructure, power and water, rely critically upon Engineering skills and technologies. This employer survey provides important new insight on which specific skills are important for employers and where the graduates currently fall short. In what follows, we present the main findings and the policy implications that we draw from each finding. However, it is important to keep three caveats in mind: (i) the quality improvements in education lie squarely within the scope of pedagogy, education policy and education management, which is outside of the scope of this paper; (ii) the engineers evaluated by employers should be seen as the end product of the entire education system, not just engineering education. The same question should be posed as to graduates of other stream of higher education in India and to other levels of the education system. Clark, 2001 examines the culture of pedagogy in the primary and secondary education system. She finds a pervasive focus of teaching and learning in India on lower order thinking-typified by repetition and memorization-and the lack of attention given to the development of higher-order thinking. The Engineering colleges receive graduates from the secondary education system with a set of skills upon which they add. In particular, the *Soft Skills* are influenced by a prior schooling and the family setting; and

(iii) although the sample size is fairly large compared to similar surveys, it is relatively small compared to the large population of Indian firms. Further, the survey may be biased due to a small size of convenience sampling and a possible over- sampling of large firms. Keeping these important caveats in mind, we limit the recommendations to a set of broad actions within Engineering education to improve the skill set of future Engineers.

1.1 There is substantial dissatisfaction with the quality of graduates. 64% of employers are only somewhat satisfied or worse with the current Engineering graduate skills. This confirms the finding of a number of other surveys showing that the skills set of fresh Engineers are inadequate. Although, there are always caveats when comparing satisfaction surveys internationally, we find that Indian employers are less satisfied with their Engineers compared to US employers. Obviously, the dissatisfaction suggests that renewed efforts are necessary to raise the skill set of Engineering graduates in India through an improvement in the quality of Engineering education. We particularly recommend that each Engineering programme explicitly states and measures the desired learning outcomes (the skills set of their graduates). The accreditation agency, NBA, in particular could have a tremendously important impact if it increased the weight of graduates' learning outcomes compared to other input-oriented accreditation criteria (such as classroom and curricula). Also, while the results may appear gloomy, reforms and quality improvements programmes have successfully taken place at individual state and institutional level. There are several success stories as described elsewhere in the Technical Education Quality Improvement Programme. What is required is a scale-up of the reforms and investments at the national level addressing the shortcomings in the skill set of engineers.

2. The skills set of engineers can be characterized by three overall skills factors:

(i) Core Employability Skills (which cover generic attitudinal and affective skills, such as reliability and team-work);

(ii) Communication Skills (such as English skills, written and verbal communication), and

(iii) Professional Skills (which generally covers cognitive skills related to the Engineering professions, such as ability to apply Engineering knowledge; as well as design and conduct experiments and related data analyzing and interpretation).

Core Employability Skills and Communications Skills are often referred to as soft skills. The factors also have important similarities with theoretical skill domains developed in the educational literature.

2.1. All three skills factors are important- Core Employability Skills, Communication Skills and Professional Skills are important. Engineers that are in high demand possess all three skills sets. Engineering education programmes therefore have to put in place a comprehensive quality upgrade of their programmes. However, while Professional Skills remain important, employers consider Soft Skills (Core Employability Skills and Communication Skills) the most important skills. Employers look for engineering graduates who show integrity, are reliable, can work well in teams and are willing to learn.

3. Further, employers across India ask for a similar set of soft skills. Irrespective of the size of the company, the economic sector, or the region, the above Soft Skills (integrity, reliability, teamwork and willingness to learn) remain the important ones.

The policy implication is the need to improve the Soft Skills of graduates. This could come about by: (i) Colleges and teachers recognizing that Soft Skills are important and include soft skills as part of the desired learning objectives that teachers should foster in their students. Technical knowledge and applicability are fundamental to Engineering education. However, they are not all; Student's soft skills need to be honed as well; (ii) The National Accreditation Board could enhance the importance given to soft skills in the programme outcomes; For example, NBA does not explicitly include – team working skills as an expected skill for an engineering graduate; (iii) The teaching-learning process could be adjusted to include more project-work in teams and possibly receive grades as a team; and

(iv) Introduce or scale-up specific courses providing students with opportunities to enhance their English skills, communication skills or other forms of Soft Skills, for example through finishing schools (courses for graduating students focusing on specific skills are in high demand).

4. The survey finds that colleges are doing very well meeting the demand for English skills, since the graduates are rated in English. (This need not be true of Kerala). The skill gap in English communication is the smallest among all the skills. Yet English communication is rated as the most important communication skill and higher than any technical skill. Although the advantages of teaching in a local language is understood , it is recommended that caution is exercised when considering changing the language of instruction from English to a regional language, because the change may put graduates from local language programmes at a significant disadvantage at the job-interview.

5. Graduates seem to lack higher-order thinking skills (analyzing, evaluating and creating). The employers think that graduates are relatively strong in lower-order thinking skills (knowledge and understanding), but fall short when it comes to the more complex tasks such as application of appropriate tools to solve a problem, and analysis and interpretation. Employers are less than - Somewhat satisfied with these skills. Further, these higher-order thinking skills are the most important professional skills. In short, memorizing textbooks for examinations is not a skill appreciated by the employers. This raises a question of fundamental importance, whether the Indian Engineering education system overly trains students to memorize science and Engineering knowledge, without adequately emphasizing the applicability, analysis and out-of-the-box thinking that employers look for. The Indian Engineering firms increasingly require more analytical, adaptive, and creative Engineers to upgrade the country's infrastructure, to respond to climate change and compete for higher value-added IT-orders on the global market.

5.1. The following is recommended to improve higher-order thinking skills. First of all, the question has to be further examined and debated given the importance. Secondly, if the finding is true, which several qualitative studies suggest; major initiatives are required to reform the system: (i) reshape assessment methods, especially exams at the large affiliating universities, to assess higher-order thinking skills and not measure memorized knowledge. This would require institutions to focus on learning rather than memorization and mere understanding. In order to do so, curricula should be designed in a way where students learn how to abstract out complex and practical issues within limited time; (ii) reform curricula to increase the share of tasks where the student or a team of students lead their own problem identification, experimenting, and solving using Engineering knowledge and methodologies; (iii) promote teaching-learning sessions where students are actively learning and developing their own analytical and evaluating skills as compared to simply listing and taking notes. This would most likely require significantly increased academic autonomy of institutions, substantial professional development of the teacher force and recruitment, and attention to instructional skills when recruiting teachers.

6. Employers ask for different professional skills depending upon their economic sectors, the firm size and the region. To illustrate; IT companies, in general, demand creativity and strong system design skills while the knowledge of mathematics, science, and Engineering are less important. On the other hand, the infrastructure firms prioritize graduates with strong ability to use modern tools and the knowledge of mathematics, science, and Engineering, but focus less on creativity and system design skills.

This leaves an important role for institutions to prepare their graduates to meet the demand for skills from different sectors. Institutions therefore have to increase their interaction with various kinds of employers. Hence, the institutions should customize programme outcomes to meet the specific demand. Further, extracurricular activities such as internships and involvement of institutions with community would also help students to deepen the understanding of demanded skills and respond well to particular demanded skills.

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