



**UNIVERSITY INDUSTRY LINKAGE IN TERMS
OF RESEARCH: THE CASE OF ADDIS ABABA
UNIVERSITY**

BY

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THESIS

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List of Abbreviations

AAIT	Addis Ababa University institute of Technology
MoE	Ministry of Education
METEC	Metal Engineering Corporation
IPR	Intellectual Property right
MoST	Ministry of Science and Technology
OECD	Organization for Economic Co-operation and Development
AAU	Addis Ababa University
U-I	University Industry Linkage
MoFED	Ministry of Finance and Economic Development
CSIC	Spanish National Research Council
R&D	Research and Development
HEIs	Higher Education Institutions
ESTA	Ethiopian Science and Technology Agency
PASDEP	Plan for Accelerated and Sustained Development to End Poverty)
MDGs	Millennium Development Goals
SDPRP	Sustainable Development and Poverty Reduction Program
FDRE	Federal Democratic Republic of Ethiopia

Abstract

The study was designed to describe and analyze the University-Industry (U-I) linkage in the case of Addis Ababa University College of Natural Science and Institute of technology which are located at Arada Sub-city. This research employs mixed methods to address the issue. Sample survey of 68 individuals was conducted using the quantitative method. While the qualitative methods applied, were interviews with associate deans for research university and Industry linkage, METEC research and development vice director, university industry link and technology transfer unit director, ministry of science and technology expert. Document analysis was also used to analyze policy related to university industry linkage. The national science and technology policy, intellectual property right policy and higher education proclamation: university internal policy and industry research and development strategies have been the Conceptual Model of the study that underpins this study. This study investigate that there is no university-industry linkage in terms of academic research. This study also revealed the power of implementation of policies in connection with university industry linkage is very poor in national and university level, the leadership commitment to creating linkage with industry doesn't get priority attention by the university and the industry owner as well. Moreover this study also shows that the university academic staffs are not competitive to conduct competitive academic research which can be sold to industries, the university come up with financial constraint and limited allocation of annual fund for the university industry linkage unit. Moreover the study findings indicate that lack of incentive mechanisms to motivate the academic staff, low level supply of updated research infrastructure and facilities, low level commitment and poor management system were the lion share for the low level status of university industry linkage in the case of Addis Ababa University. Furthermore, the study find out that patents have a key role in creating a favorable condition for the networking of the different actors in the national system of innovation but the national IPR policy has low impact to create strong linkage. The results of the research analyzed that funding in research play a dominant role to have novel technology result but at national level, in the university and METEC it is really below average. The university and industry partnership in terms of research is still on its minimal stage because of the two parties miss communication, low level industry owner awareness, university leadership commitment and competence to create the linkage is also below average.

Chapter one

1 Introduction

1.1 Background of The Study

Higher education is among the fundamental pillars for ensuring social and economic development. Investing in tertiary education is a means to economic growth through human development. Recognizing this, many countries of the world have been investing in their higher education institutions. In connection with this, how to get the university to better contribute to innovation process has become an international agenda.

Universities have long been recognized as sources of knowledge creation, innovation, and technological advancement. Globally from western developed countries to China, Brazil and other emerging economies, universities are positioned as strategic assets in innovation and economic competitiveness, and as problem-solvers for socio-economic issues affecting their countries (Gigerr, 2006). In order to fully capitalize on the potential of universities in this aspect, governments and institutions are actively pursuing strategies to strengthen university linkages with industry (and for that matter the productive sector in general) through research and other forms of collaboration (Gigerr, 2006).

National interventions and pro-active engagement of universities and industries have, however, been less forthcoming in many African countries. African universities also face considerable constraints with regards to the structure of their economies, political environments, and institutional research capacity (Ginies and Mazurelle, 2010). Despite criticisms of the poor state of university-industry linkages in Africa, African universities are taking steps to initiate and accelerate measures to strengthen institutional capacity to support linkages with the industry and the broader productive sector (Tiyambe, 2004). Yet, there is lack of data to provide a comprehensive and informed picture of what steps African higher education institutions have already taken and what is needed to provide a strengthened, more comprehensive platform for promoting, building, and managing synergetic partnerships with the productive sector (Munyoki *et al*, 2011).

The collaboration link between universities and the industry is necessary for technology transfer and the commercialization of academic research. Any technological innovation process implies close linkage among different players. The University, Industry and Government, and the intensity and nature of instruction among these actors critically influence the innovative performance of institutions/enterprise within a given Innovation system (Nelson: Lunduvall and Johanson , 2009 cited in Mulu Nega, 2009)

Consequently, as noted by Mulu, these days, institutional arrangements that facilitate university-industry linkage is in place and creating link with industry has become one of the mission and mandates of higher education institutions in the industrial world. Mwiria (1994) identified the type of linkages that have the potential to enhance the collaboration between African universities and their respective national populations, the business community and government. At that time, such linkages were still in their infant stages. In terms of teaching and training, University-Industry activities include offering professional courses on a fee-basis to respond to the particular skill and training needs of the industry. Universities may engage industry and other productive sector representatives in course curriculum development to ensure that degree programmes can produce graduates with the required knowledge and skills for the workforce. Creating opportunities for student attachments and co-op placements in the productive sector is another common way in which universities link up with the industry (Homma and Attalage, 2008; Munyoki et al, 2011).

University-industry linkages can take various forms and involve different intensities of engagement. These include Research and Development (R&D), training and curriculum development and consultancy (Martin, 2000). Enterprises and other actors may commission a specific research project, sponsor a university chair in an area of interest, or engage in joint R&D with universities. Through prototype development, technology incubation, the creation of spin-off companies for commercialization, licensing and royalty agreements and other related-activities, universities promote technology transfer to the productive sector. Other universities focus on providing consultancy and business services, such as testing and certification (Basant and Chandra, 2007).

The university-industry linkages can either be formal or informal. As a means to support a more institutional approach to promoting linkages, many universities set up industry liaison offices, technology transfer offices, technology and business incubators, and in some cases establish science parks on or near campuses to facilitate such interaction (Lundvall, 2009). Leadership, dedicated posts, clear strategic direction, and policies for managing the effective governance of industry linkages are also important for promoting a more directed institutional approach to building industry linkages (Kruss, 2008).

1.2 STATEMENT OF THE PROBLEM

Nowadays in global thinking the demand of academic research and technology transfer for development and poverty reduction is an inevitable. Currently Higher Education institutes are asked to engage with research and universities have an important role to play in this feature therefore, the main objectives of the university should be research, community service and teaching which can be used to eradicate poverty (MOE, 2004).

On the Ethiopian context academic research and technology transfer have been considered as the best means for the country economic development. There is an agreement claim that research and technology transfer, transform investment and aptly designed university-industry linkage play a dominant role for national Economic development (MoST, 2010). Obviously, research is one of the potential universities mission to create university industry linkage as a result, due attention be given the effective utilization of university industry link. Like any other country aspiring for poverty reduction, Ethiopia needs to have effective university industry linkage.

Therefore, different strategies need to be identified to encourage university academic staff to conduct research and to engage technology transfer area which enables the university to grasp the industry attention as well. The linkage between university and industry also must be well planned, managed and organized to attain the purpose of the linkage and the attainment of the goal of higher education, it is because higher education is crucial to make a change for socio economic and political development which is important for poverty reduction and sustainable development.

Overall there is a lack of empirical data that provide a comprehensive and informed picture of what steps Ethiopian higher education institutions have already taken and what is needed to provide a strengthened, more comprehensive platform for promoting, building, and managing synergetic partnerships with the productive sector (Mulu, 2009).

Thus, this study intends to examine the linkage between Higher education sector and industry at Addis Ababa University and thereby elicit areas where advocacy and support could help the University overcome any capacity deficits and accelerate its progress.

1.3 Research Questions

This study attempts to answer the following basic research questions:

1. What is the status of university and industry linkage at Addis Ababa University
2. What are the factors that enable or hinder university and industry link at Addis Ababa University?
3. How can we improve the link between university - industry (U-I) in the Ethiopian context?

1.4 Objectives of the Study

General Objective

The general objective of this thesis is to investigate and analyze the University-Industry (U-I) linkage in the case of Addis Ababa university targeted to College of Natural Science and Institute of Technology. More specifically the study intends to:

- Establish a current understanding on the University-Industry linkage in Ethiopia particularly at Addis Ababa University.
- Identify the efforts that has been exerted to fill the gap of University –Industry linkage
- Investigate the positive and negative factors that affective the University-Industry linkage
- Recommend on what has to be done to fill the gap between University- Industry links

1.5 Significance of the Study

- The research may provide a clear picture on the current status of university industry linkage for researchers and practitioners who work in the university industry linkage under the study.
- Based on the nature of the finding, the university leaders, industry owners and policy makers can design the necessary measures
- The academic staff can get a better insight that enables them to know the industry interest corner.
- Finally, new insights for further study may be also obtained from the research.

1.6 Delimitation (Scope)

The thesis focuses on the university-industry link at the Institute of Technology and college of Natural Science of Addis Ababa University in Ethiopia. Although the scope of the empirical work limited to two institutes college of Natural Science and Institute of technology at Addis Ababa University, and its surrounding industry (METEC) in 20014. There is still possibility to derive some general trends, indicators, and facts which would contribute to the theory and guide further empirical research.

1.7 Limitation

University –industry link which can be dealt in terms of research, innovation, human capital development, as well as, poverty reduction strategy and other concepts are too broad and complex issue which can also be dealt with other concepts. Despite this, investigation suffered from a number of constraints, chief amongst which is data and Document availability in the University this factor constitutes a formidable disincentive to research in the study area. The last but not the least time constraints of academic staff were the limitation of the study it was hardly possible to meet them for the interview or to fill out the questionnaire according to our appointment.

1.8 Operational Definitions

Research for universities is the type of research directed towards increasing knowledge in science (Sanow 1959).thus may have no known immediate application,

University: For the purpose of this research, ‘university’ refers to the institutions which impart higher education in Ethiopia which disseminate knowledge in various disciplines. Furthermore, the words ‘higher institutions’, ‘higher education’, ‘Higher Educational Institutions (HEIs)’, ‘Institutes’, ‘academics’, ‘academicians’ have been used as synonymous to each other and taken to mean ‘institutions imparting higher learning.

Industry: For the purpose of this research work, ‘industry’ means various private manufacturing industry which producing goods.

Linkage: Throughout this research paper, the words ‘convergence’, ‘interface’, ‘interactions’, ‘partnership’, ‘alliance’, ‘cooperation’, ‘linkage’ and ‘strategic relations’ have been used as synonymous and taken to mean the ‘coordination’ between academic research institutions and industry.

1.9 Organization of the Thesis

The research has five chapters. The first chapter deals with presentation of statement of the problem, background of the study, objective and research question of the research and significance of the study. The second chapter provides an overview of related literature and researches conducted so far and deal with conceptual model. The third chapter outlines the research methodology and it also discusses issues such as study area, study design, study subject, sampling, sampling techniques and sample size, while the fourth chapter discusses the key findings of the study and the last chapter attempts to offer an overall conclusion to the reader.

Chapter two

Review of Related Literature

Research on technological innovation has shown the importance of cooperation between many public and private sector organizations for effective high-tech development. Universities, among others, have attracted a lot of attention, starting with OECD's comment that recognized centers of commercial innovation generally profit from links with universities.(OECD, 1984) and the observation by David that communities situated around technical universities experience a higher than average rate of growth,(Birch ,1987). This insight was reinforced by the visibility and success of the high-tech growth poles which developed around Stanford, and other leading research universities. Early research has documented the positive effect of university research on local industrial R&D spending and on the local rate of innovation Jaffe (1989, p. 957) and shown that physical proximity between a firm's R&D facility and a university seems to be a major determinant of applied research funding at universities. (Mansfield, .Lee, 1996, p 1055).

This early research has led to the realization that successful technological innovation, the creation and commercialization by industry of new or improved products, services and processes, relies not only on industry but also on a complete local "systems of innovation". (Smith, 1998). In addition to a cluster of large and small firms in a common domain, such a system includes research organizations, universities and other educational institutions, a well trained manpower base, knowledge networks, government programs and policies supportive of technology transfer, business services and financial resources, including venture capital, to support commercialization, a solid local infrastructure, and a local culture supportive of entrepreneurship and of interpersonal communications and networking (OECD, 2001).

Universities are a key component of that local system of innovation through their traditional functions (teaching, research, and community service) and increasingly as active participants in the innovation process (OECD, 2001).

- ❖ **As teaching institutions**, their traditional role, they contribute to the local supply of trained manpower for local industry and of trained researchers for local research

organization. They also increasingly contribute to the upgrading of local skills and knowledge through continuing education and professional development activities

- ❖ **As research institutions**, they contribute to the development of knowledge, both basic, driven by curiosity and the desire to extend the boundaries of knowledge, and applied, oriented towards innovations and the commercialization of knowledge. The balance between basic and applied research has led to endless debates. One side of the argument is that applied research is industry's responsibility and that universities should focus on publicly funded basic research. The other side of the argument is that university research should be relevant in the short term and lead to innovations, research commercialization and partnerships with industry
- ❖ **As community service institutions**, they contribute to local community and to the society at large.

2.1 conceptual considerations of university industry linkage

2.1.1 Links between University and Industry.

Within the last decade two main parallel changes have taken place: transformation of society and transformation of science. These changes have direct impact upon each other, and it is a co evolutionary process. The traditional modes of organization characterized by rigid borders between disciplines and isolation from society and industry to some extent have been challenged and alternative relations have taken place (Lundvall, 2002). Alliances and networking with the universities and other kind of research centers have become critical factor behind the success and competitiveness of industries. The interactions between knowledge centers and industry have become interactive, which is beyond a flawless flow of knowledge from universities to industry. As these relations have become much more interrelated and non-linear, the forms and patterns of these relations have diversified.

The interaction between university and industry has been a classical theme in the agenda of nation states, OECD, EU, and several other organizations, as well as among the academic circles (Faulkener&Senker, et al 2001). It has been discussed that much of the academic knowledge comes out not in the forms of written knowledge, but as tacit knowledge within the individuals

(i.e. researchers and graduates). The flow and mobility of these skilled individuals from academy to industry are the most important way for the transition of knowledge from basic research to applied research or innovation. However the flow of knowledge is not an easy matter.

The transition of academic knowledge into commercial sector requires several factors, such as an excellent research results, managerial and industrial competence and financial support. Traditionally academic sector is assumed to provide basic research results, but in most of the cases it lacks of commercial skills which is normally found outside academia like in firms. Therefore it has become rational for academia to build relations with industry. On the other side, partly due to the increased competition from companies with low R&D costs and low profit margins, globalization of production systems; firms with higher R&D costs or high R&D intensive companies are stripping down their big, fundamental research laboratories (Nordfors et al. 2003:, p.12-13).

Companies want universities supply the fundamental research needs, which are generally pre competitive. Apparently both sides are willing and in need of cooperation. The interaction and relations between university and industry need to be institutionalized and regulated in order to eliminate the cultural clashes as well as to endow both sides and society with benefits. Consequently in cases where there is lack of interface settings between university and industry, the state participation has become common in order to ensure the flow of ideas and people between these two important components of the innovation systems (Nordfors et al. 2003:1, p.13). Therefore benefits of this interaction for both sides would explain not only the gains of these two settings, but also the implications on the whole innovation systems would be clarified. On the other hand in the survey of university-industry links in the UK (Howells. et al 1998). were categorized as:

- ❖ Commercialization of research
- ❖ Linkages in research and training
- ❖ Consultancy

Martin (2000) has classified university-industry linkages in to:

- Teaching and curriculum development(such as sandwich courses, jointly developed various courses, exchange of staff, on job training)

- Consultancy (conducted formally or informal way)
- Research and Development(R&D)
- Others (such as regular mutual visit, jointly organised meeting, joint publication, etc .

Broadly speaking, universities have emerged as central actors in the knowledge-based economy, (Bramwell, J. and Wolfe, 2005) .despite he added no longer confined to their traditional roles of teaching and conducting primary research, the famously successful examples of Stanford University and the growth of Silicon Valley, indicate that they are increasingly viewed as key drivers of innovation and “major agents of economic growth”.

Universities do not only generate new knowledge through primary research, they also provide technical support and specialized expertise and facilities for on-going firm-based R&D activities (Esham, M., 2008).University activity is not confined to the process of knowledge transfer on a local basis, but also acts as a conduit of new knowledge through the “global pipelines” of international academic research networks (Maskell, P. 2004).

From the economic perspectives, most scholars agreed that the role of a university can be viewed from its significant impacts in generating localization economies. Those impacts from the university as the center of knowledge creation and the enhancement of exiting knowledge generate categorically from the direct, indirect and induced impact. Universities with the greatest local economic impacts are generally those with the highest quality research programs (Hill, K., etc, 2006). Moreover he added the most compelling reason for technology-based firms to locate near universities is to facilitate tacit knowledge transfer from faculty who are on the leading edge of scientific breakthroughs.

The role of the universities is significantly important in creating the wealth of a nation, through the practices of research and scholarship. Universities are fore mostly education institutions and without any doubt the production of highly educated graduates is by far the largest contribution universities make to the creation, transfer and dissemination of knowledge, (Grossman, J.H. et.al. 2001). Student placements in the form of internships, co-op education, or student research projects on company problems as part of project paper or final examination are some the examples (l ibid). The transfer is not a one-directional handing over of theoretical knowledge and

its application to a practical problem, but a two way exchange and multiple site/multiple mode learning process,(Gossman, J.H. et.al. 2001). In the era of globalization and digital technology propelled by the advancement of information and communication technology, the university and industrial linkages are widening with much broader range of knowledge creation, dissemination and utilization.

The reasons for universities to seek cooperation with industry appear to be relatively simple. Peters and Fufeld (1982) have identified several reasons for this interaction: (1) industry provides a new source of money for university; (2) industrial money involves less “red tape” than government money; (3) industrially sponsored research provides student with exposure to real world research problems; (4) industrially sponsored research provides university researchers a chance to work on an intellectually challenging research programs; (5) some government funds are available for applied research, based upon a joint effort between the university and industry (Peters, L. S. and Herbert I. Fufeld ,1982).

On the other hand, several main reasons, which are claimed to motivate the industry to increase university- industry links, have been provided also by (Atlan and Peter and Fufeld,1982) They are: (1) access to manpower, including well-trained graduates and knowledgeable faculty; (2) access to basic and applied research results from which new products and processes will evolve; (3) solutions to specific problems or professional expertise, not usually found in an individual firm; (4) access to university facilities, not available in the company;(5) assistance in continuing education and training; (6) obtaining prestige or enhancing the company’s image; and (7) being good local citizens or fostering good community relations.

The links between university and industry can go beyond the service supplier oriented. Technology transfer is the key aspect of industry and university interaction. According to Van Dierdonck and Debackere, (1988) interaction between industry representatives and university faculty follows a predictable sequence. Initially, faculty members serve as consultants and assist with data analysis, at the next stage, industry may choose to license innovations developed by university personnel, Spin-off companies based on these innovations generally follow and as the university becomes more involved in technology transfer, the establishment of

a science park and an incubator for new technology-based start-up companies is considered by university administrators and the university board of directors or trustees.

The establishment of such entities reflects a university's commitment to the region's economy and finally step in the technology transfer sequence is the establishment of a venture capital fund, attached to, or managed by the university (Yves, Fassin, 2000). University and industrial linkages should take collective and consensus manner in order to bring changes and promoting growth and development of an area.

According to Doutriaux J and M. Barker (1995 p75-81) University-industry linkages take many forms:

Teaching and training,

- ❖ Industry participation in academic planning and course design
- ❖ In-kind support by industry (donation of equipment, student scholarships, teaching grants)
- ❖ placement of staff by industry to university as part-time professors, visiting professors, executives in residence
- ❖ Industry provision of on-the-job training opportunities (co-op programs, summer jobs) and of part-time work opportunities.
- ❖ Delivery of specialized courses by universities (continuing education, executive development, specialized customized programs)
- ❖ Participation of university professors in industry-led professional development activities, faculty consulting in industry, participation on company Boards and other industry-driven committees.

Research relationships:

- ❖ Tangible industrial support to the university: Research grants, research contracts, funding for research chairs and research institutes
- ❖ Donation of equipment
- ❖ Access to industry research facilities Exchange of knowledge:
- ❖ Industrial project by students as part of their program (theses, class projects).

Technology transfer:

- ❖ Sale or license of patent
- ❖ Joint venture for the commercialization of joint research
- ❖ Creation of spin-off firms.

Doutriaux J and M. Barker (1995) discussed that U-I links are not always easy, the two partners having different cultures and motivations. Industry culture is driven by market demands, profit maximization, and competition. University culture is based on the advancement and public dissemination of knowledge. Industry research tends to be pragmatic, applied, results oriented, dealing with innovations and the commercialization of knowledge. Competition in the market place requires short development times and proper management of intellectual property that restricts publication of research outcomes.

University research is driven by individual curiosity and the desire to extend the boundaries of knowledge. It tends to be more basic and long-term than industrial research, and is generally funded, at least partially, from public sources. One danger of the growing emphasis on the commercialization of research at universities is a shift towards projects that may lead to commercialized technologies to the detriment of basic research. Another issue are the restrictions on the dissemination of knowledge (publication, talk at conferences, knowledge sharing) often imposed on research of a commercialized nature.

The traditional culture of universities is evolving, not only with the development of private universities but also because of the growing number of public “entrepreneurial “ universities, “universities taking on entrepreneurial tasks such as marketing knowledge and creating companies...” and therefore becoming more industry-like,(Leydesdorff,. and Etzkowitz ,1998). This change was spurred by the Bayh-Dole University and Small Business Patent Act (1980) in the United States that gave recipients of federal research grants the right to patents federally funded innovations. This made it possible for universities to commercialize their research. And large firms in industry increasingly have their own professional development and training centers, taking on functions traditionally reserved to universities.

2.2 Benefits of University-Industry linkage

Benefits for universities are generally stated as follows; new funding for research; new opportunities for graduates; new directions for research. The gains of industries are mainly based on earlier and easier access to university graduates and faculty members; research results; intellectual property rights. All these features implicitly reflect that the university-industry interaction provides the innovation system with much more dynamism and efficiency compared to each actor working separately (Patel, 2000).

However despite this positive picture there are problems and clashes among these actors in not only sharing the results of this co-operation but also in coming together. These conflicts and problems generally emerge due to the differences in culture, contributions and expectations.

What universities bring to this picture: People (education and training); Publications (knowledge creation and dissemination); Patents and Copyrights (intellectual property rights) (Patel, 2000). On the other hand firms generally complete this picture by bringing: Access new world class important problems; Access to other activities of the innovation cycle (development, engineering, manufacturing,...).Access to a different cultural thinking; new ways of synthesizing knowledge Research funding at the margin (Patel, 2000). Although all of these contributions from both sides are important and integral to the whole innovation system, there are risks and problems in this interaction.

Technology transfer from universities to industry, which is partly overlapping with the contribution of universities, is listed as such: people (graduates, post-docs); publications; consulting; research partnerships; Licensing of intellectual property; small and startup companies. On the other hand some scholars stated that despite these tendencies and facts, the main contribution of universities would remain as well-educated graduates with critical minds and updated education (Lundvall, 2002).

2.2.1 Incentives in the University -Industry linkage

The universities often pursue basic research and laboratory work on a small scale in projects that are a long way from commercialization. The companies, on the other hand, are more interested in applied research that leads to new or improved goods and services that can subsequently be

produced on a large scale. The question is *how* the new knowledge produced at the universities should be made available to industry and, not least, *who* has an incentive to repackage the knowledge so that it becomes attractive to industry.

Scaling-up work from the universities' small-scale laboratory experiments to large-scale production often requires pilot and prototype activities that are both expensive and associated with high risks. Finding someone who is prepared to take on this role is often difficult. Irrespective of who is responsible for the commercialization of university inventions, the active participation of the researchers/inventors is usually required for commercialization to be successful (Zucker et al., 1998; Audretsch and Stephan, 1996; Siegel et al., 2002). Jensen and Thursby (2001) show that 71 per cent of the commercialized university inventions studied require the participation of the researchers. This is because the researchers often have specific technical (tacit) knowledge about the inventions that cannot be codified and that is needed when adapting the innovations to the needs of the market. It therefore becomes important that the individual researchers have incentives to participate in the commercialization process.

A rule of thumb is that the further the project is away from commercialization and the less codifiable the knowledge is, the greater is the involvement required on the part of the researchers. The incentive structure that is usually found in the university sphere is that the researchers receive prestige (appointments as professors etc.) and payment in accordance with how useful their research is to other university researchers, i.e. the extent to which they publish their work in research journals (Stern, 1999). This does not provide any incentive to commercialize the inventions. Working with Commercialization entails an alternative cost in terms of time and money for the university researchers to the detriment of their traditional research work (e.g. publication) and teaching. It is not only the use of time that creates a conflict between publishing the research results and commercializing them. University research with publication in journals is based on openness. It is believed that it is precisely this openness that generates new knowledge, as researchers can freely build on each others' results.

However, there is a conflict between, on the one hand, publishing new research results in journals in the traditional way, which entails openness and making the results available to all,

and, on the other hand, commercializing the results with or without a patent. In a commercialization process, the aim is to keep the discovery secret for as long as possible. This means that it is not possible to publish an article before the patent application has been submitted and approved. If the results have already been published elsewhere, the patent will not be approved. If a patent is not applied for and it is decided instead to exploit lead times in a newly-established company it becomes even more important to refrain from publishing the new discovery (Geuna and Nesta, 2006). Henrekson (2002) presents four ways in which researchers can receive payment and thus be given an incentive to participate in a commercialization process:

1. Research grants from companies, which usually means that the external company owns the results.
 2. Consulting assignments with external companies with remuneration in the form of a salary.
 3. Payment in the form of royalties in connection with licensing or part-ownership where the external company runs the commercialization process; and
 4. Direct part-ownership if the researchers themselves are involved in starting a new company.
- Variable payments in the form of royalties or part-ownership as in examples 3 and 4 mean that the researchers are paid in accordance with how successful the commercialization process is. This gives them a better incentive to work hard than if they only received a salary or a fixed payment (Jensen and Thursby, 2001). This has to a certain extent been verified empirically.

Patents with license agreements that have both fixed and variable payments survive longer than those that have either fixed or variable elements (Svensson, 2007b). If the knowledge cannot be codified and it is thus difficult to get a patent for the research results, it has been shown that part-ownership is much more effective than licensing (Shan, 2002).

2.3 Research in university-industry links

Research is a systematic investigation of some phenomenon or series of phenomena by the experimental method to discover new facts or information or to coordinate these facts as laws” (Wehmeier, 2000). Within the context of this paper, research may be classified into two main spheres: academic or basic research, and applied or technical research. In the following section I will explore these two forms of research, within the purview of how R&D has transformed

companies and their evolution. Research may be classified in two main dimensions: the basic research; and the applied research. Basic research seeks essentially an extension of knowledge. Basic research may be defined as the human activity directed toward the advancement of knowledge, and thus may have no known immediate application, it normally requires underwriting by foundations or universities or government. Applied research is problem oriented where the results are predictable and relate only to solve a specific problem (Clover and Balsley, 1974).

Basic research for universities is the type of research directed towards increasing knowledge in science (Sanow, 1959). Applied research is directed to the discovery of new scientific knowledge that has specific commercial objectives to solve production problems and invent new processes or products (Masfield, 1968). Consequently, “basic research is fundamental; applied research is consequential” (Holland, 1973).

Since their beginnings, universities have been dedicated to developing basic research, “and will continue to do so because it is one of the pillars of knowledge their existence is based upon” (Holland, 1973). However, industries have developed applied research for commercial reasons and in order to “move faster to face competitor’s innovation” (Cohen and Levinthal, 1989), by trying to find new products and processes or improve existing ones (Wehmeier, 2000). Hence, if there were no long-term basic research, applied research would be very limited and product development would suffer (Zieminski and Warda, 1999).

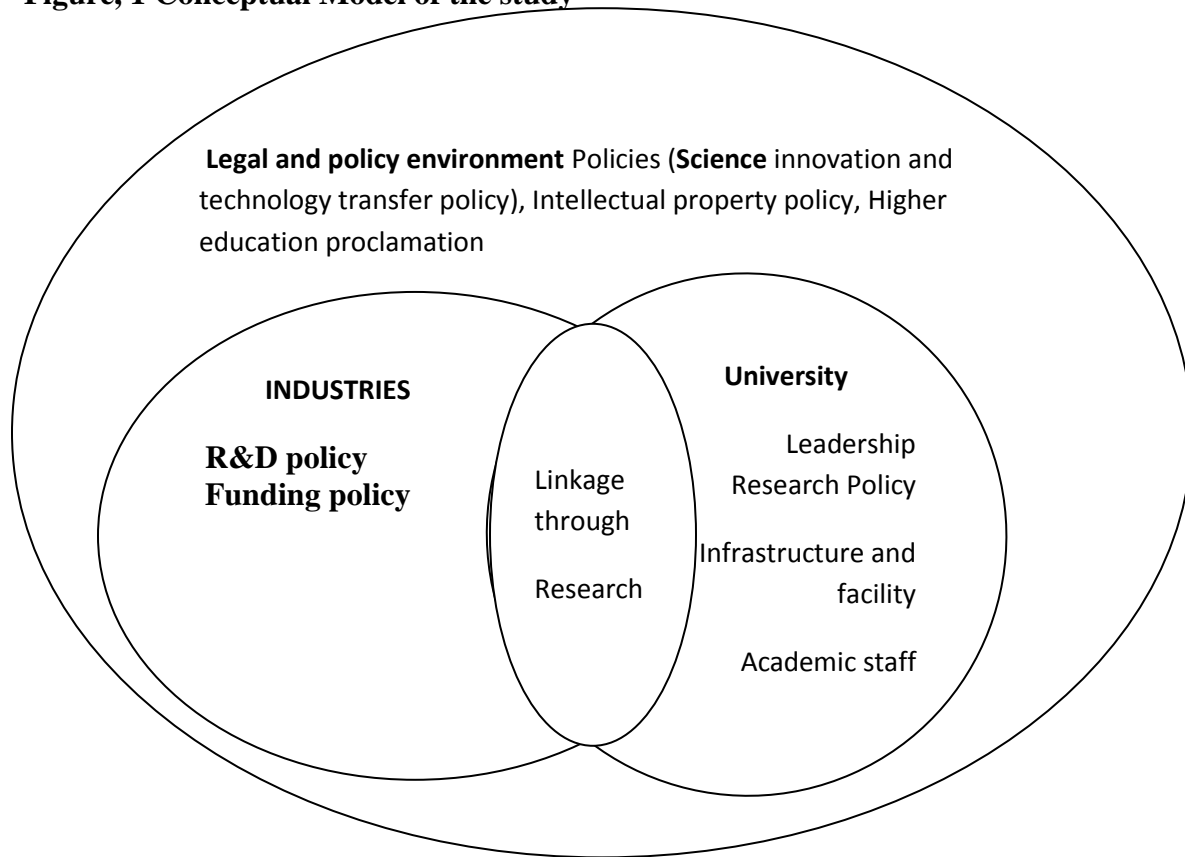
More over Ziminski added in most industrialized countries there is a wide spectrum of R&D activities, which spans the field from basic research to development of problem-solving processes. The research end is characterized by long-term exploration of scientific possibilities with high risk in the market place, while the development end tends to be driven by low risk, short-term satisfaction of urgent needs. In between those two extremes, there are other R&D priorities that ensure the continuity required for an effective industrial R&D system in a highly competitive market.

Due to historical, political and/or organizational reasons, middle-level research is performed by various actors in different countries. Where universities work under liberal regulations, as in the United States, academic research can be extended to cover middle-level research on an industry-

sponsored basis. Some national governments were provident and created early middle-level research institutes to serve their Industries, as in Canada and Mexico. In the latter country the research institutes are concentrated in the National University of Mexico (UNAM), which concentrates the largest proportion of research in Mexico, and is largely supported by the National Council of Science and Technology (Wehmeier, 2000)

2.4 Conceptual Model of the study

Figure, 1 Conceptual Model of the study



Source, Own construction

Policy issues (Environment)

Innovation policy generally and HEI-industry links policy in particular has increasingly been informed by two important theoretical developments in the literature. The first, broadly termed endogenous growth theory (Schumpeter et al, 2006) argues that innovation and knowledge transfer from within the economic system is a key driver of economic growth. The number of knowledge workers and how much innovation is generated (measured through patenting and innovation

based start up activity) is a determining factor in generating productivity growth amongst small firms, albeit in a random and unpredictable way (Mac, A and Holt, R. 2007).

The second, broadly termed the "Triple Helix" approach (Leydes, 2005a 2005b) sees knowledge transfer as a function of the complex set of formal and informal linkages between research institutions, finance and commercial businesses and the government (Berg-Jensen, B et al 2007). The interaction between the three strands of the "helix" creates the unique and distinctive characteristics of an innovation system -the" symbiotic tension" that reflects the simultaneous interdependency and competition between actors (Harding, 2000, 2001) –at either a national or regional level.

Regional policy

Within the triple helix literature there is a distinct group of authors who regard national competitive innovation advantage as generated at the regional rather than at the national level (Cooke, Saxenian et al 2006). This is because the region is a focus for sectoral specialization and, hence, related know-how accumulation. This in turn allows symbiotic learning relationships between institutions to develop (Harding 2000, 2001) making regions important as drivers of innovation and competitiveness (Azagra-Caro, 2006; Hussler and Rondé, 2007, Heidenreich, 2006), Fritsch and Slavtchev, 2007). Learning and adapting to changing market and technological conditions is more likely to be effective and sustainable at a regional level since tacit knowledge transfers more easily between actors in close spatial proximity with clear links to the cumulative skills and attributes of the regional labor market (Todtling and Kaufmann, Braczyk et al 2001). As expertise starts to build, specialist financiers, accountants and lawyers are established to support the base in knowledge production and, accordingly, any start-up businesses are provided with appropriate and readily accessible advice and consultancy. The evolution of this type of regional "industrial system" is argued to go some way to explaining the development of Silicon Valley and Route 128 in the US (Saxenian, 2006).

This is taken further by Porter who develops the concept of regional "clusters" or agglomerations around specific technologies or industrial sectors. The attractiveness of this, "cluster" approach (Porter 1998, 2002) to policy makers is clear, especially in the area of innovation policy.

Innovators are dependent on scientific, innovation, commercial and financial networks both for ideas and for markets.

For example, universities or the research function of large corporations are known to act as pulls for entrepreneurial activity (Czarnitzki & Kraft,2001) insofar as entrepreneurs will tend to locate close to research and commercial hubs. If this set of inter-relationships can be systematized, then regionally generated knowledge will add value through the cumulative learning process to create the specialization that is so important to international competitive advantage, particularly in research-led sectors such as information and communications technology or biotechnology (Cooke 2001, 2002). The assumption tends to be that the institutional base (venture capital and business angel networks, universities and inward investment, for example) will generate entrepreneurial activity and that knowledge will transfer between knowledge generators and knowledge users automatically.

It is this concept of clustering and regional development that has dominated policy in OECD Countries and particularly in Germany over the last ten years. Large as well as small firms compete as much on innovation as they do on productivity and clustering of expertise means that there are innovation synergies between actors in the form of intellectual, technological and social spill-overs (Dohse, 2007). Regions compete globally for the location of Direct Foreign Investment, innovation, skills and, specifically in the context of this chapter, enterprise (Gardiner, B. et al 2004, Kitson et al 2004, Maleki, 2004). The critical success factor for any region in generating this competitiveness is the extent to which it can create learning “networks” or “social capital” to ensure that knowledge transfers between actors in a way that creates competitive advantage in global markets (Saxenian, 1997; Cooke 2007). However, in the context of this chapter, neither innovation in itself nor university -industry links by themselves are sufficient to create market opportunities and therefore increased university spin out activity. For this, entrepreneurs are necessary as well (Harding 2007a, Levie et al,2007).

Intellectual property

The protection of intellectual assets is essential to the competitiveness of most organizations, private or public, and to their attractiveness to investors (URL <http://ec.europa.eu/invest-in->

research/policy/ipr_en.htm). Special emphasis needs to be placed on specific issues relevant for R&D collaboration and technology transfer between public research organizations and industry, since “university –industry relations” are an increasingly important way of enhancing the impact of scientific achievements on European competitiveness.

Moreover, Industry could take the view that they paid for the research and should own the intellectual property (the patent) especially since it may be vital to their business and competitive position. However, most universities insist on owning the patents arising from their research, since only through such ownership can it (i) assure that the technology will be developed; (ii) assure also that the university can retain the rights to practice under its own inventions to assure its freedom of action in the future and (iii) maintain a consistent policy for its investigators whether they are working on government-funded ventures to own patents on research which had been federally-sponsored. The legislation allowed universities to license their patents to industry, exclusively or non-exclusively. Royalties, received by the universities for such licensing, were to be used for further research and education as well as for rewarding the inventor(s) (L. Nelsen, 1998).

Much is made of the importance of robust intellectual property regimes to protect ownership and to generate returns proportionate to the risk taken. The Bayh-Dohl act in the US provided a clear delineation between university research and commercialization and incentivized not-for-profit and research organizations (in particular HEIs) to patent. This act has been mimicked around OECD countries to stimulate patenting from the University base including in Germany. The result is growing university/HEI patenting across Europe, for example (Geuna & Nesta , 2006).

However, ownership issues have become more complex as David and Hall (2006) point out. For example, where a clear delineation has existed in the past, the frequency of personnel exchange between public and private sector research domains, the increasing returns to individual public sector research from the commercialization of their innovations and the fact that technology moves quickly and therefore the patenting process slows the process of commercialization have meant that intellectual property arrangements are no longer easy to define. Allocation of risk and return has become blurred and complex rendering legislative frameworks at best slow and at

worst downright inhibitive of innovative effort. The implication for policy, therefore, is that systems must be flexible and lithe as well as robust.

Educational Cooperation

Industry and university can transfer knowledge by cooperating in education. Since education is one of the core businesses of the academe, it can also be used to educate employees of the industry. For the students from the three educational levels (bachelor, master and doctoral) it is crucial to obtain real word experience by taking part in internships or industrial placements.

R&D Cooperation

From the firms' point of view, the relative importance of R&D cooperation with universities is as an external source of information for new ideas and access to highly educated people and young talent. In the short term, universities are only occasionally successful and helping industry to solve its immediate problems. In the long term, the new ideas and understandings will result in the creation of new technologies as well as continuous improvements in the already existing technologies (G. Heaton et al,1997). The forms of interaction vary greatly: from ad hoc consultation to joint research activity. The most valuable R&D cooperation is joint projects.

Publications

Both, Universities and Companies use these channels (publications, informal contacts, conferences, recruitment of students, formal collaborative contracts, etc.) to exchange knowledge. Conferences and workshops give opportunities to academic researchers and companies to create networks of people within a certain field of science. Social networks that come from the education system, for example alumni societies have a strong influence on university – industry relationships. First contact between universities and industry often originates from personal networks.

On the on the other hand it is an absolute requirement for university professors and their students to publish their results since dissemination of knowledge is the essence of academic research. This is the chief way by which professors are judged by their peers, achieve advancement and obtain future grants and recognition. For students, publication is essential to obtaining post-doctoral positions and jobs. Since industrial partners fear that publication will endanger their

intellectual property arising from the collaboration, some compromise has to be worked out (Arnold L. Demain, 2001).

Funding

Technology-based firms from the university science base are potentially both more suited to venture capital investment and more likely to seek venture capital investment. They require significant amounts of capital but, because their business is based on an innovation rather than a proven business concept, investments in them are inherently more risky. In theory, at least, this ought to be the domain of risk-takers and, hence, also the domain of venture capitalists.

Yet an equity gap in the financing of university spin-outs is evident in many OECD countries. This is a clear challenge for policy. Linking venture capital with technology-based university spin-outs is, at best, complicated: Returns to technology investments are high but inherently risky: The Bank of England estimates average returns on technology investments to be around 23% (Bank of England, 2000). But one technology investor claimed return rates of 45% in the UK and rates in the US are certainly higher at 33.7% (www.nvca.com). This return rate is evidence of the high growth and wealth creation potential of technology-based firms as much as evidence of their suitability for venture capital funding. Yet venture capitalists themselves will not be able to take advantage of these potential returns unless they can be encouraged into riskier, technology-based investments.

The growth potential that these companies have is embedded in the value that they add to their initial concept. This value is as much a function of people and networks and therefore particularly high for university spin-outs yet time scales to realize returns are too long for orthodox VCs at the early stages. All technology-based companies start with a commercially unproven innovative idea at the seed stage –this is the risk. The growth process is the cumulative proof of the idea or concept's commercial viability.

The value at the end is the return. But, especially in science-based industries like biotechnology, this growth process requires substantial development funding. This funding can be necessary over a long period of time –as long as ten years. This is significantly longer than most venture capitalists will invest without a clearly defined exit route, thus there is a clear role for

government support at the seed stage and even at the start-up stage to leverage in informal and formal venture capital. The acquisition of substantial capital investments allows technology-based firms to attract key scientists and innovators into their business and this is easier in a university-led venture.

It is important that such companies can easily access the high-net -worth individuals that add value to an innovative concept. This is primarily a function of the supply of such people from universities, colleges and industry and, as Fritsch and Slavtchev (2007) argues, this is easier where universities work in close proximity to finance and commercial structures. The role for policy here is in creating an infrastructure that creates such high value „human capital“ in which venture capital can invest.

Finally, in order that the rate of return is fully realized and venture capitalists continue to invest in technology projects, there has to be a good supply of investment opportunities for venture capitalists. This deal flow stems from universities and colleges through academic entrepreneurs and from indigenous and overseas hi-tech companies with research capacity. Governments can do much to stimulate a culture of science and technology-based entrepreneurship through funding for basic science, significant funding for university-business partnerships, science parks, incubators and programs to stimulate high technology investments. Yet there is evidence that there is a weakness in the commercialization of science from the research base across Europe but in the UK in particular (Bank of England, 2001).

The other key issue in generating viable university spin-outs is that of intellectual property. Much is made of the importance of robust intellectual property regimes to protect ownership and to generate returns proportionate to the risk taken. The Bayh-Dohl act in the US provided a clear delineation between university research and commercialization and incentivized not-for-profit and research organizations (in particular HEIs) to patent. This act has been mimicked around.

2.5 Experience of other countries

Developed world experience

Over the past couple of decades, ‘globalization’ and the emergence of the ‘knowledge economy’ have given rise to new economic, social, political and cultural challenges to which nations, regions and higher education systems and institutions are responding. It is widely assumed that

in the context of these new challenges specific knowledge, competencies and skills – often referred to as ‘human capital’ – come to play an increasingly important role in developmental efforts, as do research, innovation and technological development (Castells,2002). Knowledge production, accumulation, transfer and application have become major factors in socio-economic development and are increasingly at the core of national development strategies for gaining competitive advantages in the global knowledge economy (Santiago *et al.* 2008,).

Higher education institutions are seen by many as playing a key role in delivering the knowledge requirements for development. Research has, for example, suggested a strong association between higher education participation rates and levels of development. While the higher education participation rates in many high-income countries are well over 50%, in sub-Saharan Africa they are in most cases below 5% (Bloom *et al.*, 2006). Furthermore, there is increasing evidence that high levels of education in general, and of higher education in particular, are essential for the design and productive use of new technologies, while they also provide the foundations for a nation’s innovative capacity, and contribute more than any other social institution to the development of civil society (Carnoy *et al.* 1993,Serageldin, 2000). This type of ‘evidence’ has led to a number of countries putting knowledge and innovation policies, as well as higher education, at the core of their development strategies.

The best known model in a developed country is that of Finland which, following the deep recession of the early 1990s, selected knowledge, information technology and education as the major cornerstones of the new (economic) development policy (Hölttä&Malkki, 2000). South Korea, Singapore, Denmark, Australia and New Zealand have also followed this route successfully. The Chinese and Indian economies have displayed unprecedented levels of sustained growth since the early 1990s. China embarked on a knowledge-based growth track by attracting massive foreign direct investment and then building indigenous knowledge capacity through huge investments in education and research. India has succeeded by making the best use of its elite education institutions and exploiting international information technology-related opportunities, in part through the deft use of knowledge assets Höltta & Malkki, 2000)

More over Hölttä discussed the Chinese and Indian economies, however, exhibit two important characteristics with respect to higher education that set them apart from both the ‘East Asian tigers’ of the 1980s and from some other contemporary developing countries. First, investment in higher education is seen as a parallel process (and not a consecutive one) to providing broader access to and improving the quality of primary and secondary schooling. The second, related, point illustrated in the development pattern of the Chinese and Indian economies is that the traditional growth path of domination first of primary sector activities (agriculture and mining) followed by manufacturing and then by services, does not necessarily hold.

The speed and extent, to which developing countries are able to absorb, utilize and modify technology developed mainly in high-income countries, will determine whether they will be able to realize a more rapid transition to higher levels of development and standards of living. In this way, some developing countries and emerging economies have ‘leap-frogged’ stages of development by investing in higher education.

The African Context

Many countries in Africa lack an enabling environment for reorienting and aligning universities and other higher education institutions (HEIs) towards a more entrepreneurial role. Apart from perhaps the Maghreb region and South Africa, most of sub-Saharan Africa lacks high-tech industries and a true technology culture (Barryand,2008). Many of Africa’s industries are often small to medium-scale firms producing for local markets, while the relatively larger ones are subsidiaries of transnational companies which draw upon the in-house R&D capabilities of the parent company (Munyoki et al, 2011).

Others note the lack of awareness of the existing research results and new technologies by industry; the absence of strong involvement of the users in defining the research agenda; and the irrelevance of some university research (Dhesi & Chadha, 1995). Arguably, many African universities are not in a strong position to conduct research and technology development. Long years of neglect in financing higher education in Africa and university research have left many universities with weak research infrastructure (Atuahene, 2011).

Under the present massification of higher education in Africa, research activities among academic staff frequently take a back seat to fulfilling the ever growing teaching demands (Mohamedbhai, 2008). Despite growing student numbers, enrolment in sciences and engineering in many countries is low with less than 10% of students enrolled in these disciplines in some universities (Goransson and Brundenius, 2011).

Meanwhile, the brain drain to developed world compounded by low salaries and Moon lighting activities of some academic staff, have left many universities with few qualified researchers to conduct local research (Barry and Sawyerr, 2008). Many African countries produce negligible research output (Moutonet al, 2008). He also argued that low investment in science and technology and lack of national strategies in these areas further compound the difficulties He further discussed that many African countries do not invest significantly in Research and Development (R&D) with GERD falling well below the standard 1% of GDP set for developing countries.

Similarly, many African countries lack relevant Science & Technology strategies, up-to-date policies on intellectual property rights (IPR) protection, and other such policies needed for direction and governance (Mouton et al, 2008).

Transferring the results of university research to industry may take several forms and thus can be achieved in different ways. i.e. patenting, licensing, spin-off firms, etc. although the transformation of academic research results into industry is widely accepted as a crucial factor for the industrial growth and competitiveness, this is not an effortless or simple linear process that flows directly from academy to industry.

2.6 The Ethiopian context

The main development objective of The Government of Federal Democratic Republic of Ethiopia (FDRE) is poverty eradication. Because of this the Government had have design and implement Sustainable Development and Poverty Reduction Program (SDPRP) which covered the years 2002/03-2004/05) and a Plan For Accelerated and Sustained Development to End Poverty (PASDEP) that ran from 2005/06 to 2009/10 the Growth and Transformation Plan

(GTP) has been prepared with clear objective and targets to meet the general objective of the country the industry and university linkage in terms of research play a dominant role because it enable the country to achieve rapid economic growth, targeted for 11% per year at worst and, at best, to double the size of the economy by 2015, with (GDP) per capita expected to reach \$698 by 2015 agricultural production is to double, to ensure food security in Ethiopia for the first time(MOFED, 2010). Here one can understand that the policy guide line shows its clear objective about industry-university linkage and the importance of industry-university linkage in the country to cope up poverty and to bring rapid economic growth of the nation.

An increased contribution from the industrial sector, particularly focused on increased production in sugar, textiles, leather products and cement and achievement of all Millennium Development Goals (MDGs) to achieve this national goal creating university industry linkage is play a dominant role. In this regard, there is an increased demand for the higher education institutions to be responsive to national development.

The Government of Ethiopia has radically expanded higher education universities, from two federal universities to 31 in just over a decade. According to UNESCO (2011), the percentage of the available cohort that attends higher education is still low at about 3%, compared with a Sub-Saharan average of 6% in 2011/12. This increasing number of universities however needs to go along with and meet the existing as well as the future economic development of the country.

2.7 Summary of the review literature and conceptual model of the study

University-industry links have become a common and widely accepted phenomenon of the 21st. There is a flourishing of literature and policy programs all around the world. There are several reports of (OECD, 1998-2000), EU framework Programs, World Bank 2007, UNESCO 2011. By the same token, various scholars have worked on this subject matter based on different concepts and assumptions. Namely, Mulu Nega, 2009; David, etal, 2006 have mainly based their theories on the concept of scientific networks. Although all these reports and theoretical discussions aim to understand these diverse relations and mutual benefits of university-industry relations; they still underline how difficult it is to obtain information to uncover these relations, and thus illustrate the role of these settings in the achievement of an interaction between university-

industry. Thus this thesis aims to document the university-industry relations further. Addis Ababa University which typically exhibit not only successful academic records but also surrounded by a dynamic industrial environment and firms are chosen to analyze the university industry relations.

Moreover Ethiopia university-industry link play a crucial role for its gross domestic product (GDP) as well as for the success full accomplishment of Growth Transformation Plan (GTP). To discuss about the conceptual model the government as a policy maker may try to make science and innovation policy, Intellectual Property Right policy and other working guidelines to create conducive environment for the university and industry, because university industry linkage will help a nation to have technological innovation. Industries also may give priority for their research and development and funding policies it may give opportunity to develop their production and increase their competitiveness to the market, finally university Leadership shall be committed and motivated, Research Policy and IPR shall be functional and implemented, Infrastructure and facility should be updated and well structured, Academic staff shall conduct valuable research which can be bought by the industry, and Funding must be available because all are enablers for strong university.

CHAPTER THREE

3. DESIGN AND METHODOLOGY OF THE STUDY

Methods and Design of the Study

This chapter presents a systematic account of the research methods employed to generate the answers to the research questions posed earlier and the paradigms and arguments underlying the choice of the research strategy. The chapter therefore explains the type of research design, the data collection methods. It also discusses issues such as study area, study design, study subject, type of analysis and issues relating to the validity and reliability of the research and its findings.

3.1 Study design

The study employs a mixed method in the study to assess the university and industry linkage in the case of Addis Ababa University College of Natural Science and Institute of Technology.

An appropriate research design is important to any research, as it guides the process for collecting the desired data and the process for analyzing that data. Mixed research method: both quantitative and qualitative approach was employed for this study. A mixed research method is a philosophical assumption that guides the direction of the collection and analysis of data and the mixture of qualitative and quantitative data in research process. Its central premise is that the use of quantitative and qualitative approach in combination provides a better understanding of research problem than other approach that stand alone. Mixed research method is important to offset the weakness of both qualitative and quantitative research methods (Creswell, 2007).

The justification for the quantitative approach is to quantify the data on the issue under study and to provide statistical information about problem (Creswell, 2009). The quantitative research design is cross-sectional design, because the data that gathered through questionnaire were collected once and it is significant to study.

The reason to use qualitative approach is that it is effective in obtaining information about the values, attitudes, behaviors, and social contexts of particular populations (Creswell, 2009). In

addition, this approach is the best way to access the participants' ideas, memories and attitude in their own words rather than the words of the researcher (Cohen, 1994).

3.2. Study Area

Study area of this research was Addis Ababa University College of Natural Science and institute of technology which are located at Arada Sub-city North of Children and Youth, South of Tourist Hotel, East of Finance and Economic Development Ministry and West of Ethiopian Patriots Square. The rationale behind selecting the study area was that its accessibility and the university is the pioneer institute in the country teaching learning process since Addis Ababa University which is found in 1950 as a first higher education institution in the country by accepting 71 undergraduate students now a day's 51,000 students are enrolled in the university. The university has 70 under graduate programs and 225 postgraduate programs it indicates the university is a pioneer university to take apart on teaching, community service and research.

The rationale of the selection of Metals and Engineering Corporation (METEC) was one of the national interest to achieve the country industrialized journey since the establishment of the corporation as a public enterprise by the Council Of Ministers regulation number 183/2002, one of the institutions established by the Federal Democratic Republic of Ethiopia (FDRE) to enable the realization of the government's Growth and Transformation Plan (GTP) and to accelerate the ongoing transition of Ethiopia into industrialization and becoming a middle-income countries. Currently, METEC is comprised of 15 semi-autonomous, and integrated manufacturing companies that are operating in more than nine different sectors. In addition to supporting key stakeholders in the public sector, the METEC companies were established for developing their respective private sector value chains and accelerating the technological capacity of the country. Most of the METEC companies are situated in the Addis Ababa – Adama corridor where higher education institutions, R&D, manufacturing and the supplier ecosystem are forming industry pre-clusters and clusters that are conducive for innovation which is important for the desired linkage.

3.3 Study Participants

College associate deans for research and industry transfer and industry linkage, of the college of Natural Science and Institute of Technology, university industry linkage unit director, research, and development vice head of the corporation, Ministry of Science and technology officer were subject of the study. Moreover, key informants such as instructors, department heads, were subject of the study.

3.4 Sampling and Sampling Techniques

The researcher used stratified and purposive sampling techniques to select participants of the study. The reason to use stratified sampling technique is in order to ensure the representation of respondents from selected department. Moreover, departments are not homogeneous which require to be stratified. In order to do so, the researcher tried to include sample respondents from each department through lottery method after stratifying them in department.

Purposive sampling was used to select respondent and interviewee. The researcher clearly expressed the objective of the study and all of the participants were informed for their consents that were volunteered to participate in the study

3.4.1 Sample Size

From the selected 4 schools in Institute of Technology, Biotechnology Engineering, Electrical and computer science Engineering, Mechanical Engineering, Chemical Engineering and Food processing, Environmental, Applied chemistry, Physics, Biology departments were from natural science department as well, research and development department Vice head of METEC, university industry linkage unit director, associate deans of college of Natural Science and Institute of Technology for research.

10% of the total population was sample size for this study. According to the registrar data Addis Ababa University collage of natural science has 324 where as institute of technology has 335 academic staff so the total population is 659. The rationale behind taking this 10% of the total population is based on the rule of thumb. According to Blanch et al (2006), 10% of total population is recommendable for moderately large population, 1% for large population and 0.025% for a very large population.

3.6 Data Collection Instruments

Since, the study focuses on university - industry linkage in the case of Addis Ababa University; it pays attention on exploring what is going on in the university in creating linkage and what elements hinder or facilitate it. Thus, both the quantitative and qualitative methods of data collection instruments believed to give rich information about the case under study.

For this paper, three data gathering instruments were used these were questionnaire, interview and document reading were employed in order to gather the necessary information.

Questionnaire

A mix of close ended and open-ended multi option questionnaire was used in the study for the quantitative data. Questionnaires are preferred for studies which measure attitude/perception, behavior, lifestyle pattern and demography (Linda, 2005). Detailed open-ended and close-ended questionnaires related to the background of respondent in line with the objective of the study were developed and distribute to the sample respondents to generate a primary data. The researcher distributed the questionnaire to the 80 respondents and 68 of the respondents filled the questionnaire and returned.

Interview

It is a face-to-face communication between interviewee and interviewer on certain area of inquiry, and thereby allows the interviewee to speak up freely and more data that are empirical might be directly obtained. Thus, using interview was important in order to support or strengthen the data gathered from the questionnaires. This data collection tool was also employing to gather detail information about the issue at hand from interviewee.

A structured open ended (semi-structured) one to one interview was used as the data gathering instrument for the qualitative data to get information about, funding scheme, policy and guide line, leadership, academic staff, technology infrastructure and facilities, internal governance.

The number of individuals who participated in the study were, 2 associate deans for research and university and Industry linkage, 1 METEC research and Development Vice director, 1,

university industry link and technology transfer unit director, 1 Ministry of science and technology expert, were selected purposively for the interview.

Document Analysis

The documents including Growth and Transformation Plan (GTP), National Science and technology transfer policy, National property right policy, university research policy, higher education proclamation and some portfolios were used as the source of data to see the university industry linkage. Relevant documentation about university industry linkage policies and activities at each of the case sites was obtained from the MoST; and the documents were used to clarify information gained from interviews and questionnaires and to corroborate researcher's understanding of policies and procedures with regard to university industry linkage.

3.7 Data Quality Assurance

The questionnaires and interview items were prepared by the researcher through scrupulous reading of literature reviews. The researcher was carefully organized and critically read the items. Given that, to see the items validity and reliability, the researcher primarily conducted pilot test. Moreover, in order to see the representativeness of sample respondents, the researcher has taken 10% of the population following the rule of thumb. Further, the researcher was careful to the intention of the items so that they can measure what is intended to measure. The informants and respondents of the research were requested their informed consent and provided detail explanation about the overall objective of the study in advance. Furthermore, in order to minimize external factors such as matter of confidentiality; they were also informed that the information they gave would be kept secret and will not be transferred to a third party or will not be used for any other purpose apart from this study. The researcher also used maximum effort to open up informants and respondents.

3.8 Plan of Data Analysis

This part of the paper deals with presentation; analysis and interpretation of data collected through questionnaire, interview, and document analysis. Both qualitative and quantitative analyses were presented in descriptive manner according to the items in the questionnaires and interview and document analysis guiding. The researcher used quantitative data analysis method

using percentage and qualitative methods of data analysis such as, document analysis, and analysis of interview to elicit detailed descriptive information on the university industry linkage in the study sites.

Relevant documentation about university industry linkage policies and activities at each of the case sites was obtained from the MoST, MOE, AAU; and the documents were used to clarify information gained from interviews and questionnaires and to corroborate researcher's understanding of policies and procedures with regard to the university industry linkage. Thematic analysis was used for the qualitative data. This involves creating categories or themes to group the different variables.

CHAPTER FOUR

FINDINGS

This chapter mainly discusses the status of the linkages between university and industry in Addis Ababa University, Collage of Natural Science and Institute of Technology and it discussed the enablers and barriers to create the link. Thus, it discuss research budget, technology and infrastructure facility, internal governance, university strategic plan in creating the link, industries participation in research and development issues, as well as, university leadership.

As I indicate in the conceptual model research and funding policy, technology and infrastructure facility, internal governance, university strategic plan in creating the link, industries participation and leadership are enablers and challenges to establish university industry linkage.

4.1 Characteristics of Participants

The questionnaire was distributed to a total of 80 respondents and 68 of the respondents completed and returned the questionnaires, which represent an 85% response rate. These respondents who returned the questionnaires response were department heads and school directors 8 (12%) senior instructors 26 (38%) and instructors 34 (50%). Educational background of the respondents is MA /Msc 36 (53%), Phd 32 (47 %). Respondents were from College of Natural Science and Institute of Technology. The researcher distributed 40 for each and college of Natural Science has returned 52% (35) while Institute of Technology has returned 48% (33).

With regard to gender, majority of respondents (82%) were male. Similarly, majority of the respondents (70%) were with 10 years and below teaching and research experience.

The result of the data analysis on the status and contributing factors of university-industry linkage are presented in the section that follows.

4.2 Status of the linkages between university and industry in Addis Ababa University

Table 1 status of university industry linkage

Do you think that there is a link b/n industry and university?	Respondents	Percentage
No	42	68%
yes	26	32%

Finding of quantitative data indicated that, majority of the respondents (68%) perceive that, there is no institutionalized university industry linkage in terms of research. The respondents do perceived lack of university industry linkage in the College of Natural Science and Institute of Technology in terms of research. Few (32%) of the participant expressed that, the university especially the departments create university industry linkage in terms of Fellowship, consultancy, and capacity building but it is minimal.

An interview from the unit director in the university strengthen the above data

As we know very well, the university forms new structure two years ago, in between this two years we pay effort to asses and to evaluate the current status of the university industry linkage. The second is how to improve the university linkage and how to approach with the productive sector specially the privates we are tiring to find new linkage corridor. After this the university has to conduct a workshop to make an agreement with the productive sector but the participants were few in number. He also added that even though there is a link between government firms and ministry offices in terms of consultancy service, curriculum development and capacity building there is no fruit ful research and development linkage with the industry (UIL, 2014).

The METEC research and development vice head corroborate the above idea as follows:

Even if we signed memorandum of understanding with Addis Ababa University, Jimma , Mekle and Bahirdar Universities in terms of collaborative Research, internship and consultancy service we have no strong linkage in terms of research

with Addis Ababa University, rather we have strong linkage with college of Major General Mulugeta Buli and Mekele University in terms of research and technology transfer. As far as I know the Addis Ababa University take a consultancy part in our Great Renaissance Dam and fertilizer factory projects (MET, 2014).

The data from existing documents also strengthen the above data and interview result:

Thus, according to the University- Industry linkage unit report, 3696 students get internship opportunity and 56 instructors took part on job training. For the 2006 fiscal year in connection with collaborative project with the industry, Institute of Technology has a collaborative agreement with Valsecs Nutritional Foods P.L.C, in connection with quality control test, College of Natural Science has a link with Ethiopian Health Nutrition Research Institute and the university signed memorandum of understanding with METEC to give consultancy service. The Addis Ababa University Institute of Technology has a joint project with Urban and Construction Ministry and Ethiopian Rail Way Corporation to design postgraduate curriculum and implement the program.

From the data, interview and the existing document we can analyze that, Addis Ababa University tries to form linkage with the public institutions through consultancy service, capacity building and student internship programs, but it seems that there is no strong university industry linkage in terms of research with private industries

4.3 Factors that enable and hinder university industry linkage

4.3.1 Legal and policy frame works

4.3.1.1 National Science and technology transfer policy

Science and Technology Ministry, (MoST) is a governmental institution that established for the first time in December, 1975 by proclamation No.62/1975 as a commission. Following the change in government in 1991 and with the issuance of the new economic policy, the commission was re-established in March 1994 by Proclamation No.91/94. The commission went into its 3rd phase of re-institution on the 24th of August 1995 by Proclamation No.7/1995, following the establishment of (F D R E) as an agency.

The first Ethiopian National Science, Technology and Innovation policy has been endorsed by the parliament in 1993. To ratify the science and technology role for the country development, the main objective of this policy are import, develop, disseminate technology and create well technology literate society (ESTA, 2006). The very weak side of this policy is it does not give detail emphasis to innovation, capacity building and university industry linkage; rather it deals with awareness creation and technology adaptation.

Later on, in 2008 the government upgraded the agency as one of the cabinet ministries, accountable to the prime minister and the council of ministers by the proclamation No. 604/2008 and reestablished recently too in October 2010. To create a technology transfer framework that enables the building of national capacities in technological learning, adaptation and utilization through searching, selecting and importing effective foreign technologies in manufacturing and service providing enterprises as objective. On the basis of this objective the Federal Democratic Republic of Ethiopia, has prepared a Science Technology and Innovation policy focusing on building the technology capacity of medium and higher manufacturing and service enterprise and has embarked on activities. Among the 11 highly important issues included in the Science Technology and Innovation policy is the linkage of universities, technical and vocational training institutions and, research institutions and the industry.

According to the Federal Democratic Republic of Ethiopia National Science, Technology and Innovation Policy, there is lack of systematic transfer of foreign technologies based on the demands of the various social and economic sectors and there is also weak technological capability for the effective absorption of foreign technology. To this end, the country shall devote resources to assimilation, adaptation and improvement of foreign technologies with prior attention given to development of domestic technological capabilities. In order to do so, the policy comes up with the following strategies:

- 1, Expand the flow of technology through foreign direct investment,
2. Promote the development of domestic technological capabilities for the effective absorption of foreign technologies,
3. Accelerate inter-firm dissemination of technological information and know-how,

4. Set national priority programs for the transfer of major technologies,
5. Use intellectual property and standards information as sources of foreign technology,
6. Access technological information in whatever way,
7. Train critical personnel in selected areas.

The Interview result from Ministry of science and technology expert about the policy also stated as follows:

The new science, technology and innovation policy contribute to the country's overall development .This policy is very important in such a way that it better paves the way to integrate science, technology and innovation with the national development agendas. In order to realize the visions of the country and enable the industry lead the economy building a better technological capability is vital. Technological capacity in terms of searching technologies, the kind of technologies that we need is important. Then comes the issue of selection, importing and effectively adopting and adapting those technologies. This enables the manufacturing and service sector products to be better qualified (Most, 2014).

In this regard, the policy put general direction to have university industry linkage in federal level but, from the interview result and the policy strategies. The researcher understand that, the policy mainly focus on technology adaptation than technology innovation which is important to create university- industry linkage, not only this but also, the mechanism which is important for industry linkage is not well identified in the policy. Moreover, in the policy the technology transfer is expected from foreign direct investment than to have effective and strong university industry linkage in the country level, so the implementation of the policy seems it is not remarkable.

4.3.1.2 Higher education proclamation

The Ethiopian Higher Education Proclamation number 650/2009 has been proclaimed to achieve the following objectives of higher education, to prepare knowledgeable, skilled and attitudinally mature graduates in numbers with demand-based proportional balance of fields and disciplines. So that, the country shall become internationally competitive; promote and enhance research

focusing on knowledge and technology transfer consistent with the country's priority needs; ensure that, education and research promote freedom of expression based on reason and rational discourse and are free from biases and prejudices; are the main objectives among others.

Moreover, higher education proclamation indicates the research and research direction. Due to this, the university has focus on promoting the relevance and quality of education and on the country's development issues focusing on transfer of technology. By taking this into account, the priority needs of the country to solve its challenges and build its capacity through technology transfer and have an institutionalized system that enables it to carry out planned research and conduct joint research projects with other national and international institutions, research centers, and industries.

Even if, the proclamation said like this, how to create university and industry linkage in terms of research and how it is implemented is not yet expressed, not only this but also there is no law enforcement mechanism. Even though, the proclamation order every higher institution shall have an institutionalized system that enables it to carry out planned research and conduct joint research projects with other national and international institutions, research centre and industries. But it is not well expressive how to form university industry linkage internal governance and the proclamation not in force higher institutions to create U-I linkage by using institutional modality.

4.3.1.3 Intellectual Property Right policy

Intellectual property, very broadly, means the legal property which results from intellectual activity in the industrial, scientific and artistic fields. Countries have laws to protect intellectual property for two main reasons. One is to give statutory expression to the moral and economic rights of creators in their creations and such rights of the public in access to those creations. The second is to promote, as a deliberate act of government policy, creativity and the dissemination and application of its results and to encourage fair trading which would contribute to economic and social development. Patents play a key role in the flow of knowledge between the main actors in the national innovation system such as University, industry and research centers. Universities and research organizations are generators of knowledge while enterprises are mainly knowledge users.

The Ethiopian constitution of 1994, everyone has the right to own property. Property includes both tangible and intangible property owned by individuals, organizations and communities (Article 44).The Federal government shall patent inventions and protect Copyrights {Article 51(19)}.

To implement Constitutional direction, the Ethiopian government establishes the intellectual property right case team under Science and Technology Agency and the first patent right proclamation became enactment in the year of 1995, to create a favorable environment in order to promote local inventive and related activities, as well as, to encourage the transfer and adoption of foreign technology. By giving protection to local inventions it encourages further creativity and the development of indigenous technological capability. Through the protection it gives to foreign technology owners, it facilitates the transfer of foreign technology and it is up grade as an office which is responsible for ministry of Science and Technology Ministry in 2003 and finally, the first intellectual property right policy launched in 2003 proc no, 378/2003.

To give legal protection for intellectual property, collection, organization and dissemination technological information contained in patent documents, study analyze and recommend policies and legislation on intellectual property to the government, promote knowledge and understanding of intellectual property among the general public, are the objectives of this office and the policy as well. The second IP strategic plan which has been operational since 2006 is also producing some results in such areas as the use of IP to enhance export revenue and (eg. Coffee trade marking) promotion of IP information services. (A national IP center created with the assistance of WIPO and the World Bank).

Even if the intellectual proclamation is there, there are lots of limitations on creating university industry linkage. For instance, the following issues are not well articulated: when does the researcher own IP, what is considered to be within the scope of employment of the researcher as far as IP is concerned? How is the benefit from commercialization of research results protected by patents distributed among the different parties? Who is owner of IP generated during contract research? What are rights of visiting researchers over their findings?

To create university- industry relationship by using patent right, the policy encourage and the office developed guidelines for the formulation of institutional IP policies, conducted various IP awareness creation programs so far none of the universities have IP policies.

There is lack of clearly defined benefit sharing mechanisms for commercially applied intellectual creations, such as research out puts of students academics who use the time and resources of the institutes, absence of disclosure form or similar standard form for disclosure of new intellectual creations, and a general consensus on the need to the formulation and implementation of institutional IPR policies are not well articulated in the policy.

4.3.2 University research policy encourage university industry linkage

Table 2, the extent of University research policy and Intellectual property Right Encourage university industry linkage

To what Extent the university internal policies encourage university industry linkage?	Number of respondents	Percent of respondents
High	8	12%
Medium,	11	16%
Low	32	47%
Very low	17	25%

Source, field work

Looking at the results by number of respondents, 72% of respondents perceive that the university research policy encourage the university industry linkage in low level the reset of the respondent 16% (n=11) and 12% (n=8) respond the research policy of the university is high and medium respectively. The result of the respondent show that the university research policy by creating university industry linkage is well expressed but the implementation is at a lower level.

The April 2010, Addis Ababa university research policy, deals with key issues in the generation and dissemination of knowledge and conducting academic, basic and thematic research and scholarly inquiry as well. In the university policy faculty members are guaranteed academic freedom with the acceptance of corresponding responsibilities.

The senate of AAU is responsible to respect and ensure the main principles regarding faculty academic freedom in research and technology transfer. The AAU fosters an environment

conducive to research undertaking and generation of new technologies. In situations where the university system becomes unable to support a given research because of constraints of resources, it shall allocate space, facilities, funds and other available resources for research programmes based on the scholarly and educational merits of the proposed research, and not on speculations concerning the political or moral impropriety of the uses which might be made of its results.

The Interview result from university industry linkage and technology transfer unit also shows that:

The university research policy identifies nearly 21 main research areas and it gives detail emphasis on its article to create conducive Environment for Academic research and technology transfer. Not only this but also the policy granted the academic staff their academic freedom to choose the subject matter of their research. The problem is not the policy to create university industry linkage in Addis Ababa University the implementation is main challenge and also the academic staff is run into teaching and learning process (UIL,2014).

An interview from associate deans for university industry linkage and technology transfer developed the data:

The university research policy is as a document available in the university but the enactment and implementation is not well remarkable. Because the attention of the university and the leadership is not in research. They are interested in teaching learning activities and other routine activities. Not only the research policy but also the non existence and low level of awareness of internal intellectual property right policy on the university academic track record is the other factor for the low level status of industry university linkage (DUIL, 2014).

The literatures indicate that, this kind of policies may address, benefit from income-supplementing work, and that ethical and environmental considerations are taken into account. These considerations are important given the prominence of current practices in which many professors undertake individual consultancy work that utilizes university resources, but it is

undertaken for personal benefit (Hernes, 2001). He added, such policies would also help universities address ethical issues and potential domination of the research agenda that may arise from working with industry.

From the interview, the data and the policy document, the researcher can understand that, the university research policy is well expressed and identifies the research area. But its power of enforcement and implementation level is seems it is minimal to engage with academic research and technology transfer, the National Science and Technology Innovation policy to create university industry linkage also don not have implementation ground in the university. Moreover, the university research policy does not indicate how to create institutional modality which is enabling the university to link with the industry.

The policy is too theoretical and does not give practical facilitation. The administration and the responsible body all are not willing to engage with industry. The respondent added, there is no practical attachment and mechanism to create the linkage so the policy should not encourage both side and no power of enforcement to create the link. The Intellectual Property Right policy, the most important institutional policy which is pay dominant role for university industry linkage and a trigger factor to motivate the academic staff in conducting research and technology transfer is not exist in the university.

In general the under staff of University Intellectual Property Right Policy, as well as the low level implementation of the existing research policy specially in collaborative research and academic research with the industry are bottle neck for U-I linkage in the university.

4.3.3 Research Budget

Table 3, University budget allocation for research

How do you rate the allocation of university funding and resource for research with the comparison of the university annual budget?	Number of respondents	Percent of respondents
very low		
low	55	81%
Medium	13	19%
High	-	-

Source, field work

The respondents 81% (n=55) respond that, the university research budget is low and 19% (n=13) said that the university research budget is medium. From an open ended questioner the respondent express that, the university research fund is not enough to conduct long term experiments, not only the amount but also the utilization is difficult.

Research fund for College of Natural Science and Institute of Technology, should be very high because of its nature of laboratories and demand of facilities. But the university allocating small amount of research fund for basic research and also to support Phd research. For example a Phd candidate granted 30,000 birr for research is too small even to make any preparation. Due to, limited financing of research most of the professors and post graduate students always limited their research scope, so the university research budget is low.

The following interview result from associate dean for technology transfer and university linkage of Natural Science also developed the data:

In general the research budget allocated for Research by the Government is low and proportionally that allocated in the university is also low .But there is an increasing trend in recent years (UDIL, 2014).

The other interview results from university industry linkage unit director also strengthen the above data shows that:

To develop university industry linkage, research funding is crucial so this spice is come from industry and government. Universities role in this regard is teaching learning, community service, and research and development to achieve this and to form strong linkage fund is important. But the industry specially the private once do not allocate fund for research and development not only the industries the government also do not allocate fund for research and technology transfer from its GDP. Because the government intention also focus on capacity building than build and support research works (UIL,2014).

The other interview result from METEC also corroborate with the above interview:

Even if minimum budget allocate by the government for research but the corporation allocate proper research fund from its annual budget for applied research than basic research based on the projects vulnerable rate which has vulnerable rate from 0.5 to 5% the corporation give priority. The rationale behind the corporation allocate budget for research is that mega project are working by the corporation but in general the research and technology transfer fund is in adequate (MET, 2014).

Financing research in the national science technology and innovation policy, also discuss as follows:

According to Federal Democratic Republic of Ethiopia National Science, Technology and Innovation Policy, the current total research expenditure in Ethiopia is one of the lowest in the world. According to this policy the existing financial system of the country is not also designed to address the needs of innovative activities in the enterprises sector. To create appropriate financing and incentive mechanisms that promote scientific, technological and innovative activities the following strategies have been designed.

1. Create national technology and innovation funds.
2. Introduce fiscal incentives such as tax exemption and duty free privileges for scientific, technological and innovative activities of Ethiopian SMEs.
3. Create a system of special privileges and awards for outstanding innovations/achievements
4. Develop and implement pro-innovative government procurement policy.
5. Increase budget allocation for adaptive & applied research at tertiary education institutions and TVET centers.

The following interview from MoST expert also corroborate the above data by explaining the policy direction in terms of research financing:

The policy encourages local innovation. The policy document clearly stated this. But when we look at the reality at a country level, we do not

have the capacity to generate new technologies. We might have a few individuals who might come up with new technologies. However, this won't enable us to say we are in a position to focus on creating new technologies. Our research institutions and technology schools have not been focusing on innovation. You do not see many creative works and inventions from universities and research institutions. When one thinks of consider invention there should be a capability to do so. Not only had the financial input, we even do not have the human resource to undertake technological invention at the macro level. We have to first build our technological capability while importing appropriate, important and effective foreign technologies. This is a better way at the moment to realize visions of the country to become a middle income nation after few decades. Though we are not discouraging invention, until we build the necessary capacity, the only fit alternative is to focus on adaptation (Most, 2014).

Even if the National Science and Technology policy encourage innovation but it seems not well articulated how to support research works by allocating adequate funding. Further, the interview result confirmed that, since the country do not have the capacity to generate new technology and lack of financial constraint to allocate sufficient budget for academic research and technology transfer the national interest and the policy emphasise on technology adaptation, so that, national interest is mainly focus on financing for adaptation of technology, than financing research.

The data from the document show also, the university research budget increase from 450,000 to 26, 000,000 Et Birr from 2000 E.c to date. This research fund allocated by the government for the university is allocated not for academic research but it is for Phd dissertation and MA/Msc thesis. Addis Ababa University reported total research revenues of nearly 166 Million Et birr has been get through collaborative research by individuals and the Sweden government also granted 3 million Sec for 2013/14 fiscal year.

From the questioner, interview, existing documents and the literature the university research funding is low. For example Ethiopia spends about 2.8% of its GDP on education sector

development. This is lower than the Sub-Saharan Africa average which is around 3.9 % (Teshom, 2004). The data show that, even if the research fund increase year after year but it is minimal to conduct technology transfer activities and academic research. On the other way round the data from METC show that there is budget for research in the corporation, because there is national interest on the corporation.

4.3.4 Research technology and infrastructure facility

Table 4, Technology and infrastructure facility

How do you evaluate technology and infrastructure facilities of the university?	Number of respondents	Percent of respondents
High	-	-
average,	41	60%
low	27	40%

Source, field work

From the result of respondent the university technology infrastructure and facility 60% (n=41) respond that the university technology and infrastructure facility is in average level and 40% (n=27/68) respond the university technology infrastructure facility is in low level.

From an open ended questioner the respondent who said the university technology and infrastructure facility is in average level discussed that, it is improving but a lot needs to be done. The university tries to have relatively competitive technology and infrastructure to provide the required service by the stake holders. The university has modest facility to run laboratory based analysis and pay attention to provide sufficient computers and laboratory equipment.

The respondents who said, the research facility and infrastructure are low on the open ended question, they argued that the university technology infrastructure laboratories and equipments are not well installed. The supplies or consumables, lack of update software and models are the challenge and some are out dates technology, not only this but also, the internet service and electric power nonexistent of generator for supply of electric power, while when the researcher needs to control temperature or motion and also lack of expertise to operate the instruments are the main challenge for the university technology facilities.

The interview result from associate of dean industry linkage and technology transfer in Institute of Technology show as follows:

Addis Ababa University is struggling to fulfill the university technological facilities which have a positive remarkable impact for university industry linkage. For instance, the university has expended 100,000,000 Eth Birr to fulfill the university laboratories. This indicates how the university is straggling but the staffs need to be Encourage to write grant project for more update of the university facilities (DUIL, 2014).

From the data and the interview, Addis Ababa University pay an attention to modernize technology infrastructure and facilities for teaching and learning process but there are still constraints in updated model, software, chemicals and other related supplies. Moreover, shortage of power and most inefficient internet service is an obstacle to engaged with laboratorial analysis and conduct academic research which is required service by the industry. To produce novel products one may need advanced facilities, because with ordinary products it is difficult to attract industry.

4.3.5 The role of the university strategic plan in creating link

Table 5, the role of the university strategic plan in creating link

	Number of respondents	Percent of respondents
Very low,	9	13%
Low	7	10%
Medium ,	38	56%
High	14	21%

Source, field work

Finding of quantitative data indicated that, majority of the respondents 77% perceive that, the strategic plan in creating university-industry linkage is in medium level in the university.

The literature result also sows: in directing priorities, strategic plans can help institutions shift away from the current system of disparate, fragmented, individualistic researcher collaborations aimed primarily at career advancement a problem encountered in many African universities - towards building over all institutional research capacity (Kruss et al, 2007).

From the literature and the result 77% from the total population responded the university strategic plan at medium and high level the respondents argue that on the strategic plan how to create smooth relation with industry is well expressed and creating a link is one of the plan objective among others, so as a document the strategic plan is well done.

The others 23 % respondents from the total answered that strategic plan is very low and they responded low, even if the strategic plan is there, since the university focused on teaching learning process and the academic research and technological innovation suffer in adequate of finance the strategic plan is not well implemented.

The interview result also shows that:

The university strategic plan is well articulated and it is our working guide line to perform our day today academic and research activities. Not only this but also university industry linkage is well placed in the university strategic plan the only problem for low level university industry linkage is the implementation of the plan is not remarkable (UIL,2014).

From the interview and data result the university strategic plan in creating university industry linkage is placed as a guide line the drawback and the problem is its implementation.

4.3.6 Industries participation in research and development issue

Table 6, Industries participation in research and development Issue

How do you rate the level of industries participation in research and development issues?	Number of respondents	Percent of respondents
Very low,	28	41%
Low	33	49%
Medium	7,	10%
High	-	-

Source, field work

The result of the university-industry participation in research and development issue is interpreted as follows 90 % of the respondents reported that the industries engagement with the university research and development issue is low in their respective college or institute.

The interview result from the METEC vice head for research and development support the data as follows:

Virtually the industry may get applied research and advanced technology from the university unfortunately we did not get this from AAU. So our participation in connection with research and development issue is below average. The reasons for the limitation of industries participation in the university are limited on their compound and hide on routine shell. On the other way round, we do highly participate in Mekelle University and General Mulugeta Bullei University College from curriculum development to student evaluation (MET, 2014).

From the open ended questioner the respondent who said the industry participation is very low and low thought that, lack of collaboration and linkage culture from both sides and lack of well appreciated mutual benefit make the gap to have appropriate and sufficient fund for academic research.

The industries are not fully aware of the benefit of such research and development linkage .They rather prefers do not to be innovative and comfortable with routine. Most industries are interested for imported raw materials with the aim of profit maximization therefore the industries do not give a priority because they don't want to invest (support) on research, they do not believe in the quality of outputs and they may have fewer or no idea on relevance of research.

4.3.7 Leadership

Table 7, Level of leadership competency and commitment for creating the linkage

No	How do you rate the quality of leadership and management in your university to create strong link with the industries?	Rating scale								
		SA %	N	AG	N	UD	DA	N	SDA	N
1	Level of competence and commitment	16 %	11	12%	8		44%	30	28%	19
2	Competency of monitoring and evaluation			25%	17		53%	36	22%	15
3	Creating transparent and smooth work environment	19 %	13				26%	18	55%	37
4	Motivating the researcher	13 %	9				50%	34	37%	25

Source, field work

The result from the data indicates that, level of leadership competency 88% of respondent from the total population agreed that the level of leadership competence and commitment in creating linkage is poor.

In connection with leadership competency of monitoring and evaluation is really low, the 75% of the population rated on disagree rate for the leadership competency of monitoring and evaluation.

Creating transparent and smooth work environment from the total population 81% of the population perceive that, there is no transparent and smooth working environment crated by the leadership in their respective college or institute.

And finally, the leadership commitment to motivating the researchers 87% of the respondents are rate on disagree and strongly disagree scale, so they are not committed to motivate the academic staff.

From the result the level of university leadership competency and commitment is in low level, since they are encounter to achieve teaching learning and other routine bureaucratic activities they are not capable to think beyond the horizon to have strong and desired linkage with the productive sector.

Nowadays, the university management signed memorandum of understanding with government institutions like METEC, construction and urban development ministry and others in terms of capacity building and mainly in consultancy services, it indicates the leadership commitment is questionable.

Conducive work environment is crucial to create novel research work, but from the data the researcher identify that, there is lack of transparency and smooth work environment for researcher in the university, which is enable them to produce desirable product and service.

The university leadership also does not create effective institutional modality and system to monitor and evaluate the academic staff and rewarding them based on their research activity is not well done.

4.3.8 Academic staff

Addis Ababa university Collage of Natural Science and Institute of Technology, has 659 academic staff from this 201 Phd holders, 345 MSc holders and the reset 113 are BSc holders virtually higher education instructors specially Phd and MSc holders are from their training and educational attainments are typically responsible for initiating and undertaking research, graduate student supervision, and holding senior management positions.

It is interesting to note that 31% from the total population are with doctorate degrees 52% are with MSc holders the reset 17% with BSc holders, so 83 percentage of doctorate degree holders and MSc holders can enable the university for the implementation of strategies and policies at the national and institutional level for promoting university linkages with the industry and networking universities into the national innovation system but the following interview result disproof this data.

The interview from associate deans for university industry linkage and technology transfer the College of Natural Science stated the following:

There is limitation in producing novel research which is important to grasp industries attention with in academic staff, rather they are interested to conduct basic research than applied once, this may be the drawback of the academic staff role in creating university industry linkage (DUIL, 2014).

From the interview we can perceive that, the potential of academic staff in conducting applied research and technology is low.

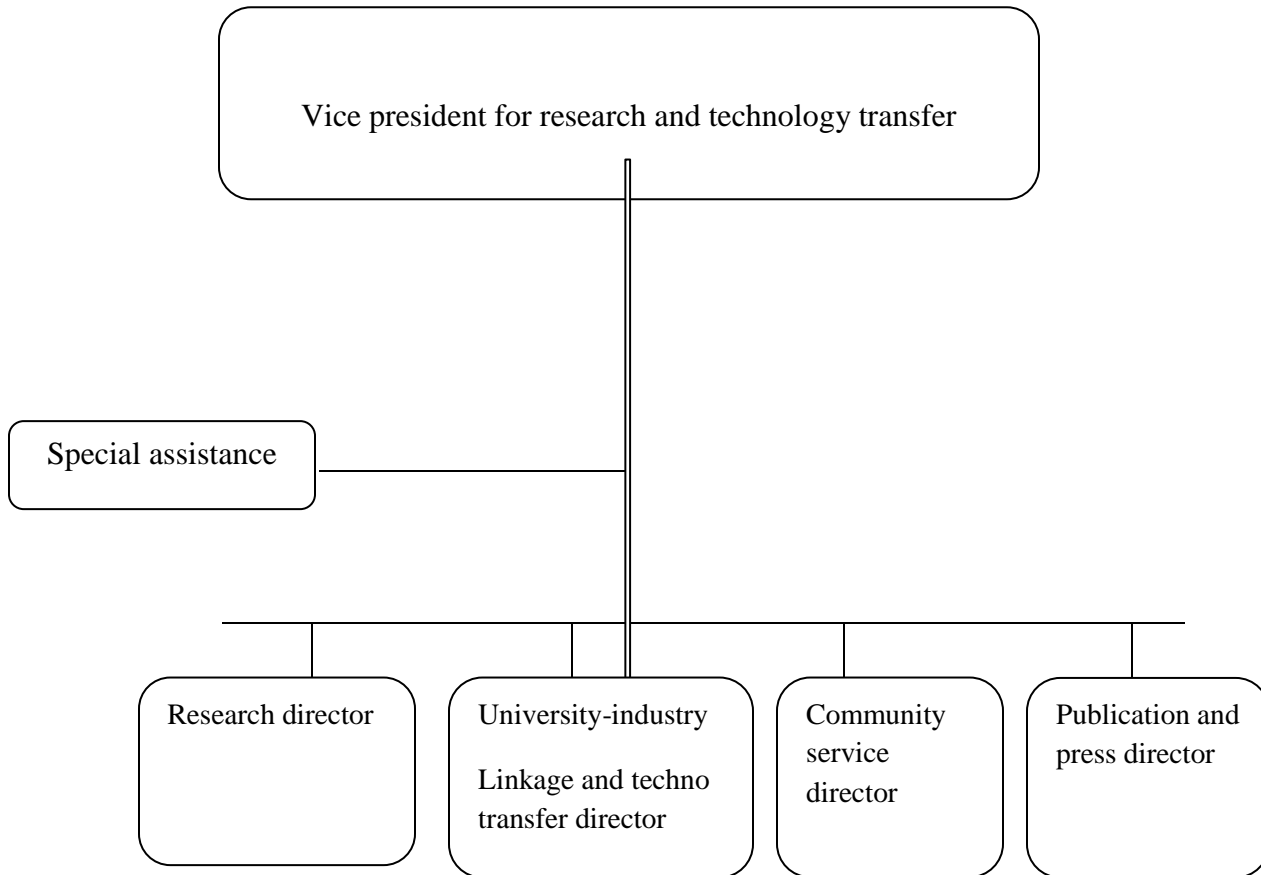
4.3.9 Internal governance

From the observation and the interview, Addis Ababa University created designated positions and offices for promoting industry linkages.

It has Vice-President in charge of research and Technology transfer and the Addis Ababa University industry- university linkage and technology transfer unit lead by the director. Not only this but also the institute of technology and college of natural since appoint associate dean for research and technology transfer deans.

Fig no, 2

OFFICE OF THE VICE PRESIDENT FOR RESEARCH AND TECHNOLOGY TRANSFER



Source, from university industry linkage unit.

Main responsibilities of the university industry linkage and technology transfer unit are;

- University-Industry Cooperative Research,
- Industry-Sponsored Research Projects,
- Patent Licensing,
- Consultancy Services Agreement between University and Industry,
- Using Science and Technology Parks and Technology Business Incubation centers,

Industrial Internship

The interview gets from the university industry linkage briefs the general activities of the unit as follows.

At the movement the university industry linkage and technology transfer unit try to install good environment to achieve the above mentioned goal. But the progress is not yet remarkable, especially on university industry collaborative research; industry-sponsored research projects are almost null because of the low level awareness of the industry sector. We are trying to launch the first university intellectual property right policy and Science and Technology incubation center. The university make a change on industrial internship, engineering and medical students have a chance to get internship opportunity and on job training for instructors and consultancy service Short-term training, construction supervision, design verification, etc are common channels used to transfer knowledge. The university has clear consultancy service arrangements and is the most effective and widely used channel at the moment. In connection with the unit annual budget the university allocates limited resource for routine activities not only this but also the bureaucratic challenges are the unit traits. Within this two years when the university restructure the unit we come up with internal and external challenges inefficient projects financial flow, low level of deliverable supply and academic staff are pretty busy by teaching learning are internal challenges. Whereas external challenges are industries are not coming they don't have trust by the local technology and local expertise (UIL, 2014).

From the interview result we can understand that, the university pays initial effort to foster and institutionalize linkages with the productive sector by creation of designated post and office. However, it is clear that, the structure dedicated to such linkages is operating on minimal budgets with perhaps three expertises and it is straggling to create the link but at the movement except industrial internship and consultancy service there is no effective collaborative research with the industry.

Even though, the unit has three experts, it is on enfant stage in addition it come up with financial constraint, like bureaucratic challenge due to this, it takes a facilitation role to coordinate research consultancy work and fellowship.

Moreover, lost of trust by the productive sector on the university research and expertise become the undines problem to the unity and creating the necessary linkage

4.4 Challenges faced in university - industry linkage

Challenges in creating strong linkage with the industries in terms of research and technology transfer at university level are diverse and depend on each institute and college circumstances of research activity. Interviews at the case sites reveal that low level enforcement power of the existing national policy which enforced the university and the industry to create strong linkage in accordance with national interest, the non existence of University Intellectual Property Right Policy (IPR) and institutional policy for university industry linkage. Other examples of special challenge to university industry linkage, is the university industry leadership themselves, who are not committed to organize, give priority and are not committed to create the link.

From information collected through the questionnaire and in the interviews with university industry linkage unit director, vice deans for university industry linkage and technology transfer and instructors, the researcher identified several factors that, present special challenges to the linkage. For example, low level of incentives from the government (tax deduction for new technology, and based on their linkage for industries) which is important to grasp industries attention on university academic research new technology and using local expertise, low level incentives modality for instructors in the university.

From the questioner the other challenges is attitudes and misunderstanding of the two parties the university should be identify the industry exact problem and should try to give immediate solution by new and low cost technology and academic research. Industries do not have awareness and research interest of the university and the university also don't aware the problem of the industry as well.

The leadership doesn't motivate to bring applied research to the industries and the industries don't have interest to bring their problem to the university, low level of clear communication is the main challenge.

Absence of the culture unable to appreciate the mutual benefit to both sides, lack of research awareness by industry owners' Ethiopian industry mainly focused on import goods than import substitution goods and technologies it needs knowledge based industry leaders who initiate and

trigger the university to produce competitive technology and to conduct problem solving academic research.

According to the results of the questioner and the interview, in adequate research and technology transfer budget allocation from all stakeholders: university, industry and the government. The government, as a regulatory body should assign adequate budget from its GDP for the university. Lack of financial institution which is responsible to alleviate this financial constraint for research. The university also does not give priority for applied research and technology transfer rather it is focused on teaching learning process and other routine activities and finally, the industry low level attention for Research and Development (R&D) works by support the University for Collaborative Research and grant for research development.

Challenges also existed in non existence incentives mechanism and modality for researchers in the university which is allocated for university industry linkage, lack of interest and concern from the industry the industries are not confident by the university research product as well as poor attention has been given for research in the industry, illiteracy of industry owners, infancy of knowledge based economy. Lack of facilities for high tech research the university may not have high technology and the expertise to operate the facilities. The structure of university – industry linkage unit must be power full than its current coordination and facilitation role the unit has only play the coordination role and it is running with minimal annual budget with few expertise it hinders the unit to exist and implement institutional IPR Policy and conduct marketing activity as well as to form science and technology incubation park.

Low level researcher competency and commitment a research which is conducted in the university are mainly focus on basic research than scientific and applied research.

4.5 Mechanisms to improve the low level university industry linkage

From the open Ended questioner and interview respondents discuss the following mechanism to create the required university-industry linkage.

The existing and endorsed policies like Science Technology and Innovation policy and others institutional policies in the national and institutional level trying to have strong power during

their implementation, as well as the policy makers should understand the different culture of the university and industry. Moreover, university industry and government also preferable to have memorandum of understanding which enables them to be acquainted with their role on the linkage and their role should be write in clear and precise way . On the other hand, these three parties should have common strategic plan to have a frame work for the desire linkage.

University industry and government must establish working modality and there must be functional institution to ran and organize university industry linkage in the national level. And also dedicated university industry linkage unit should be functional in the university than acting like facilitator.

The university leadership should be committed to create the linkage and they shall motivate the academic staff, there must be conducive working environment for researchers in the university since researchers' needs a clean head their life status must be improve. The university has to start to move the industry rather than wait, in the other word the university leaders try to have smooth relationship and move half a way to approach the industry than waiting them.

Incentive mechanisms from the government for university academic staff by giving national award, promotion and for the industries like incentives by implementing tax exemption strategy and giving recognition based on their participation role in the linkage.

Allocating sufficient fund for research in national, university and industry level for instance the government pay an attention to improve and allocate research fund from its GDP. Not only this but also, there must be an institute which is dedicated to support research works and allivate research fund problems at the national level. The university shall give priority for academic research than teaching and learning, finally the industry owners both the public once or the privets pay their effort for the implementation of universities academic research, new technologies and their acceptance for local research and expertise should be positive.

Strongly working on awareness creation of industries owner by creating continues work shop, discussion seminars, dialog forums as well as to have annual research call for industries to promote and sell the university academic research and new technologies.

Academic research should address the industries problem and working on dissemination of applied research finding than putting them in bookshelf to industries to solve the real problems of the industries.

CHAPTER FIVE

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The objective of this study was to investigate the current status of university industry linkage in terms of research at Addis Ababa University College of Natural Science and Institute of Technology. This research employs mixed methods to address the issue. This research is guided by a conceptual model derived from the review of the literature in the conceptual model the government as a policy maker try to create policy and legal environment and the industry by having research and funding policy play a crucial role for supporting university research and from the university leadership, academic staff as well as institutional policies are integrated to create desired linkage.

Data was collected from College and Institute associate deans for research and technology transfer and industry linkage, university industry linkage unit director, research, and development vice head of the METEC, Ministry of Science and technology officer. Moreover, from key informants such as instructors, department heads, working in college and institute.

Results from assessment of the university -industry linkage in terms of research reveal important findings for the status of the linkage in the case of Addis Ababa University. From the policy, the proclamation the MoST expert, from the interview indicated that the policy primarily focus on adaptation, so its empowerment to create university industry linkage in the university is really low and there is no institutional mechanism to support and evaluate this linkage. The other drawback of the policy is there is no clear implication to solve financial constraint and lack of human resource to creating new technology.

The study revealed that the university industry linkage is in its infant stage. The data signified that the university has consultancy and capacity building linkage with the public institute than private productive sector, the national science, technology and innovation policy is not well implemented in the national level and its legal empowerment to enforce the university is not efficient, AAU research policy and others which has significant role in creating the desired

linkage at the institute and college were in the same way. The overall data indicate that there were no power of implementation and enforcement of the policy.

Patents have a key role in creating a favorable condition for the networking of the different actors in the national system of innovation but the national IPR policy has low impact to create strong linkage because the policy specially the internal policy don't answer the researcher question as well like:- Who is owner of IP generated during collaborative research why? because the university do not have internal Intellectual Property Right policy.

There is no industry university linkage in the case of Addis Ababa University especially with the private once, because the industry participation on research and development issue because the industry owners are not interested with local expertise and research works. Moreover, the university research may not have applied research based on the actual problem of the industries.

The university and industry partnership in terms of research is still on its minimal stage because of the two parties miss communication, low level industry owner awareness, university leadership commitment and competence to create conducive working environment, implement the existing policies, to motivate academic staff, as well as the competence of the leadership to solve constraints which are hinder the linkage is also below average. The industry participation on university research is almost none. The two parties are inside their shell and boundary.

The academic staffs are not engaged with in producing applied research and new technologies which is play a dominant role for creating the linkage

There is no any institutional motivating mechanism in national level and in the university for the linkage practitioners, the university facilities and infrastructures are not well competitive Funding in academic research play a dominant role to have novel technology result but at national level, in the university and METEC it is really below average. The literature also indicates that the national Research fund from the GDP is low like some sub-Sahara countries so the university can't allocate substantial budget to university- industry linkage and technology transfer.

5.2 Conclusion

Based on the major finding of the study the following conclusions were drawn.

One of the major objectives of the university is conducting research and creating technology transfer mechanism by using this research, however, the result of this study conducted in Addis Ababa University College of Natural Science and Institute of Technology demonstrates that the linkage in terms of academic research is very low. Moreover, the leadership commitment to creating linkage with industry is not remarkable. Creating university linkage doesn't get priority attention by the university and the industry owner as well because the industry owners do not give priority for local technology and expertise. Not only this but also they are interested with profit. Accordingly the university leadership focuses on other routine activities and bureaucratic issues. As a result the status of the two colleges in creating the link is very low.

To produce high tech and competitive academic research and to grasp industries the university come up with financial constraint and limited allocation of annual fund for the university industry linkage unit. Lack of incentive mechanisms to motivate the academic staff , low level supply of updated laboratory materials and facilities, low level commitment and poor management system were has the lion share for the low level status of university industry linkage in the case of Addis Ababa university.

There was a gap between policies and its implementation, the recommended stake holders, University, Government and the Industry did not put functional mechanism and institutional modality to implement the policy into practice. The non existence patent right policy in the university is one of the hindrances among others to motivate the university academic staff to engage in the linkage.

Lack of unadulterated communication and different culture between university and industry were the other draw backs, besides the industry owners don't have knowledge and the leadership of the university didn't give attention to create the desire linkage.

5.3 Recommendations

Based on the finding and the conclusion drawn the following recommendation is forwarded to ensure or create university industry linkage.

- ❖ University government and industry should be actively engaged in creating institutional frame work to implement national policy and institutional policies, mainly the integration of these three parties need to be considered.
 - 1 Universities as key research producer to increase their participation in producing problem solving quality research.
 - 2 The industries as beneficiaries from academic research and technology transfer should use research and local technology outputs and support the universities by allocating sufficient fund, giving capacity building for academic staff.
 - 3 The government as policy maker should be provide conducive Environment like reducing tax, giving recognition for industries based on their participation in the linkage.

- ❖ University leadership should be committed and be competent to implement national and institutional policies, should pay their effort to solve research funding problem they must create transparent working environment

- ❖ Shortage of research and technology transfer fund and update facilities were the bottle neck to conduct strong and problem solving research and to innovate high level technologies in the universities. Hence, the provision of fund, alleviate financial problem, as well as, provide scientific and relevant facilities are essential to produce the desired research by the industries. Introduce and implement remarkable incentive mechanisms for those who are engaged with the linkage and who have done research because low income and unconvinced work environment put its own negative impact on university industry linkage.

- ❖ Relevant stake holders , and academic staff should think of establishing institutional governance for university industry linkage, researchers, others who are part of the

university industry linkage, must be afforded the time to devote to conduct problem solving research and innovate effective technology which is important to the linkage.

- ❖ A range of incentives strategies for academic staff who are engaged with university industry linkage should be available for use in university industry linkage. For example, providing national award; giving high level academic rank; salary increment and intellectual property for their work all offer important vehicles to motivate researchers to conduct the fruitful academic research.

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Appendix one questioners

To be filled by

Deans

Department heads

Senior instructors

The purpose of this questioner is to get valuable data to the study entitle the link between university and industry in terms of research in the case of Addis Ababa University. Since the accomplishment of the study with your genuine response.

You are kindly request to be honor towards all items in providing in this questioner

Please note the following points before you start filling the questioner

- You don't need to write your name.
- Read all the instruction before attempting to answer the question
- There is no need to consult others to fill the questioner
- Please provide appropriate response by using a tick mark " " or X to choose one of the suggestion scale. kindly request to write your opinion briefly for the short answer questions on the space provided
- Please don't leave the question un answered

Thank you in advance for your cooperation

1. General Information and personal data

1. Name of faculty-----

1.2 Sex female

Male

1.4 work Experience in teaching and research-----

Current work position

College dean	<input type="checkbox"/>
Department head	<input type="checkbox"/>
Senior instructor	<input type="checkbox"/>
Postgraduate student	<input type="checkbox"/>

1.5 educational back ground

BA MA PHD

Educational rank

2. Do you think that there is a link b/n industry and university? Yes
no, if your answer is yes how and if your answer is no why?

.....
.....
.....

3. To what Extent the university internal policies encourage university industry linkage?

Very low low medium high

If your answer is very low and low why and if your answer is medium and High how?.....

.....
.....

3.1 How far the university research policies implemented and dose it create industry and university link?

.....
.....
.....
.....

3.2 How does the university Intellectual property right and patent right policy encourage the university industry link?

4. How do you rate the allocation of university funding and resource for research with the comparison of the university annual budget?

Very high high medium low

If your answer is medium and low why and if your answer is high and very highly how?.....
.....
.....
....

5. How do you evaluate technology and infrastructure facilities of the university? Why?

.....
.....
.....
...

6. Do you think that technology and infrastructure facilities can promote/affect university-industry link?

How.....
.....

. How do you evaluate the research structure in the university? Why?

7. How do you rate the role of the university strategic plan in creating link with the industry?

Very low low medium high

If your answer is very low and low why and if your answer is medium and High how?.....
.....
.....

8. How do you rate the level of industries participation in research and development issues?

Very high low medium

If your answer is very low and low why and if your answer is medium and High how?.....
.....

.....

9. What are the basic problems in participating the industries in the university research?

.....

10. What are the main motivators for your college in creating link with the industries?.....

.....

11. Factors affecting link between your university and industries in terms of research. By making mark to your corresponding answer 5, strongly agree (SA) 4, Agree (A) 3 Undecided (UD) 2 Disagree (DA) 1 strongly disagree (SDA)

no	Cause of loss of linkage	Rating scale				
		5	4	3	2	1
11.1	Lack of institutional strategy					
11.2	Lack of Research and development agreement					
11.3	Lack of adequate funding					
11.4	Lack of human capital					
11.5	Lack of internal research and development Policy					
11.6	Other specify					

How do you evaluate the leadership competency of leaders in the university to create University industry linkage? Why?

.....

12. How do you rate the quality of leadership and management in your university to create strong link with the industries.

no	Management and leadership	Rating scale				
		5	4	3	2	1
12.1	Lack Develop joint action plan					
12.2	Monitoring and evaluation					
12.3	Transparent and smooth work Environment					
12.4	Motivating the researcher					
12.5	Other specify					

Do university leaders motivating the researchers to work on university-industry link? How

.....

 ...

13. In your observation do you think the main activities have been done in building the link between university and industry?

.....

14. What mechanisms do you suggest in improving the effectiveness of university industry link in terms of research?

.....

Appendix 2 interview questions for METEC

To what Extent the corporation internal policies encourage university industry linkage?

.....

2.1 How far the Corporation research policies implemented and dose it create industry and university link?

.....
.....
.....
.....
.....

3. How do you rate the allocation of Corporation funding and resource for research with the comparison of the university annual budget.

?.....
.....
.....

4. How do you rate the quality of leadership and management in your corporation to create strong link with the university

5. How do you evaluate technology and infrastructure facilities of the Corporation for research? Why?

.....
.....
.....
.....

7. How do you rate the role of the Corporation strategic plan in creating link with the industry?

.....
.....
.....

8 how do you rate the level of the industries participation in research and development issues?

.....
.....
.....

Appendix three

Interview question with University industry linkage unit

1. Do the university have Research and development policy which enable to create university industry linkage? In what extent it implements and creates the linkage?
- 2, do you have the Strategies for collaboration in terms of research with the industry?

3, what are the main objectives of the unit? Does the university allocate the running cost for the unit as well?

4, what is the Current status of the university specially Institute of technology and college of natural science by creating linkage with the industry.

In terms of Funding for academic research and technology transfer

To make Joint research

Fellowship (internship)

5 how do you evaluate the university leadership commitment and competency to create the linkage with the university

6. What are the main challenges that hinder to create the university industry linkage?

7. What do you suggest to improve the then university industry linkage status?

Appendix four

Interview with Most official

1. How do you see the present state of using university industry linkage and technology transfer for various development endeavors in the country?
2. What would the new science, technology and innovation policy contribute to create university industry linkage and its level of implementation to the country's overall development in the near by creating linkage?
3. The new policy mainly focuses on effective adaptation of imported technologies. Is it not possible to undertake technological generation side by side with adaptation by making strong U-I and do you think that this may reduce the strength of the linkage?
4. There are expected challenges in implementing this new policy as is the case before. How have you planned to overcome the challenges?

Appendix five

Interview questioner for university industry linkage and technology transfer deans

1 Policy and guide line

1. Do the university have institutional policy and guide line to create University industry linkage?
2. How do you see the implementation of those institutional policy and guide lines?
3. How does intellectual property help to link University with industry?
4. Do you think that patent right is the tool to link University with industry? How?
5. Do you have policy guide line regarding to patent rights?

2 Funding scheme

- 2.1. How do you allocate your recourses for strength university industry linkage and for academic research and technology transfer?
- 2.2. Do you think that your resource allocation affect/ promote university-industry link? How?

3. Leadership

- 3.1. How do you evaluate the leader's commitment in the university to creat and support university industry linkage? Why?
- 3.2. Do you think that university leader's commitment affect/promote the university-industry link? How?
- 3.3. Do university leaders motivating the researchers to work on university-industry link? How?
- 3.4. Do you think that university leaders are transparent? How?
- 3.5. Do you think that university leader's transparency affect/promote university-industry link? How?

4 Technology infrastructure and facilities

- 4.1. How do you evaluate technology and infrastructure facilities of the university? Why?
- 4.2. Do you think that technology and infrastructure facilities can promote/affect university-industry link? How

5 Internal governance

5.1. How do you evaluate the structure of the university in terms of research? Why?

5.2. Do you think that the structure of the university affect/promote university-industry link?
How?

