INFRASTRUCTURE DEVELOPMENT AND EDUCATIONAL OPPORTUNITIES IN THE LEAST DEVELOPED COUNTRIES: ISSUES AND RECOMMENDATIONS

Kochi University of Technology O Rajendra NIRAULA[1]
Kochi University of Technology Yoichi HIROTA[2]
Kochi University of Technology Shunji KUSAYANAGI[3]

ABSTRACT: This study based on the Nepalese and Cambodian context investigates the necessity of integration of education system to industrial activities for improving socio-economic conditions in the least developed countries. Infrastructure and human resource development environment is very dismal in Nepal and Cambodia. The quality of human resources in infrastructure development is not compatible with the needs of the construction industry. Scanty fund and inappropriate education system in Nepal and Cambodia are investigated. Industrial needs oriented universities collaboration, and center of excellence and research approaches are discussed. Integrated construction management and civil engineering education to enhance the quality of human capital in the construction industry has been proposed.

Key Words: *Least developed countries, infrastructure development, human resource, quality education*

1. INTRODUCTION

The least developed countries are concentrated on construction of infrastructure putting aside quality of human capital development. The countries like Nepal and Cambodia, despite large development expenditure, cannot develop efficient infrastructure. Nepal and Cambodia were selected in this study to represent the least developed and low-income developing countries from the Asia as these two countries fall under the least developed countries (LDCs) category of Development Assistance Committee (DAC) and Low-income developing countries (LICs) category of the World Bank (WB). This study mainly focused on influence of quality of human capital in infrastructure development in the selected countries: Nepal and Cambodia. This paper discusses practice of infrastructure development and quality of education in Nepal, and issues in infrastructure development in Nepal and Cambodia. This study provides a way to enhance the quality of human capital for efficient infrastructure development in the least developed countries.

2. INFRASTRUCTURE DEVELOPMENT IN NEPAL

Infrastructure development in Nepal started taking shape from the first plan period (1956-1961), which envisaged an investment of NRs. 330 million in public sector. In 1951, Nepal had 276 km of motorable roads, 6200 hectares of irrigated land, 1.1 MW of electricity, 2 hospitals, 300 schools and 25 telephone lines[1)]. After 51 years, the road network had reached 16 thousand km, power generation had gone up to 549 MW and irrigated land had extended

[1]Ph.D. Candidate, Infrastructure System Engineering, Kochi University of Technology, Kochi, Japan; Tel: 0887-57-2098; E-mail: 076024c@gs.Kochi-tech.ac.jp
[2]Ph. D. Candidate, Infrastructure System Engineering, Kochi University of Technology, Kochi, Japan; Tel: 0353-37-4062; E-mail: hirota@beige.ocn.ne.jp
[3]Professor, Infrastructure System Engineering, Kochi University of Technology, Kochi, Japan Tel: 0887-57-2415; E-mail: kusayanagi.shunji@Kochi-tech.ac.jp

to 1.128 million hectares. Similarly, the number of hospitals had increased to 83, schools numbered 39000 and there were 394 thousand telephone lines[2]. Much of this achievement had been possible through foreign aid. However, the situation of infrastructure is not satisfactory. The road density of 10.8 km per 100 square km of land area is among the lowest in the Asia. Out of total 75 districts, still 17 district headquarters are not connected with motor able roads. Moreover, only 49 percent of total village development committees (VDCs), the lowest unit of government for administration of one or more villages, have access to telephone service. Furthermore, much of the existing infrastructure is concentrated in the capital city, Kathmandu.

3. DEVELOPMENT EXPENDITURE AND FOREIGN AID

During the 104-year rule of Ranas until 1951, Nepal had been kept in isolation form from rest of the world. Many Ranas had used their own money to hire the services of foreigners, mainly from the British, to establish hydroelectric schemes, drinking water networks, irrigation systems and to construct palatial buildings and to manage the Terai-based *Sal* forests. The first foreign aid to Nepal was a sum of US$ 2000 provided by the United States to the Rana government in January 1951, just a month before the Rana regime collapse[1]. The Figure 1 and 2 below show that acute dependency to foreign aid of Nepal's national budget as well as development budget[1), 2)]. The situation is also similar in Cambodia where more than 75 percent of capital formation in infrastructure development had been supported through foreign aid as shown in Figure 3[3].

The main providers of aid to Nepal in the 1950s were the US and India. In the 1960s, the UK, Switzerland, China and the United Nations came to support Nepal. In 1970s, the West German and Japan provided large volume of aid, and the Soviet Union also kept on providing supports. India was the largest donor in 1980s but Japan became the

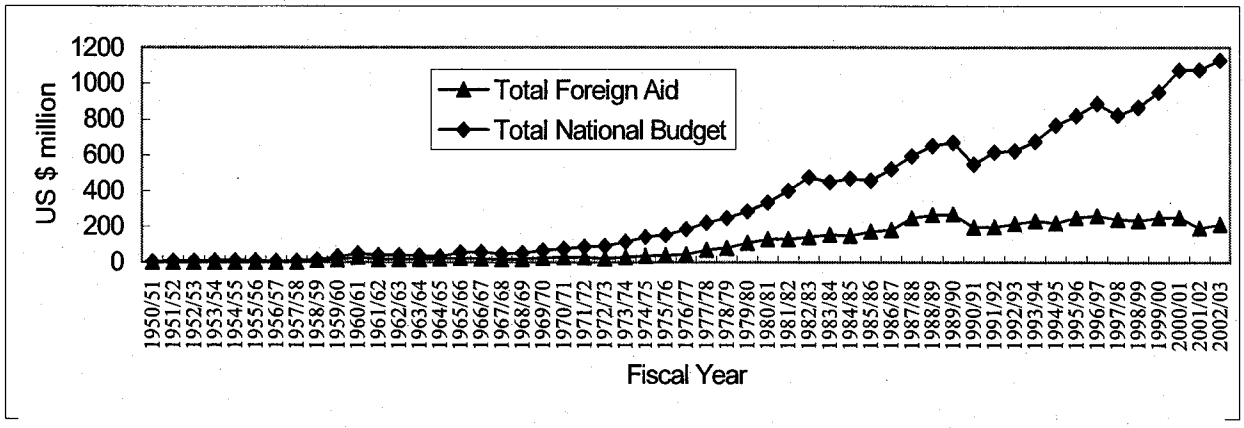

Figure 1: Nepal's national budget and Foreign Aid

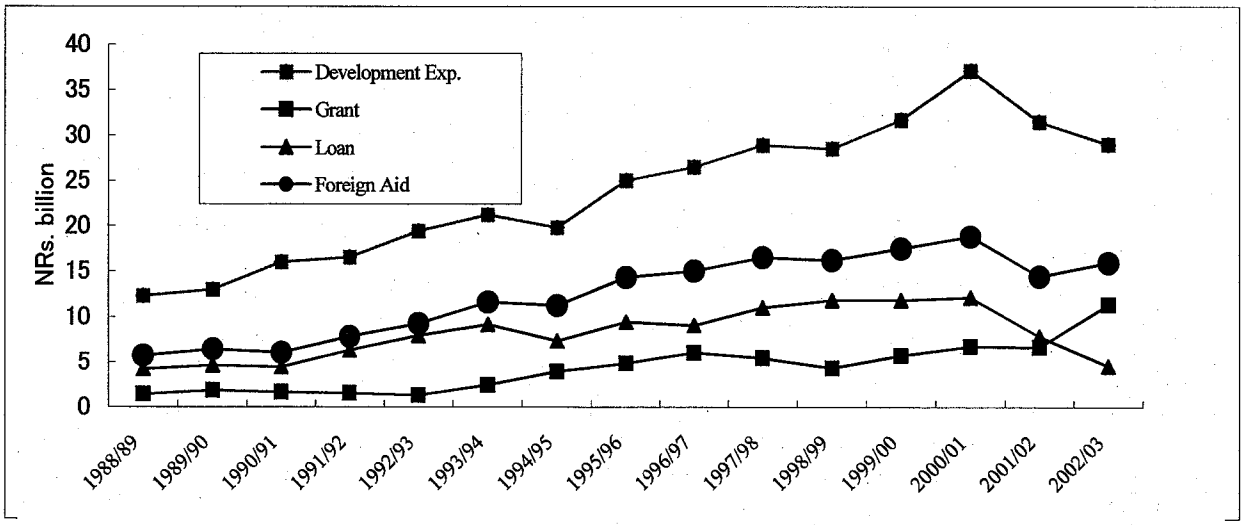

Figure 2: Nepal's development expenditure and Foreign Aid (Grants and Loans)

biggest donor to Nepal in 1990s. Likewise in 1990s, Denmark, the Netherlands, Finland, Norway and the multilateral agencies such as the Asian Development Bank (ADB) and the World Bank (WB) also provided significant amount of aid to Nepal in Infrastructure development. Moreover, Japan is also the largest donor to Cambodia since middle of the 1990s.

4. JAPAN'S AID TO DEVELOPING COUNTRIES

Japan was the largest donor in 1990s among the development assistance committee (DAC) members. However, Japan still maintains its second position since 2001 in providing official development assistance to developing countries. Japan's financial assistance was started with the treaty of peace, reparations and economic cooperation concluded between Japan and Burma in November 1954. Since then the Japanese government concluded reparations treaties with Philippines, Indonesia and Vietnam. The quasi-reparations, non-reimbursable financial aid has been provided to Cambodia, Laos, Thailand, Malaysia, Singapore, Korea and Micronesia.

Japan's official development assistance (ODA) has following five basic policies; supporting self-help efforts of developing counties, perspective of human security, assurance of fairness, utilization of Japan's experience and expertise and partnership and collaboration with international community. The major priority areas of Japan's ODA are poverty reduction, sustainable growth, addressing global issues and peace building in developing countries.

Japan's ODA is classified into three types: i) bilateral grants, ii) bilateral loans, and iii) financial subscriptions and contributions to international organizations. Bilateral grants include technical cooperation that transfers technology to developing countries and grant aid that provides funds with no obligation for repayment. Bilateral loans are the loans that provide the funds needed for development under long-term and low interest conditions. Subscriptions and contributions for multilateral aid are indirect methods of extending aid by channeling funds through international organizations.

Japan, among the DAC members, has still providing second largest amount of grant aid to developing countries. Grant Aid including technical assistance in Japan's ODA since 1993 is higher than the loan and contribution to the multilateral agencies, as seen in Figure 4[4]. Further, the six

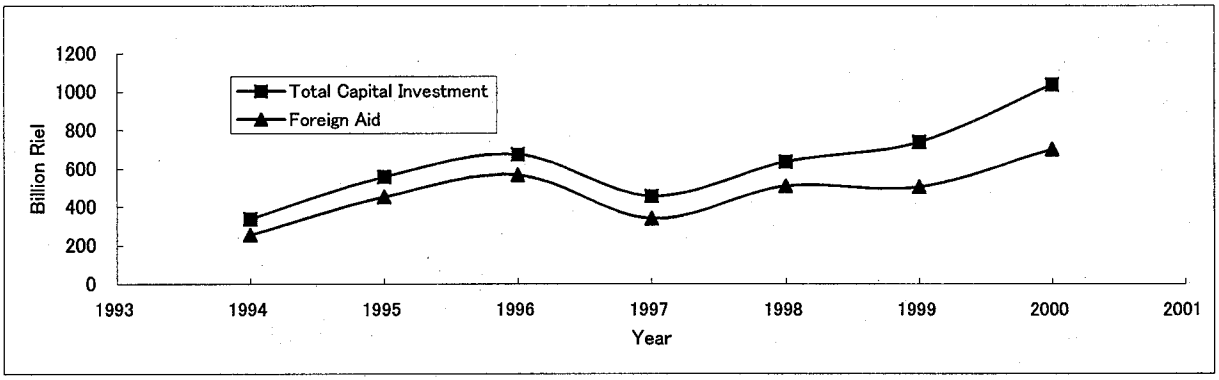

Figure 3: Total capital investment and foreign aid in Cambodia

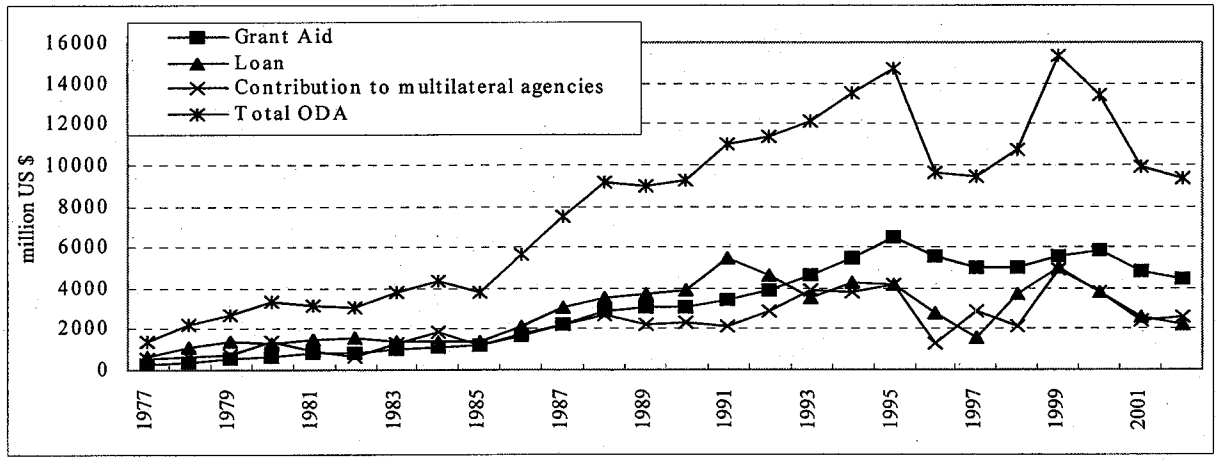

Figure 4: Japan's ODA (1977-2002) Source: JBIC

among nine least developed Asian countries (classified by the DAC) had received largest amount of ODA from Japan in 2002 and 2003. Those six countries are Bhutan, Cambodia, Laos, Maldives and Nepal. Like many other developing countries, Nepal and Cambodia have been very much benefited from Japan's ODA. The Figures 5 and 6 show Japan's ODA in 1994 - 2001 to Nepal and Cambodia. All grant aids in 1994-2001 to Nepal was used in the construction of infrastructure in which as much as 3 percent was utilized in education related infrastructure-- materials and equipment for the construction of primary schools[5]. Similarly, less than 1 percent of the grant aids to Cambodia in the same period was used in human resource development scholarship[5]. Acceptance of trainees mostly from executing agencies of developing countries and dispatch of the Japanese experts in technical cooperation scheme were only the means for technology transfer and human resource development program in ODA. However, Japan's ODA had not been directed to improve the quality of higher education in Nepal and Cambodia. With the inflow of foreign assistances, most of the developing countries especially low-income countries are suffering from heavy foreign debt. For instance, the GDP and the foreign loan in Nepal are increasing in parallel with insignificant repayment of the loan (Figure 7)[2].

5. DEVELOPMENT WORKS EXECUTION SYSTEM

Infrastructure development projects in Nepal until 1950 were executed departmentally in which the government procured construction materials and equipment locally or from India and Britain. Project planner and designers were also brought from India on the recommendations of Indian rajas and princes. The designers also brought in skilled tradesmen and craftsmen for the execution of a project[6]. The unskilled labors of rural Nepal as well as India were employed during the execution.

The industrial enterprises act 1974 of Nepal made a provision for the classification and registration of contractors. Contractors in Nepal are classified in to four categories; A, B, C and D based on financial, technical manpower, plants & equipment and experience. There were (as of 2002) 176 'A', 315 'B', 1500 'C' and about 10,000 'D' class contractors licensed for construction in Nepal[7]. Similarly, the 'Prakash on the governance over the Consultants and Construction companies

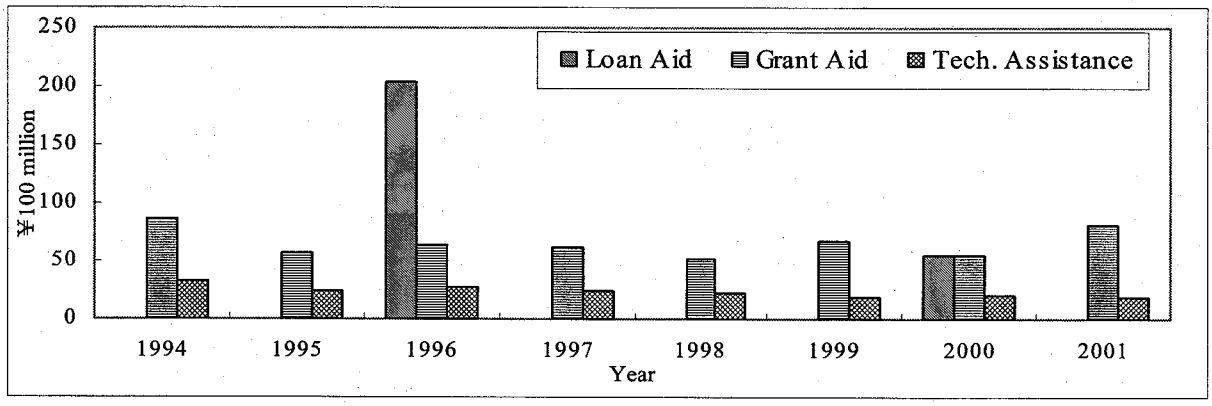

Figure 5: Japan's ODA to Nepal (1994-2001)

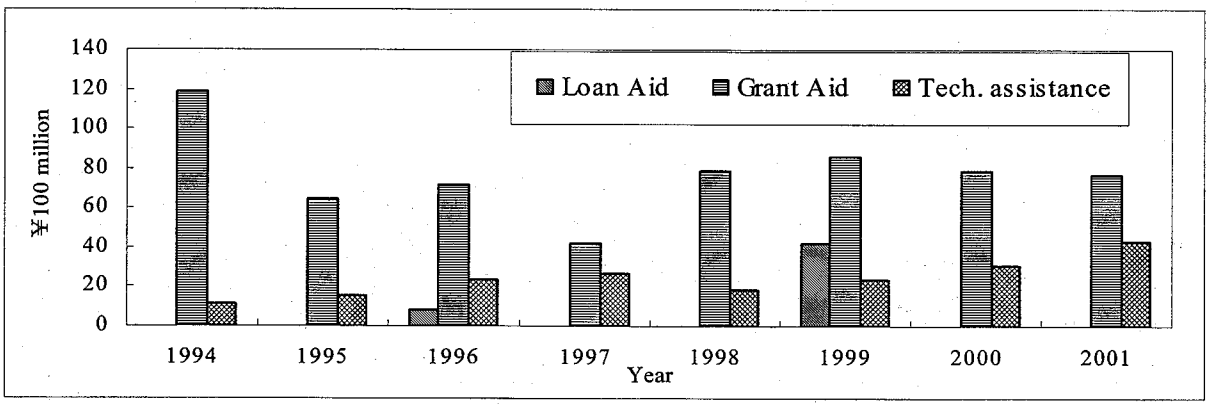

Figure 6: Japan's ODA to Cambodia (1994-2001)

1999' has classified the Cambodian construction companies in to four categories[8].

Most of the infrastructure development projects in Nepal and Cambodia are still financed by bilateral and multilateral funding agencies. The traditional competitive bidding system has been used in public infrastructure development. The system of international competitive bidding introduced by donor agencies allowed foreign consultants and contractors to work in these countries.

Moreover, donors' consultants and contractors were deployed to execute bilateral and grant aid projects. The Nepalese contractors did not have enough capacity in terms of experience, financial strength, technical soundness, and equipment holding, and management skills. The local contractors were involved in small petty works. A foreign expatriate's salary including allowances in Nepal is about 30 times higher than that of a local engineer[6]. Similarly, large foreign-based firms typically dominate the Sub-Saharan African construction industry. There are often a few medium size firms, some of which may be purely local firms, and others are based in neighboring countries such as South Africa, Zimbabwe and Kenya in the case of Southern Africa. A large number of local contractors do not have enough market access because of partly due to the contracting process: frequency, size, condition imposed by employer/owner. The difficulties of the local firms are further exacerbated by i) limited access to construction equipment, ii) limited access to capital and credit facilities, and iii) lack of business training and shortage of technical and managerial skills[9]. The situation of the Cambodian construction industry is also the similar to the Nepalese and Sub-Saharan African construction industry. The conditions like annual turnover, working capital, equipement holding, technical and managerial capability imposed in foreign assisted project in the least developed countries are beyond the capacities of most of the local contractors. Such situation has created a favorable business environment for international companies in the least developed countries like Nepal, Cambodia and in Sub-Saharan Africa. The amount expended on fees for consultants services in foreign assisted roads development projects in Nepal are higher than that paid for consultants services in irrigation development projects. For instance consultants' service fees in the Road Maintenance Project (RMP) incurred unto 40 percent of the construction cost. Further, some other projects costed even higher amount such as *Kadmaha chowk-Gaighat* and *Charali-Ilam* road project expended 51.3% and 72% of the construction cost respectively for the consultants services[10].

Moreover, the users (beneficiaries) use to complain the performance of the local contractors as most of infrastructure development projects in Nepal suffered from delay and variations[10]. All infrastructure development projects in Nepal and Cambodia have still been carried out through the traditional Design-Bid-Build project delivery system. The existing project execution system could not encourage the local contractors for innovations. Despite large expenditure on foreign expatriates' services, project designed and supervised by the expatriates in Nepal were also suffered from delay and cost overrun.

6. QUALITY OF HUMAN CAPITAL

The literacy rate in Nepal has reached to 54.1% for population of 6 years and over[11]. The school level education system with Primary Education of grades 1 to 5 (corresponding age 6-10), Lower Secondary education of grades 6 to 8 (age 11 – 13) and Secondary education of grades 9 to 10 (age 14-15) that was created in early 1990's, still remains in practice. Government's efforts are underway to integrate the school level education system with the

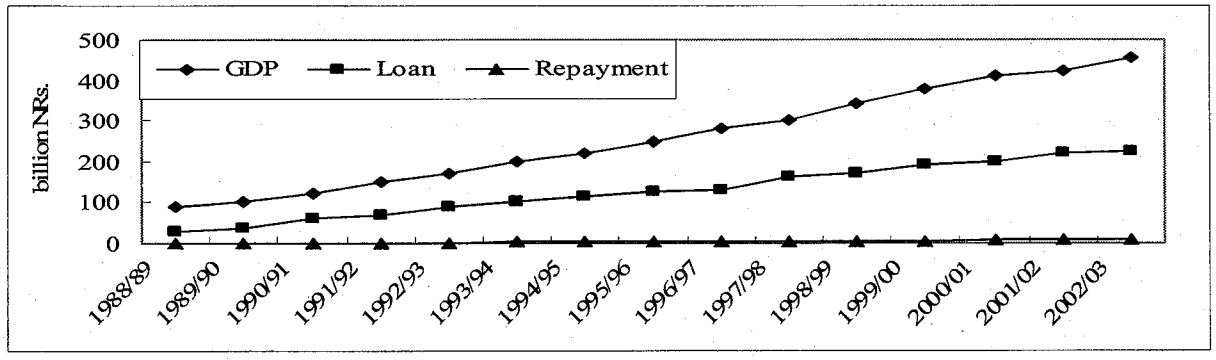

Figure 7: GDP, Foreign Loan and Repayment of Loan in Nepal

higher secondary education (grades 11 & 12).

The enrolment ratio at the primary level is 81.1 percent, 39 percent at the lower secondary level and similarly the enrolment ratio at the secondary level is only 25 percent. The trained schoolteachers are scarce in Nepal. The ratios of trained and untrained teachers as of 2002 in primary, lower secondary and secondary level of education were 47:53, 36:64 and 47:53 respectively. The pass rates of students from the grade 10 of school education (school leaving certificate examination) in Nepal have varied from 33 percent to 45 percent in different years[11].

Higher secondary education system was introduced in early 1990's to produce supportive manpower and to prepare for higher education in general and professional areas. The quality of higher secondary education is further unenvied, for instance the graduation rates in 2003 from grade 11 was 34.5 percent and grade 12 of the same year was 39.7 percent. Technical education and vocational training is targeted to students with some years of secondary education to produce the skilled labors and technicians. There are five universities under which 81 constituent campuses and 232 affiliated (private) campuses/colleges are engaged in higher education in Nepal. The tertiary students in science, math and engineering (percentage of all tertiary students, 1994-1997) were only 14 percent. However, the annual enrolment capacities of 13 engineering institutions in a masters and bachelor's degree in civil engineering were 104 and 813 respectively. Similarly, production capacities of technical institutes were 702 civil technicians and total 1065 civil, mechanical and electrical skilled labors annually. Most of the private universities in Nepal and Cambodia did not have sufficient infrastructure and competent teaching persons for quality education. No systems have existed to monitor and ensure the good quality of education. More emphasis on hard infrastructure development in developing countries put the quality of education away from the limelight.

Theoretical knowledge imparting is the domain of education system of many developing countries including Nepal and Cambodia. Lack of appropriate teaching materials and qualified teachers are the major problems in all level of education in Nepal and Cambodia. The written examination of theoretical knowledge at the end of the academic year is the only measure of competency of a student. A school graduates cannot acquire basic skills from the school education. Moreover, the civil engineering education, which is supposed to contribute in improving quality of life, does not emphasize on the application of science and engineering knowledge to societal problem, and could not make graduates creative and adequately prepared for the construction industry.

Human resources produced through such dismal environment have been directly (without training) involved in infrastructure development in Nepal and Cambodia. Neither industry nor government has been providing trainings for the construction workers and graduates. Further, lack of apprenticeship in technical/engineering education has been making the skilled workforce candidate: craftsperson, technician and engineers to acquire theoretical knowledge only leading to increase white-collar expectations without having appropriate basic skills. In addition, the construction industry in Nepal and Cambodia has been employing the unskilled labors from the agriculture profession. The culture of Learning-by-doing in the industry has made infrastructure inefficient. Further, the existing technical/engineering education system in Nepal and Cambodia has not built the construction industry healthy.

7. SURVEY RESULT

A questionnaire survey followed by interviews with clients' engineers, consultants, contractors and university teachers and field visit were conducted in Nepal and Cambodia. 11 people from Cambodia (clients' engineers-3, consultants-2, contractors-3 and university teachers-3) and 15 from Nepal (clients' engineers-6, consultants-2, contractors-4 and university teachers-3) participated in the survey and interviews. The respondents were selected to represent all stakeholders of infrastructure development as maximum as possible.

The respondents of the interviews were asked to state the existing infrastructure development environment and problems associated through written questionnaire and face to face interviews. The survey revealed that delay, cost overrun and poor quality in public works were acute problem in Nepal and Cambodia. The study further investigated that the construction industry professionals (technicians and engineers) lacked construction management skills and the industry needed its own standards for design and construction to ensure quality and uniformity in infrastructure development. The respondents claimed that the fresh graduates of civil engineering in Nepal and Cambodia lacked practical skills and ability necessary for the construction industry. Further, some contractors from Nepal in the interviews told that they would not hire fresh civil engineers which implied that a low employment opportunities for the fresh graduates from the civil engineering in the

construction industry. It was found that the civil engineering curricula in Nepal and Cambodia included professional practice area as much as 6 percent and 9 percent respectively which covered only a little on construction project management. But the construction industry desired graduates with more practical skills and ability in construction project management. It was found that the civil engineering education could not provide enough opportunities to acquire practical skills from university and no institutions were established to deliver training and continuing education. The undergraduate curricula were not updated for the last 10 years and no industry professionals were involved in educational activities like curricula design and teaching. Moreover, the Cambodian university also lacked resource persons on construction management. There were no any mechanisms to link universities and industry. The data given by the Nepal Engineering Council as of 2002 revealed that there were 4,690 engineers registered for working of which about 60 percent (2,759) were from civil engineering (including architecture) background. In addition, almost 90 percent of the civil engineers (2,379) were one-degree graduates. Further, there were 38, 310 and 32 post-graduate, masters and PhDs[12]. The industry professionals agreed that the quality of human resources in the construction industry has affected its performance in service delivery, and need to improve through quality university education. The survey study had concluded that applied research-based education could help improve socio-economic infrastructure development environment in Nepal and Cambodia. Further, the Nepalese and Cambodian construction industry was in immediate need of research and development on construction materials and management education.

8. DISCUSSION

Investment in infrastructure alone does not guarantee economic growth. The returns to a given investment depend on the efficiency with which the overall facility is implemented and operated[13]. Efficient economic infrastructure and qualified domestic human resources are prerequisite for the economic growth. Competency of a graduate is greatly influenced by quality of education and training. Wright (1999) remarked that scientific and engineering knowledge doubles every 10 years[14] but the civil engineering universities in Nepal and Cambodia have been following a curriculum without updating for 10 years. This indicates that the civil engineering education in Nepal and Cambodia cannot cope with the contemporary development in the civil engineering especially in the field of construction materials and management. Educationalists focus students to learn not only what is known but also how to keep their knowledge up to date, and further emphasize on curricula design so that students learn how to learn. However, the theoretical textbook knowledge imparting by mediocre teachers and mechanistic testing system of education in developing countries like Nepal and Cambodia has contributed to increase the number of graduates rather than to acquire skills and ability from school and university education. It is a common fact that people with insufficient skills and ability cannot have access to gainful jobs. The low wages lead to low saving and investment which further leads to grow poverty.

Moreover, the capacity of an industry depends on its reserve of human resource, fixed capital and technology, and not directly on firms[15]. In addition to political, economical and legal conditions, the quality of technical manpower also greatly influences the efficiency in a project delivery. The inefficiency in a project delivery would increase cost and defer benefits. Moreover, poor quality of works generates less benefit and requires high operation and maintenance cost. But public works carried out by local contractors in Nepal are characterized by delay, variations and poor quality. Increase in contract amount is also seen in the international contract bidding projects[10]. Research and development activities would help investigate problems, find solutions, develop technology and consequently enhance the efficiency in service delivery. However, there was no visible research and development activities in government, industry and universities in Nepal and Cambodia. It was observed that the middle income developing countries from the Asia and Africa has put larger investment on education (Table 1) for quantitative and qualitative development[16]. Those investments (in Nepal, Cambodia and other least developed countries) were done just to run the system but not directed to improve quality of education and support research and development functions of universities. Moreover, lack of research and development activities has isolated universities from industry and society. As a result, industrial and societal needs were not incorporated in education and therefore graduates produced in such environment could not acquire skills and ability even from university education. This has made low productive human resource and consequently low performance of industries.

Applied research-based education was the central principle in producing qualified technical

manpower and developing technologies in Japan. Consequently, there were no necessity of foreign human resources in her development and technological innovations. Moreover, the Nature 1877 had apprised engineering education of Japan at that time was the best in the world in producing engineering human resources which incorporated appropriate combination of theory and practice in university education[17]. The expansion of such education system could fully satisfy the nationwide demand for human resources trained in applied sciences including the civil engineering in Japan. This had important consequences in the course of Japan's industrialization[18]. In addition to hard infrastructure development, quality human resource development should, therefore, be a central focus of the least developed countries for sustainable socio-economic development. The Japanese experience especially in human capital development would be very appropriate for the least developed countries. The Japanese aid to developing countries should therefore be directed to improve quality of education in parallel to hard infrastructure development by helping them to set up applied research-based education in universities. The returns to investment in quality education, and research and development could be ensured through higher wages and enhanced benefits from increased efficiency in project delivery due to the higher productivity of human resources and technological innovations.

In addition, local industries in developing countries are deprived from opportunities to enhance their capacities. The history of infrastructure development in Nepal showed that the British and Indian executed all the projects in early period. Later, with the inflow of foreign assistance, international consultants and contractors from donors and the developed countries occupied the construction market. As such, Nepal did not have sufficient internal resources; it could not provide local industry enough opportunities in infrastructure development. The situation of the construction industry in Cambodia was also similar to Nepal. Of course, participation needs a certain level of capacity. Further, if there were no opportunity for participation there would be no capacity enhancement. Thus opportunity, participation and capacity are entangle in a circle and should be dealt in parallel.

Developing countries are potential market place for the developed countries and are striving for socio-economic infrastructure development which requires modern technology and management. The developed countries should, therefore, support to make competent human capital and provide enough opportunities in order to make enable to absorb and internalize the modern technologies and their sustainable transfer in developing countries. Foreign assistance especially in the least developed countries should not only be concentrated in hard infrastructure development but also focus on quality human resource development to enhance efficiency in implementation and operation of facilities.

9. RECOMMENDATIONS FOR QUALITY HUMAN RESOURCE DEVELOPMENT

Existing independent contribution of universities and industry cannot boost the socio-economic development of developing countries especially in the least developed countries. The prevailing human resources development systems need reform for better human capital and efficient infrastructure development. Universities should provide opportunities to enhance faculties' capacities to fulfill industrial needs, and students to acquire practical skills and ability.

Table 1: Expenditure on Education in developing countries

	Expenditure on Education (% of GNP)							
Country	1970	1980	1990	1995	1998/99	1999/00	2000/01	2001/02
Malaysia****	4.2	6	5.5	-	5.1	6.1	6.8	8.5
Thailand***	3.2	3.4	3.6	4.1	5.2	5.9	5.3	-
Mongolia**	-	-	12.9	6	-	-	6.6	-
Nepal*	0.6	1.8	2	3.2	2.8	2.9	3.6	3.3
Cambodia*	5.8	-	-	-	1.4	1.1	1.9	2.1
Botswana****	4.7	6	6.9	8.6	-	-	-	-
Namibia***	-	-	7.4	8.4	7.9	7.7	-	-
Kenya**	5	6.8	7.1	6.8	6.7	6.9	6.3	-
Benin*	-	-	-	3.2	2.5	2.5	3.1	3.3
Niger*	1.1	3.1	-	-	-	2.1	2.8	2.4
Mali*	-	3.7	-	2.2	3	2.9	-	-

*: Least developed countries, **: Low-income countries,***:Lower middle income countries, ****: Upper middle income countries (DAC classification)

- : not available

Source: UNESCO

Quality improvement should be the main target of human resource development. Integration of university functions and industrial activities would create appropriate environment to acquire enough practical skills and ability from university education. Applied research-based education system would help technology development and innovations. Involvement of students in real work through internship would help to acquire practical skills and realize industrial/societal need during university education. This would make graduates ready-to-use and industries more productive. Training and continuing education should be provided for continuous improvement. Thus, a new system, which consists of continuous assessment of industrial need and university capacity, followed by university's capacity improvement and university-industry cooperation would help improve quality of human capital. An interface would be essential to assess and feed the industrial needs in to university education which further to provide opportunity for research and development.

An entity having research and development functions, and comprised of highly educated and experienced people with enough capacity for research and development called Center of Excellence and Research (COE&R) would be an appropriate interface to bridge universities and industry, and to activate their research and development functions. Capacity of universities in the least developed countries could be enhanced through universities and/or university-industry collaboration. The subsequent paragraphs will describe how universities collaboration helps improve capacity of a university in the least developed country.

(1) Center Of Excellence & Research (COE&R)

A center of excellence and research (COE&R) is a body of knowledge and it normally, comprises of faculties, researchers and professionals with enough capacity for education, research and development. This center is established at the universities. However, the management of the center should be made free from the governmental bureaucracy to reduce the control over knowledge creation and academic freedom. The center's business and management is similar to a non-profit making organization (NPO) which helps to make easy and radial interaction and business with government and industries. A university can create several branches under the central COE&R.

The center will engage in technological research, development and innovation, and developing practical educational materials and curricula compatible with industrial needs in close coordination with industry professionals. The center is also envisaged to provide continuing education and training facilities for professional practitioners which could be a resource for its sustainability. Moreover, the service function of the COE&R would enable industries be able to get integrated professional services from a single entity.

The center could be developed as a technology diffusion center to disseminate the modern technology and researches. The modern technology developed in the developed countries could be made available in the least developed countries through ODA and/or universities/industries collaboration.

In effect, the incorporation of COE&R at universities has been planned to consolidate the

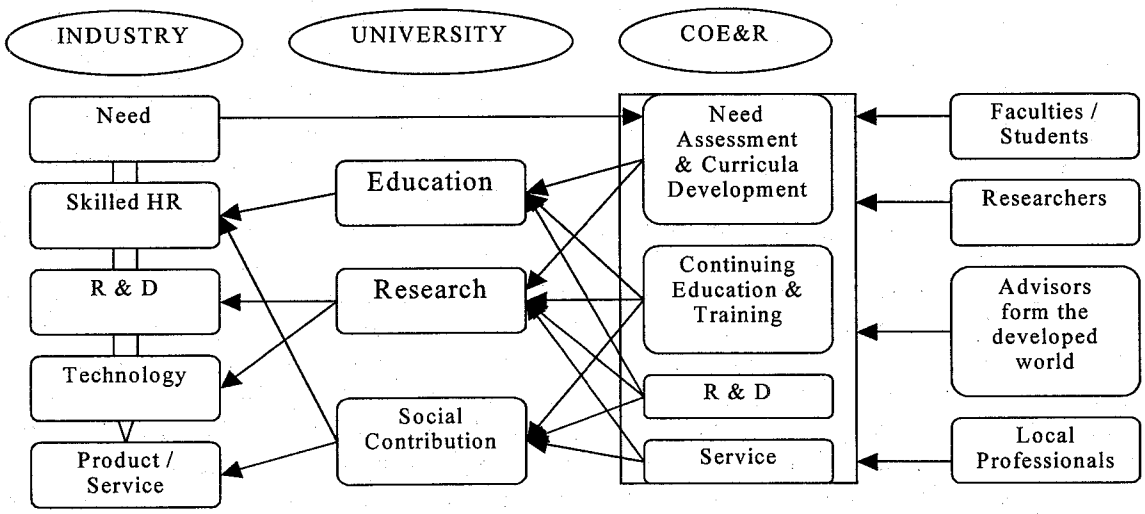

Figure 8: COE Interface to strengthen Industry through University functions

scattered human resources and knowledge, and to integrate industrial activities to education so that graduates could acquire practical skills and ability from university education making them ready-to-use. Further, such system helps universities to enhance the education, research and social contribution functions, and industry to acquire capacity for technology development and innovations. Thus, the center would help improve the quality of education, and provide academics and professionals opportunities to work together. The integration system of industrial activities to university education through the functions of COE&R is shown in Figure 8.

The existing human resource and infrastructure development environments in Nepal and Cambodia show that these countries need immediate establishment and operation of COE&R for infrastructure development and management at the civil engineering university. The COE&R should first work on infrastructure design and standards, and construction materials, technology and management. Thus, a COE&R in Nepal and Cambodia may have several branches like infrastructure design and standards, construction materials, construction technology and construction project management. However, the existing faculties strength and financial resources of a typical civil engineering universities/colleges from Nepal and Cambodia are not sufficient to perform research and development in the above-said areas. In order to improve the situation, industry and the governments should allocate additional funds to universities for research and development which is not existed now. Further, inviting foreign advisors and/or sending faculties for higher studies through universities collaboration and technical cooperation from the developed countries could strengthen the capacity of the universities and the center as well. Industrial need oriented universities collaboration established in this research would be appropriate for a university from the least developed country to enhance the human resource and technological strength required to contribute for the industries. The collaboration between the Kochi University of Technology (KUT), Kochi, Japan and Institute of Technology Cambodia, described in following paragraphs, shows industry-oriented universities collaboration.

(2) Universities Collaboration - A Case in Cambodia

As stated above, the Cambodian construction industry was in need of their own standards for infrastructure design and construction to ensure consistency and quality in infrastructure development which require research and development on construction materials and management. However, neither the industry nor universities had initiated research in those areas. The Cambodian universities also did not have enough human resources to conduct researches. The oldest and most equipped university in Cambodia, Institute of Technology Cambodia, had total 15 faculty members in the civil engineering department among them 8 were bachelor's degree holder and the remaining 7 were masters. Moreover, those faculties did not have enough capacity to deal with the need of the construction industry.

Universities collaboration between Kochi University of Technology, Japan (KUT) and Institute of Technology, Cambodia (ITC) was established in 2003 to enhance the capacity of the ITC (Figure 9) in construction materials research and management. Two faculties from the ITC were invited for higher studies on concrete and construction management at the KUT. A successful test production of Self Compacting Concrete in Cambodia was already demonstrated in June 2004. Further research in materials and management are undergoing and the collaboration will continue in other fields also. This universities collaboration aiming at contributing to prevailing specific needs of the local industries has attracted interest of other universities from China, Nepal and Mongolia. New collaborations will be forwarded on the basis of the need of the construction industry of these countries.

Further to universities collaboration, as a part of this research, a Center of Excellence and Research was proposed to establish at the ITC to initiate research and development works on construction materials and construction project management to fulfill the needs of the Cambodian construction industry. The center will provide opportunities to university faculties, students and local professionals to conduct research and development works together to develop appropriate construction materials and their standards in Cambodia. In addition, the center will remain continuously investigating needs of the industry and providing feedback to education to help improve curricula, educational materials and teaching-learning environment in the Cambodian university education. The center will bring professional practitioners and foreign experts in to the academic, research and development activities in parallel. The center could also be developed as a center for technology diffusion in Cambodia. The proposed organizational location of COE&R at ITC is shown in the Appendix (figure A1).

However, this system requires coordinating executing and donor agencies for financial support to enable to establish and run smoothly. ODA from the developed country in the form of technical assistance and grant aid would be essential for

start-up of the center. The investments on education in some middle-income developing countries indicate that at least additional 2 percent of the gross domestic product should be allocated to improve quality of education, and for research and development in the least developed countries.

(3) Appropriate Curricula Development

Educationalists advocates that students must understand the societal activities, development and needs, and be capable of becoming responsible contributors. Curricula and quality of learning materials affect the productivity of graduates which ultimately influence the performance of industries. What is needed is a clear definition of what industry currently desires in engineering and engineering technology students. Once this is achieved, curricula must be reformed to give students the skills they will need to be successful, and provide the graduates who will be productive in industry[19]. Integration of needs of industry, society and universities through a practical project would help develop appropriate curriculum[20]. This would enable university to incorporate hands-on experience into the engineering curricula.

As stated in previous chapters that infrastructure development projects in Nepal and Cambodia have been suffering from delays, variations and poor quality of works. Almost 90 percent of the civil construction engineers are the undergraduates, and are not familiar with modern tools and techniques for time, cost and quality management. Further, the civil engineering education in Nepal and Cambodia cover mainly elemental design of infrastructure; however, do not incorporate the necessary knowledge areas of construction project management.

A practical construction project management course should be introduced in the civil engineering curricula which would improve the construction project management knowledge area of the construction engineers and consequently improves the efficiency in infrastructure construction. The construction project management curricula requires to incorporate knowledge areas and skills which are required for each life-cycle stage such as feasibility, planning, procurement, execution and operation of a project. Based on the curricula proposed by Kusayanagi S.[21] a curriculum on practical

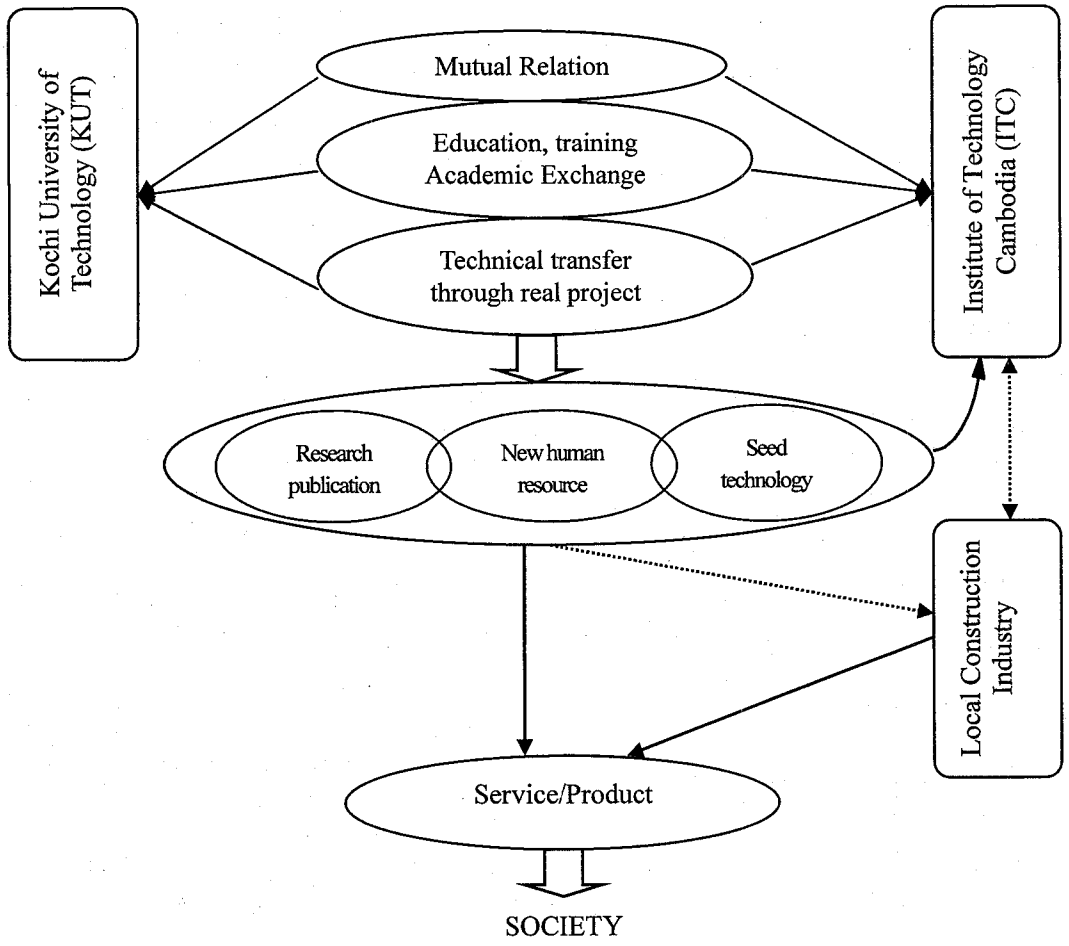

Figure 9: Working model of Universities (KUT and ITC) Collaboration

construction project management has been developed through literatures review, survey and interviews with construction professionals and academics in Nepal and Cambodia based on the model shown in Figure 10.

The proposed curriculum covers sufficient technical and management aspects for the whole project cycle to address the existing problems in infrastructure development in Nepal and Cambodia. Infrastructure development, planning and assessment part of the curricula offer trend of infrastructure development, construction industry and economy, globalization, engineers' mission and ethics, and so forth. Similarly, project mission management covers the legal system, procurement system, risk management and project assessment areas of infrastructure development and management. These knowledge areas would help to improve the efficiency in project implementation including decision-making ability of the project managers and construction engineers. Likewise, project execution management and field management part offers to acquire hands on knowledge for construction project administration, management and field work which would help to improve time, cost and quality efficiency of a project execution. And, project operation and management covers management system for infrastructure operation and maintenance.

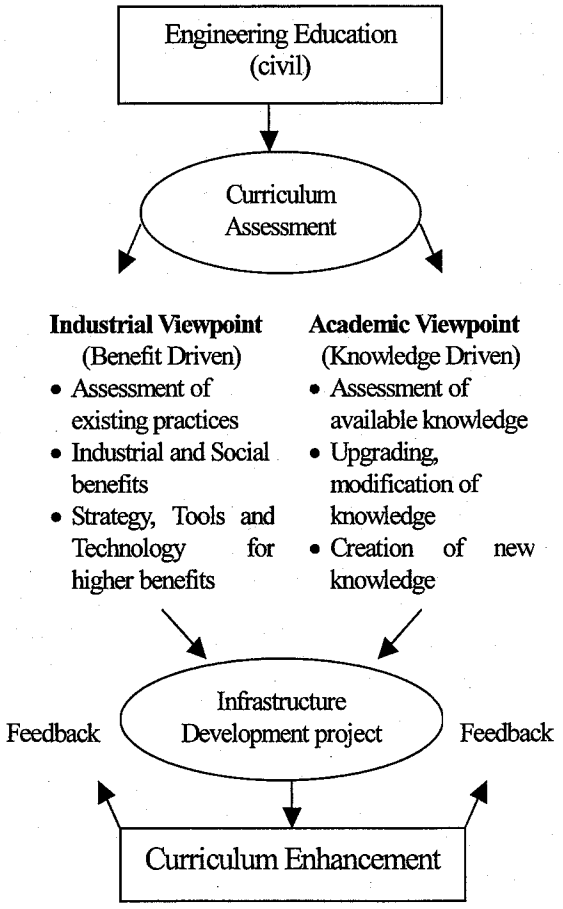

Figure 10: Integration of Industry and University needs in curriculum enhancement (modified from Badiru A.B.)

Thus, introducing the construction project management in the civil engineering education would enable graduates to visualize a project in a holistic way i.e. integrated from planning through execution to operation. However, the contents of the curricula need to be updated continuously with the industrial and contemporary development in related areas. The proposed curriculum for practical construction project management for the civil engineers is shown in the Appendix, Table A1.

10. CONCLUSIONS AND FURTHER RESEARCH

The existing infrastructure development environments and human resources in Nepal and Cambodia are discussed here. This study has shown that it is possible to make a university enable to contribute to the industry provided appropriate knowledge acquiring system – industrial need oriented universities collaboration. This study further provides a way to enhance quality of human capital in a least developed country. Universities from the least developed countries need to identify the needs of industry, and assess their own capacities and performance of graduates. A university from the least developed country should search for source of knowledge and technology compatible with local industrial needs as done by the ITC. The COE&R would bridge the gap in education and industrial development, and activate research and development functions of universities and industry. Finally, universities collaboration and COE&R approach in the least developed countries would enable universities to work with industry, and to develop quality human resources and technologies. ODA in construction of infrastructure should integrate educational and research activities to improve human resource development environment in the least developed countries. This research mainly focused in the construction industry; however the proposed system could be used for other areas also. The research will be further continued to develop a prototype for human capital development in the least developed countries.

APPENDIX

Table A1: Curriculum on Practical Construction Project Management (recommended)

1. Infrastructure Development, Planning and Assessment	
Infrastructure Development, Planning and Assessment	Infrastructure Development in the world
	International Construction Industry
	Globalization, International Regulations & Standards
	International Issues in Construction
	Development Planning; National Infrastructure development (mission & policy);Master, Regional & District Plan
	Domestic Construction Industry and National economy
	Project Financing, Investment Appraisal
	People's participation in Infrastructure development
	Environmental Issue
Role of Civil Engineers	Engineers' mission, ethics, Leadership, Communication
2. Project Mission Management	
Laws & Regulation	Laws, Rules and Regulations related to Procurement, Construction, Arbitration, Audit, Tax, Environment, Property & others
Procurement	Project Delivery & Contracting System
	Conditions of Contracts for various type of Contracts
	International Standard Condition of Contracts
	Tendering, Evaluation & Contract Award
	Public procurement, Procurement standards of various International Financing Institutions
Risk management	Risk Evaluation & management
	Insurance
Project planning & Assessment	Roles and responsibility of Stakeholders
	Environmental assessment, Feasibility Study & Project Appraisal
	Engineering cost and Financial Management
3. Project Execution Management	
Construction Project Administration and Management	Partenering; Joint venture
	Construction Organization
	Human resource Management
	Construction planning, Scheduling
	Cost estimation
	Schedule control
	Cost Control
	Quality management
	Productivity in Construction
	Contract Administration, Reporting, Documentation
	Claim & Dispute management, Negotiation
	Tax & Accounting
	Technical Audit
	Security & External management, Public relation
4. Project Field Management	
Field work plan and control	Technology Transfer
	Capital & Labor-based Technology and Construction Equipment
	Construction environment, Stakeholders coordination
	Material Management
	Health & Safety
	Quality Control
	Productivity Improvement
	Personal control
5. Project Operation and Mmaintenance	
Operation and maintenance	Project Operation Organization
	Social Impacts
	Monitoring and Investigation
	Maintenance Plan, Methods

REFERENCES

1. Mihaly, E.B. : Foreign Aid and Politics in Nepal, Himal Books, pp xxv-Ivi, 2002
2. Economic Survey (2003-04) of Nepal, HMG Nepal, Ministry of Finance, pp 25-34, 125-196, Statistical Tables pp 1-17, (2003-04), 2004.
3. Kaneko A. and Adachi H. : Infrastructure Development, Country study for Japan's ODA to the Kingdom of Cambodia, pp 199-220, 2002.
4. Japan Bank for International Cooperation: Kokusai Kyouryoku Binran, http://www.jbic.go.jp, 2004 (in Japanese),
5. White papers on Japan's ODA, Ministry of Foreign Affairs, Japan
6. Vaid K.N. : The Construction Industry in Nepal, A NICMAR Publication, 1999.
7. Ministry of Physical Planning and Works, HMG Nepal, 2002
8. Ministry of Land Management, Urban Planning and Construction, Cambodia, 1999.
9. Brushett, S. et al. : Construction Industry Development and the Road Sector, Africa Transport Technical Note, Sub-Saharan transport Policy Program Note 38, 2005.
10. Auditor General of Nepal (AGR), Nepal, 1998-2000.
11. Central Bureau of Statistics : Population Monograph of Nepal, 2003.
12. Nepal Engineering Council : Database, http://nec.org.np, 2002.
13. Kessides, C. et al. : Infrastructure's Impact on Development: Lessons from WDR 1994, Journal of Infrastructure Systems, Vol. 1, pp 16-32, 1995.
14. National Academy of Engineering of the National Academies. : The Engineer of 2020, The National Academies Press, Washington, DC, pp 23-25, 2004.
15. Gruneberg S.L. et al. : The Economics of the Modern Construction Firm, Macmillan, pp 171-186, 2000
16. UNESCO : Expenditure on Education Database, http://unesco.org/
17. The Nature : Engineering Education in Japan, pp 44-45, May 1877.
18. Akatsuka, Y. et al. : Systems for infrastructure Development, Japan's Experience, Japan International Cooperation Publishing Co., Ltd., 1999.
19. Lahndt L. : Industry mentored engineering and engineering technology curricula, Anonymous Publisher, 1998.
20. Badiru A.B. : Engineering Education and Curriculum Design, Anonymous Publisher and Date.
21. Kusayanagi S. : To build up the appropriate education program for construction management in Japan, JSCE, Construction Management, Vol. 11, pp 281-292, 2004.

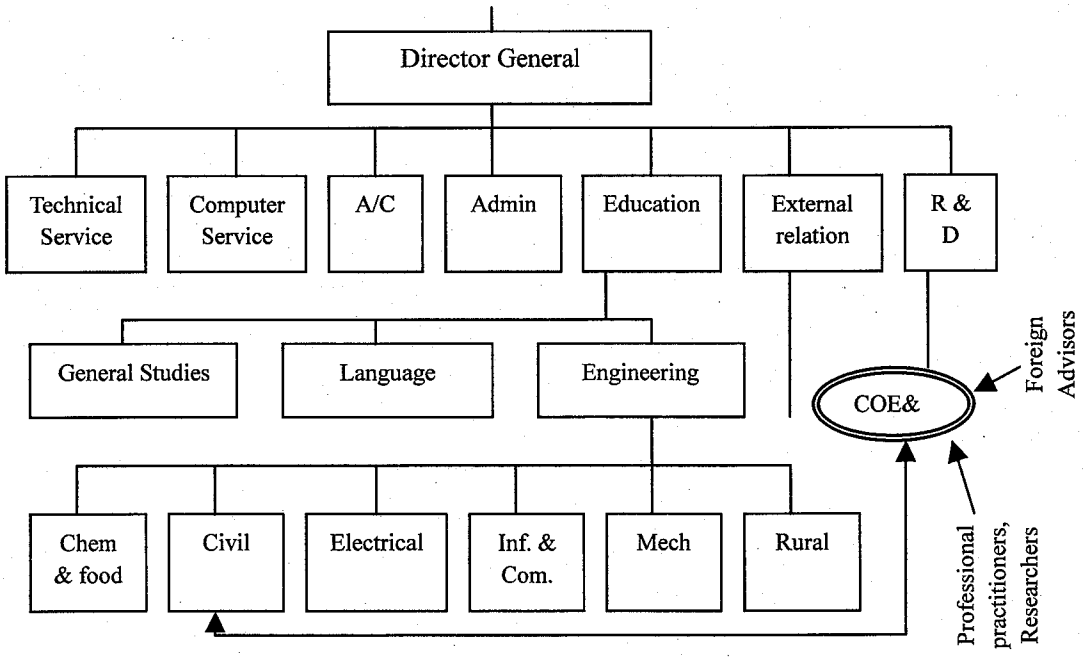

Figure A1: Organizational location of COE&R at Institute of Technology Cambodia