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Status of Technology Transfer and Innovation in Ethiopia

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ABSTRACT : In the context of academic organizations, a technology transfer refers to the mechanism through which the institutions produce new technologies. Technology transfer may be accomplished in two ways: selling proprietary intellectual property to businesses or forming start-up firms. Universities, businesses, state and national economies and society as a whole prosper from successful technology transfer. Every institution, school, and university as a whole would benefit from the establishment of university industry links and a Technology Transfer Policy. It is critical to promote partnerships and strong collaboration between universities and industries that encourage realistic information development while also facilitating technology transfer. Students must be nurtured and equipped with realistic skills, which can only be accomplished by near collaboration and win-win agreements between universities and businesses in general. As a result, Ethiopia's educational system has placed a premium on university-industry linkages and technology transfer, resulting in the establishment of offices in all public universities throughout the region. The aim of this analysis is to evaluate the success of technology transfer and innovation in western Oromia, Ethiopia. To determine the root cause of the issue, quality tools: Cause effect diagram and Parato diagram was used in this analysis. Mitigation techniques were designed to prevent recurrence of known poor performance areas (weaknesses), as well as a planning structure that traces the area's goals.

KEYWORDS: Technology Transfer, University-Industry linkage, Institutions, Innovation, Root cause, Cause effect diagram, Parato diagram.

I. INTRODUCTION

Technology transfer is the process of exchanging proficiency, skill, abilities, knowledge, experience, industrial production techniques, manufacturing techniques, and services provided by the governments or academic institutions to the end customer in order to ensure that science and technical advances are available to a wider range of consumers who can then further improve and use the technology Moini et al (2012) .This paper discusses emerging developments and terns in the global economy from 1975 to 1995, concentrating on modern technology generation and technology transitions, as well as trends in the background of developing countries and industrial concentration of technology in terms of indices of R&D operation, patent holding, and collections of technology payments and royalties(Nagesh, 1998). To improve the pace of transition of such research technologies to the corporate companies, several universities have developed Technology Development offices. Any of these offices have lately been placed under strain to improve their efficiency and, as a result, boost local economies. Different technological transition approaches are discussed in this article. These initiatives provide engineering guidance to small businesses, as well as matching funds for research projects, incubator room, and other resources (Parker and Zilberman, 1993).As a result, technology and information transfer from research and science organizations has been a strategic variable for companies and countries in a global environment to address these issues. His paper begins with an examination of competitive advantage locational factors and how they influenced the development of other major industries in the state. He then contrasts and evaluates the state's industrial directions in these primary growth segments, as well as the state's previous industry successes and our perceptions of competitive causes David et al (2014).Measuring the flow of expertise from fundamental science research to technology is one of the most challenging and significant obstacles of technology transition (Perko and Narin, 1997). Identification and recognition of high-value products is a critical challenge for effective technology transition. Since most invention transfer deals are

aimed at obtaining inventions for potential applications, finding future successful patents is especially critical. This paper suggests an innovative strategy for defining patents of strong potential for technology development and transfer.
We used TRIZ evolution patterns as a criterion for evaluating patent technology, as well as a text-mining methodology focused on Subject–Action–Object (SAO) to cope with large amounts of patent data and interpret them automatically Park et al (2013). Understanding how the legislation and its attendant processes affect university technology transition as a vital framework for the diffusion and commercialization of emerging technology resulting from federally sponsored research is essential. The paper examines existing legal scholarship and illustrates how case law, legal frameworks, and the peculiar existence of intellectual property law influence technology transition, as well as higher education policy and management (Hayter and Rooks 2015). The capacity of a nation to sustain fast economic growth in the long run is highly dependent on the efficacy with which its institutions and policies promote the information creation, technical transformation and innovation of its industries or sectors. Science, technology and creativity are the cornerstones of development from which a nation relies to attain rapid growth and vibrant interconnected self-sustaining economy(Clark and Frost, 2016).Successful integrated technological progress necessitates a thorough comprehension of the scientific background of applications, as well as the operational setting in which physicists, architects, and engineers, frequently from disparate disciplines, collaborate and collaborate.

The following section argues that successful technology transfer seems to be a more complicated and labor-intensive process than previously thought, requiring significant technological modification and additional developments, as well as an adequate legal framework. Bellais et al (2006).Firms that engage in foreign information transfer initiatives have significantly and noticeably higher productivity growth, according to estimates from a lively productivity model. While the results do not seem to endorse a compromise between domestic and foreign technology procurement, companies that mix international and domestic adopt new strategies have the greatest influence on productivity, implying that a flexible external technology outsourcing approach mixing local know-how with know-how from abroad is the most successful in increasing productivity. Belderbos et al. (2012).Because of the crucial assessment of technology's economic and social effect on developing nations, the transition mechanism has become increasingly more sophisticated and dynamic. Harvey (1984).The effect of environment related patents on economic growth, as well as cross-continent technological transitions and structural considerations. Environmental patents may be successfully used thanks for countries' innovative capacities on how they disseminate scientific technologies. Finally, taking a cross-continental look at environmental patents helps one gain a better understanding of current TT patterns. Ferreira et al (2019).The method was modelled to establish a forum for discussing a range of quality improvement problems that, if ignored, may have a negative impact on the process's capacity to convey information to mothers in a volume and manner sufficient to produce desired decision-making. The quality improvement and value appraisal systems, it is argued, should obtain further consideration in the push to minimize morbidity and mortality by information transfer. Yassin and Anita et al (2003).The lessons gained regarding successful technology transfer are presented in this article, which is based on studies on the technology transfer method. Technology conversion is a challenging form of communication that necessitates the use of specialized and qualified workers, sufficient equipment, and institutional and other incentive mechanisms. Rogers et al (2001). Technology transfer, and therefore industry-relevant studies, entails more than only making research findings and publishing them in journals and professional papers. Throughout the study phase, it necessitates strong coordination and partnership between business and academia. Technology transition occurs through time, through minor, gradual, and occasionally unplanned changes to the overall research initiative, and is continuously embraced by practitioners.

This can be daunting from a scientific standpoint since it's difficult to quantify the effect of such "improvements." But, under the right circumstances, the joint research phase which can be seen as latent technology transfer Gorschek et al (2009).The voluminous, multidisciplinary literature on technology transition is reviewed, synthesized, and critiqued by (Bozeman, 2000). It starts by looking at a few basic philosophical problems, including how the analytical ambiguities concerning technology transfer concepts affect analysis and theory. We also know very little about technology transition politics, and how technology-based economic growth affects delivery. Many important effects, such as changes in scientific and strategic human resources, arise over lengthy stretches of time, and we have no knowledge of them. We don't know anything about how technology transition affects organizations, their architectures, and their wide spectrum of capability. The aim of this paper is to find contextual connections between creativity and technology transition.

The study question was developed through an analysis of concepts for creativity, technology, and technology transition, as well as a focus group conversation. Three forms of partnerships between creativity and technology transition have been established in this report. The prevalent perspective of creativity and technology transition inside a culture is very necessary (Dubickis and Sarkane 2015).
The aim of our research is to evaluate and refine the rapidly developing literature on the efficacy of technology transfer. Since certain technology transition outcomes can be realized in sources of gains and costs over time, there is no more important Out-the-Door practice than having strong periodic metrics. If activity measurements are going to be the most important benchmarks, they must be as accurate as practicable and monitored over time Barry Bozeman et al 2015.This paper presents a model for handling the innovation phase of small and medium-sized enterprises. The process of development by means of innovation is analyzed from two perspectives, namely: from the perspective of companies that apply the innovations and from the perspective of universities as suppliers of technologies and knowledge. The technological transfer involves the transmission of science and technological material, expertise, and the means of infringement of intellectual property rights to third parties in order to manufacture a commodity or create a method Miorița and coworkers (2014). SMEs usually depend on technology transferred from developing Western countries' international partners. About the fact that the subject of technology transfer has long been explored, the main stream studies have focused on the hardware dimensions, the soft –knowledge- facet of technology transfer remains a source of concern. This research fills a void in the literature by investigating the interrelationships between information exchange and the success of technology transfer from industrialized countries to SMEs in developing countries. First, the study's results showed that knowledge sharing and technology transfer scales, and second, this study examined the contingencies of knowledge sharing on the feasibility of technology transfer in the sense of collaborations and other forms of collaborative relationships (Gunsel, 2015).The author Chais et al. (2016) seeks to investigate how technology transition works, utilizing the Schumpeterian approach to innovation trilogy, with an emphasis on the relationship between the university and the business. This study's approach consisted of an exploratory and qualitative examination of two events.

Two Brazilian universities acted as case study subjects: Semi-structured interviews were used as the data collection technique, whereas content analysis was used as the analysis technique. Some of the factors to address are changes to the institutions' internal policy, current negotiations, researchers' actions in terms of spreading the innovation ethos, and the success of technical innovation centers, which are increasingly being prepared to operate at the industry as well as at the university. It is important that businesses and institutions recognize that they must engage in joint technical research such that the financial resources expended are not only recognized as published publications in qualified papers, but often develop into market-accepted technological advances. All of this expenditure would pay off in the form of new goods, services, and technology that have a local, regional, global, and even foreign effect, enabling the implementation of new styles of companies and new markets and yielding an economic impact in the world, thus generating creativity and social well-being. The researcher (Cunningham and Reilly, 2018) published a study into the various facets of technology transition that has evolved considerably and has mostly taken a macro viewpoint. This study has generated a body of expertise and an evidence base that has added original ideas to the field's development while also shaping policymaking and practice. This study is uncovering fine-grained complexities and observations that offer further proof of how technology transition practices are influenced and develop in various regional and organizational contexts. The aim of this special issue is to have a better view of the macro, meso, and micro viewpoints of technology transfer, as well as an agenda for future study that integrates these multi-level perspectives of technology transfer. Policies aimed at the international-domestic technology transfer thus undermining the digitized of foreign technologies to contribute to technology transfer. Frontier technology transfer when accompanied by seven conditions: (1) solid state funding for industrial development, (2) oligopoly competition, (3) other policies strongly are complementing FTT policies, (4) high technological uncertainty, (5) Regulation mode of action that allows for easy adaptability and is tailored to the industrial system, (6) reform avoidance by the state, and (7) stringent policy enforcement mechanisms. We develop a Strategy & Risk Matrix to forecast the overall leverage of individual FTT policies Prud'homme et al (2017).

II. TECHNOLOGY TRANSFER IN ETHIOPIA: CURENT SITUATION

In today's Ethiopian background, the need for creativity and technology transfer for growth and poverty reduction is unavoidable. Academic research and technology transfer have long been recognized as the most successful ways of advancing the country's economy. Clearly, one of the future university missions is to establish an internal technology transition. As a consequence, careful consideration should be given to the

efficient use of link between various organizations. As a result, various techniques must be found in order to inspire society to perform research and participate in the technology transfer field, which will allow the industry to pay more attention. To accomplish the aim of the linkage and the objective of innovation, the linkage between university, business, research institution, and TVET college organization must also be well prepared, controlled, and coordinated. There is almost no shared institution between western regions; there is no strong rivalry on innovation and introducing new designs on the market; small and medium enterprises lack common cooperation for improvement; and there is no exchange of information and expertise with one another; lack of retail competitiveness; the adoption of emerging technology, and the lack of an exhibition Centre for creativity and inspiration; absence of a knowledge transition scheme and an image of creativity. A stronger, more detailed proposal for encouraging, developing, and maintaining synergistic relationships with the profitable sector is needed. The current state of technology transfer and innovation in Ethiopia, especially in western Oromia which poses a host of concerns regarding the degree of success of capacity development on information and expertise transfer programs carried out in different sectors.

III. DATA COLLECTION AND METHODOLOGY

The study's goal is to evaluate technology transfer in Ethiopia's Western Oromia Region. The East Wollega, Horro Guduru Wollega, IlluAbbabor, Bunno Beddelle, West Wollega, Kellem Wollega, and Jimma are the areas that are covered in this zone. In this research three methods are utilized: observation, questionnaires, and informal interviews. By questioning the respondent, the observation approach is used to sort results. The researcher gathered data in the field of industrial sectors, university incubation centers, and technology transfer testing institutes. According to the guidance given by researcher Ha and Nguyen (2020) [24], a questionnaire is circulated to a sample of respondents to determine the existing degree of technology transition mechanisms. Personal interviews were often performed to explain certain questions, recognize the root cause of problems, and recommend remedies. The information was gathered from the areas. A mixed approach methodological assumption is used to drive the course of data collection and interpretation. This approach is essential to allow for the shortcomings of testing methods. The aim of utilizing a qualitative method is to collect reliable details about a population's beliefs, perceptions, habits, and social contexts. The questionnaire consists of three sections:

- Preliminary knowledge and information about the respondents.
- variables to measure comprehension and reasoning, as well as the degree of efficacy in western Oromia
- Factors to determine the institution's knowledge about technology transfer output on different metrics.

The following are the considerations to consider while evaluating the state of technology transition and innovation mechanisms.

- Research and development institute
- Competition strategies of educational organization.
- University -Industry linkage
- Cooperation of small and medium enterprise
- Creativity and innovation mechanism
- Motivation and awareness of the community

The survey results of the respondents are shown in Table 1.

Table 1.Cumulative parentage of respondent

Performance metrics and weaker sections	Numbers of Respondents					Total number of respondents
	Case study 1: Western Oromia university (Wollega University: (Wollega campus, Shambu campus, Gimbi campus), Jimma university and TVET college (in %)				Case study 2: Western oromia region: Small and Medium scale industry.(in %)	
	Managers	Teachers	Students	Researchers	Managers	
Weakness in R&D	37	18	15	30	20	100
Technical skill	20	30	35	15	40	100

transfer gap						
Weakness in Competition	18	15	45	22	20	250
Linkage gap	27	18	25	45	45	50
Creativity gap	20	15	45	20	50	200

For data processing, statistical quality management technique like Parato analysis and the cause effect analysis are used to analyze the weaker section.

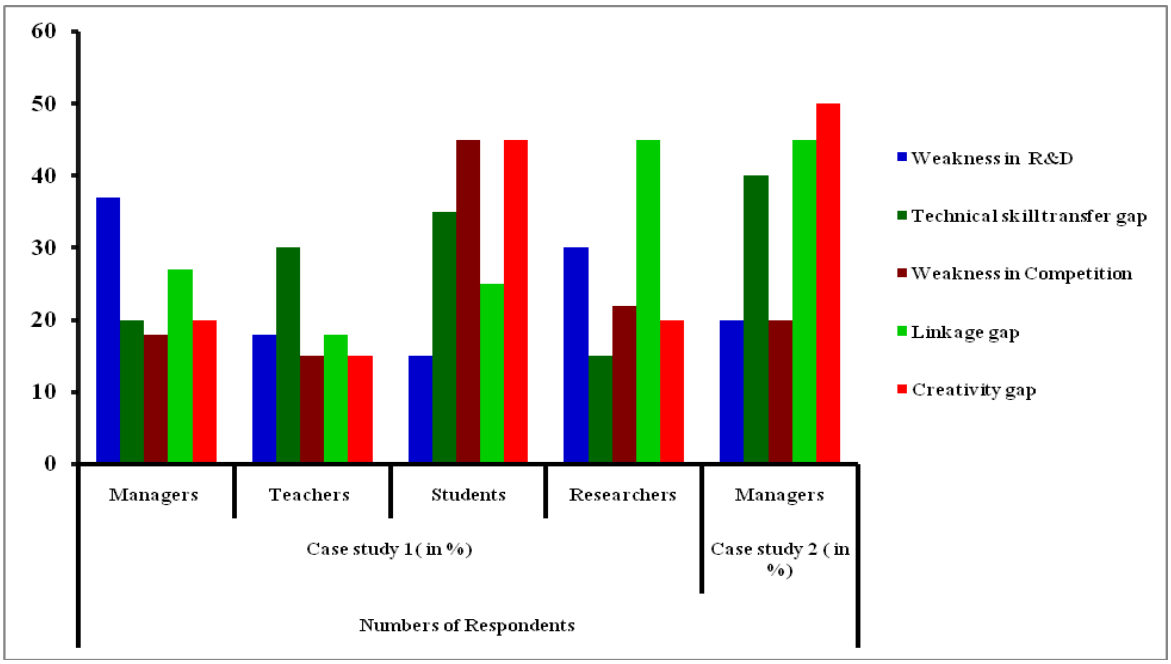

Figure 1.Percentages of Technology Transfer indicators

IV. RESULTS AND DISCUSSION

The data is compiled from a broad variety of demographic and numerical data, and it contains informative and informative material. As a result, a survey method of study is used to assess the state of Technology transition in Oromia in terms of experience and expertise transfer utilizing various forms of criteria, which are then used to address the research questions. Different forms of survey questionnaires were created based on this to assess the awareness and thought of technology, as well as innovation management and a specific field.

Discussion 1: Technology and Economic Development: The economic growth of a nation is determined by the inflow and outflow of technology. Economic development, market industries, engineering, and the transportation infrastructure all influence technology transfer strategy.

Discussion 2: Outflow and Inflow of Applied Research : Another major accomplishment was the development of educational institutions, diverse science and sectors, both of which increased people's service capability. However, poor performance was found in the areas of technological acceptance and capacity building. According to the findings, 87.5 percent of respondents used low effectiveness of technology.

Discussion 3: Competitiveness : Economic growth is the foundation upon which a country's success in both manufacturing and service sectors is built. Bad credit was granted for rivalry in all directions, according to the researcher. The lack of innovative concept generation and investment follow-up were identified as major weaknesses by the respondents. Employment opportunity, funding inflow, startup companies, and power usage were the major assessing criteria. The quantitative changes in these parameters are listed below.

- Job opportunity
- Investment inflow

- Startups business
- Capacity utilization training

DISCUSSION 4: IMPROVING MANAGEMENT CAPABILITY, DECISION-MAKING, AND INSTITUTIONAL ADMINISTRATIVE CAPABILITY BUILDING

For every institution, one of the components of the business and technology group was training. As a result, training is an important tool for developing managerial and technical capacity. According to the results, training exercises were grouped under different sub-groups of activities, but this was insufficient for the global market and emerging technology, according to the researcher.

In each of the research groups, the main technology transition success gaps and vulnerabilities were defined and listed. Respondents of varying frequencies pointed out the holes in the accompanying Table 2. When considering the total amount of issues, the critical factors can be described as a combination of causes and limitations in each parameter. The researcher used Pareto analysis and a Fishbone diagram to describe and solve the problem. As a result, it's worth looking at why these five major causes are so important using Pareto diagrams. The relationship between the key difficulty recorded success differences and the factors underlying them can be seen in this diagram (figure 4).The investigation of the root causes of such performance issues, as well as the generation of improvement ideas known as internal or external causes, is often aided by analysis. The bulk of issues would be minimized or protected if the key issue is addressed. According to respondents in western Oromia, and no motivating action has been taken to promote creativity and ingenuity. According to the findings, 70 percent of the barriers to technological transfer are a lack of confidence in competition, a lack of creative knowledge due to a lack of expertise, and a faulty invitation process. Another 15% of respondents said the research and development institute was a point of concern, specifically the research, manufacturing, and execution. The remaining 15% was due to a lack of technical capacity, cross-sectoral linkages, and a lack of integration and cooperation. Weakness in confidence level of experts was mainly caused due to less competition on the respective subject matter as they were busy with routine tasks.

Table 2: Total cumulative of complaints

Areas of low performance/ type of problems	No of complaints	Total cumulative of complaints	Percentage of complaints	Percentage of cumulative complaints
Weakness in Competition	250	400	35.7143	58
Creativity gap	250	700	35.7143	100
Weakness in R&D	100	100	14.2857	15
Technical skill transfer gap	50	150	7.14285	23
Linkage gap	50	450	7.14285	65
Total	700		100	

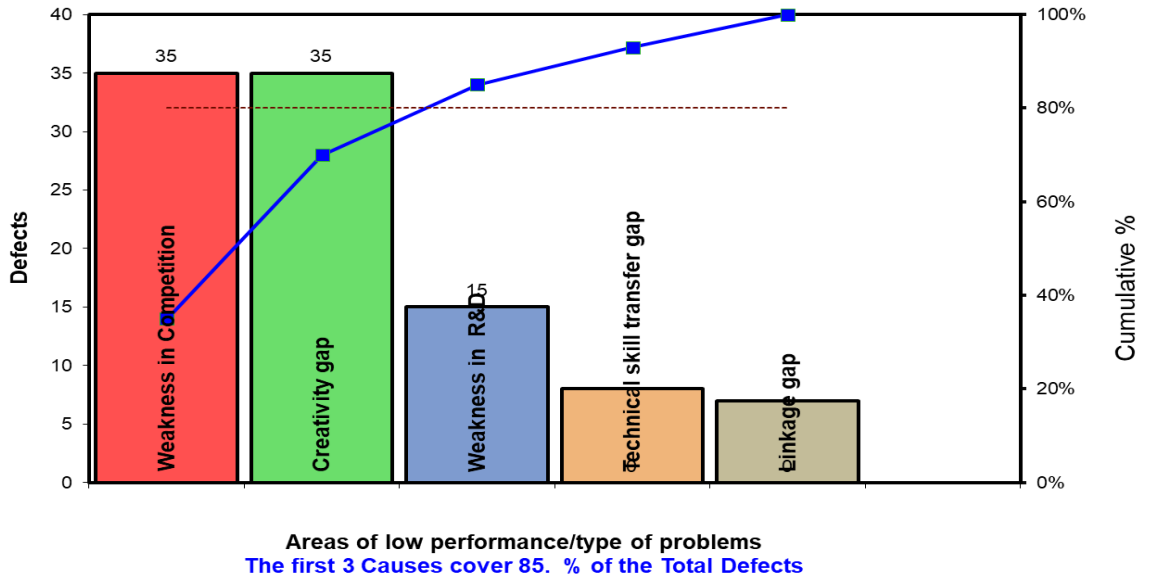

Figure 2. Pareto diagram

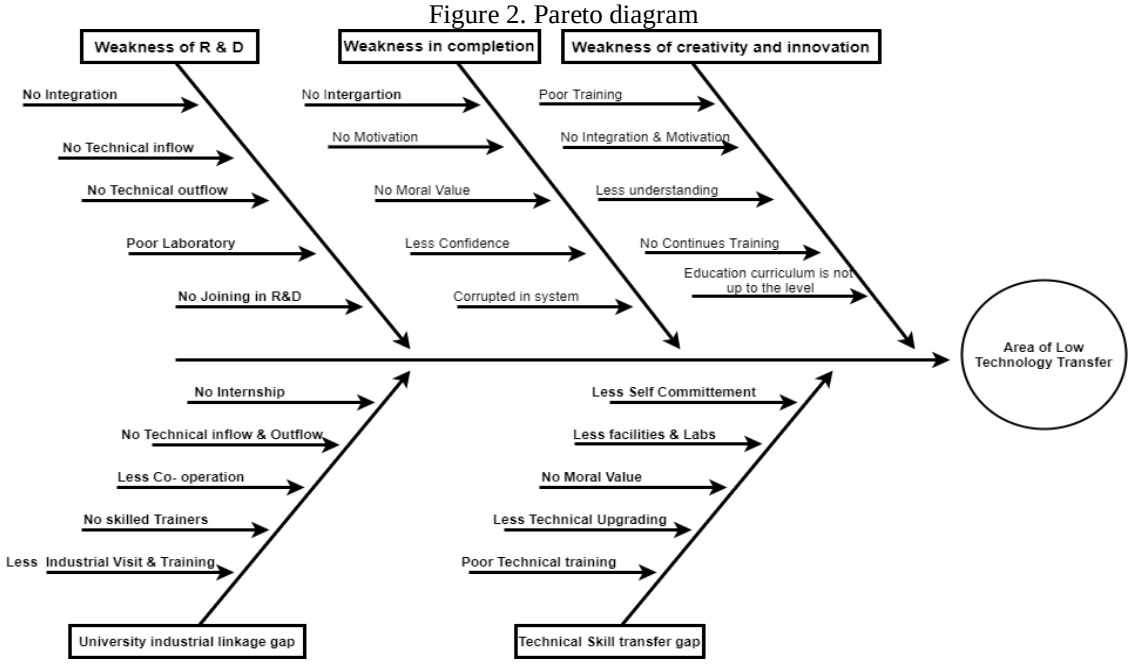

Figure 3. Fishbone Diagram

Western Oromia has left a series of achievements that may be considered best practices, even though society's view of technological change and innovation remains low, so they consider technology use to be technology transfer. Non-commercial methods were used even more than commercial strategies in the area for innovation and knowledge transfer. It is more important to understand the essence and sophistication of the techniques. The plurality of the research's expected outcomes were not achieved in Western Oromia. It implies a low rate of acceptance, implying a low level of technical change and creativity. TEVT schools, universities, scientific institutes, and businesses have no common framework to achieve the success technology transfer.

V. TO OVERCOME

The nature of different institutions with respect to their activities are varies accordingly. Therefore, most the infrastructures, R&D and education& training activities can be commonly used for those institutions with modifications and adjustments. In the same way, R&D institutions are varying due to nature of the products and items, share generic similarity with these findings. Based on this perspective, in addition educational

organization, industries and R &D institutions were selected for receiving the best practices obtained from each other. In terms of their operations, the existence of various organizations differs. As a result, with minor changes in infrastructures, research and development, curriculum and training activities may be utilized by certain organizations, results a better improvement. In addition, educational institutions, businesses, and research and development agencies were chosen based on this viewpoint to receive best practices from one another.

- Understanding Innovation and Technology Supply
- Understanding Technology transfer channels
- Prevent factory affecting technology transfer and innovation.
- Environmental instability
- Learning environment:
- Transferor characteristics
- Transferee characteristics

VI. DEVELOPED FRAME WORK FOR TTI

These issues/weaknesses must be thoroughly tackled in order to ensure long-term success and a competent human capital that will strengthen and promote the regions. TTI implementation needs a consistent plan and guidance to resolve this problem. However, certain methods can be systematic and others are particular triggers, depending on the form and circumstances of the root causes. Western Oromia needs various mitigation strategies for this analysis, and researchers defined mitigation strategies based on measuring variables. It includes the key root causes of the problems mentioned, which are split into internal and external causes that can be resolved by specialists and others with the

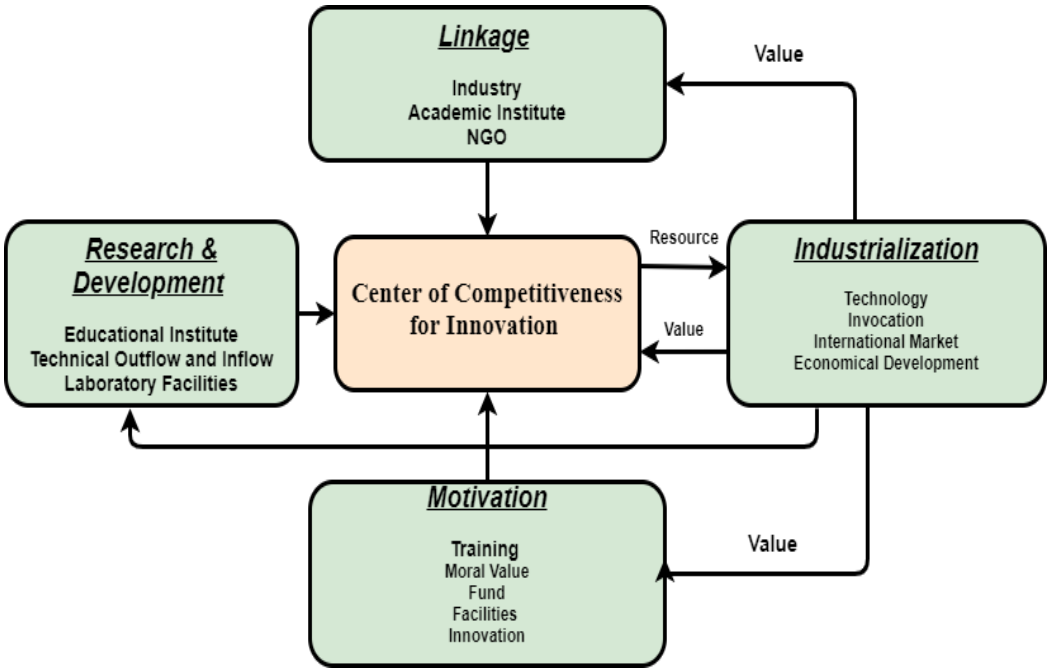

Figure 4.Center of competitiveness for Innovation (CCI)

assistance of external organizations or stakeholders. The researcher created a checklist to help in the adoption of policies and strategic structures by reflecting on core aspects that should be implemented by the related bodies. It also aids in the productive and efficient utilization of capital. The advice also allows tracking and managing the successful completion simpler. As a result, general measures are taken here to be used by the center of competitiveness for Innovation (CCI) and are focused on a conceptual structure and numerous TTI mechanisms.

VII. CONCLUSION

In this study researchers evaluated that the management engagement, group understanding, business linkage and inspiration for innovation. Generally, the status of technology transition and creativity in case of Western Oromia is very low. Particularly the roles of R&D institute, TVET College, University Industries Linkage are very low in collaboration. To overcome those vulnerabilities researcher suggested system that allows to more understanding technology transition process and evolving economic backgrounds.

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