



COLLEGE OF TECHNOLOGY AND BUILT ENVIRONMENT

Model development for Industry Extension Services in Small and Medium Enterprises to Promote Innovation and Technology Utilization: A Case study of Gulele Sub City Wereda 04 and 07.

By

Cherent Tsegaye

Advisors:

Dr. Merertu Wakuma (PhD)

Micheal Getachew (MSc.)

A Thesis Submitted to the School of Mechanical and Industrial Engineering in Partial Fulfillment for the Requirements for the Degree of Master of Science in Industrial Engineering

Addis Ababa, Ethiopia

June, 2025



College of Technology and Built Environment

School of Mechanical and Industrial Engineering

Title: Model development for Industry Extension Services in Small and Medium Enterprises to Promote Innovation and Technology Utilization: A Case study of Gulele Sub City Wereda 04 and 07.

Submitted by: _ **Cherent Tsegaye**

Approved by the Board of Examiners:

Dr. Merertu Wakuma (PhD)

Advisor Name

Signature

Date

Dr.Kassu Jilcha (Asso.Prof)

Internal Examiner

Signature

Date

Dr.Gezahgn Tesfaye (PhD)

External Examiner

Signature

Date

Dr. Abdulkadir Aman

Interim Head, SMIE

Signature

Date

Dr. Shegaw Ahmed

Interim vice Executive Dean for Academic Affair,
(CoTBE)

Signature

Date

DECLARATIONS

I hereby declare that this thesis proposal entitled “*Model development for Industry Extension Services in Small and Medium Enterprises to Promote Innovation and Technology Utilization: A Case study of Gulele Sub City Wereda 04 and 07.*” is original work of my own, has not been presented for a degree of any other university and all the resources used for the thesis have been duly acknowledged. I understand that non-adherence to the principles of academic honesty and integrity, misrepresentation or fabrication of any data, idea, fact and source in the future works will constitute sufficient ground for disciplinary action by the University and can also evoke penal action from the sources which have been properly cited or acknowledged.

CHERENT TSEGAYE

Student Name

Signature

June 05/2025

Date

This is to certify that the above declaration made by the student is correct to the best of our knowledge and thus we hereby endorse his proposal for approval.

Dr. Merertu Wakuma (PhD)

Main Advisor

Signature

June 05/2025

Date

ACKNOWLEDGMENT

First and foremost, I want to express my deepest gratitude to Almighty God for guiding me on the ability to successfully complete this thesis.

*I would like to thank my mother **Yeshewa Zewd Kebde**, May God rest your soul in paradise. I will thank you in the rest of all my life. Even today, I walk the path you showed me.*

*Next, I would like to start by thanking **Dr. Merertu Wakuma (PhD)** for her constructive remarks, for giving me the freedom to work on my own initiative, and for encouraging me to use the potential that I have with confidence in my skills. In addition, I would like to extend my gratitude to **Dr. Gezahgn Tesfaye (PhD)** for all his guidance, attitude, support and brilliant ideas throughout this research.*

*Last, but not least, I would like to give my deepest thanks to **all AAiT industrial engineering department instructors** and I would like to express my gratitude to all who helped me with their moral and technical supports during the entire process of this thesis.*

ABSTRACT

Industry Extension Services (IES) refer to support programs designed to enhance the productivity and competitiveness of businesses and also plays a crucial role in supporting small and medium-sized enterprises (SMEs) by providing essential support mechanisms by collaboration with TVET trainers. Industry extension service elements consist of entrepreneurship, kaizen, technological and technical support. This studies concern on technology support ones only due to the wider concept of to address the others industry extension packages.

Small and medium enterprises (SMEs) faces different challenges such as poor infrastructure, lack of appropriate marketing options, lack of integrated technology to increase their productivity and lack of financial options are the main challenges SMEs faces currently. The primary objective of this research is to identify and analyze any existing gaps in the technology support system of the case enterprise and develop a model for industry extension services on the promoting innovation and technology utilization within SMEs. It looks at how much these services help SMEs embrace and use technology in better way and techniques to improve their overall performance, productivity, and competitiveness. The research methodology involves conducting a comprehensive literature review, collecting, and analyzing quantitative and qualitative data on the main factors that affect the Industry Extension Services (IES) of the SMEs regarding technology support system. The collected data using both primary and secondary data collection methods was thoroughly analyzed using statistical software SPSS Version 26.

The quantitative data was obtained from questionnaires administered to 102 respondents are participated that are 36 Trainer,4 deans ,42 SMEs workers,8 woreda experts and 12 SMEs owners are participated and their responses were analyzed using SPSS.

The study's findings propose that Industry Extension Services (IES) for SMEs can solve different critical factors such as poor infrastructure, lack of market relations, and skill of SMEs workers to handle the technology effectively and efficiently and fostering innovation and technology utilization.so This study highly attempts to find possible weaknesses and opportunities for improvement in the current support systems provided to SMEs by critically evaluating the efficiency of industrial extension services due to promoting innovation and technology. The results of this study will aid in the development of more specialized and successful methods to assist

SMEs in fostering innovation and the use of technology by policymakers, business professionals, and development organizations.

Key Words: Industry Extension Services (IES), Small and Medium Enterprise (SMEs), Technology Utilization and Innovation.

Table of Content

DECLARATIONS	ii
ACKNOWLEDGMENT	iii
ABSTRACT	iv
List of Table	viii
List of Figure	x
CHAPTER ONE	1
1. INTRODUCTION AND BACGROUND	1
1.1 Introduction	1
1.1 Background and Justification	3
1.2 Problem statement	4
1.3 Research questions	6
1.4 Research Objectives	6
1.5 Scope of the Study	6
1.6 limitations and specific challenges	7
1.7 Significance of the study	7
1.8 Beneficiaries	8
1.9 Organization of the Research	8
CHAPTER TWO	9
2. LITERATURE REVIEW	9
2.1 Small and Medium Enterprises (SMEs)	9
2.2 Overview of industry extension services in SMEs	11
2.3 Significance of Industry Extension Services in SMEs	13
2.4 Current trends of TVET in Ethiopia	14
2.5 Industry Extension Packages/components	14
2.6 Innovation in SMEs	16
2.7 Technology Utilization in SMEs	17
2.8 conceptual frame work	18
2.9 Summary of literature	18
2.7 literature gap	22
CHAPTER THREE	23

3. RESEARCH METHODOLOGY	23
3.1 Introduction	23
3.2 Study Area	23
3.3 Research Design	23
3.4 Population	26
3.5 Sample Size	26
3.6 Data Collection	28
3.7 Methods of Data Analysis	30
3.8 Validity	30
3.9 Ethnical Consideration	31
CHAPTER FOUR	32
4. DATA PRESENTATION, ANALYSIS AND RESULTS	32
4.1. Introduction	32
4.2. Response rate	32
4.3 Analyzing the Demographic Information.....	32
4.4 Quantitative Data Description	36
4.5 Qualitative data analysis	53
4.6 Survey Result and Model Development.....	55
4.7 Bench marks to develop a model.....	60
4.8 Model Implementation Benefit and Justification	61
4.9 Model Validation.....	62
4.10 Findings and Result Discussion.....	63
CHAPTER FIVE	66
5. CONCLUSION AND RECOMMENDATION	66
5.1 Conclusion.....	66
5.2 Recommendation	67
5.3 Future research direction	68
Reference	69
APPENDIX	73

List of Table

Table 2.1: Classification of enterprises performance.....	10
Table 2.2: Main Constraints Facing SMEs in Ethiopia.....	11
Table 2.3: Summary of literature.....	20
Table 3.1 Population size	26
Table 3.2 Sample size.....	28
Table 4.1 Response summery.....	32
Table 4.2 Demographic results regarding Age.....	34
Table 4.3 Demographic results regarding Education.....	36
Table 4.4 Demographic results regarding Working Position.....	36
Table 4.5 Technological utilization.....	39
Table 4.6 Training and support.....	40
Table 4.7 Skill level and commitment of Enterprise.....	41
Table 4.8 Resource/infrastructure.....	42
Table 4.9 Technological support activity for Small and Medium Enterprise (SMEs) from the college.....	44
Table 4.10 currently implemented industry.....	45
Table 4.11 technology utilization area.....	45
Table 4.12 more implemented industry extension services.....	46
Table 4.13 Technological utilization.....	47
Table 4.14 Training and Support.....	48
Table 4.15 Skill level and commitment of Trainers.....	50
Table 4.16 Resource/infrastructure.....	51

Table 4. 17 Technological support activity by the Trainers.....	52
Table 4.18 more implemented industry extension services packages.....	52
Table 4.19 the rate of currently implemented industry extension service package.....	52
Table 4.20 evaluation of industry extension services' ability.....	53
Table 4.21 frequency of the colleges support	53

List of Figure

Fig1.1: Conceptual frame work developed by the researcher based on empirical literature discussed above.....	18
Figure 3.1: Research methods and process : (own source).....	25
Fig 4.1 Demographic results regarding Gender.....	33
Fig 4.2 Demographic results regarding experience.....	35
Fig 4.3 Improved Model Development of technology support for small and medium enterprise (source own work).....	60

ACRONOMY

IES = Industry Extension Service

SMEs = Small and Medium Enterprises

MSE = Micro and small enterprise

MInT = Ministry of Innovation and Technology

MFI = Micro Finance Institutions

PTC = Polytechnic college

R&D = Research and Development

SPSS = Statistical Package for the Social Sciences

TVET = Technical and Vocational Education and Training

ILO = International Labor Organization

CHAPTER ONE

1. INTRODUCTION AND BACKGROUND

1.1 Introduction

Industry Extension Services refer to support programs designed to enhance the productivity and competitiveness of businesses and also plays a crucial role in supporting small and medium-sized enterprises (SMEs) by providing essential technical and business assistance. These services, often government-sponsored or university-based, aim to enhance the competitiveness and growth of SMEs through various outreach initiatives and diagnostic tools (Shiferaw, E. R.2024).

In today's competitive business landscape, SMEs face numerous challenges in adopting and adapting to technological advancements and innovations (Singh, D, 2019). Industry extension services have become a support system for SMEs in response to this problem, offering them the tools, information, and direction they need to encourage innovation and make efficient use of technology.

Industry extension service, we commonly hear these days is the process jointly executed by technical and vocational education and training institutions and other stakeholders to assess and filling the gaps of micro and small enterprises to make them competent, productive, progressive, and profitable in the large economy (Dehnie, F. A, 2014).

According to Fita (2014) industry extension service elements consist of entrepreneurship, kaizen, technological and technical support. The mechanism of dissemination of the service is mainly through in-company training, consultation and through group discussions with enterprises engaged in the same sector. The beneficiaries of the industry extension service are selected based on interest, evaluation of individual demand and physical observation and evaluation of the enterprises' working premises (Gebrehiwot, A., & Wolday, A, 2006).

Ethiopia also use the industry extension service in different Small and Medium Enterprises (SMEs) that organized by governmental procedures and policy. In Addis Ababa there are 11 sub city administrations are found from their activity once are they organize and gives industry extension service for Small and Medium Enterprises (SMEs) with collaboration to different poly technical colleges that found in the city.

Currently the only activity of technology supports with in the Small and Medium Enterprises (SMEs) are develop different technologies in different poly technic colleges and transfer it to them but if we say technology support it includes gives training and support how can they use their machinery effectively and efficiently. How they will develop their innovative idea and assess the current technological advancement/integration and how they compare and able competent with market and such like questions must answer on the technological supports not only consider on technology transfer parts only. This is the main problems faced on industry extension service due to technological supports.

The primary objective of this research is to develop a model for industry extension services on the promoting innovation and technology utilization within SMEs. It looks at how much these services help SMEs embrace and use technology in better way and techniques to improve their overall performance, productivity, and competitiveness.

The research was uses various methodologies, including surveys, interviews, and data analysis, to collect and analyze primary and secondary data from a diverse sample of SMEs that found in Gulele Sub city at wereda 07 and 04. And also investigate factors such as the nature and types of industry extension services offered, their accessibility, relevance, and effectiveness in stimulating innovation and technology utilization.

This study highly attempts to find possible weaknesses and opportunities for improvement in the current support systems provided to SMEs by critically evaluating the efficiency of industrial extension services due to promoting innovation and technology. The results of this study will aid in the development of more specialized and successful methods to assist SMEs in fostering innovation and the use of technology by policymakers, business professionals, and development organizations.

Overall, this research endeavors to contribute to the body of knowledge on industry extension services and their impact on SMEs' innovation and technology utilization. It seeks to provide insights into how these services can be enhanced to better serve the needs of SMEs, ultimately driving economic growth and sustainable development.

1.1 Background and Justification

Small and medium-sized enterprises (SMEs) are defined variably across different contexts, reflecting their diverse roles in the economy. Generally, SMEs are characterized by their size, operational scope, and economic impact, with definitions often tailored to specific regional or sectorial needs (Gougé, E., & Torrecilla, V.2017).

According to Fujita, M. (1997), the European Union Definition says that SMEs are enterprises with fewer than 250 employees and an annual turnover not exceeding EUR 50 million, or a balance sheet total not exceeding EUR 43 million and on some Global Variations Definitions can vary significantly; for instance, some countries classify SMEs based on employee count thresholds that can reach up to 500 for manufacturing.

Industry Extension Services refer to support programs designed to enhance the productivity and competitiveness (Shiferaw, E. R.2024).this services for SMEs vary significantly across different countries, reflecting diverse economic contexts and innovation ecosystems. These services aim to enhance the capabilities of SMEs, facilitating their adaptation to market demands and technological advancements (Gibb, A., & Manu, G.1990).

Countries like the US, Japan, and Germany have established technology extension programs that focus on building innovation capabilities in SMEs. These programs are tailored to the specific innovation systems of each country, providing best practices for others For instance, Germany's initiatives emphasize collaboration between SMEs and research institutions, fostering a culture of innovation (Shapira, P., Youtie, J., & Kay, L.2011).Even though SMEs' extension services are essential for promoting innovation and global competitiveness, there is rising doubt regarding how well these services meet the particular requirements of smaller businesses. There is a need for more extensive support systems that can adjust to their unique circumstances and difficulties, as many SMEs find it difficult to negotiate the complexity of global markets (Fujita, M.1997).

In the Ethiopian context, technology support services for SMEs are crucial for enhancing their competitiveness and operational efficiency. The primary challenge for Ethiopian SMEs is the absorption of external technological innovations, which is hindered by limited human capital and access to knowledge. The government has emphasized improving access to public domain patent information, but uptake remains low due to these barriers (Belete, W, 2015).

According to [Shiferaw, E. R. \(2024\)](#), the effective support for technology-based small businesses, including those in Ethiopia, should be local, easily accessible, and tailored to different stages of business development. It highlights the need for programs that are informal, personal, and integrated, combining advice, consultancy, and financial support. Additionally, employing better-qualified personnel and focusing on managerial development are crucial for adapting to new technologies. Marketing support should also be an essential component of the overall assistance provided to SMEs.

SMEs face challenges such as financial constraints, technical difficulties, and knowledge gaps when adopting emerging technologies. To enhance competitiveness, SMEs in Ethiopia could benefit from tailored technology support services that address these challenges, including training programs, strategic partnerships, and access to affordable technology solutions, which are crucial for successful implementation and sustainable growth in the local market ([Bakhary, et al, 2024](#)).

According to [Fita \(2014\)](#) industry extension service elements consist of entrepreneurship, kaizen, technological and technical support. In the Ethiopian context, Small and Medium-sized Enterprises (SMEs) face significant technology support challenges that hinder their growth and digital transformation. A diversified strategy that includes strategic alliances, infrastructure development, and human capital enhancement is needed to address these issues. Many SMEs have challenges with insufficient technology infrastructure and poor internet connection, both of which are essential for digital transformation. Therefore, the models for industry extension service for SMEs on technology support system are used to promote innovation and technological utilization of the enterprises and fill the gaps on the sectors.

1.2 Problem statement

In many nations, Small and Medium Enterprises (SMEs) are the main force behind economic development and progress. SMEs innovation and technology adoption are essential for maintaining competitiveness in the global market. By offering a range of support mechanisms, such as networking opportunities, consulting services, and training, industry extension services (IES) have developed as a viable way to assist SMEs in this area. The success of these IES in encouraging SMEs to innovate and use technology is still up in the air ([Ababa, A, 2014](#)).

Ethiopia also use the industry extension service in different Small and Medium Enterprises (SMEs) that organized by governmental procedures and policy. In Addis Ababa there are 11 sub city administrations are found from their activity once are they organize and gives industry extension service for Small and Medium Enterprises (SMEs) with collaboration to different poly technical colleges that found in the city.

The Industry extension service given for Small and Medium Enterprises (SMEs) in our country have four main programs/packages entrepreneurship, technical support, production improvement (Kaizen) and technology development and transfer. From this packages this study are focus on technology development and transfer support mechanisms.

Currently the only activity of technology supports with in the Small and Medium Enterprises (SMEs) are develop different technologies in different poly technic colleges and transfer it to them but if we say technology support it includes gives training and support how can they use their machinery effectively and efficiently. How they will develop their innovative idea and assess the current technological advancement and how they compare and able competent with market and such like questions must answer on the technological supports not only consider on technology transfer parts. This is the main problems faced on industry extension service due to technological supports.

So this study will develop a model for industry extension service due to the technological support package and will solve the problems due to that will capable them on promoting innovation and better utilization of technology by developing a models and frame works that better for this sectors Based on the findings.

By tackling this issue, the study can offer insightful information to industry professionals, legislators, and SMEs alike. The results can be used by policymakers to create and execute industry extension programs that are more tailored to the unique requirements of SMEs. Industry practitioners may learn about the best approaches and tactics for helping SMEs embrace innovation and technology. SMEs can also gain from making educated decisions, realizing the possibilities of industry extension services, and making the most of the assistance that is offered.

1.3 Research questions

1. What are the factors that influence industry extension service in relating to technology support in small and medium enterprise?
2. What are the challenge and success of industry extension service in relation to technology utilization and promote innovation in small and medium enterprise in Gulele Sub City Wereda 04 and 07?
3. How can develop the industry extension service model for small and medium enterprise towards the implementation of technology utilization and promote innovation in Gulele Sub City Wereda 04 and 07?

1.4 Research Objectives

1.4.1 General Objectives

- The main objective of this research is to develop a model for SMEs to enhance effective industry extension services for innovation and technology utilization.

1.4.2 Specific Objective

- To identify and analyze the challenge and success of industry extension service in relation to technology support in small and medium enterprise in Gulele Sub City Wereda 04 and 07.
- To develop the industry extension service model for small and medium enterprise towards the implementation of technology support in Gulele Sub City Wereda 04 and 07.

1.5 Scope of the Study

This work is purposely designed for Addis Ababa, Gulele sub city at wereda 07 and 04 small and medium manufacturing enterprises and service providers in Addis Ababa city. The focus of the research is how IES influences the innovative capacities and technological adoption of SMEs in various industries The Industry extension service given for Small and Medium Enterprises (SMEs) in our country have four main programs/packages entrepreneurship, technical support, production improvement (Kaizen) and technology development and transfer. From this packages this study are focus only on technological utilization and support systems by Entoto TVET trainers for SMEs.

1.6 limitations and specific challenges

The location of each SME firm, as well as the selected enterprises, which are located in different areas and most of the time the owners of the enterprises doesn't found on the working area, is the study's initial obstacle and also was a serious challenge that this research face and also some of the respondents were not willing to fill the provided questionnaires due to being attached with their regular works and carelessness. As a result, time is a constraint during data collection, as is a personal issue that causes discomfort and diverts attention from investigating the problem and following up on instances in a timely manner. It's also difficult to find a publication that discusses the elements that influence industry extension service on promoting innovation and technology transfers and success from polytechnic schools to SMEs. Aside from that, data gathering and interactions with business owners and higher-level officials are essential.

From the fourth industry extension service packages that are interprnnership, Kaizen, Technical and technological support activity that address for SMEs this study only concerns on the technological support system only but it is better and efficient if it will address the remains industry extension service support packages.

1.7 Significance of the study

This study is aimed to produce well-organized documents that demonstrate the magnitude of factors influencing IES and that influences the innovative capacities and technological utilization activities in Addis Ababa, Gulele Sub city at wereda 07 and 04.

This study can offer insightful information to industry professionals, legislators, and SMEs alike. The results can be used by policymakers to create and execute industry extension programs that are more tailored to the unique requirements of SMEs on technology support system. Industry practitioners may learn about the best approaches and tactics for helping SMEs embrace innovation and technology. SMEs can also gain from making educated decisions, realizing the possibilities of industry extension services, and making the most of the assistance that is offered.

Furthermore, the study can help identify any gaps or challenges in the current implementation of industry extension services on technology support system, allowing for targeted improvements and interventions. Ultimately, the results of this study can help guide strategies and decision-making processes targeted at SMEs' innovation and technology utilization, increasing their

competitiveness and promoting sustainable development in the business sector and a model also specifically for them addresses their unique challenges.

Technological utilization can increase efficiency and production when used properly. The goal of the model is to make this process easier by making sure SMEs use contemporary tools efficiently. It also offers a framework that encourages collaborations between SMEs and TVET sectors, which promotes resource access and knowledge exchange. The concept has the potential to enhance the industrial landscape, spur creativity, and foster economic progress by fostering technology and innovation.

1.8 Beneficiaries

The study will contribute to the study on the title model development for Industry Extension Services in Small and Medium Enterprises on Promoting Innovation and Technology Utilization, as a stepping stone to do further studies, as well as, it will be useful to the stakeholders including; scholars, TVET colleges, micro and small enterprises', government policy makers, NGO practitioners and other decision makers on technology and innovation output to embraces participants' interests to be included.

1.9 Organization of the Research

This study report is organized into five chapters, each with a distinct function. The following components are included in the first chapter: introduction, background, problem justification, research question and objectives, study scope, research limitation and challenges, importance of the study and how the research was structured. A systematic analysis of the relevant literature is covered in the research paper's second chapter. The research methods and study design framework are covered in detail in Chapter three. The outcomes of the data interpretation, analysis and proposed model development are briefly summarized in Chapter four. The fifth chapter also focus on the conclusion and recommendations derived from the study. The research paper's reference list, which offers a detailed and precise citation of all the sources cited throughout and appendix is included in the last section.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Small and Medium Enterprises (SMEs)

Small and Medium Enterprises (SMEs) widely acknowledged as a crucial component of economic dynamism and are seen as a major engine of economic development, productivity, innovation, and employment. (UNDP, 2016). SMEs, which account for over 90% of enterprises in all countries, are an important source of output and employment. They employ 33% of formal sector workers in low-income countries and 62% of such workers in high-income countries. Because poor countries have large informal economies, dominated by micro-businesses, the SMEs portion of total employment is much higher (ILO, 2006).

Micro, small and medium enterprises (MSMEs) are the backbone of the economies, because they trigger employment, output, export, economic development, poverty alleviation, economic empowerment, etc., in developed and developing countries. These industries are more important to developing countries because poverty and unemployment are burning problems.

In the present age of globalization, micro, small and medium enterprises (MSMEs) are consistently causative to productivity growth and, consequently, competitiveness and aggregate economic growth by providing the training opportunities, basic services and are believed to be especially effective job creators and enjoy the reputation of being sources of income. But technological progressions have increased greatly (Singh, D, 2019).

According to Micro and Small Enterprises Development Strategy of Ethiopia, designed to ensure the sustainability of the development achieved in all economic sectors of the country, the main focus of the government is creating job opportunities through MSEs development, to reduce unemployment and alleviate poverty and enhancing MSEs to be base for industrial development in the country (Ayele, T, 2018).The strategy emphasized that industry extension service package incorporating four segments: Bookkeeping, technology, production improvement/kaizen and entrepreneurship is believed to be pillars so as to upgrade MSEs in to medium level enterprises in the process of transforming the country from agriculture led to industrialization. The service provision started since 2011 to all MSEs focusing on selective developmental sectors mainly manufacturing, urban agriculture, construction and agro processing.

International experience suggests that an efficient SME sector is conducive to rapid industrial growth and a flexible industrial structure. Tai- wan often is held out as an example of an economy built on the foundations of an efficient SME sector (Hill, H, 2001).

Table 2.1: Classification of enterprises performance

Types of enterprises	Sector	Human power	Total asset
Micro enterprises	industry	< 5	< 100,000 Birr
	service	< 5	< 50,000 Birr
Small enterprises	industry	6-30	< 1.5 million Birr
	service	6-30	< 500,000 birr
Medium enterprises	industry	> 30	> 1.5 million Birr
	service	> 30	> 500,000

Source: Endris, E., & Kassegn, A. (2022).

2.1.1 Major Challenges and Constraints of SMEs in Ethiopia

Small, medium, and micro enterprises (SMMEs) play a vital role in Ethiopia’s economic development, contributing to job creation, poverty reduction, and community livelihoods. However, these enterprises face significant challenges that limit their growth, profitability, and long-term survival (Gebrehiwot, A., & Wolday, A.2006).

And also according to Ayele, T. (2018), SMEs in Ethiopia are essential for economic development and poverty reduction but face persistent challenges, especially in finance, infrastructure, and management. Addressing these barriers through targeted policy, improved financial access, and capacity building can enhance their growth, profitability, and long-term sustainability.

Table 2.2: Main Constraints Facing SMEs in Ethiopia

Constraint	Description/Impact	Description/Impact
Finance	High collateral, limited loans, informal sources	
Infrastructure	Poor facilities, unreliable utilities	
Skills & Management	Low education, poor managerial/technical skills	
Market Linkage	Limited access to reliable markets	
Gender Gap	Women underrepresented in key sectors	
Government Support	Insufficient, inconsistent, or poorly targeted	

Source: (Gebrehiwot, A., & Wolday, A. (2006).

2.2 Overview of industry extension services in SMEs

Industry Extension Services (IES) refer to support programs designed to assist small and medium-sized enterprises (SMEs) in improving their productivity, efficiency, and innovation capabilities. These services aim to facilitate the adoption of new technologies and practices. The primary purpose is to bridge the gap between knowledge and practical application, enabling SMEs to adopt new technologies and improve their competitive edge (Budianto, R.et al 2022).

According to Shiferaw, (2024), Industry extension services (IES) are designed to enhance the performance and sustainability of small and micro enterprises (MSEs) through targeted support and resources. These services aim to address specific challenges faced by industries, particularly in developing economies, by providing training, consultancy, and technological assistance. The objectives of IES include improving productivity, fostering innovation, and facilitating market access for small-scale industries.

Industry extension service means a method of providing services to micro and small businesses after determining and gathering their fundamental weaknesses. The Extension is an array of encircling, broad actions intended, among other things, to foster progress that apparently aids in the resolution of difficult problems (International Labor Office, 2003).

Industry extension service, we commonly hear these days is the process jointly executed by technical and vocational education and training institutions and other stakeholders to assess and

filling the gaps of micro and small enterprises to make them competent, productive, progressive, and profitable in the large economy (Dehnie, F. A, 2014).

And also Gibb, A., & Manu, G. (1990), SMEs often face resource constraints, making it challenging to invest in research and development. IES helps SMEs access expertise, training, and resources that they may not afford independently. It fosters a culture of innovation, leading to improved products, processes, and overall business sustainability.

According to Fita (2014) industry extension service elements consist of entrepreneurship, kaizen, technological and bookkeeping competency. The mechanism of dissemination of the service is mainly through in-company training, consultation and through group discussions with enterprises engaged in the same sector. The beneficiaries of the industry extension service are selected based on interest, evaluation of individual demand and physical observation and evaluation of the enterprises' working premises (Gebrehiwot, A., & Wolday, A, 2006).

On other country context according to Shapira et al., (2015), Services provided by industry extensions have been essential in helping small and medium-sized businesses modernize their technology. Examples of the transition from basic help to comprehensive, structured assistance programs include the U.S. Manufacturing Extension Partnership and England's Manufacturing Advisory Service. These services typically involve direct assistance to enterprises, focusing on technology transfer, business upgrading, and innovation. They are characterized by diverse funding structures, governance models, and client engagement strategies.

2.2.1 Industry

It is a type of economic activity where products are produced in factories and raw materials are processed. From the definition, it is clear that industry is a way to convert raw materials into more usable commodities that have the following three requirements Inputs, outputs, and production (Fita, 2014).

2.2.2 Extension Service

Under Ethiopian context, Extension services aim to encourage the adoption of improved technologies by providing information, knowledge, and skill development. They also facilitate linkages with other institutional support services, such as input supply, output marketing, and credit (Berhanu, 2014).

2.3 Significance of Industry Extension Services in SMEs

Industry extension services, when effectively delivered, have a positive and significant impact on the performance of SMEs. This includes improvements in entrepreneurship, technology adoption, and technical skills, which are crucial for the growth and sustainability of these enterprises (Gibb, A., & Manu, G.1990).

According to Motwani, J et al (1999), Studies indicate that the support provided by Technical and Vocational Education and Training (TVET) trainers to SMEs is often inadequate. This inadequacy is observed across various dimensions such as technical, technology, Kaizen, and entrepreneurship support. The performance of SMEs in these areas remains low, suggesting that the current model of service delivery may not be sufficient it is recommended that industry extension services should be provided by full-time experts rather than as a supplementary task by TVET trainers. These experts should possess the necessary skills, knowledge, and attitude to effectively deliver support in all dimensions of industry extension services.

Manufacturing extension services have been shown to significantly boost labor productivity growth, with participating enterprises experiencing between 3.4% and 16% higher productivity growth compared to non-participants. This highlights the effectiveness of extension services in enhancing productivity (Jarmin, R. S.1999).

Digital extension services, especially in agriculture, provide personalized information that helps small enterprises optimize their operations. This includes guidance on crop selection, input usage, and cultivation methods, leading to increased input intensity, production diversity, and crop income (Rajkhowa, P., & Qaim, M.2021).

The design of extension services is critical. A well-structured model for small-scale enterprise (SSE) extension services can provide sound practices and guidelines, ensuring that support services are effectively tailored to the needs of SMEs (Gibb, A., & Manu, G.1990).

Innovation capability is a crucial driver for SME performance, particularly in manufacturing industries. It helps SMEs achieve sustainable performance and competitive advantage, especially when combined with technology adoption. SMEs that integrate technological and innovation considerations with strategic development can achieve significant benefits, such as increased

productivity, adaptability, and sales through unique or higher-performance products (Motwani, J et al 1999).

The utilization of social media and digital marketing technologies can significantly improve SME performance by enhancing information sharing, interaction, and advertising capabilities (Subagja, A. D 2022).

2.4 Current trends of TVET in Ethiopia

According to the National TVET Strategy (2008), Technical institutions were not created just to impart knowledge. It is expected of them to evaluate the job market and prepare their students for the workforce by providing cooperative training, apprenticeships, and internships. That way the students will get the opportunity to get the skills, knowledge, and attitudes expected of them in the real world of work. The National TVET Strategy (2008), states that “technical and vocational education and training (TVET) programs perform the primary function by generating skilled labor that may be used to either start their own business or get employment in other organizations.

And also “technical and vocational education and training (TVET) gives industry extension services for different enterprises based on the strategy and the packages.

2.5 Industry Extension Packages/components

2.5.1 Entrepreneurship Support

An individual's capacity to translate ideas into action is referred to as entrepreneurship (Yodit G, 2015). Therefore, being an entrepreneur is a critical skill that enhances one's creativity and confidence in any endeavor. The ability to be an entrepreneur is essential for managing business operations, taking calculated risks, and succeeding in one's chosen field. The business development service, business network building, business development and expansion, and business opportunity management are all included in the entrepreneurial training program for MSEs (Ababa, A, 2014).

According to Fita (2011) entrepreneurship support means business related support giving to MSEs in order to make them competent and competitive enough in the local and international market.

2.5.2 Technology Supports

The term “technology” has not found to be easy as per different scholars’ argument. Due to this nature of technology, researchers have been discussed the definition from different perspectives.

Technology consists two primary components ([Wang.et.al, 2010](#)). These are a physical component and informational component. A physical component which comprises of items such as products, tooling, equipment's, blueprints, techniques, and processes; and the informational component which consists of know-how in management, marketing, production, quality control, reliability, skilled labor and functional areas.

The term "technology" can be used to refer to anything, real or intangible, that advances a nation's economy, industry, or culture. According to [Fita, A. \(2014\)](#) Technology is a resource that businesses must adapt to maximize its effectiveness and productivity. For MSEs a technology which is more of labor intensive, low-skill spheres and that can use local materials and resources is recommended. [Fita, A. \(2014\)](#) also added that the design of new tools, machinery, materials, industrial procedures, and organizational techniques are all part of technological development.

2.5.3 Kaizen Support

According to [Singh, J., & Singh, H. \(2009\)](#) The ultimate objective of manufacturing industries today is to increase productivity through system simplification, organizational potential and incremental improvements by using modern techniques like Kaizen. Kaizen is a process of continual understanding by an organization to improve its business activities and processes with the goal to always improve quality of products and services so that the organization can meet full customer satisfaction.

Kaizen is a Japanese word that has become common in many western companies. The word indicates a process of continuous improvement of the standard way of work ([Chen et al., 2000](#)). It is a compound word involving two concepts: Kai (change) and Zen (for the better) ([Palmer, 2001](#)).

2.5.4 Technical Support

TVET educational institutions should work with industry partners to close the skill gap, with an emphasis on economic and technological activities. People work, and a large part of their productivity at work is determined by the possibilities they have to learn and keep up with critical skills. In aspiring to comprehend the potential of skills development, they face common challenges (International labor office ([ILO, 2010](#))).

2.6 Innovation in SMEs

2.6.1 Invention and Innovation

According to [Malerba, F., & Orsenigo, L. \(1997\)](#) defines invention as a new idea, a new scientific discovery or a technological newness (which has not been implemented and diffused). While innovation refers to a tradable application of an invention, as a result of invention integration into economic and social practice. Innovation is regarded, therefore, being a result of a process that starts with an idea genesis and continues with its materialization.

So, to develop innovation activity it is important that enhance 'innovative capability', is defined as a set of knowledge-related resources that generate and manage technological changes, including skills, knowledge and experience, and techno-physical and organisational systems.

Accumulating higher levels of innovative capabilities generates opportunities for firms to utilise such capabilities to diversify into new technological activities and business lines, thus creating new industrial sectors within the economy. SMEs may utilise the knowledge of users, suppliers, and other partners to complement their capabilities they may engage in collaborative innovative activities for market-related motives such as meeting customers' demands ([Figueiredo, P. N., & Piana, J, 2018](#)).

2.6.2 Innovation in SMEs

According to [Wang.et.al \(2010\)](#), Innovation is vital to the expansion and viability of small and medium-sized businesses (SMEs), since it boosts customer happiness, productivity, and competitiveness. In a business environment that is changing quickly, SMEs who use innovative practices are better able to overcome obstacles and take advantage of possibilities.SMEs that implement environmentally friendly innovations experience higher growth rates compared to those that do not ([Fernandes et al., 2023](#)).

There are **three types** of innovation according to [Malerba, F., & Orsenigo, L. \(1997\)](#).

- **Product Innovation:** Development of new or improved products to meet changing consumer demands.
- **Process Innovation:** Enhancements in production or delivery methods that increase efficiency.

- **Organizational Innovation:** Changes in business practices or workplace organization that improve performance.

SMEs often face challenges like limited access to financing and risk aversion, hindering innovation efforts. Embracing innovation as a strategic priority can help SMEs overcome obstacles and achieve long-term sustainability (Wang.et.al, 2010).

To cultivate a culture of innovation for SMEs investing in research and development, forming collaborations with other businesses or institutions, and leveraging technology to enhance their innovative capabilities (Malerba, F., & Orsenigo, L. (1997).

2.7 Technology Utilization in SMEs

2.7.1 Technology Utilization

Technology utilization is a process that has a profound impact on the survival of the firm, particularly in today's high technology market where technological changes are rapid and often dramatic. The market place both locally and internationally is replete with business failures resulting from the inability of firms to maintain a competitive edge in technology utilization and/or transfer (Varzaly, L. A., & Elashmawi, F, 1984).

According to Jayawardena et al (2024), the utilization of technology in small and medium enterprises (SMEs) significantly enhances their capabilities, particularly in industry extension services. By integrating technology into their operations, SMEs can improve marketing strategies, innovate processes, and access vital resources that foster growth. This integration is crucial for competing effectively in both local and global markets.

SMEs benefit from technology-driven marketing strategies, such as social media and email campaigns, which are more cost-effective than traditional methods. A significant number of SMEs utilize information communication technology (ICT), with email being the most common tool, enhancing communication and marketing efforts. Approximately 79% of SMEs recognize that adopting new technologies leads to increased profitability, highlighting the economic benefits of technology utilization (Shapira, 1990).

While technology utilization offers significant advantages, SMEs often face challenges such as limited resources and strategic focus, which can hinder their ability to fully leverage these technologies. Addressing these barriers is essential for SMEs to maximize the transformative

potential of digital technologies and maintain their competitive position in the market (Chabalala et al., 2024).

2.8 conceptual frame work

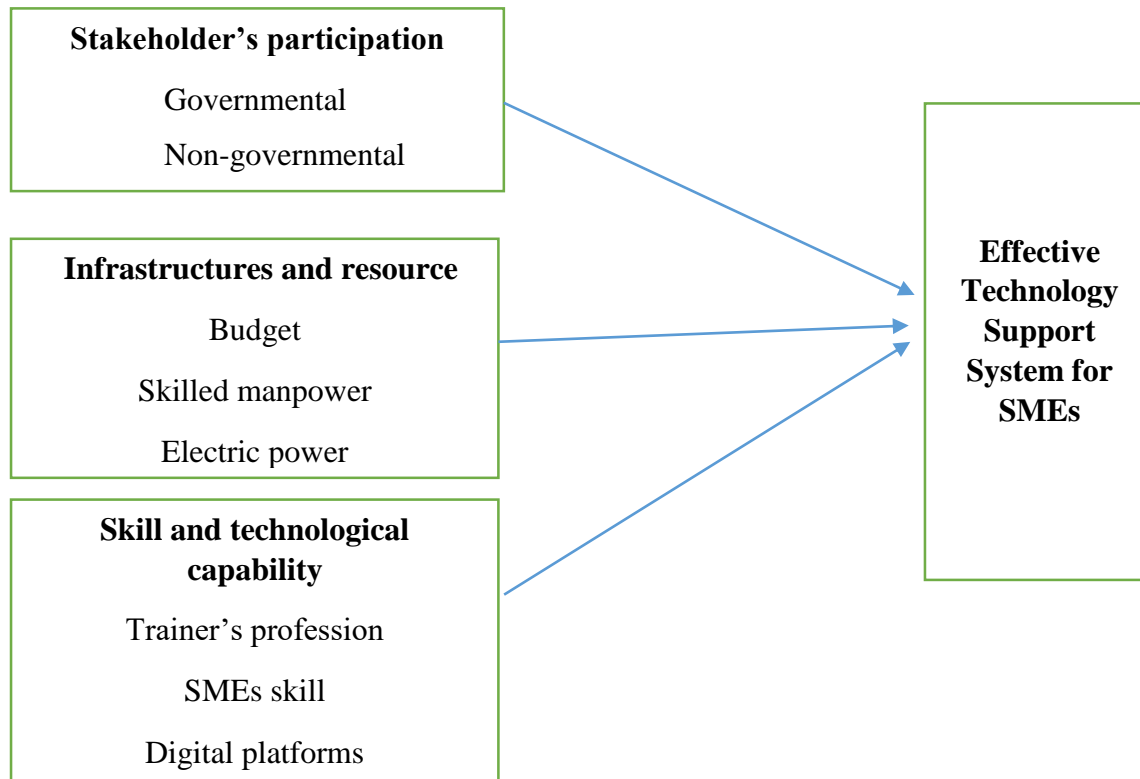


Fig1.1: Conceptual frame work developed by the researcher based on empirical literature discussed above

2.9 Summary of literature

Industry extension service, we commonly hear these days is the process that technical and vocational education and training institutions, together with other stakeholders, work together to carry out to evaluate and close the gaps that exist in micro and small businesses so that they can become viable, competent, and forward-thinking businesses in the larger economy. Industry extension service elements consist of entrepreneurship, kaizen, technological, and bookkeeping competency.

Small and Medium Enterprises (SMEs) are widely acknowledged as a crucial component of economic dynamism and are seen as a major engine of economic development, productivity, innovation, and employment. The main focus of the Ethiopian government is creating job opportunities through MSE development, reducing unemployment alleviating poverty, and enhancing MSEs to be base for industrial development in the country. International experience suggests that an efficient SME sector is conducive to rapid industrial growth and a flexible industrial structure.

Accumulating higher levels of innovative capabilities generates opportunities for firms to utilize such capabilities to diversify into new technological activities and business lines, thus creating new industrial sectors within the economy

Table 2.3: Summary of literature

Authors	Year	Main point/ Findings
Fita (2014)	2014	<ul style="list-style-type: none"> ▪ Found that despite the fact that industry extension service is already started in all TVET institutions, equal attention is not given to all the packages. Kaizen is found to be the most implemented package among the four industry extension services. ▪ the industry extension service is not provided in accordance with the standards due to lack competent service providers
Ginja, T. G. (2016).	2016	<ul style="list-style-type: none"> ▪ MSEs in Wolayta Soddo town are facing challenges in lack of training and advice in the areas of financial management, time management, inventory, record keeping, supply chain management, market promotion, and human resource management.
Singh, D. (2019).	2019	<ul style="list-style-type: none"> ▪ The study finds that two different firms have faced similar kind of challenges in this competitive environment. Also the findings suggest that an effective TII (Technology Innovation Implementation) can contribute to enhance manufacturing performance in MSMEs in India.
Wube, M. C. (2020).	2020	<ul style="list-style-type: none"> ▪ The results of the analysis show that industry extension service supports provided by TVET trainers to MSEs is not adequate in all the four dimensions: technical, technology, Kaizen and entrepreneurship
Siddiky, M. R., & Uh, S. B. (2020).	2020	<ul style="list-style-type: none"> ▪ The study has proposed a partnership-based approach to TVET where both the partners – TVET institution and industry – will work together and undertake joint initiatives based on mutual commitment and shared responsibility to promote formal and non-formal TVET in Bangladesh in line with labor market needs and technological changes.

Chavez et al,(2020)	2020	<ul style="list-style-type: none"> ▪ The paper proposes a conceptual model for SMEs' digitalization, focusing on capability building to enhance production processes. It emphasizes a structured approach for technology support, enabling continuous improvement and aligning with SMEs' specific business needs for effective digital transformation.
Lewandowska,etal,(2023)	2023	<ul style="list-style-type: none"> ▪ The paper discusses strategic models for mobile application development and emphasizes the need for innovative business models in SMEs, addressing challenges like limited resources and infrastructure hurdles, which can support technology in industry extension services for SMEs.
Baritto,et al,(2020)	2020	<ul style="list-style-type: none"> ▪ The paper proposes a methodology to assist SMEs in understanding Industry 4.0 implementation requirements and benefits, which can serve as a model for technology support in industry extension services, guiding managers on migration strategies to enhance productivity and efficiency

2.7 literature gap

This study seeks to develop a model for Industry Extension Services in Small and Medium Enterprises to Promoting Innovation and Technology Utilization in Addis Ababa at Gulele Sub city wereda 07 and 04. A prior study that analyze The Effect of Industry Extension Services Packages on the Performance of Small and Micro Enterprises in Dessie, South Wollo and Oromia Zones of Eastern Amhara (Wube, M. C, 2020) had limitations, as the research that able to cover all the four packages of industry extension service this action cannot be address effectively each package due to the wider and broader concept of the packages and other literatures are focus on the view of the service provider direction only not consider the user/enterprises like (Fita, A, 2014).

Most of the authors that conduct the research on industry extension service they consider the challenges and effectiveness of the sector and after finding the results they only recommend the solution based on their expectation but it needs better and applicable solution for the findings so due to this direction this study will fill this gapes by applying properly the developed model it is based on evidence and the findings.

The other ones are, the previous research are conducted on industry extension service and technology development and transfer parts only but this study was identify the gaps due to the technological support mechanism out of the transfer part by looking the support mechanism in other/new side and develop a model based on the findings.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is the path through which researchers need to conduct their research. It demonstrates the process by which these researchers define their problem and objective and then present their findings based on the information gathered throughout the study period. The chapter on research design and methodology also demonstrates how the study's goal was met by the research outcome at the conclusion. Thus, the research methods that were employed during the research process are discussed in this chapter. It includes all aspects of the study's research methodology, from the research plan to the dissemination of the findings.

3.2 Study Area

The Industry extension service given for Small and Medium Enterprises (SMEs) in our country have four main programs/packages entrepreneurship, book keeping, production improvement (Kaizen) and technology development and support. From this packages this study are focus on technology development and support once. The Data was collected from the Small and Medium Enterprises (SMEs) that found in Addis Ababa, Gulele Sub City at wereda 07 and 04 enterprise owners and workers, supervisors, industry extension experts that works in wereda, poly technical college stakeholders are participated. The participants are selected randomly.

3.3 Research Design

The goal of the research design is to offer a suitable framework for a study. The decision to be made regarding the research approach is very important because it determines how pertinent data for a study will be obtained; however, the research design process involves many interrelated decisions (Aaker, 2008).

This study was used a mixed type of methods. The study's first phase included semi-structured interviews with important participants (industry extension service providers and Small and Medium Enterprises (SMEs) in participating organizations as well as a series of well-structured questionnaires (for owners of enterprises, experts, and coordinators of technology transfer office). The second design involves field observation at the chosen enterprises, as well as interviews with

Stakeholders to ascertain how they feel about the factors influencing on promoting innovation and technology utilization and its effectiveness at work.

In order to analyze the variables affecting on promoting innovation and technology utilization and its efficiency among Small and Medium Enterprises (SMEs) for particular manufacturing enterprise sectors and service providers, this study uses a descriptive research design. Descriptive research, according to [Saunders et al. \(2009\)](#) and [Miller. P, \(1991\)](#) accurately profiles people, events, or situations. This design provides researchers with a profile of pertinent phenomena-related elements from an individual, organizational, and business-focused perspective. As a result, the researcher was able to collect information from a variety of respondents about the variables that affect on promoting innovation and technology utilization and its success in the study area.

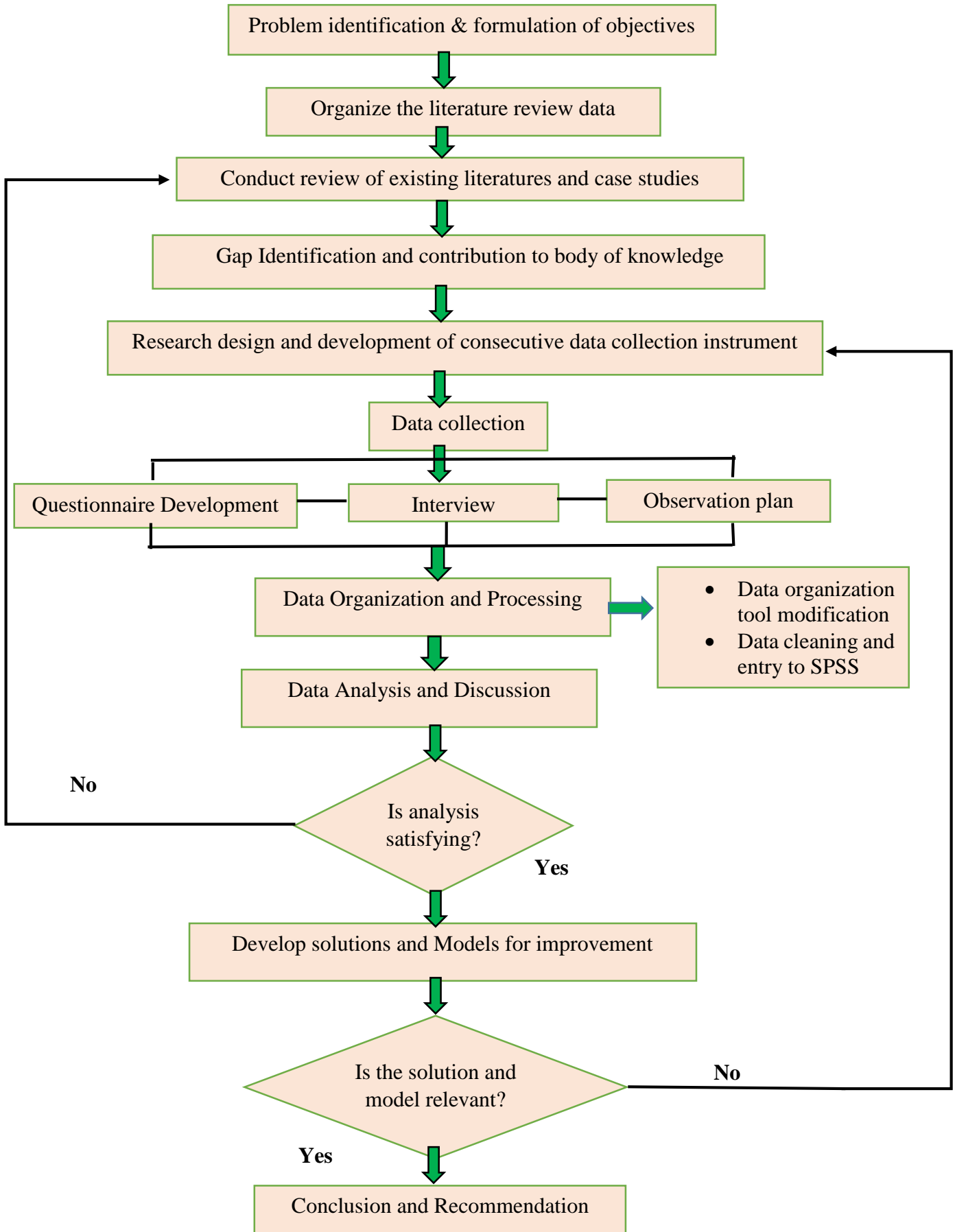


Figure 3.1: Research methods and process : (own source)

3.4 Population

According to [Fraenkel and Warren \(2002\)](#), a population is any group of individuals (subjects or events) who all share the characteristics the researcher is interested in. Small and Medium Enterprises involved in manufacturing operations and service providers in the designated area make up the research population, this are 102 samples from the broader population are chosen as a sample. To choose operators for data collection through a questionnaire, a stratified sample strategy is employed. The survey's total number of respondents was determined to be representative.

Table 3.1 population size

No	Population		Total	
1	Entoto Poly Tecnic College	Trainers	30	44
		Industry Expert	10	
		Deans	4	
2	Small and Medium Enterprise of wereda 04 and 07	Owner of the enterprise	42	62
		workers	20	
3	Wereda Expertes	Experts	8	8
				<u>114</u>

3.5 Sample Size

An optimum sample is one which fulfills the requirements of efficiency, representativeness, reliability and flexibility. The sample size was determined by considering the desired precision and an acceptable confidence level for the estimate. The total sample size will determine using [Israel, G. D. \(1992\)](#).provides a simplified formula to calculate sample sizes. This formula will have used to calculate the sample sizes. A 95% confidence level and $P = 0.5$ are assumed.

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = sample size

N = population size

e = sampling error (0.05) which is 95% of the level of confidence.

- The sample size for population of Entoto Poly Tecnic College calculated by:

$$n = \frac{44}{1 + 44(0.05)^2}$$

Hence out of the total population of **44** sample size determined will be 39.64 approximately to **40** samples.

- The sample size for population of **Small and Medium Enterprise** of wereda 04 and 07calculated by:

$$n = \frac{62}{1 + 62(0.05)^2}$$

Hence out of the total population of **62** sample size determined will be 53.67 approximately to **54** samples.

- The sample size for population of **wereda experts** calculated by:

$$n = \frac{8}{1 + 8(0.05)^2}$$

Hence out of the total population of **8** sample size determined will be 7.84 approximately to **8** samples.

So the total sample of each population size is $8+54+40 = \mathbf{102}$ **sample** this helps to get fair distribution of the gathered data from the respondent.

Table 3.2 sample size

No	Population			Total	sample size
1	Entoto Poly Tecnic College	Trainers	30	44	40
		Industry Expert	10		
		Deans	4		
2	Small and Medium Enterprise of wereda 04 and 07	Owner of the enterprise	42	62	54
		workers	20		
3	Wereda Expertes	Experts	8	8	8
				Total sample size	=102

3.6 Data Collection

Primary data and secondary data are two different types of data. Primary data are current information that can be gathered through questionnaires or interviews. These are brand-new, never-before-used data that have just been generated. However, secondary data are those that have been gathered through publications, databases, and earlier efforts. Although they are both significant, primary data might be more timely, expensive, and lucrative. With the exception of secondary data, market analysts often favor primary sources (Peterson, 2006). A survey is employed to obtain data for this investigation. The primary objective of this study, as I already indicated, is to evaluate the variables that have an impact on the efficiency and effectiveness of technology support system with in industry extension services. Data collection was conducted in 54 enterprises, 40 collages trainers and 8 woreda experts from the middle of November 2023 to the middle of December 2024.

The data was gathered using a questionnaire. Demographic data and open-ended questions that let the researcher learn more from the respondents on technology support and its effectiveness were included in the first phase questionnaire

The data gathering tools are questionnaire and interview. Also observation and informal interviews was utilized. By questioning the respondent, the observation approach are used to sort results. A mixed approach methodological assumption also used to drive the course of data collection and interpretation on this study. 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 questioners and interviews that prepared for enterprises owners and workers are prepared by **Amharic language** because most of the respondents can't understand and respond in English so for abettor achievement of this studies using the local language was very important and I can got full responds.

3.6.1 Questionnaire

The owners, employees, and other stakeholders of small and medium-sized enterprises (SMEs) are participated and complete the questionnaire. Both open-ended and closed-ended questions will be included in the questionnaire. Items requiring respondents to rank the relative relevance and difficulty of the activities was included in the questionnaire.

3.6.2 Interview

In addition to the questionnaire, a semi-structured interview with outlined topics for discussions was used to gather data for the study. This are held with owners, employees, and other stakeholders of small and medium-sized enterprises (SMEs).

3.6.3 Observation

Direct observation method was applied on this study that are asses and evaluate written documents that found within the colleges and from the enterprises as well as from wereda expersts and also by observing the work shop of the enterprises.

3.7 Methods of Data Analysis

The study's findings are examined using both qualitative and quantitative approaches. A "YES" or "NO" question, the level of agreement, a limited number of open-ended questions, and the level of quality are features of a questionnaire question. The questionnaire can be used for preparation by the owners, employees, and other stakeholders of small and medium-sized enterprises (SMEs). In a similar spirit, interview questions also be created with the express purpose of determining the respondents' familiarity and comprehension of the variables influencing on promoting innovation and technology utilization and its effectiveness.

In order to examine the elements promoting innovation and technology utilization and its effectiveness. Excel are used to generalize factors influencing on promoting innovation and technology utilization and its effectiveness.in table and graphic form. Statistical quality control (SQC) tool also be used to assess the weaker portion in order to identify the main cause of the factor impacting innovation and technology utilization and its effectiveness.

To exhibit correlational correlations SPSS statistical software updated version 21.0 was utilized in the analysis. To identify the characteristics of participant responses, tables, graphs, and pi-charts powered by Excel and Software are employed. Confidence intervals, significance tolerance, and data variance in terms of standard deviation and variance are all calculated using statistical data. Finally, the study was determine a regression model based on previously recorded historical data from various officials using the multiple regression modeling concept.

3.8 Validity

Before the questionnaire was made available and used to collect data from respondents, my adviser approved it. This phase, which can be thought of as a pre-test, was used to make sure that the questionnaire was accurate, significant, and understandable to respondents. The respondents were asked to read the instructions and the table of criteria at the start of the questionnaire before responding to the questions while the researcher was present. After that, they were asked to comment on the questions and the way they were laid out.

The former work of other researchers that I used from different source of literatures on this studies are given recognition and indicate their works by using appropriate citation methods.

3.9 Ethical Consideration

The ethical issue of this study in mixed method of research are based on numbers of data collection, data collection method, more intensive over short period of time and on the participant expectations. Due to this research under take mixed method of data collections method of questionnaire, interview and documented reports. The study's uniqueness are kept, and all references to previous studies, facts, and literature that was included into this study were properly recognized with their respective authors. Before distributing questionnaires and conducting interviews, all research participants in this study was formally informed about the aim of the research and asked for their willingness and consent to be documented.

CHAPTER FOUR

4. DATA PRESENTATION, ANALYSIS AND RESULTS

4.1. Introduction

This chapter presents the data obtained from questionnaires, interview, direct observation and by surveying secondary data. So each result analyzed based on the questionnaire. A response rate and demographic profile of respondents is presented followed by presentation of result and analysis of responses on factors affecting the technological utilization of micro and small enterprises: Descriptive statistics were employed to analyze the data collected from the target respondents. The percentage response from each respondent was shown in frequency distribution charts.

4.2. Response rate

The data in table 4.1 shows that, 102 questionnaires were delivered to randomly chosen respondents in order to collect primary data via questionnaires all questionnaires were completed and returned to the researcher, providing a response rate of 100%, giving the researcher confidence in the study's conclusions.

Table 4.1 response summery

No of participants	Unwilling respondent	Collected questioners	Response rate %
102	0	102	100 %

Source: - Own survey, 2024.

4.3 Analyzing the Demographic Information

As mentioned in the previous chapter, 102 respondents were chosen to participate in the survey and all of the participants are respond to the question properly Therefore, the result of this research is 100% based on responds responses.

4.3.1 Demographic results regarding Gender

On the following fig 4.1 the respondent data based on gender there are 62 male and 40 also female. The participation of female on this response also good and approaches to no of male participated.

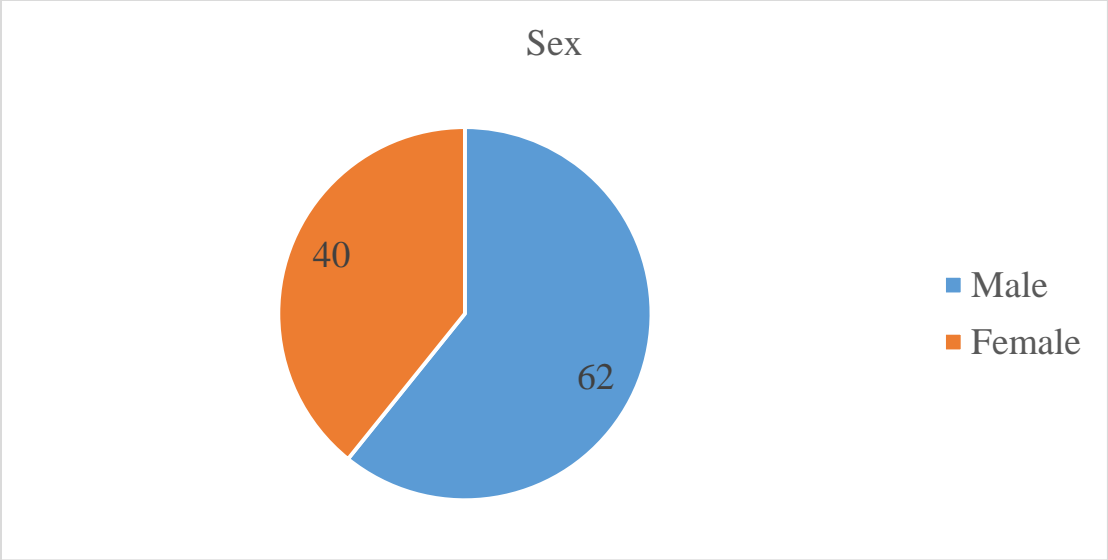


Fig 4.1 Demographic results regarding Gender

4.3.2 Demographic results regarding Age

Table 4.3 Shows that Demographic results regarding Age based on this 34.3 % of the respondents between the age 20-25, 21.6 % of the respondents between the age 25-30, 35.3 % of the respondents between the age 30-35 and 8.8 % of the respondents are Above 35 years old. Based on this more of the respondents are 35.3 % are between age 30-35 this shows that the respondents are on the productive age.

Table 4.2 Demographic results regarding Age

		Age			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-25	35	34.3	34.3	34.3
	25-30	22	21.6	21.6	55.9
	30-35	36	35.3	35.3	91.2
	Above 35	9	8.8	8.8	100.0
	Total	102	100.0	100.0	

Source: - Own survey, 2024.

4.3.3 Demographic results regarding experience

The data in table 4.4 shows that, among the selected 102 respondents which include Trainers, Enterprise Operator, Wereda Experts and Dean of Entoto poly technic college 26.5 % of them have

less than 2 years' work experience 29.4 % have 2 to 5 years, 38.2 % have 6 to 10 years and 5.9 % of the respondents have more than 10 years' work experience.

So based on this information more of the respondents 38.2 % of them have 6 to 10 years stay on their work position. This shows that the respondents are more experienced and have knowledge and skills on their working environment.

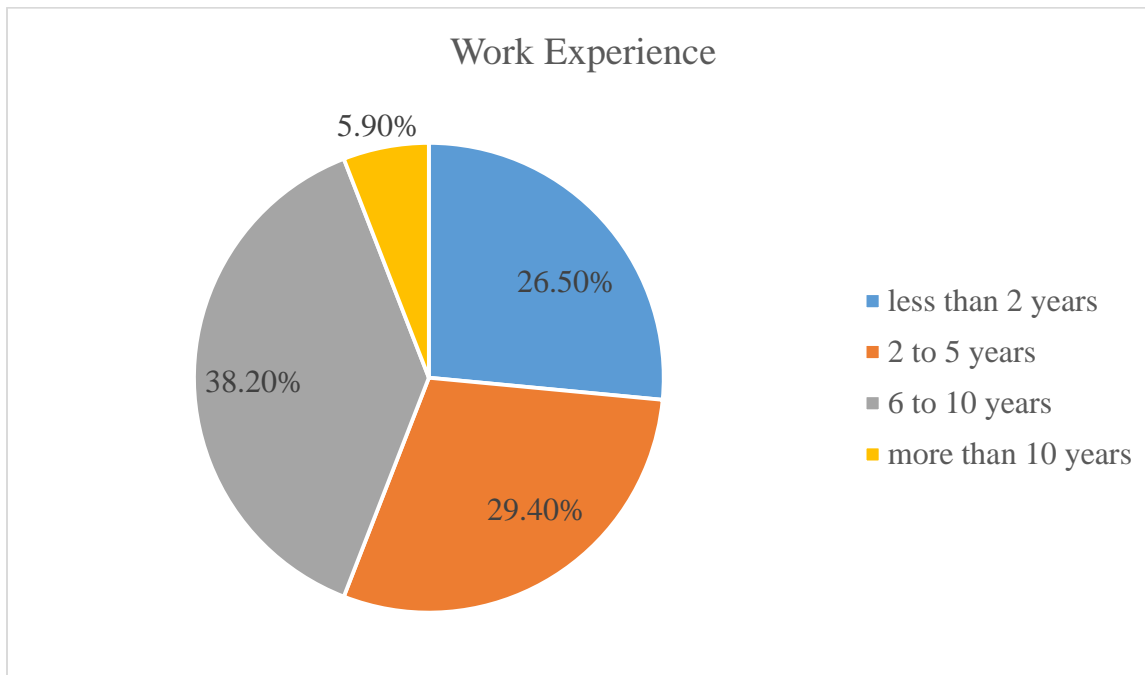


Fig 4.2 Demographic results regarding experience

4.3.4 Demographic results regarding Education

The data in table 4.5 shows that, among the selected 102 respondents which include Trainers, Enterprise Operator, Wereda Experts and Dean of Entoto poly technic college, 14 of them or 13.7 % were educated in Mechanical Engineering field ,12 of them 11.8 % had Automotive Engineering and Technology, 22 of them or 21.6 % were GMFA(Manufacturing),16 of them or 15.7% were Leather and Garment, 9 of them or 8.8 % had educated in Civil engineering and construction Technology,2 of them or 2.0 % were Electrical and Computer Engineering,4 of them or 3.9 % educated in Furniture making and the remaining 23 respondent or 22.5% of them had other field of study.

So based on this information more of the respondents had other field of study which are 23 respondent or 22.5% next to this GMFA (Manufacturing) are the second which are 22 of them or

21.6 % were filed of study of the respondents and Electrical and Computer Engineering are the least filed of the respondent based on the information which are 2 or 2.0 %.

Table 4.3 Demographic results regarding Education

Field of study		Frequency	Percent	Cumulative Percent
Valid	Mechanical Engineering	14	13.7 %	13.7
	Automotive	12	11.8 %	25.5
	GMFA(Manufacturing)	22	21.6 %	47.1
	Leather and Garment	16	15.7 %	62.7
	Civil engineering and construction	9	8.8 %	71.6
	Electrical and Computer Engineering	2	2.0 %	73.5
	Furniture	4	3.9 %	77.5
	Other	23	22.5 %	100.0
	Total	102	100.0 %	

Source: - Own survey, 2024.

4.3.5 Demographic results regarding Working Position

On table 4.6 Shows that the result of the respondent based on there working positions so there are 4 deans of the college, 36 trainers, 12 owners of SMEs, 42 workers of SMEs and 8 woreda experts are participated on this study the highest percentage are 41.2 % that are SMEs Worker next to that 35.3 % of participants are Trainer of the college.

Table 4.4 Demographic results regarding Working Position

	Working Position					Total
	Dean	Trainer	SMEs Owner	SMEs Worker	Woreda Expert	
Frequency	4	36	12	42	8	102
Percent	3.9 %	35.3 %	11.5 %	41.2 %	7.8 %	100 %

Source: - Own survey, 2024.

4.4 Quantitative Data Description

4.4.1 Data Analysis of Enterprise Operators

Enterprise operators means both workers and owner of the enterprises. So the data that gathered from those responsible bodies by rising different questioners and analyzed based on their response as follow properly.

4.4.1.1 The major challenges that affect the Technology support in SMEs.

Based on the data that gathered from the enterprise operators which are both the workers and owner of the firms are participated that able to understand the current major challenges that affect the Technology support in SMEs are described on percentage of the respondents on the table 4.7 based on this there are four dependent variables and independent variables are listed and described in percentage values of the respondent rates.

The first one is regarding to technological utilization, under this the question are there is lack of appropriate working machinery, equipment and other technology 40.7 % of the respondents are strongly agree on this statement and 44.4 % also agree totally 85.1 % of the respondents are say there is no appropriate working machinery, equipment and other technology to utilize technological advancement. The rest of the respondent are 11.1 % Disagree and 3.7 % strongly disagree totally 14.8 % are believe on the SMEs have use appropriate working machinery, equipment and other technology.

So based on this information we can conclude that most of the SMEs have not used appropriate working machinery, equipment and other technology.

And the other one 22.2 % strongly agree and 18.5 % agree on the statement of SMEs have no awareness and information about technological utilization total respondents are 40.7 %.

18.5 % Undecided, 25.9% Disagree and 14.8% strongly disagree based on this result there are 40.7 % of the respondent believes SMEs have awareness and information about technological utilization. So the result that can show there are equal percentage of agree and disagree on the statements.

The question on SMEs think your working instrument is almost modern? The results show that 14.8% strongly agree and 7.4% agree on this statement and total 22.2 % are think there working instrument is almost modern. The rest of the respondents are 25.9% strongly disagree and 33.3 %

Disagree, totally 59.2 % are think there working instrument is not almost modern.so based on this result most of the SMEs operators have not use modern work instruments or they have concepts about modern instruments.

The other one is due to the Perception of that SMEs cannot afford technologies around 16.7 % strongly agree and 22.2 % agrees on this statement totally 38.9 % of the respondents have Perception of that SMEs cannot afford technologies. The rest of the respondents 37.0% Disagree and 24.1% strongly disagree totally 61.1 % are have Perception of that SMEs can afford technologies. So based on this result SMEs can afford technologies.

The enterprise lack promotion for the products by using any latest technology due to this statement, 44.4% strongly agree and 33.3agree totally 77.8 % of the respondents says and the results show that SMEs lack promotion for the products due to using any latest technology.

Table 4.5 Technological utilization

Technological utilization		Strongly agree %	Agree %	Undecided %	Disagree %	Strongly disagree %
1	There is lack of appropriate working machinery, equipment and other technology.	40.7	44.4	0	11.1	3.7
2	There is lack of awareness and information	22.2	18.5	18.5	25.9	14.8
3	Do you think your working instrument is almost modern?	14.8	7.4	18.5	33.3	25.9
4	Perception that SME cannot afford technologies	16.7	22.2	0	37.0	24.1

5	The enterprise lack promotion for the products due to using any latest technology	44.4	33.3	0	14.8	7.4
---	---	------	------	---	------	-----

Source: - Own survey, 2024.

Regarding to training and support mechanism for SMEs

On the statement of SMEs have ability to copy other Instruments by their own?77.8 % strongly disagree and 22.2 % disagree totally 100 % of the respondent’s answers they have no ability to copy other Instruments by their own so this results shows that they need other support mechanism or perches the instruments.

The other one also about is there sufficient training due to technology support44.4 % disagree and 40.7 % strongly disagree totally 85.1 % of the respondents are say there is no sufficient training about technology support. This results show that from industry extension package technology support is not given for most of the SMEs.

Also 33.3disagree and 55.6% strongly disagree totally 88.8 % of the respondents says that they have not gotten enough and tangible training in technology support packages of industrial extension service.

25.9 % disagree and 37.0 % strongly disagree totally 62.9 % of the respondents think that the trainers have not enough/efficient and ability to train SMEs on technology support package. 14.8 % agree on the statement of trainers have enough/efficient and ability to train SMEs on technology support package.

Table 4.6 Training and support

Training and support		Strongly agree %	Agree %	Undecided %	Disagree %	Strongly disagree %
6	Do you have ability to copy other Instruments by your own?	0	0	0	22.2	77.8

7	Is there sufficient training about technology support	0	14.8	0	44.4	40.7
8	Do you have gotten enough and tangible training in technology support packages of industrial extension service?	0	0	11.1	33.3	55.6
9	Do you think that the trainers have enough/efficient and ability to train you on technology support package?	0	14.8	22.2	25.9	37.0

Source: - Own survey, 2024.

Skill level and commitment of Enterprise

Around 40.7 % disagree and 33.3 % strongly disagree totally 74 % of the respondents says that enterprise have skilled employees to handle technology properly.

On the other hand 29.6 % disagree and 40.7 % strongly disagree totally 70.3 % of the respondents are says the enterprises are not capable to select proper technology. Only 11.1 % of the respondent that says the enterprises are capable to select proper technology.

Due to technical skill of the enterprise in utilizing the technology around 38.9% disagree and 27.8 % strongly disagree totally 66.7 % of the respondents are says there is Low technical skill of SMEs in utilizing the technology.

Furthermore 25.9% disagree and 40.7% strongly disagree totally 66.6 % of the respondents says that the enterprises cannot doing current and modern work. The remaining respondent about 14.8 % strongly agree and 11.1 % agree totally 25.9 % believes on the statement that the enterprises can do current and modern work.

40.7% strongly agree and 29.6% agree totally 70.3 % of the respondents says that there is Difficulty of integration of new technology with existing one on SMEs.14.8% disagree and 7.4% strongly disagree on the statement so totally 22.2 % of the respondent says that there is no Difficulty of integration of new technology with existing one on SMEs.

Around 48.1 % disagree and 33.3 % strongly disagree on the statement totally 81.4 % of the respondents says that the enterprises are not use modern and standardized instruments/tools that use on production activity. Only 7.4 % of the respondents that says the enterprises are use modern and standardized instruments/tools for their production purpose.

29.6% disagree and 22.2% strongly disagree totally 51.8 % of the respondents are says that there is Absence of organizational support and leadership in providing technological support on SMEs.

The remaining respondent 37 % of them believes on there is organizational support and leadership in providing technological support on SMEs.

Table 4.7 Skill level and commitment of Enterprise

Skill level and commitment of Enterprise		Strongly agree %	Agree %	Undecided %	Disagree %	Strongly disagree %
10	The enterprise lack skilled employees to handle technology	0	25.9	0	40.7	33.3
11	The enterprise unable to select proper technology	0	11.1	18.5	29.6	40.7
12	Low technical skill in utilizing the technology	0	25.9	7.4	38.9	27.8
13	Do you believed you do current and modern work	14.8	11.1	7.4	25.9	40.7
14	Difficulty of integration of new technology with existing one	40.7	29.6	7.4	14.8	7.4
15	The instruments/tools that you use are modern and standardized	0	7.4	11.1	48.1	33.3

16	Absence of organizational support and leadership in providing technological support.	25.9	11.1	11.1	29.6	22.2
----	--	------	------	------	------	------

Source: - Own survey, 2024.

Table 4.8 Resource/infrastructure

Resource/infrastructure		Strongly agree %	Agree %	Undecided %	Disagree %	Strongly disagree %
17	There is limited financial resources	59.3	29.6	0	7.4	3.7
18	High cost of technologies	63.0	25.9	3.7	7.4	
19	Do you bring the products to the market with a quality and standardized product?	25.9	22.2	3.7	33.3	14.8
20	Is there Connectivity and infrastructure limitations: like Slow internet speeds, electric power, water delivery etc.	77.8	18.5	0	3.7	0

Source: - Own survey, 2024.

Regarding on Resource and infrastructure

59.3 % strongly agree and 29.6 % agree totally 88.9 % of the respondents are says that there is limited financial resources to implement technological advancement and innovative capability.

There is around 88.9 % of the respondents says due to High cost of technologies the enterprises cannot be afford the technology and able to modernize there working conditions and cannot be improve and increase their productivity.

48.1 % of the respondents says that the enterprises cannot be bring the products to the market with a quality and standardized product. The remaining 48.1 % also believes on that the enterprises can bring the products to the market with a quality and standardized product. Based on this result we cannot decided either the enterprises bring their products to the market with a quality and standardized product or not.

On the other side due to Connectivity and infrastructure limitations: like slow internet speeds, electric power, water delivery etc. around 96.3 % of the respondents are Shure about this problems and limitations are occurs on the enterprise.

4.4.1.2 The method of technology support by Entoto Poly Technic College

Technological support activity for (SMEs) from the college

Based on the table 4.1 I can got the answer for what is look like Technological support activity for Small and Medium Enterprise (SMEs) from the college? So based on the respondent responses 100 % of Small and Medium Enterprise (SMEs) have technology support from Entoto Poly Technic College.

Based on as enterprise opinion, there are only 9.3 % of the respondent says the current industry extension service (IES) packages of supporting service is effective due to technological support. The rest of the respondent 90.7 % says the current industry extension service (IES) packages of supporting service is does not effective due to technological support. Based on this response the supporting mechanism is not comfortable and effective for the enterprises.

And the other one there are 33.3 % of enterprises have linkage with technology transferring centers with Entoto Poly Technic College 66.7 % have not linkage with technology transferring centers with Entoto Poly Technic College. And also 100 % of the respondents says that there is no new technology are transferred to the enterprise from Entoto Poly Technic College.

So based on this response all of the enterprise does not have advantages with the new technology that developed by the college and technology transferring activity does not meet the goal.

Table 4.9 Technological support activity for Small and Medium Enterprise (SMEs) from the college

Technological support activity for Small and Medium Enterprise (SMEs) from the college		Yes		No	
		Frequency	Percentage	Frequency	Percentage
1	Did you have technology support from Entoto Poly Technic College?	54	100 %	0	0 %
2	As your opinion, the current industry extension service (IES) packages of supporting service is effective due to technological support?	5	9.3 %	49	90.7 %
3	Did you have linkage with technology transferring centers in Entoto Poly Technic College?	18	33.3 %	36	66.7 %
4	Does the new technology are transferred to you from Entoto Poly Technic College?	0	0 %	54	100 %

Source: - Own survey, 2024.

Due to the rate of currently implemented industry extension service package based on the following table 4.12 shows that 16.7 % of the respondent says that it is good, 11.1 % of the respondent say that it is fair, 42.6 % of respondent says that it is poor and 29.6 % also says that the currently implemented industry extension service package is very good.

Based on this result the supporting activity of industry extension service package as we see the four packages generally it is fine.

Table 4.10 currently implemented industry

		Good	Fair	Poor	Very Poor
1	How would you rate the currently implemented industry extension service package?	16.7 %	11.1 %	42.6 %	29.6 %

Source: - Own survey, 2024.

Based on the table 4.13 there are 42.6 % of the respondents says sometimes that the Trainers support there on technology utilization areas and 57.4 % of the respondent Rarely the trainers support on technology utilization areas. Based on this result the technological support activity are very weak as compared with other industry extension support packages.

Table 4.11 technology utilization area

	Always	Often	Sometimes	Rarely
How frequently does the Trainers support your enterprise on technology utilization areas?	0 %	0 %	42.6 %	57.4 %

Source: - Own survey, 2024.

On the following table 4.14 the result of which one industry extension services packages is more implemented are clearly presented. Based on the response 31.5 % of the respondents says that Entrepreneurship Training are more implemented, 68.5% says that Kaizen are implemented and there is no technical and Technology Support are implemented.

Table 4.12 more implemented industry extension services

	Entrepreneurship Training	Kaizen	Technical	Technology Support
From industry extension services packages which one is more implemented?	31.5%	68.5%	0%	0%

Source: - Own survey, 2024.

4.4.2 Data Analysis of Trainers

The data that collected from trainers, industry experts and deans of the college are collected by answering the questioner and analyzed the responses as follows.

Regarding to technological utilization.

under this the question are there is lack of appropriate working machinery, equipment and other technology 22.7% of the respondents are strongly agree on this statement and 31.8% also agree totally 54.5 % of the respondents are say there is no appropriate working machinery, equipment and other technology to utilize technological advancement. The rest of the respondent are 22.7% Disagree and 22.7% Undecided about the question totally based on this result most of the trainers responses are there is lack of appropriate working machinery, equipment and other technology.

77.3 % of trainers respond are most of the enterprises have basic awareness and information about technological utilization and support mechanism.

Perception that SME cannot afford technologies are not acceptable by 72.7 % of the trainers so this result that can shows that most of small and medium enterprises (SMEs) that can afford technologies.

90.9 % of the trainers accept the enterprise lack promotion for the products by using any latest technology. This result can show small and medium enterprises (SMEs) doesn't use any latest technology to promote their products and the service they are providing.

By direct observation of the researcher that can show and able to understand the enterprises sell their products directly to the users by direct delivery system simply communicate with the customer by phone.

Table 4.13 Technological utilization

Technological utilization		Strongly agree %	Agree %	Undecided %	Disagree %	Strongly disagree %
1	There is lack of appropriate working machinery, equipment and other technology	22.7	31.8	22.7	22.7	0
2	There is lack of awareness and information	9.1	13.6	0	50.0	27.3

3	Perception that SME cannot afford technologies	9.1	13.6	4.5	31.8	40.9
4	The enterprise lack promotion for the products by using any latest technology	40.9	50.0	0	6.8	2.3

Source: - Own survey, 2024.

Regarding to training and support

58.1 % of trainers have ability to copy other Instruments by their own ability this also shows that the respondent can copy instrument and functional it for the purpose of enterprise need. And also 22.7 % of the trainer says that they have not ability to copy other Instruments by their own ability.

Around 59.1 % of the trainers have given sufficient training to SMEs about technology support and also the rest of 18.2 % of the respondent have not given sufficient training to SMEs about technology support. Based on this result more of the trainer can deliver technological support for the enterprises.

Regarding to have ability to copy other Instruments by their own or with other Trainers. Around 95.4 % of the trainers says that they have ability to copy the instruments this result shows that the trainers have better collaboration and knowledge sharing activity.

Based on the researcher direct observation, interviews and by surveying secondary data from the colleges can understand the trainers perform with collaboration to develop technologies and transfer for the enterprises and also perform different project activity for their colleges.

63.6 % of trainers believes on they have gotten enough and tangible training in technology support packages of industrial extension service. And also 36.3 % of trainers responds to they have not gotten enough and tangible training in technology support packages of industrial extension service.

79.5 % of the trainers says that they have enough and efficient ability to train SMEs on technology support package and also 20.5 % says they haven't.

Table 4.14 Training and Support

Training and Support		Strongly agree %	Agree %	Undecided %	Disagree %	Strongly disagree %
5	Do you have ability to copy other Instruments by your own?	29.5	38.6	9.1	18.2	4.5
6	Is there sufficient training have you given to SMEs about technology support	34.1	25.0	22.7	18.2	0
7	Do you have ability to copy other Instruments by your own or with other Trainers?	54.5	40.9	0	2.3	0
8	Do you have gotten enough and tangible training in technology support packages of industrial extension service?	22.7	40.9	0	13.6	22.7
9	Do you think that the trainers have enough/efficient and ability to train SMEs on technology support package?	31.8	47.7	0	9.1	11.4

Source: - Own survey, 2024.

About Skill level and commitment of Trainers

About 59.1 % of the respondent says that the enterprise lack skilled employees to handle technology and 31.8 % of the respondent says that the enterprise have skilled employees to handle technology.

Regarding to The enterprise unable to select proper technology 40.9 % of the respondent believes on this statement and also 59.2 % of the respondent says that the enterprise capable able to select proper technology.

72.8 % of the respondent says that small and medium enterprises (SMEs) have Low technical skill in utilizing the technology and 22.7 % of the respondent have technical skill in utilizing the technology properly.

22.7 % of the respondent believed on their support mechanism are doing current and modern work and also 63.6 % of the respondent believed on their support mechanism are not doing current and modern work. So based on this result most of the trainers support mechanism need upgrade and reform.

86.4 % of the respondent are not believes on Difficulty of integration of new technology with existing one and 13.6 % of the respondent says that there is Difficulty of integration of new technology with existing one. Based on this result most of the trainers have ability to copy new technology and integrate it with existing ones.

22.7 % of the respondent are belief on the instruments/tools that SMEs use are modern and standardized but 77.3 % of the respondent says that the instruments/tools that SMEs use are not modern and standardized.

11.4 % of the respondent says that there is Absence of organizational support and leadership in providing technological support for small and medium enterprises (SMEs) and 48.7 % of the respondent says there is organizational support and leadership in providing technological support for small and medium enterprises (SMEs).

Table 4.15 Skill level and commitment of Trainers

Skill level and commitment of Trainers	Strongly agree %	Agree %	Undecided %	Disagree %	Strongly disagree %
---	------------------------	------------	----------------	---------------	---------------------------

10	The enterprise lack skilled employees to handle technology	22.7	36.4	9.1	27.3	4.5
11	The enterprise unable to select proper technology	18.2	22.7	0	31.8	27.3
12	Low technical skill in utilizing the technology	36.4	36.4	4.5	18.2	4.5
13	Do you believed your support mechanism are doing current and modern work	15.9	6.8	13.6	29.5	34.1
14	Difficulty of integration of new technology with existing one	4.5	9.1	0	40.9	45.5
15	Do you belief The instruments/tools that SMEs use are modern and standardized	9.1	13.6	0	36.4	40.9
16	Absence of organizational support and leadership in providing technological support.	2.3	9.1	0	43.2	45.5

Source: - Own survey, 2024.

Regarding to Resource and infrastructure

81.8 % of the respondent says that there is limited financial resources and 18.2% of the respondent says that there is no limited financial resources about technological support to small and medium enterprises (SMEs).

54.5 % of the respondent believes on there is High cost of technologies and also 45.4 % of the respondent says the cost of the technology is not high.

18.2 % of the respondent believe on the SMEs are bring the products to the market with a quality and standardized product and 81.8 % of the respondent not believe on the SMEs are bring the products to the market with a quality and standardized product.

100 % of the respondent says that there is there Connectivity and infrastructure limitations: like slow internet speeds, electric power, water delivery etc.

Table 4.16 Resource/infrastructure

Resource/infrastructure		Strongly agree %	Agree %	Undecided %	Disagree %	Strongly disagree %
17	There is limited financial resources	50.0	31.8	0	18.2	0
18	High cost of technologies	22.7	31.8	0	40.9	4.5
19	Do you believe SMEs are bring the products to the market with a quality and standardized product?	0	18.2	0	50.0	31.8
20	Is there Connectivity and infrastructure limitations: like Slow internet speeds, electric power, water delivery etc.	77.3	22.7	0	0	0

Source: - Own survey, 2024.

4.4.2.2 The method of technology support by Entoto Poly Technic College

Table 4. 19 shows that 65.9% percent of the trainers’ gives Technological support for Small and Medium Enterprise (SMEs) and 34.1% of the trainers does not give Technological support 11.4% of the trainers also giving Technological support for Small and Medium Enterprise (SMEs) by making frequent contact and follow up to enterprise, 86.4% of the trainers does not give technology support by making frequent contact and follow up to enterprise.

Based on the trainers' opinion, 6.8% of the trainers says that the current industry extension service (IES) packages of supporting service is effective due to technological support and 93.2% of them says that it is not effective due to technological support. This results shows that the supporting activity have so wide problems and the result and supporting activities does not satisfactory for the trainers. But within the college 75% trainers have developed new technology and 25% does not developed new technology.

Table 4.17 Technological support activity by the Trainers

Technological support activity for Small and Medium Enterprise (SMEs) by the Trainers		Yes		No	
		Frequency	Percentage	Frequency	Percentage
1	Did you give technology support to the enterprise?	29	65.9 %	15	34.1%
2	Do you give technology support by making frequent contact and follow up to enterprise?	5	11.4 %	38	86.4 %
3	As your opinion, the current industry extension service (IES) packages of supporting service is effective due to technological support?	3	6.8 %	41	93.2 %
4	Did you have developed new technology in your college?	33	75.0 %	11	25.0 %

Source: - Own survey, 2024.

On the following Table 4.20 shows that the more implemented industry extension services packages are ranked by the trainer based on this result Entrepreneurship Training are 18.2 % implemented, Kaizen also 52.3 % implemented, Skill gap training 29.5 % implemented and Technology Support 0 % implemented. From industry extension services packages Kaizen are the more implemented service and Technology Support does not. Based on this result there is a gap on technology support activities.

Table 4.18 more implemented industry extension services packages

		Entrepreneurship Training	Kaizen	Skill gap training	Technology Support
1	From industry extension services packages which one is more implemented?	18.2 %	52.3 %	29.5 %	0 %

Source: - Own survey, 2024.

The following Table 4.21 shows that the result of the total rate that trainers currently implemented industry extension service package based on this 36.4 % of them says that it is good, 13.6 % says that fair, 50 % says that poor based on this result currently implemented industry extension service package have a gaps due to its effectiveness.

Table 4.19 the rate of currently implemented industry extension service package

		Good	Fair	Poor	Very Poor
1	How would you rate the currently implemented industry extension service package?	36.4 %	13.6 %	50 %	0 %

Source: - Own survey, 2024.

On the Table 4.22 the result shows that 50.0 % of the respondent have Significantly Positive responses about industry extension services' ability that foster innovation and the use of technology, 38.6 % Moderately Positive response and 11.4 % Moderately Negative.

So based on this result the trainers believes on industry extension services' have ability to foster innovation and the use of technology for Small and Medium Enterprise (SMEs).

Table 4.20 evaluation of industry extension services' ability

		Significantly Positive	Moderately Positive	Moderately Negative
1	How would you evaluate industry extension services' ability to foster innovation and the use of technology?	50.0 %	38.6 %	11.4 %

Source: - Own survey, 2024.

On the Table 4.23 the response of the trainer about how frequently does the colleges support on technology utilization areas delivered to the enterprise 13.6 % says that sometimes and the rest of the respondent 86.4 % says that Rarely. So the result shows that the frequency of colleges support on technology utilization areas delivered to the enterprise are very weak.

Table 4.21 frequency of the colleges support

		Sometimes	Rarely
1	How frequently does the colleges support on technology utilization areas delivered to the enterprise?	13.6 %	86.4 %

Source: - Own survey, 2024.

4.5 Qualitative data analysis

Based on workplace observations, interviews, and an open-ended research question from trainers, enterprise operators, dean of the college and woreda experts, the following conclusions were presented.

4.5.1 Qualitative data from the enterprise

Enterprise operators both workers and owner of small and medium enterprise (SMEs) have better knowledge about the industry extension support service. But most of them does not identify the four packages separately.

By conducting direct observation kaizen support is more implemented rather than the other packages for this indication 5's, Flore design, kaizen bored and etc. are can be shown in the work place of the enterprises.

As a general most of the small and medium enterprise (SMEs) they said we have no better market relation, loan to run our business and other infrastructures are not full fill and its obstacles and challenges for us to run our works properly and we need a solution. It is better the Industry extension service activity will concerns on our neck bottle problems and tangible, effective, modern and skill based support mechanisms will developed.

Most of the trainers have a schedule for supporting activity but they are not bring properly on their schedule only they come for reporting that needed in their college and support the enterprise out of their academic proficiency so this is obstacles for a better industry support practices and affect

the acceptance of the enterprises. Weekly reporting paper of the trainers reports are attached on **Annex** part on this study document.

The work place of small and medium enterprise (SMEs) mostly it is not well organized, poor ventilation system, un proper machine arrangement, working without protective equipment, haven't schedule for maintenance activity only they take corrective activity if the machine failures occurs generally they take input output activity there is no well-organized manufacturing procedures and documentation procedures.

4.5.2 Qualitative data from the college

By surveying, taking interview question and examine the recording documentations from the college and stake holders the industry extension service that provided for small and medium enterprise (SMEs) are applied by taking different supporting mechanisms of the trainers.

Within the college there is vice dean for industry extension bureau and have two section technology design and verification team and industry extension service team are organized and conduct their works. Both team are works with the small and medium enterprise (SMEs) for their productivity and improve the challenges of the enterprise.

The technology design and verification team works on accepting new technology idea or amendment for the existing technology that presented by trainers based on the enterprise need that can develop and manufacture the technology that can able to solve the problem of the enterprises and transferred for them. Most of the technologies are presented by the trainers each year and developed with in the college but the transferring activity for the enterprise is conducted only by document it is not tangible or the machines are not delivered to the enterprise on hand.

By surveying the document there are different technology are developed and it's stayed on the incubation store without any functional activity so this is wastage of the time and material.

Most of the trainers develop technology because of to get salary growth and it is mandatory for the trainers each years if they are not develop technology they have not get advantages from the college like if they are junior instructor they does not growth to senior instructors so due to this they must develop technology and will gate advantages.

From most technology developed by the trainers there are project based activities are included under this activity and most of the trainers are interested on this project based technology development activity it is like re arranging work shop of different department and Applying kaizen and constructing different infrastructure within the college.

The second team are industry extension service team this team are works on the trainers supporting activity in industry services for small and medium enterprise (SMEs) by using different follow up mechanisms like by taking direct observation of enterprise and weekly reporting check list that brings from the trainers.

But can simply understand from weekly reports from the four industry extension supporting packages it is not equally implemented specially we can say that there is no technology supports for the enterprises.

4.6 Survey Result and Model Development

Based on the survey result of this study that gathered from trainers, enterprise operators, woreda experts and college deans by different data collection methods and by analyzing using appropriate software SPSS version 22 according to the analysis and interpretation This information can be used to refine and optimize the model to enhance the industry extension service on technology support package can improve overall performance and productivity of the enterprises. For example:

- Small and medium enterprises need practical support rather than theoretical advice for their overall productivity
- Project based technology are more implemented and preferable by the trainers with in the compound of the college so this trained can be simply adapt for enterprise needs.
- Small and medium enterprises need market relation to distribute and sell their products in smart and modern delivery system
- Small and medium enterprises have infra-structure limitations on their working area so this problems also affect the productivity of the enterprises

The integrated and developed model system shown in the picture is intended to boost productivity in the small and medium enterprise sector. Let's break down the components and investigate how output is impacted by them:

Industry Extension Service

The service that provides supporting activities for small and medium enterprises in four packages entrepreneurship, kai-Zen, technical and technological supports. On this context the technology support are under industry extension system and also industry extension service have direct relation with the enterprises, governmental or non-governmental stake holders. So it is the back drive force for a better implementation of the technology support by gathering and addressing the information of the enterprise innovative idea and technological needs.

Technology Support

Technology support have a back ward relation with industry extension service and forward relation with Project based technology, Digital Marketing, Machine utilization and Technology Transfer and also have direct relation with others stakeholders that shows in direct arrows and works with cooperatively.

So technological supports that provided for the small and medium enterprises on this modified models are Project based technology, Digital Marketing, Machine utilization and Technology Transfer are the main and core support that used to improve and solve the problems of the enterprise.

Project based technology

Project based technology are one supporting mechanisms under the technology support and by nature it have short period of time for implementation. on the developed models that shows on the figures for small and medium enterprises this supporting mechanisms are very useful because it mostly practically implemented by the trainers and the trainers have high interest and motive for this activity and also by other side for the enterprises need on the un fulfillment of different infrastructures problems this project based technology are highly improve and solve the problems effectively.

As we say infrastructure there is electrical installation, water line maintenance and service and smart garden area and so on activities are implemented within the college by the trainers and have documented evidence for this activity so simply adapt this practice for the enterprises.

Digital Marketing

Digital marketing includes a broad variety of online marketing activities and is the use of digital platforms and technologies to promote goods and services. Based on the data from small and medium enterprises operators they have high problem of market to promote and sell their products. So this platforms are simply can be developed by the trainers and address it for them there is different departments are found in the colleges like ICT, Business and Electronics departments are can be develop the system and support the enterprises in this digital marketing platforms to promote and sell the products. For example E-commerce

Machine utilization

On the collected data there is huge problems can be observed and analyzed related with how can small and medium enterprises uses a machine properly how much? They know the machine properly and so on. So based on the collected empirical evidence it is better to give a technology supports to maximize and improve the machine utilization for the enterprises.

For example

- Giving a supports on Regular maintenance to reduce downtime and other maintenance activity like preventive, corrective types
- Implementing better scheduling and planning processes
- Using Integrate technology

By providing a better machine utilization supports for small and medium enterprises can be improve and solve different problems and can give a practical, more attractive and productive support mechanisms for enterprises. Also highly reduce the cost of maintenance and down time as well as machine failure, under production and un proper use of machines.

Technology Transfer

This activities are previously and still know practiced between the colleges and enterprises. The trainers develop technology and transfer it for enterprises but this process have its own problems that identified in this study but it not be questionable about its advantages.

So on this developing model technology transfer supports have can give different advantages for enterprises and a better knowledge, innovative idea generation and can substitute and modify different machinery for a better achievement of productivity. But it must be upgrade and modify the system correctively.

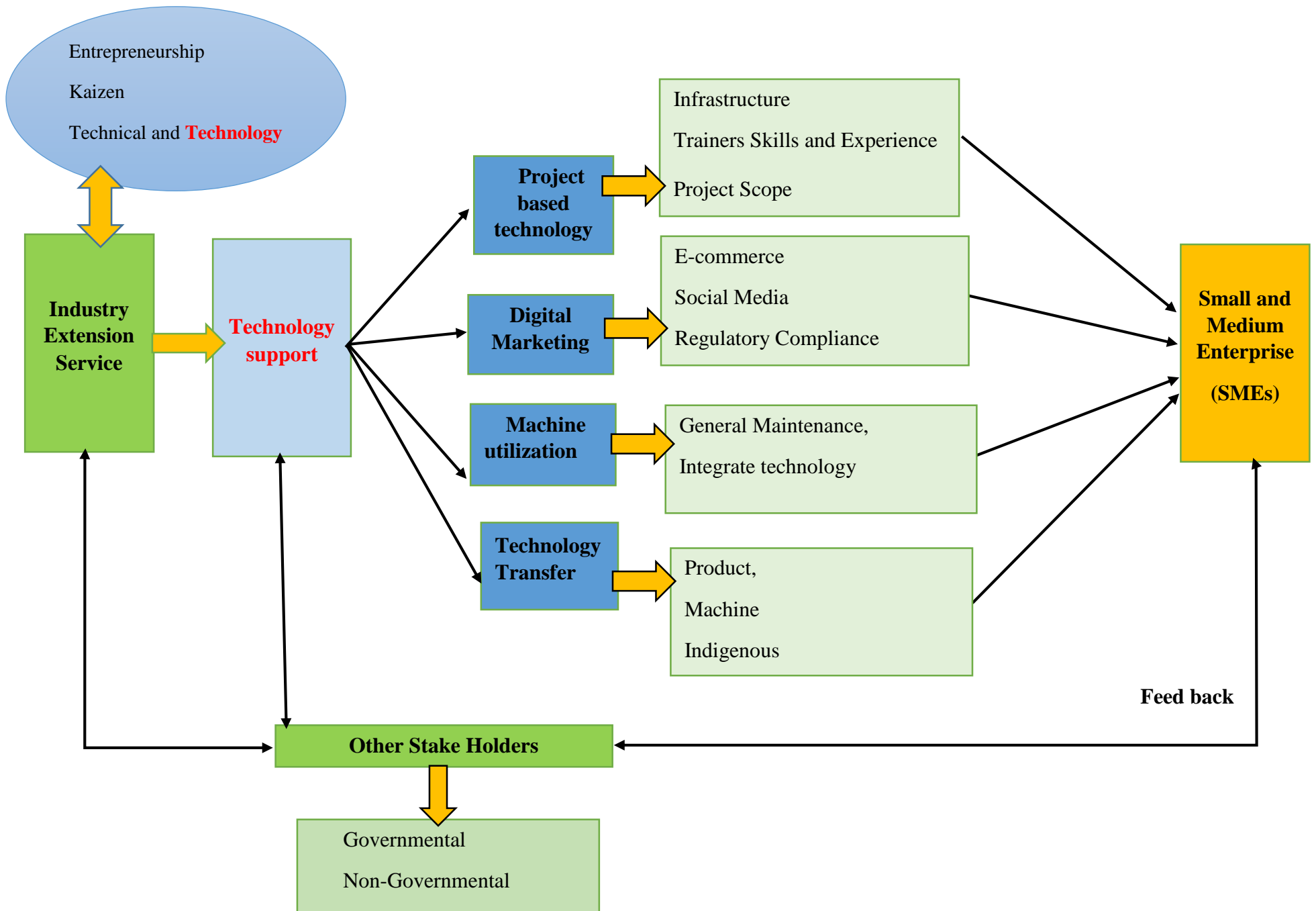


Fig 4.3 Improved Model Development of technology support for small and medium enterprise (SMEs) (source own work)

As Compared with other models that presented in literatures this models have the following Advantages.

On the previous literatures the technology supports on industry extension service are described collectively with other industry support packages and more it have a direction that's consider on technology transfer and incubation activity for small and medium enterprise as more like [Fita, A. \(2014\)](#).

On the context of current industry extension support in our country technology supports have a direction of developing a technology and transfer it for the enterprises and its expected that able to increase the productivity of small and medium enterprise but as we see how match this activity are effective and meet the expected result it is not effective.

For this indication from the collected data this support activity have so many problems and it is not satisfy the enterprise's needs.

4.7 Bench marks to develop a model

The research findings are very important to develop a model and improve the existed problems that related with technology support in industry extension service that provided for small and medium enterprise (SMEs).

Based on the research findings that collected in different ways that means by questioner, interview, and direct observation from trainers, college deans, wereda experts and enterprise operators and working workshop.so based on this procedures and findings from industry extension support packages technology supports are low implementation as compared with others packages for this indication the following findings are clearly shows the problems and justify the models.

- The trainer's intensions on technology transfer are only to get academic advantage either salary or job levels.
- On the enterprise workshops based on technology support there is only identifying what type of technology are needed and theoretical advice for enterprise out of this there is not clearly show the technology support by surveying direct observation.
- Most of the enterprises problems are lack of marketing relations, basic infrastructures, and machines failures or not working efficiently.
- There is miss understanding about technology support that included under technology transfer activity only understand it by the direction of trainers developing a machines by

100 % copy from different source or partially modifying it and transferred to different enterprises to incubate the machine or use it for their own production activity.

- Technology transferring activity have different barriers for it achievement the first one the developed technology are transferred to enterprises most of the time by documentation way not practically the developed technology are stays on the colleges workshop because the enterprises must be pay the cost of technology if they need it for this activity they have not sufficient financial ability to purchase it.
- The documented data from the colleges describes that the trainers most activity or interests are for project based technology with in the colleges for example modifying or constructing different infra-structure facility.
- The enterprise limitation about the machines and method to utilize it properly and update the system with the current situation or far from integrated technology

4.8 Model Implementation Benefit and Justification

The models are developed based on the empirical evidence of the data that gathered and analyzed in different context and able to address different problems that related with the technology support method for small and medium enterprises.so if this models are implemented properly it gives the following different benefits for the enterprise and trainers.

- The models can solve enterprises' marketing problems by facilitating a modern, digitalized way of promoting and selling their products.
- Increase the technological utilization of the enterprises by facilitating different maintenance services and integrating technology with the current one.
- The models can be applied project-based technology. This activity is more implemented in colleges and is effective, so it gives a solution and benefits for enterprises with different infrastructural problem requests.
- Facilitate a better knowledge transfer between the sectors
- The trainers can give practical supports for the enterprises
- Increase the productivity of the enterprises by reducing different costs and by increasing the production rate, using best way of market delivery system

- Facilitate open activity for innovative idea generation and developing quick responses for different problems
- Deliver better industry extension services for the enterprises and meet the needs of the enterprises

Justification

Based on the evidence that gathered from this study small and medium enterprises are not satisfied on the current industry extension support system especially on technological support from the colleges this problems are clearly able to show on this study and understand the cause of the problems and address what is needed by the sectors.

Small and medium enterprises have not better and modern marketing systems to sell and promote their products for the end user or whole sellers. 77.7 % of enterprise lack promotion for the products due to not using any latest technology to solve this problems this study able to develop a model that solve this gaps based on the enterprises need and interest by checking its effectiveness.

Practical application of support mechanism are also needed by the enterprises and trainers also beliefs on this support methods that related with their professions. For this better indication 66.6 % of the enterprises are not beliefs they uses modern method of production system and also 25.9 % of them have better technical skill in utilizing the technology.so it is better to address tangible and effective support systems to the sectors to solve different problems like machine failures, under production, wastage of time and man power etc. by providing different maintenance activity, better production process and method.

The models are meet the strategic goal of the sectors that able to develop the modern technology utilization and capacity building as well as achieve a better productivity of the enterprises.

4.9 Model Validation

To validate the new developed model for technology support Model would perform better than the sectors current practices, the evidence was obtained by the researcher via a thorough assessment procedure. The steps the researcher recommended were:

- 1. Asses and evaluate the current state of industry extension service of the sector**
 - Understood the sectors existing system of technology support process for the enterprises

- Collected data of the enterprises and other stakeholders about technology support system such as technological utilization, training and support, infrastructure and skill level
- Identified any challenges or pain points the sectors was facing with its existing approaches

2. Conducted a gap analysis

- Evaluated the proposed Model against the current practices of technology support system.
- Determined the main distinctions between the new model and the current system, as well as any potential advantages.
- Identified the areas in which the new model could enhance overall performance and address the sector's present problems.

3. Performed a qualitative assessment

- Evaluate and assess the existed qualitative data with the current developed models
- Gather feedbacks and shares perceptions from both trainers and enterprises
- Incorporated their suggestions to improve the model and resolve any issues.

By following this comprehensive evaluation process, the researcher was able to gather the necessary evidence to validate the performance and feasibility of the developed models compared to the current practices of the sectors. Stakeholder input, benchmarking, and data-driven analysis offered a strong basis for deciding whether to implement the new approach and get better results of the technology support.

4.10 Findings and Result Discussion

The study titled “Model development for Industry Extension Services in Small and Medium Enterprises to Promote Innovation and Technology Utilization: A Case study of Gulele Sub City werda 04 and 07” by the researcher examines the industry extension services to promote innovation and technology support system of the sectors. This studies aims to identify barriers in existing technological support methods for small and medium enterprises and propose solutions to address the issues.

The key findings of the study include:

- Industry extension service provided for small and medium enterprises have a gaps on the technology support system for this indication the empirical evidence that gathered on this study that clearly described and analyzed by following proper way. Based on the collected data technology support packages are rarely implemented as compared with other industry extension support packages.
- The qualitative data that gathered from the colleges describes project based technology are mostly implemented by the trainers and most of the trainers have better participation on this activity rather than technology development and copy and it is practical implementation on the colleges like electrical installation, different construction activity, workshop arrangement, smart garden system etc.
- Small and medium enterprises need practical and tangible support rather than theoretical advices and they need solution for their financial and marketing problems.
- There is a gap on how the enterprises use their machinery on the proper way and how can increases their productivity due to poor machine utilization and methods.
- The trainers supporting activity are very low especially on technology support and they have not proper schedules for supporting activity.

To address these issues, the paper develop a model for industry extension service for a better technological support system and effectiveness. The result of this paper supports industry extension services by filling the gaps that investigated on different methods. The short coming that have been found are absence of continuous and proper follow up from different stakeholders.

The model developed are based on the empirical evidence and analyzing the current and earlier supporting system and able to solve the gaps on the supporting system of technology. The project based technology that practiced with in the colleges by the trainers are more effective and practical implementation so this is a better trained that is adopted to the enterprise working areas because it solves their different problems specially related with different infrastructure gaps. The models are included this better and effective trained for the enterprises and also for trainers.

By Gathered feedbacks and shares perceptions from both trainers and enterprises the models are solve the gaps that shows on un practical support system able to more tangible and continuous implemented support system like by providing proper maintenance service and applying project based technology for the enterprises.

Small and medium enterprises (SMEs) are the pillar of development especially for developing country like Ethiopia so this study able to contribute for the development of enterprises by addressing the gaps and fill it by developing a proper model that found on the industry support system.

In conclusion, this thesis offers a comprehensive analysis of the integration of technology utilization and support systems and provides a framework for raising productivity and efficiency in the sectors. The results and the recommended methodology are highly valuable to academic researchers, other stack holder, trainers, small and medium enterprise and industry practitioners.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The study focus on from industry extension service packages for small and medium enterprises (SMEs) that is on technological support system to promote innovation and a better technological utilization of the enterprises, specifically in Addis Ababa gulele sub city on wereda 04 and 07. The literature review indicates that industry extension service (IES) are refer to support programs designed to assist small and medium-sized enterprises (SMEs) used to improving their productivity, efficiency, and innovation capabilities. Many researchers are working on the industry extension service (IES) challenges and its success on SMEs able to them productivity and digitalization marketing system.

The main aspect of the study were to identify factors that affect industry extension service (IES) on technology support system and develop a model that emphasizes the relationship between the various factors influencing the technology support system and analyzed the existed empirical evidence of implementation.

Though a compressive literature review, a survey, interviews and questioners, several key variables affecting technology support system were identified and building up on this study foundation technology support system that used to promote innovation and a better technology utilization model were developed.

As explained in the data finding and analysis result, the major challenges that affect the Technology support in MSEs are evaluated that are technological utilization, Training and Support, Skill level and commitment of enterprise/trainers and Resource/infrastructure. The way of Technology Support by Entoto Poly Technic College to MSE also the second part of the data analyzed and there are so different barriers are identified that affect innovation and the utilization of technology for SMEs.

The developed models are based on the documented empirical evidence, analysis and evaluating the barriers that affect the technology support system for SMEs and facilitate the better models

that improve, address the challenges and solve the existed problem of technology support system in industry extension service.

In conclusion the study findings revealed significant gaps in the existing industry extension service on technology support package for SMEs at gulele sub city wereda 04 and 07, including lack of appropriate working machinery, equipment and other technology, lack of sufficient training about technology support, lack skilled employees to handle technology, Difficulty of integration of new technology with existing one, limited financial resources and poor infrastructures. This gaps lead to challenges to give a better technology supports for SMEs to address this issue, the researchers proposed a model frame work that provides a structured approach to a better technological support for SMEs able to them foster innovation and technological utilization.

5.2 Recommendation

To provide a better industry extension service on technology support packages for SMEs at gulele sub city wereda 04 and 07, it is important that implement the model developed to solve the problem of technology support by considering the key factor affecting the support system for SMEs. The developed models on this study have highlighted the vital role of Technology transfer, Project based technology, Digital marketing and Machine utilization. by integrating those basic activities in to the support system the SMEs can benefited from the system as well as the trainers.

This will help the models can solve different challenges that highly affect the support system of technology for the enterprise that are:

- **Project based technology:** mostly practically implemented by the trainers and they have high interest and motive for this activity and also by other side for the enterprises need on the un fulfillment of different infrastructures problems this project based technology are highly improve and solve the problems effectively.
- **Digital Marketing:** it includes a broad variety of online marketing activities and is the use of digital platforms and technologies to promote goods and services. Based on the data from small and medium enterprises operators they have high problem of market to promote and sell their products.

So this plat forms are simply can be developed by the trainers and address it for them there is different departments are found in the colleges like ICT, Business and Electronics

departments are can be develop the system and support the enterprises in this digital marketing platforms to promote and sell the products. For example E-commerce

- **Machine utilization:** On the collected data there is huge problems can be observed and analyzed related with how can small and medium enterprises uses a machine properly how much? They know the machine properly and so on. So based on the collected empirical evidence it is better to give a technology supports to maximize and improve the machine utilization for the enterprises.
- **Technology Transfer:** This activities are previously and still know practiced between the colleges and enterprises. The trainers develop technology and transfer it for enterprises but this process have its own problems that identified in this study but it not be questionable about its advantages.

In general it is important to note that the model development for technology support in SMEs in this study was based on a combination of data sources, including literature reviews, surveys, questioners, interviews, and direct observations.it includes trainers, SMEs workers and owners of the enterprises and woreda supervisors are participated on this study so all participants have high responsibility and plays crucial rules on the support system so the researcher highly recommend all the participants by understanding and applying the developed model efficiently and effectively that able to solve the current technology support gaps that addressed on the study.

5.3 Future research direction

There are four industry extension support packages that are technical, Kaizen, Entrepreneurship and Technology supports. From this support packages this study was address the technology support ones only due to the broadness of the support systems so for the future research direction it is better if the remaining support systems are investigated and will done a research on them and able to address different issues that highly support the industry extension support system for SMEs.

Reference

1. Aaker, D. A. (2008). Marketing research. John Wiley & Sons.
2. Ababa, A. (2014). Assessment of the implementation of industry extension service and challenges; the case of selected technical and vocational education and training institution in Guraghe Zone (Doctoral dissertation, Addis Ababa University).
3. Ayele, T. (2018). Review on factors affecting the performance of micro and small enterprise (MSE) in Ethiopia. *International Journal of Political Science and Development*, 6(8), 6.
4. Budianto, R., Praptapa, A., Herwiyanti, E., Puji, P., Suyono, E., & Rusmana, O. (2022). Technological innovation in Small and Medium Enterprises: A bibliometric analysis. *Journal of Sustainable Tourism and Entrepreneurship*, 3(4), 289-303.
5. Chen J C, Dugger J and Hammer B (2000), "A Kaizen Based Approach for Cellular Manufacturing Design: A Case Study", the *Journal of Technology Studies*, Vol. 27, No. 2, pp. 19-27.
6. Dehnie, F. A. (2014). Assessment of the Implementation of Industry Extension Services and Challenges; the Case of Selected Technical and Vocational Education and Training Institutions in Guraghe Zone (Doctoral dissertation, Addis Ababa University).
7. Endris, E., & Kassegn, A. (2022). The role of micro, small and medium enterprises (MSMEs) to the sustainable development of sub-Saharan Africa and its challenges: a systematic review of evidence from Ethiopia. *Journal of Innovation and Entrepreneurship*, 11(1), 20.
8. Fernandes, C. I., Ferreira, J. J., Veiga, P. M., Kraus, S., & Jones, P. (2023). Does sustainable innovation respond to SME's growth? European empirical evidence. *The International Journal of Entrepreneurship and Innovation*, 14657503231194263.
9. Fita, A. (2014), Assessment of the Implementation of Industry Extension Service and Challenge, Addis Ababa University, Ethiopia
10. Fraenkel FJ, W. N. (2002). How to Design and Evaluate Research in Education. 4th ed. New York: McGraw-Hill.
11. Figueiredo, P. N., & Piana, J. (2018). Innovative capability building and learning linkages in knowledge-intensive service SMEs in Brazil's mining industry. *Resources Policy*, 58, 21-33.

12. Fujita, M. (1997). Small and medium-sized enterprises in foreign direct investment. In *International Technology Transfer by Small and Medium-Sized Enterprises: Country Studies* (pp. 9-70). London: Palgrave Macmillan UK.
13. Gebrehiwot, A., & Wolday, A. (2006). Micro and small enterprises (MSE) development in Ethiopia: Strategy, regulatory changes and remaining constraints. *Ethiopian journal of economics*, 10(683-2016-46843), 1-32.
14. Gibb, A., & Manu, G. (1990). The design of extension and support services for small-scale enterprise development. *International Small Business Journal*, 8(3), 10-26.
15. Ginja, T. G. (2016). Some Issues of Micro and Small Enterprises in Wolaita Soddo Town of SNNPR, Ethiopia and Implication for Technical and Vocational Education and Skills Training: Leather Sector in Extra Emphasis. *Journal of Education and Practice*, 7(31), 12-18.
16. Gougé, E., & Torrecilla, V. (2017). SMEs and patent litigation: a European perspective. *les Nouvelles-Journal of the Licensing Executives Society*, 52(4).
17. Harasty, C., & Schmidt, D. (2003). Global employment trends. International Labour Organization.
18. Hill, H. (2001). Small and medium enterprises in Indonesia: Old policy challenges for a new administration. *Asian survey*, 41(2), 248-270.
19. ILO. (2006). Vulnerability and young women Entrepreneurs: A case study of Ethiopian.
20. Israel, G. D. (1992). Determining sample size.
21. Jarmin, R. S. (1999). Evaluating the impact of manufacturing extension on productivity growth. *Journal of Policy Analysis and Management: The Journal of the Association for Public Policy Analysis and Management*, 18(1), 99-119.
22. Jayawardena, N. S., Behl, A., Nedungadi, P., Jones, P., & Raman, R. (2024). Integration of Technology and Marketing Activities Among Service SMEs in Emerging Economies: A Scoping Review. *Journal of Global Information Management (JGIM)*, 32(1), 1-27.
23. Maher, T. J. (1996). An alternative industrial extension model: The experience of the food manufacturing industry. *The Journal of Technology Transfer*, 21(1-2), 84-92.
24. Malerba, F., & Orsenigo, L. (1997). Technological regimes and sectoral patterns of innovative activities. *Industrial and corporate change*, 6(1), 83-118.

25. McAdam, R., Reid, R., & Shevlin, M. (2014). Determinants for innovation implementation at SME and inter SME levels within peripheral regions. *International Journal of Entrepreneurial Behavior & Research*, 20(1), 66-90.
26. Miller, P. (1991). *Motivation in the Workplace*. Work and Organizational Psychology. Oxford: Blackwell Publishers.
27. Motwani, J., Dandridge, T., Jiang, J., & Soderquist, K. (1999). Managing innovation in French small and medium-sized enterprises. *Journal of small business management*, 37(2), 106.
28. Palmer V S (2001), "Inventory Management Kaizen", Proceedings of 2nd International Workshop on Engineering Management for Applied Technology, pp. 55-56, Austin, USA.
29. Radicic, D. (2014). *The Effectiveness of R&D and Innovation Policy in Promoting Innovation in European SMEs: an Empirical Investigation of Additionality Effects: A thesis submitted in partial fulfilment of the requirement of Staffordshire University for the degree of Doctor of Philosophy* (Doctoral dissertation, Staffordshire University).
30. Rajkhowa, P., & Qaim, M. (2021). Personalized digital extension services and agricultural performance: Evidence from smallholder farmers in India. *PloS one*, 16(10), e0259319.
31. Saunders M, L. P. (2009). *Research Methods for Business Student*. 5th ed. Edinburgh Gate: Pearson Education Limited.
32. Shapira, P., Uyarra, E., Youtie, J., Cox, D., Gok, A., Rogers, J., & Downing, C. (2015). Institutions for technology diffusion.
33. Shapira, P. (1990). Modern times: Learning from state initiatives in industrial extension and technology transfer. *Economic Development Quarterly*, 4(3), 186-202.
34. Shiferaw, E. R. (2024). The Effect of Industry Extension Services Project on the Performance of Small and Micro Enterprises. *International Journal of Economic Behavior and Organization*, 9(2), 67-76.
35. Siddiky, M. R., & Uh, S. B. (2020). Linking TVET with industries in Bangladesh: Need for supportive policies and an approach to TVET. *Journal of Technical Education and Training*, 12(3), 1-21.
36. Singh, J., & Singh, H. (2009). Kaizen philosophy: a review of literature. *IUP journal of operations management*, 8(2), 51.

37. Singh, D. (2019). Implementation of technology innovation in MSMEs in India: Case study in select firms from Northern region. *Journal of Science and Technology Policy Management*, 10(3), 769-792.
38. Subagja, A. D., Ausat, A. M. A., & Suherlan, S. (2022). The role of social media utilization and innovativeness on SMEs performance. *JURNAL IPTEKKOM Jurnal Ilmu Pengetahuan & Teknologi Informasi*, 24(2), 85-102.
39. UNDP. (2016). *Growing Manufacturing Industry in Ethiopia: Understanding African experiences in formulating and implementing plans for emergence*.
40. Varzaly, L. A., & Elashmawi, F. (1984). Technology utilization—the new corporate challenge. *The Journal of Technology Transfer*, 9(1), 61-69.
41. Wang,et.al. (2010). An evaluation framework for technology transfer of new equipment in high technology industry. *Technological Forecasting and Social Change*, 77(1), 135-137
42. Wube, M. C. (2020). The Effect of Industry Extension Services Packages on the Performance of Small and Micro Enterprises in Dessie, South Wollo and Oromia Zones of Eastern Amhara. *Journal of Entrepreneurship and Business Innovation*, 7(1), 1-43.
43. Yodit G. (2015). *Assessment on the Challenge of Micro And Small Scale Enterprise to Contribute to Sustainable Development*, Addis Ababa University, Ethiopia.

APPENDIX



ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING

Questionnaire for the survey on the **title** of Model development for Industry Extension Services in Small and Medium Enterprises to Promote Innovation and Technology Utilization: A Case study of Gulele Sub City.

Questionnaire fills by [Trainers](#)

Dear Respondent:

Thank you for participating in this research study. The aim of this questionnaire is to gather information about the role of industry extension services in promoting innovation and technology utilization in small and medium enterprises (SMEs). Your responses will remain confidential and will be used for research purposes only.

Thank you for taking time and answering all the questions thoroughly!

Cherent Tsegaye

Directions for filling in the questionnaire:

1. Please respond to multiple choice questions by circling the letter or letters of your choice.
2. For the open ended questions, please provide brief and clear responses on the blank spaces provided

Section I. Demographic information

1. Sex: Male Female
2. Age: 25-30 30-35 35-40 Above 40
3. How many years have you been active in your current position?
 Less than 2 year 2 to 5 years 6 to 10 years More than 10 years
4. Position: Dean Trainer SMEs owner SMEs worker
5. In which field does your academic education fit?
 Mechanical engineering civil engineering & construction
 Automotive Electrical & Computer engineering/ IT
 GMFA (Manufacturing) Furniture
 Leather and Garment other:

Section II: The major challenges that affect the Technology support in SMEs.

The major challenges that affect the Technology support in MSEs are listed below. Please indicate the degree to which these challenges are affecting the support mechanism of the small and medium enterprise (MSEs). After you read each of the challenges, evaluate them in relation to your business and then put a tick mark (√) under the choices below.

Where, **5** = strongly agree, **4** = agree, **3** = undecided, **2** = disagree and **1**= strongly disagree

Please indicate the degree to which you agree or disagree with the following statements concerning Technology factors

No	Statement	5	4	3	2	1
Technological utilization						
1	There is lack of appropriate working machinery, equipment and other technology.					
2	There is lack of awareness and information					
3	Perception that SME cannot afford technologies					
4	The enterprise lack promotion for the products due to using any latest technology					
Training and Support						
5	Do you have ability to copy other Instruments by your own?					

6	Is there sufficient training have you given to SMEs about technology support					
7	Do you have ability to copy other Instruments by your own or with other Trainers?					
8	Do you have gotten enough and tangible training in technology support packages of industrial extension service?					
9	Do you think that the trainers have enough/efficient and ability to train SMEs on technology support package?					
Skill level and commitment of Trainers						
10	The enterprise lack skilled employees to handle technology					
11	The enterprise unable to select proper technology					
12	Low technical skill in utilizing the technology					
13	Do you believed your support mechanism are doing current and modern work					
14	Difficulty of integration of new technology with existing one					
15	Do you belief The instruments/tools that SMEs use are modern and standardized					
16	Absence of organizational support and leadership in providing technological support.					
Resource/infrastructure						
17	There is limited financial resources					
18	High cost of technologies					
19	Do you believe SMEs are bring the products to the market with a quality and standardized product?					
20	Is there Connectivity and infrastructure limitations: like Slow internet speeds, electric power, water delivery etc.					

Section III. The Method of Technology Support by Entoto Poly Technic College to MSE.

1. Did you give technology support to the enterprise?

- A. Yes B. No

2. How would you rate the currently implemented industry extension service package?

- A. very good
- B. good
- C. Fair
- D. Poor
- E. Very poor

3. How would you evaluate industry extension services' ability to foster innovation and the use of technology?

- A. Significantly positive
- C. Neutral
- E. Moderately negative
- B. Moderately positive
- D. Significantly negative

4. How frequently does the colleges support on technology utilization areas delivered to the enterprise?

- A. Always
- B. Often
- C. Sometimes
- D. Rarely

5. From industry extension services packages which one is more implemented?

- A. Entrepreneurship training
- B. Kaizen
- C. Skill gap training
- D. Technology support

6. Do you give technology support by making frequent contact and follow up to enterprise?

- A. Yes
- B. No

7. As your opinion, the current industry extension service (IES) packages of supporting service is effective due to technological support?

- A) Yes
- B) No

If your answer is **No** what is the reason/

.....

if **Yes** how?

.....

8. Did you have developed new technology in your college?

- A. Yes
- B. No

9. If your answer is **yes** for question no **9** do you transferred the new technology to the enterprise?

- A. Yes
- B. No

If your answer is **No** why.....

10. Do you believed the new technology transferred to the enterprise have positively impacted on productivity?

- A. Yes
- B. No

If your answer is **Yes** or **No** How?

Appendix II



የአዲስ አበባ ቴክኖሎጂ ኢንስቲትዩት

የመካኒካል እና ኢንዱስትሪያል ምህንድስና ትምህርት ቤት

መጠይቅ: በአነስተኛና በመካከለኛ ኢንተርፕራይዞች የኢንዱስትሪ ኤክስቴንሽን አገልግሎት ሞዴል ልማት እንዲሁም የኢኮኖሚክስና ቴክኖሎጂ ተጠቃሚነትን ማስፋፋት በሚል አርዕስት በጉለሌ ክፍለ ከተማ የሚደረግ ጥናት

በኢንተርፕራይዝ የሚሞላ መጠይቅ

የተከበሩ መልስ ሰጪ

በዚህ የምርምር ጥናት ላይ ስለተሳተፉት አመለካከት የዚህ ጥያቄ ዓላማ የኢንዱስትሪ ማስፋፊያ አገልግሎቶች በአነስተኛና በመካከለኛ ድርጅቶች ውስጥ አዳዲስና የቴክኖሎጂ አጠቃቀምን በማስፋፋት ረገድ ስለሚጫወቱት ሚና መረጃ ማሰባሰብ ነው። የእርስዎ ምላሾች ምስጢራዊነት የተጠበቀ ሆነው ይቆያሉ እንዲሁም ለዚህ የምርምር ዓላማ ብቻ ጥቅም ላይ ይውላሉ።

ውድ ጊዜዎትን መስዋት አድርገው ሁሉንም ጥያቄዎች በተገቢው ሁኔታ ስለመለሱ አመለካከት!

ቸርነት ፀጋዬ

በጥያቄ ውስጥ ለሚሞሉ መልሶች የተቀመጡ አቅጣጫዎች

1. እባክዎ ለምርጫ ጥያቄዎች ምላሽ በሚሰጡበት ጊዜ የእርስዎን ምርጫ የመረጡትን ፊደል ያክብቡ

2. ማብራሪያ ለሚፈልጉ ጥያቄዎች እባክዎ በተሰጡት ባዶ ቦታዎች ላይ አጠር ያሉ እና ግልጽ የሆኑ ምላሾችን ይስጡ

ክፍል I. የደግሞራፊ መረጃ

1. የታ: ወንድ ሴት
2. እድሜ-20-25 25-30 30-35 ከ 35 በላይ
3. አሁን ባሉበት ቦታ ላይ ምን ያህል ዓመታት አንቀሳቅሳችኋል/ሰርተዋል?
 ከ2 ዓመት ያነሰ ከ2 እስከ 5 ዓመት ከ6 እስከ 10 ዓመት ከ10 ዓመት በላይ
4. የስራ ድርሻ: ዲን አሰልጣኝ የኢንተርኔት ሰራተኛ የኢንተርኔት ሰራተኛ
5. የትምህርት መስክዎ ከየትኛው ጋር ተስማሚ ነው?
 ሜካኒካል ኢንጂነሪንግ ሲቪል ምህንድስና & ህንፃ ግንባታ
 አውቶሞቲቭ ኤሌክትሪካል & ኮምፒውተር ምህንድስና/ IT
 ማኑፋክቸሪንግ እንጨት ስራ
 ቆዳና ልብስ ስፌት ሌላ:

ክፍል II. በአነስተኛና በመካከለኛ ኢንተርኔት-ይዘት የቴክኖሎጂ ድጋፍ ላይ ተጽዕኖ የሚያደርጉ ዋና ዋና ፈተናዎች

በኢንተርኔት-ይዘት የቴክኖሎጂ ድጋፍ ላይ ተጽዕኖ የሚያሳድሩ ዋና ዋና ፈተናዎች ከዚህ በታች ተዘርዝረዋል. እነዚህ ፈተናዎች ሁኔታዎች በአነስተኛ እና መካከለኛ ድርጅት (MSEs) የድጋፍ አሰጣጥ ላይ ምን ያህል ተጽዕኖ እየደረሰ መሆኑን እባክዎ ይጠቁሙ. እያንዳንዱን ተፈታታኝ ሁኔታ ካነበቡ በኋላ ከስራችሁ ጋር በተያያዘ ግምገማ ያድርጉ እና ከታች ባሉት ምርጫዎች ሥር የጭረት ምልክት (✓) ያስቀምጡ::

5 = በጥብቅ እስማማለው, 4 = እስማማለው, 3 = መካከለኛ, 2 = አልስማማም እና 1 = በጥብቅ አልስማማም

የቴክኖሎጂ ሁኔታዎችን በተመለከተ በሚከተሉት መግለጫዎች ላይ ምን ያህል እንደምትስማሙ ወይም እንደማትስማሙ እባክትን ይጠቁሙ

No	መግለጫ	5	4	3	2	1
1	የግንዛቤና መረጃ እጥረት አለ					
2	የገንዘብ አቅም ውስን ነው					
3	ተገቢ የስራ ማሻገሻ፣ መሳሪያዎች እና ሌሎች ቴክኖሎጂዎች እጥረት አሉ።					
4	ኢንተርፕራይዙ ቴክኖሎጂን የሚያስተናግዱ የተካኑ ሰራተኞች የሉትም					
5	ኢንተርፕራይዙ ተገቢውን ቴክኖሎጂ መምረጥ አለመቻል					
6	ማንኛውም የቅርብ ጊዜ ቴክኖሎጂ ባለመጠቀሙ ምክንያት ኢንተርፕራይዙ ለምርቶቹ ማስተዋወቂያ የላቸውም					
7	ቴክኖሎጂውን በመጠቀም ረገድ ዝቅተኛ የቴክኒክ ችሎታ መኖር					
8	የቴክኖሎጂ ውጤቶች ከፍተኛ ወጪ መኖር					
9	አዳዲስ ቴክኖሎጂዎችን አሁን ካለው ቴክኖሎጂ ጋር ማዋሃድ አስቸጋሪ መሆን					
10	የቴክኖሎጂ ድጋፍ በመስጠት ረገድ ድርጅታዊ ድጋፍና አመራር አለመኖር.					
11	ኢንተርፕራይዞች የቴክኖሎጂ አቅም የላቸውም የሚል አመለካከት መኖር					
12	የሥራ መሳሪያዎች ዘመናዊ ይመስላሃል?					
13	ሌሎች መሳሪያዎችን በራስህ የመገልበጥ/የመስራት ችሎታ አለህ?					
14	የቴክኖሎጂ ድጋፍን በተመለከተ በቂ ስልጠና አለ ወይ?					
15	ምርቶቹ ጥራት ያለው እና ከመደበኛ ምርት ጋር ወደ ገበያ ታመጣላችሁ?					
16	የኢንዱስትሪ ማስፋፊያ አገልግሎት በቴክኖሎጂ ድጋፍ ፓኬጆች ላይ በቂ እና ተጨባጭ ስልጠና አግኝተዋል?					
17	አሰልጣኞቹ በቴክኖሎጂ ድጋፍ ፓኬጅ ላይ በቂ/ውጤታማ እና ችሎታ ያላቸው ይመስሉታል?					
18	ወቅታዊ እና ዘመናዊ ስራዎችን እንደሚሰሩ ያምናሉ?					
19	የምትጠቀሙባቸው መሳሪያዎች ዘመናዊ እና መደበኛ ናቸው ብለው ያምናሉ					
20	የመሰረተ ልማት ውስንነቶች አሉ? እንደ አዘጋጫ የኢንተርኔት ፍጥነት, የመብራት እና የውሃ አቅርቦት					

Appendix III

ADDIS ABABA UNIVERSITY
ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING
DEPARTMENT OF INDUSTRIAL ENGINEERING

Data collection Form

Interview questionnaire for [Trainers](#)

1. In your opinion, are all of the Industry Extension Service packages done in the same way?
How?
2. How does the industry extension service determine the gaps and needs in technology that SMEs have?
3. In what ways does the industry extension service usually provide SMEs with technology support packages?
4. How does the industry extension service determine which technological solutions are most suited for certain SMEs?
5. In a continually changing technical context, how does the industry extension service make sure that the technology support given to SMEs is current and applicable?
6. How is the impact and efficiency of the industry extension service technological support packages measured?
7. Could you give some instances of particular workshops, training courses, or tools that industry extension services offer to help SMEs innovate and use technology more?
8. How do TVET instructors evaluate the gaps in knowledge and technological proficiency among SMEs?
9. What are the primary obstacles that TVET trainers encounter when providing SMEs with technology support, and what steps are taken to overcome these obstacles?



የአዲስ አበባ ቴክኖሎጂ ኢንስቲትዩት

የመካኒካል እና ኢንዱስትሪያል ምህንድስና ትምህርት ቤት

ለኢንተርፕራይዥን የተዘጋጀ ቃለ መጠይቅ

1. የኢንዱስትሪ ማስፋፊያ አገልግሎት በቴክኖሎጂ ድጋፍ ላይ መተግበር አሁን ምን ተግባራት አሉት? ደካማ ነው ወይስ ጠንካራ? ለምን?
2. በኢንተርፕራይዥም ውስጥ በቴክኖሎጂ ድጋፍ ፓኬጅ የኢንዱስትሪ ማስፋፊያ አገልግሎት አፈጻጸም ላይ ምን ፈተናዎችን መጥቀስ ትችላላችሁ?
3. እስካሁን በቴክኖሎጂ ድጋፍ ፓኬጅ ላይ የተተገበረው የኢንዱስትሪ ማስፋፊያ አገልግሎት በኢንተርፕራይዥም ላይ ውጤታማ ይመስላችኋል? እንዴት?
4. በእርስዎ ድርጅት ውስጥ በቴክኖሎጂ ድጋፍ ላይ የኢንዱስትሪ ማስፋፊያ አገልግሎት የተሻለ መሻሻል ለማድረግ ወደፊት ምን መደረግ እንዳለበት ሐሳብ አለዎት?
5. የ TVET አሰልጣኞች በኢንተርፕራይዥም ውስጥ የቴክኖሎጂ ድጋፍ ጥቅሎች ተግባራዊ እንዲሆኑ እና ስኬታማ እንዲሆኑ አስተዋጽኦ የሚያደርጉት እንዴት ነው?