MBEYA UNIVERSITY OF SCIENCE AND TECHNOLOGY

REVISED RESEARCH AGENDA

AUGUST 2023

FOREWORD

Mbeya University of Science and Technology (MUST) is a higher learning institution endeavouring to lead in science and technology. In so doing, it expects to become the Centre of excellence for academics, research and consultancy and puts itself in a position where research results improve livelihood in the society. As a result, MUST commitment to academic excellence will match with serious research activities that will respond to the global challenges of science and technology.

To address this, the University with the support of Higher Education for Economic Transformation (HEET) Project revised the MUST Research Agenda and Priority Areas formulated in 2020 as a rule of thumb that policies are revised after every three years. The revision of the Research Agenda and Priority Areas serve as a blueprint for all research executed by research stakeholders. The current revision has taken into consideration changes in National Research Priorities, National reformation of education curricula in primary and secondary schools, and MUST Corporate Strategic Plan 2022/2023 – 2026/2027 and overall University transformation.

Through HEET Project support, the major revisions include research themes from the new College of Agricultural Sciences and Technology, improvement of themes in the existing Colleges, Centre for Innovation and Technology Transfer (CITT) and Centre for Gender Studies. It is hoped that MUST will produce innovative, cutting-edge and forward-looking researches that are nationally relevant and will truly provide users a better understanding of existing and emerging local and international issues in applied education in science and technology. The MUST Research Agenda outlines areas of research and innovation deemed to be priority and in-line with the National Research Priorities, development priorities and strategies of the Tanzania Development Vision 2025.

Prof. Aloys N. Mvuma

Vice Chancellor

Mbeya University of Science and Technology

TABLE OF CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

CET	College of Engineering and Technology
CITT	Centre for Innovation and Technology Transfer
CoACT	College of Architectural and Construction Technology
CoAST	College of Agricultural Sciences and Technology
CoHBS	College of Humanities and Business Studies
CoICT	College of Information and Communication Technology
CoSTE	College of Science and Technical Education
COSTECH	Commission for Science and Technology
FTC	Full Technician Certificate
GDP	Gross Domestic Product
GoT	Government of Tanzania
HEET	Higher Education for Economic Transformation
ICT	Information and Communication Technology
IPR	Intellectual Property Rights
MCST	Ministry of Communication, Science and Technology
MIST	Mbeya Institute of Science and Technology
MRCC	MUST Rukwa Campus College
MTC	Mbeya Technical College
MUST	Mbeya University of Science and Technology
R&D	Research and Development
SDGs	Sustainable Development Goals
STEM	Science, Technology, Engineering and Mathematics
STIs	Science and Technology Institutions
TCU	Tanzania Commission for Universities
TDV	Tanzania Development Vision
URT	United Republic of Tanzania
USA	United States of America

DEFINITION OF KEY TERMS AND CONCEPTS

(a) **Research Agenda**
A research agenda is a formal plan of action that summarizes specific issues and ideas in a subset of any field of study. It is a guiding plan that helps to put together a system of study so that the University can decide what should be tackled now and in the future.

(b) **Research Theme**
A research theme expresses long-term research goals of the University with respect to its departments or colleges.

(c) **Research Priority Areas**
Research priority areas are the identified research areas that will be invested in through research and development to address significant social and economic challenges facing communities and the nation to transform and improve livelihood.

(d) **Research Goal**
A research goal is an observable and/or measurable end result.

CHAPTER ONE

BACKGROUND INFORMATION OF THE UNIVERSITY

1.0 Introduction

The history of Mbeya University of Science and Technology (MUST) dates back to 1986 when Mbeya Technical College (MTC) was established by the Government of Tanzania for the purpose of training Full Technicians at Certificate Level (FTC) under the Russia - Tanzania Training Support. The College existed up to mid-2005 offering programmes in the fields of architecture, electrical engineering, civil engineering and mechanical engineering. In July 2005, MTC was transformed into a multi-disciplinary Mbeya Institute of Science and Technology (MIST) through the National Council for Technical Education (Mbeya Institute of Science and Technology) Establishment Order, 2004.

The transformation was a Government's move towards strengthening the College to become a fully-fledged University. Mbeya Institute of Science and Technology registered a number of achievements including restructuring of FTC programmes to ordinary diploma programmes and introduction of undergraduate degree programmes which eventually led to expansion of students' enrolment. Following these achievements, on 29th March 2012 after being issued with a Provisional License by Tanzania Commission for Universities (TCU), the Institute was transformed into a fully-fledged University namely Mbeya University of Science and Technology (MUST). The University was granted Mbeya University of Science and Technology Charter, 2013 on 20th August 2013.

MUST endeavours to lead in science and technology and thereby become a centre of excellence for academics, research and consultancy whose

research results will improve livelihoods in the society. In order to develop professional skills in science, technology, engineering and other related fields, MUST has to conduct research that in line with the national Research Agenda.

1.1 MUST Vision

The Vision of Mbeya University of Science and Technology is to become the leading centre of excellence for knowledge, skills and applied education in science and technology.

1.2 MUST Mission

The Mission of Mbeya University of Science and Technology is to develop academically, technologically and socially competent students, staff and other stakeholders who will be responsive to the broader needs and challenges of the society specified by:

(a) Facilitating appropriate tuition, practical training and support according to the needs of students and other customers;

(b) Encouraging staff commitment to quality education and services including research, consultancy and innovation;

(c) Fostering lifelong learning, honesty and responsibility;

(d) Promoting an environment conducive to human development; and

(e) Promoting effective entrepreneurship and usage of appropriate technology that meet national and international needs and standards through skills and practical oriented training, research and consultancy.

1.3 Situation Analysis

Major developments in various sectors are likely to present both

opportunities and challenges in the overall development of Tanzania. Research plays a crucial role in science, technology and socio-economic development of any society. It leads to the improvement of the quality of people's lives such as increasing life expectancy, enhancing agricultural productivity in critical productive sectors of the economy for improved livelihoods and food security. Moreover, it can also lead to development of technologies that would improve people's lives. At the institutional level, research can bring about product innovations and improvement, improved performance in product marketing and increased service efficiency and effectiveness. Hence, the contribution of research in development is inevitable. It is apparent that well-targeted and good quality research which addresses societal challenges is needed to inform policy and decision-making processes for sustainable development.

The existing MUST Research Agenda and Priority Areas does not cover research activities in all Colleges. This is due to increased fields and disciplines as a result of the ongoing University transformation and the need to align with the Revised National Research Priorities 2021/2026.

This Revised Research Agenda intends to fill the aforementioned gaps so as to equip researchers with the University's vision pertaining to research activities. For these reasons, the University, through the Higher Education for Economic Transformation (HEET) Project revised the MUST Research Agenda 2020 and its priority areas. The revision of the Research Agenda took into consideration the National Research Agenda and the University academic programmes through engagement, in-depth consultation and participation of academic staff and other stakeholders.

1.4 Justification of Research Agenda and its Priority Areas

The 9th United Nations Sustainable Development Goals (SDGs) aim to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation by enhancing scientific research and upgrading the technological capabilities of industrial sectors in developing countries in particular. Accordingly, Tanzania Development Vision 2025 put forward that science and technology education and awareness of its applications for promoting and enhancing productivity through continuous learning and publicity campaigns.

Thus, MUST Research Agenda and its priority areas provide guidelines and directions based on its retrospective and prospective matters on research activities. The Research Agenda intends to facilitate the integration of academic programmes with research to be conducted at the University. It ensures alignment with the National Research Priorities and thus gives direction to researchers, academia and development partners on planning and funding research. Research and development partners and other stakeholders are therefore expected to plan, undertake and promote researches that are in line with the MUST Research Agenda and National Research Priorities. MUST Research Agenda aims to facilitate both basic and applied research to generate new knowledge and solutions to the challenges encountered by various sectors.

CHAPTER TWO

BACKGROUND INFORMATION ON MUST RESEARCH AGENDA

2.0 Introduction

This part presents the Vision, Mission, Goal, Objectives, Philosophy, and Scope of the Research Agenda.

2.1 Vision

To be a University with strong, dynamic, resilient and competitive research outputs both knowledge based and innovation driven.

2.2 Mission

To develop a research system that will increase the outcome and efficiency of research and development (R & D) through participation and collaboration with various stakeholders including academicians, students, researchers and society.

2.3 Goal

The goal of the Research Agenda is to enhance sustainable socio-economic development of the University and the Country through R & D.

2.4 Objectives

The main objective of the Research Agenda is to guide research stakeholders to generate new knowledge and solutions to the challenges encountered by various sectors. Specifically, this Research Agenda aims to:

(a) Facilitate basic and applied research activities;
(b) Produce an inclusive and comprehensive Research Agenda for research stakeholders;
(c) Align the research, development and publication efforts with

the National Research Priorities;

(d) Improve the effectiveness of research, development and publication in the University by setting realistic targets;

(e) Guide the allocation of resources for research, development and publication;

(f) Create a participatory platform for shaping the direction of research, development and publication, and therefore enhancing its contribution to science, technology and economic development; and

(g) Promote the culture of conducting demand-driven research that address issues of national socio- economic importance among research stakeholders.

2.5 Philosophy

The Research Agenda aims to promote research activities that have practical consequences.

2.6 Scope

The scope of the Research Agenda is to guide academic staff, students and research partners (both public and private sectors) in executing research activities of particular interest and relevance.

CHAPTER THREE
PROCEDURES FOR IDENTIFYING RESEARCH THEMES

The participatory approach was employed in revising the Research Themes which involved stakeholders from all academic departments. This included:

(a) Assessing MUST current status and future research needs;

(b) Setting priorities of the Research Agenda in relation to the Tanzania Development Vision 2025 and the National Research Priorities;

(c) Brainstorming the research themes and priorities for MUST in line with the National Research Priorities;

(d) Compilation of research themes and sub-themes at the College, Directorate and Centre levels as shown in Appendices 1 to 6; and

(e) Compilation of research themes from Colleges, Directorates, and Centres to form a comprehensive University Research Agenda.

CHAPTER FOUR
THE UNIVERSITY PRIORITY AREAS AND RESEARCH THEMES

4.0 Introduction

The revised Research Agenda reflects the current status of the research in the University in relation to the National Research Priorities. The University Research Agenda summarizes 17 key research themes in 3 priority areas of science, technology and innovation as follows: Medical and Health Systems; Irrigation, agro-mechanization, agro-processing and marketing; Information and Communication Technology for Industrialization; Accessible and quality education; Sustainable, Renewable and conventional energy; Water management; Biodiversity conservation and sustainable utilization; Innovation, technology transfer and commercialization; Construction and infrastructure development and management; Climate change adaptation and mitigation; Aquaculture, fisheries and related products quality and marketing; Land Management and Human settlement; Supply chain management in industry; Entrepreneurship for industrialization; Exploration, mining, processing and marketing; Gender mainstreaming; and Tourism development and management as shown in Table 1.

Table 1: Research Themes

S/N	THEME
1	Medical and Health Systems
2	Irrigation, agro-mechanization, agro-processing and marketing
3	Information and Communication Technology for Industrialization
4	Accessible and quality education
5	Sustainable, Renewable & conventional energy
6	Water management
7	Biodiversity conservation and sustainable utilization

8	Innovation, technology transfer and commercialization
9	Construction and infrastructure development and management
10	Climate change adaptation and mitigation
11	Aquaculture, fisheries and related products quality and marketing
12	Land Management and Human settlement
13	Supply chain management in industry
14	Entrepreneurship for industrialization
15	Exploration, mining, processing and marketing
16	Gender mainstreaming
17	Tourism development and management

CHAPTER FIVE
DESCRIPTION OF RESEARCH THEMES

5.1 Introduction

The MUST Research Agenda defines an array of relevant areas in the field of applied education in science and technology. The research areas emanated from areas as reflected in Section 4.0. From the revised Research Agenda, Research Themes and Sub-themes have been identified to guide academic staff, students, and research partners in executing research activities. The research priority areas are as detailed hereunder:

5.2 Medical and Health Systems

Advances in medical technology have created opportunities for development of new courses at MUST with diagnostic kits, test existing biomarkers for enhancing early diagnosis to avert morbidity, promote better prognosis, hasten recovery and improve quality of life and ensure survival. Research at MUST shall focus on the efficiency and impact of existing and new medical technologies in enhancing disease prevention and treatment. Further, it shall identify the future needs so as to selectively invest in specific diagnostic technologies that are contextually safe, cost-effective, and friendlier to the environment for diseases prevention and better health outcomes.

The need for robust research on health outcomes resulting from successful efforts to offer integrated care is important in order to relieve the overburdened health system. Therefore, MUST Research shall focus on the following areas:

5.2.1 Solutions to bridge the gaps pertaining to availability, timely access and delivery of health services to all people within catchment areas (inclusive of emerging vulnerable

populations);

5.2.2 Innovative training systems for generating competent human capital resources for health, its deployment and retention;

5.2.3 Alternative health financing mechanisms that would improve access through effective mobilization for Universal Health Coverage and delivery of health services for the underserved and correct the equity gap between rural and urban areas;

5.2.4 Developing and testing models for strong disease surveillance systems and maximizing the use of health information systems for clinical decision making;

5.2.5 Application of emerging technologies to improve preventive interventions and health promotion by measuring outcomes related to community interventions, anticipatory guidance; and

5.2.6 Enhancing adoption of, adherence to health promotion, and disease prevention practices.

5.3 Irrigation, Agro-mechanization, Agro-processing and Marketing

Irrigation is essential for better crop yields and production. It mitigates vagaries of weather, which are becoming more frequent and intensive because of global climate change. Thus, research on holistic integrated planning in water resource utilization to maximize production is inevitable. Furthermore, farm machinery, implements and equipment are important tools for increasing the area under production. Despite its importance, the utilization of farm machinery and implements in the country is very low with about 64 percent of farmers using the hand hoe, 24 percent draught animal power and 12 percent tractors. Thus, MUST research shall focus on areas that include:

5.3.1 Optimization of the use of farm implements;

5.3.2 Agricultural market infrastructure for the development of agricultural commodities and stimulating agricultural production; and

5.3.3 Supportive infrastructure for production, transportation, storage and processing.

5.4 Information and Communication Technology for Industrialization

The emergence of ICT has facilitated the nation's socio-economic development process. Both developed and developing nations recognize the fact that the effective use of ICT is becoming the most critical factor and key driver for rapid economic growth and wealth creation, for improving socio-economic well-being. MUST is responsible for ensuring that the nation's capability to accelerate the development processes and gain global competitiveness is enabled to the extent that it can develop, use and exploit ICT in various forms. The Government of Tanzania (GoT) needs to acknowledge that it needs to move from industrially weak and subsistence agriculture-based economy of Tanzania towards an information and knowledge economy. Thus, it is inevitable for MUST to explore and develop Tanzania's information economy and society as part of the process of accelerating the nation's socio-economic development in the technological age. Therefore, MUST research shall focus on areas that include:

5.4.1 Indigenous products commensurate with the modern industrialization drive, responding to the current mining industry, transportation, agriculture, health and education; and

5.4.2 Design and development of software tools for industrial control and service provision as well as cyber/digital security for these systems.

5.5 Accessible and Quality Education

Access to education, its relevance, efficiency, management, financing, quality and equity are extremely fundamental in measuring the success of any country. Tanzania has instituted interventions in the education sector intended to increase access guided mainly by Primary and Secondary Education Development Programmes, Vocational Education and Higher Education Policies. Whilst these interventions have increased access to education as evidenced by enrolment at all levels, they have nevertheless impinged on quality due to several factors including overstretched educational infrastructure as well as human capital enhancement as per ongoing government curricula reformation of primary and secondary schools. Thus, MUST research shall focus on areas that include:

5.5.1 Inventiveness, innovativeness and high-level quality education that will promote an industrial based economy;

5.5.2 Quality and relevant curricula development and implementation;

5.5.3 Quality education infrastructure; and

5.5.4 Improving learning and teaching process.

5.6 Sustainable, Renewable and Conventional Energy

Lack of reliable energy supply has been identified as the main binding constraint to Tanzania's economic growth. The elasticity between GDP growth and energy demand in the form of electricity suggests that the current GDP average growth of 7% needs to be matched with the power generation and maintenance of a buffer of at least 15% of the total capacity to enable sustainable economic growth. Access to modern technology and commercialization of alternative energy in rural and urban areas of Tanzania is limited. This has an adverse impact on forest resources (de-forestation for firewood and charcoal). Thus, MUST research shall focus on areas that include:

5.6.1 Generation of accessible, affordable, and reliable energy; and

5.6.2 Sustainable exploitation of renewable and non-renewable energy sources.

5.7 Water Management

Availability of water in the country is highly dependent on rainfall. More than half of the Country receives on the average less than 800 mm of rain per annum. The scarcity of water has been a major problem especially in rural areas. Studies show that the main problems in rural communities include commuting long distances of over 2 to 3 kilometres daily in search for water from public taps; and carrying heavy containers of about 20 to 25 litres per trip. Thus, MUST research shall focus on areas that include:

5.7.1 Development of cost-effective technologies for wastewater treatment, recycling, reuse, and reducing domestic, municipal, and industrial wastes;

5.7.2 Innovative models for establishing comprehensive community and cross- border integrated water sources management; and

5.7.3 Devising appropriate local technologies for sustainable management of solid waste from industrial establishments through research.

5.8 Biodiversity Conservation and Sustainable Utilization

Human activities (such as illegal fishing/hunting, pollution, poor agricultural practices, mining, deforestation, biomass burning) and natural processes have an impact on the sustainability of aquatic ecosystems. Therefore, research is needed to establish status of human activities, and how these, together with natural processes may affect ecosystem components, structure and functioning in the future in order to devise mitigation measures.

Natural resources are one of Tanzania's comparative advantages, with the potential to boost tourism industry. For instance, marine tourism takes place along the coast and in marine environments such as coral reefs, mangroves, coastal forests, sea, islands, islets and beaches. Thus, MUST research shall focus on areas that include:

5.8.1 The impact of tourism activities on socio-economic development and environment;

5.8.2 Sustainable utilization of natural resources; and

5.8.3 Techniques to improve conservation of natural resources.

5.9 Innovation, Technology Transfer and Commercialization

Innovative and induced business clusters and incubation programmes are intended to offer support such as modular working premises; access to technology and financial services; marketing facilitation; product development support; technical assistance; as well as communication and information services. There are a number of incubator related initiatives currently going on in Tanzania, but the impact of these incubation programmes has not been sufficiently translated into creation of new employment opportunities or graduate companies in the competitive market. Research and investment in this area is needed to come up with more innovative incubation marketing models and innovation hubs that are effective for industrial development and sustainability.

Industrial development is highly dependent on research and technology transfer. The success of this sector will depend on the extent to which the country develops, consolidates and strengthens basic scientific research, technology and innovation. In Tanzania, technology transfer and commercialization has not been adequately exploited due to limited capacity in absorption, adoption and transfer of technology. There is also inadequate interaction between industry, research institutions and

knowledge centres. Thus, MUST research shall focus on areas that include:

5.9.1 Approaches for sustainable technology development and transfer and manufacturing systems;

5.9.2 Intellectual Property Rights (IPR) framework; and

5.9.3 Models for linking R&D Institutions with industries.

5.10 Construction and Infrastructure Development and Management

In today's rapidly changing world, developing countries like Tanzania are striving to achieve sustainable economic growth and address pressing societal needs. The role of construction and infrastructure development in driving this growth and creating a solid foundation for progress cannot be underrated. Mbeya University of Science and Technology (MUST) recognizes the significance of this field and has established a Research Agenda that focuses on advancing knowledge and addressing key issues in construction and infrastructure development and management.

One of the core aspects of MUST Research Agenda is to explore the relationship between infrastructure and economic growth. Extensive research has shown that a well-developed infrastructure network is a catalyst for economic expansion, attracting investment, and enhancing productivity. By delving into this relationship, MUST researches seek to advance knowledge on the specific mechanisms through which infrastructure development influences economic and social growth in developing countries such as Tanzania. This knowledge will also inform policy makers and stakeholders in making informed decisions regarding infrastructure investments and maximizing their impact on current and future economic prosperity.

Furthermore, it is crucial to identify the current research priorities and emerging trends in the field of construction and infrastructure development and

management and align these with the evolving needs of the industry and society. In this regard, MUST shall focus on areas that include:

5.10.1 Collaborative and dynamic environment that addresses the challenges and opportunities in construction and infrastructure development and management;

5.10.2 Sustainable and resilient infrastructure systems design to support Tanzania's journey towards inclusive and prosperous economic growth;

5.10.3 Sustainable construction practices and smart infrastructure;

5.10.4 Optimizing investment allocation in infrastructure projects for effective planning and resource allocation; and

5.10.5 Developing predictive models, data-driven analytics, and decision support systems to aid policymakers, planners, and investors in making informed decisions regarding infrastructure investments.

By embracing this Research Agenda, MUST aims to create a lasting impact by ensuring that Tanzania and other developing countries are equipped with the knowledge, tools, and strategies necessary to build a sustainable future.

5.11 Climate Change, Adaptation and Mitigation

Climate change has a significant impact on the ecosystem. It modifies biological, chemical and physical conditions in the environment, which eventually affects the sustainability of human and natural resources. However, there is limited understanding of the interdependency of these subsystems; as a result, Tanzania has experienced a variety of natural disasters. Experience has shown that major types of natural disasters such as drought, floods, epidemics, windstorms, landslides, earthquake, pest infestation and volcanic eruptions are caused by climate change. Moreover, some of these disasters have resulted in the loss of lives, displacement of victims,

damage to property and infrastructure consequently disrupting the development gains made over the years. Consequently, research is needed for better understanding, detecting, and forecasting climate change and providing a scientific rationale for interventions. Thus, MUST shall carry out research on:

5.11.1 Natural and social sciences as well as studies that will provide an understanding of the socio-ecological systems with a view to generating decision-relevant information to policy makers; and

5.11.2 Disaster risk reduction, geodynamics and geo-hazards, vulnerability and risk assessments, mitigating technologies and early warning systems.

5.12 Aquaculture, Fisheries and Related Products Quality and Marketing

The fisheries sector contributes to the economy mainly through capture fishery while the aquaculture industry is growing at a slow pace. Capture fishery sources are highly diverse and their sustainability depends on responsible management decisions that are based on available scientific information. Fishery and fish products contribute to the socio-economic development of the country. However, poor quality of fish and fish products leads to poor sales in the market. Furthermore, due to increasing fishing pressure and declining fish catches in the wild stocks, attention has now turned into developing aquaculture systems capable of meeting the demands of the growing human population. In order to improve quality, standards, and hence values of fish and fish products, research is required to identify ways of addressing the existing challenges in the fishery value chains by introducing innovative technologies that can contribute to industrial processing and manufacturing of products.

Thus, MUST research shall focus on areas that include:

5.12.1 Development of highly efficient and environmentally friendly aquaculture technologies;

5.12.2 Availability of fingerlings and the status of fish stocks (biology and ecology);

5.12.3 Exploitation patterns, gears, and methods used;

5.12.4 Effect of alien species; and

5.12.5 Identification of feed types and fish species that can be efficiently cultured.

5.13 Land Management and Human Settlement

Land is a basic resource on which human beings and other living creatures depend. Despite its importance, the country lacks a detailed land use plan for demarcating different uses. MUST research shall focus on addressing the challenges faced by the sector such as: Inadequate surveyed and serviced land for human settlement; inadequate development and investments as well as functional procedures for securing and use of land. It is estimated that over 70% of the Tanzanian population live in unplanned settlements and over 60% of urban housing stock recorded in these settlement areas. Therefore, research in this area shall focus on developing effective and efficient novel approaches to facilitate rapid national socio-economic development and national land use priorities, promotion of equitable distribution and ensuring access and productive use of land.

Transformation of the country's settlement pattern that is characterized by numerous scattered small villages to that of large villages, towns, municipalities and cities poses threats to health and productivity. Rapid urbanization and rural-urban migration have over the last four decades increased and continues to increase the proportion of the country's population living in urban areas. This has an implication on the

delivery of social services and infrastructure development, increased pollution, haphazard housing and settlement development, environmental degradation, land tenure insecurity, and poor infrastructure maintenance. As a result of competing land use practices in the same areas, land use conflicts are now prominent. Thus, MUST research shall focus on areas that include:

5.13.1 Addressing land use and resources conflicts, rural-urban migration, and other issues that arise as a result of urbanization; and

5.13.2 Demographic studies, community innovation platforms and traditional approaches in conflict management.

5.14 Supply Chain Management in Manufacturing Industry

In the manufacturing industry the problem of setting up and managing supply chain relationships has recently become of unprecedented complexity and importance. Currently, even the most common products are obtained through processes that are highly complex with regard to the production technology, the required knowledge and the number of stages involved. The processes in the value chain are spread across different technological areas and they require the application of specialized and advanced knowledge in all phases. Consequently, firms involved in the development of a new product must coordinate with the other actors in the chain from the earliest stages of design and engineering.

A retrospective analysis of the evolution of managerial perspectives on the supply-chain management in industrial production is required. The philosophy underlying the management of purchasing and supply in industrial firms has reflected, over time, the managerial paradigm at the basis of the strategic choices of the firm. Thus, all main firm's purchasing and supply processes have evolved in order to provide an

adequate response to the changes in the prevailing competitive environment. Thus, research is needed so as to position new firms along the production chain. Therefore, MUST shall carry out research that includes:

5.14.1 The suppliers' potential for technological and innovation development;

5.14.2 The actual reversibility of investments on a specific technological trajectory; and

5.14.3 The risk associated with dependency on suppliers and the opportunities of multiple and/or parallel relationships.

5.15 Entrepreneurship for Industrialization

Economies of the developed world have benefitted from R&D investment in entrepreneurship, which focuses on improving quality and standards so as to produce competitive products and services among other aspects of the value chain. More recently, developing countries such as Tanzania have likewise initiated R&D in entrepreneurship to stimulate industrial sector. Thus, MUST research shall focus on areas that include:

5.15.1 Entrepreneurial skills, linkages between academia and enterprises; technology transfer; start up financing; products and services competitiveness;

5.15.2 Marketing systems and entrepreneurship of the local produce;

5.15.3 Developing innovative marketing systems that would enhance competitiveness through agro-based industries and value addition throughout the supply chain; and

5.15.4 Building capacity to supply agro-processed products among others in response to new opportunities in the domestic and export markets.

5.16 Exploration, Mining, Processing and Marketing

Tanzania is endowed with large deposits of gold, diamond, tanzanite, ruby, tin, copper, nickel, iron, phosphate, gypsum, coal, natural gas, uranium and oil. Finding commercially viable concentrations of minerals for mining is a continuous process in the mining sector. Most of the companies involved in this activity are foreign while local experts mostly participate in the processes as employees. Moreover, extractives can be large scale or small scale; however, both are important to the country's economy. It is envisaged in the TDV 2025 that the mining sector should be a strong, vibrant, well-organized, private sector led, large and small-scale mining industry, conducted in a safe and environmentally sound manner. It should contribute significantly to industrialization and to export, the former through the strategic exploitation of its energy and industrial mineral resources and the latter mainly through processed and/or semi-processed mineral outputs. Tanzania has a significant number of artisanal and small-scale miners. However, there are many challenges that face small-scale miners with key challenges being technology, marketing and financing. The technology used by local small-scale miners is inefficient to trap substantial amount of minerals during processing leading to environmental and health hazards. Therefore, MUST research shall focus on areas that include:

5.16.1 Promoting affordable and sustainable technologies for exploitation and value addition that can be utilized by local small-scale miners and collaborative models with investors as well as enhance local content contribution to development and operations;

5.16.2 Development, optimization, adaptation, and deployment of mining technology models to maximize productivity;

5.16.3 Developing mining and mineral processing for value addition and marketing; and

5.16.4 Improving geological information techniques, and sustainable environmental management strategies for small and medium scale mines.

5.17 Gender Mainstreaming

Tanzania has made progress in attaining gender balance, including access to education at all levels; the proportion of women, physically challenged individuals and youth in decision making and representation in the National Parliament. Furthermore, the Tanzania Development Vision 2025 aims to attain gender equity, equality, and empowerment of disadvantaged groups in all socio-economic and political relations. However, there are still wide disparities within the population in terms of research opportunities, access to research resources, and the benefit of research findings. Thus, major areas for MUST research on gender shall include:

5.17.1 Equitable access to STI processes, products and services;

5.17.2 Equality of opportunities in employment;

5.17.3 Addressing the existing imbalances pertaining to participation in STI and research processes and access to products;

5.17.4 Affirmative action in promoting research that address challenges facing disadvantaged groups;

5.17.5 Empowering all gender to benefit from research findings; and

5.17.6 Availability and quality of facilities in R&D Institutions so as to cater for equal opportunity for all gender.

5.18 Tourism Development and Management

Tanzania is endowed with world-class tourism assets such as natural, cultural, historic and archaeological sites that are in high demand in international tourism markets. However, there is limited tourism linkages to other subsectors such as agriculture, transport, industry and services. The challenges in these sectors include poor

infrastructure; inadequate regional and international tourist linkages; lack of planned land for tourism investment outside protected areas leading to uncontrolled tourism development; shortage of appropriate and specialized core and skilled personnel; limited budgetary allocations for tourism development and promotional activities; ineffective institutional setup, technical capabilities and co-ordination among various stakeholders involved in tourism development. The priority research areas address the application of science and technology in tourism marketing and labour skills' information, tourism socio-culture and environment, domestic tourism development, product development and diversification, and quality service delivery in the tourism industry. Thus, MUST research shall focus on areas that include:

5.18.1 Relationship between tourism and the environment;

5.18.2 Community attitudes to create awareness;

5.18.3 Application of ICT and tools for eco-tourism promotion; and

5.18.4 Service provision, business and market linkage.

CHAPTER SIX
RESEARCH AGENDA REVIEW AND AMENDMENTS

The MUST Research Agenda has defined a range of relevant themes and sub themes. However, research priority areas may not be exhaustive and an end in itself since generation of knowledge is endless. Therefore, this document shall be reviewed after every three years of being in operation as new knowledge emerges or as deemed necessary.

BIBLIOGRAPHY

COSTECH (2021). National Research Priorities 2021/22 - 2025/26. ISSN: 2507-7899

COSTECH (2016). Research Priorities for Tanzania 2015 – 2020. Printed by Apex Media Ltd.

GOT (2010). The National Research and Development Policy, Dar es Salaam: MCST

MUST (2022). Corporate Strategic Plan: Five-year Rolling Action Programme 2022/23-2026/27.

URT (2000b). The Tanzania Development Vision 2025. Dar es Salaam, Tanzania. pp. 31. Dar es Salaam, Tanzania. pp. 25.

URT (2013). National Agricultural Policy. Ministry of Agriculture, Food Security and Cooperatives.

United Nations (2016). Sustainable Development Goals (SDGs). [Accessed on 21/5/2019]. NEW YORK, USA.

APPROVAL

At its 38th Meeting held on 16th day of August 2023, the Mbeya University of Science and Technology Senate RECEIVED, DISCUSSED and APPROVED the Research Agenda.

Prof. Aloys N. Mvuma
CHAIRPERSON

Adv. Lugano Mwakilasa
SECRETARY

LIST OF ATTACHMENTS

Appendix 1: Research Themes for the College of Architecture and Construction Technology (CoACT)

S/N	Research Theme	Sub-themes
1	Medical and Health Systems	i. Building Ergonomics ii. Occupational Ergonomics, Health and Safety iii. Physical Environment Sustainability iv. Healing Environment in Health Care Architecture v. Building thermal comfort vi. Acoustic comfort in building vii. Building health lighting
2	Irrigation, agro-mechanization, agro-processing and marketing	i. Architecture in agriculture (Agritecture) ii. Farm architecture iii. Conjunctive Water Use and Management for irrigation iv. Tourism infrastructure in agriculture (Agritainment) v. Sustainable agro-processing infrastructures
3	Water Management	i. Landscape architecture as a water resource steward ii. Resilient Architecture iii. Water conservation in architecture iv. Water and urban agriculture v. Water in cultural heritage vi. Water energy nexus in the built environment vii. Influence of water management on the performance of building.

		viii. Urban flooding and drainage issues
4	Innovation, technology transfer and commercialization	i. Building simulation and visualization Technology ii. Building performance analysis and simulation iii. Building automation iv. Building information modelling best practice in construction sector v. Digital fabrication and additive manufacturing vi. Parametric design and generative algorithm vii. Modular construction viii. Local construction materials technology ix. Building materials innovations x. Local building codes development xi. 3D printing technology in construction
5	Construction and infrastructure development and management	i. Sustainable construction ii. Green construction equipment iii. Artificial Intelligence in construction iv. Cost effective construction v. Sustainable urban and rural infrastructure planning and management vi. Sustainable structures in built environment vii. Value for money dimension in construction projects management

		viii. High tech construction and infrastructure management ix. Low cost housing construction technologies x. Local technology in construction and infrastructure xi. Total quality management in construction projects & value engineering management
6	Climate change adaptation and mitigation	i. Climate resilient architecture ii. Building energy simulation iii. Sustainable architecture iv. Climate responsive building design and construction technology v. Urban heat island mitigation vi. Bioclimatic design and passive building strategies vii. Building energy performance monitoring
7	Land Management and Human settlement	i. Housing and infrastructure development ii. Urban sociology iii. Human settlement and climate change iv. Hygiene in human settlement v. Human settlement improvements and security issues vi. Disaster management in human settlement vii. Social issues in informal and formal settlement viii. Land use planning and policy

		ix. Building preservation and cultural Heritage conservation x. Land management xi. Land conflicts resolutions in rural and urban areas xii. Urban planning and design issues
8	Gender mainstreaming	i. Inclusive design in built environment ii. Breaking the bias in architecture
9	Accessible and quality education	i. Quality physical environment in education settings
10	Entrepreneurship for industrialization	i. Entrepreneurship in construction industry
11	Tourism development and management	i. Architectural tourism development ii. Night scape and architectural tourism iii. Scenic architecture
12	Biodiversity conservation and sustainable utilization	i. Effects of construction bad practice on biodiversity

Appendix 2: Research Themes for the College of Agricultural Sciences and Technology (CoAST)

S/N	Theme	Sub-themes
1	Irrigation/agro-mechanization and marketing	i. Agro-processing and value addition ii. Postharvest biology and technology iii. Smart climate agriculture iv. Precision agriculture v. Storage technologies vi. Land utilization and conservation vii. Irrigation and irrigation systems viii. Agricultural modernization ix. Market driven agricultural production x. Use of unmanned aerial vehicle in agriculture xi. Soil management and irrigation systems
2	Accessible and quality education	i. Methods and techniques toward agriculture modernization ii. Education project design, implementation, and evaluation iii. Agricultural innovation and technologies dissemination iv. Agricultural extension v. Gender in agriculture
3	Water management	i. Modelling of water system networks ii. Food safety (Microbiology/toxicology) iii. Food quality management system iv. Soil and water conservation v. Rain water harvesting vi. Water recycling and reuse

4	Climate change adaptation and Mitigation	i. Modelling uncertainties for weather and climate change in agriculture ii. Farming system resilient to climate change iii. Food security iv. Adaptation to climate change stress
5	Crop management, farming system and soil health	i. Crop husbandry/agronomic practices, ii. Cropping patterns iii. Soil quality iv. Soil microbes v. Land management and evaluation vi. Crop pathology and entomology vii. Crop breeding and biotechnology viii. Soil fertility and productivity ix. Agro-forestry x. Crop pests and diseases xi. Pre- and post-harvest losses management xii. Indigenous crops and crops of cultural significance xiii. Seed and Seed Systems
6	Livestock production and diary technologies	i. Animal production and husbandry ii. Pasture production iii. Diary technology iv. Animal product and by-product processing and value addition v. Crop-livestock farming vi. Animal feeds, feeding, and animal feeds processing

		vii.	Animal improvement technologies (i.e., artificial insemination)
		viii.	Livestock pathology and veterinary services
		ix.	Animal health disease management and public health
		x.	Pastures and forages, feeds and feeding systems
		xi.	Breed improvement and reproductive technologies
		xii.	Non-conventional livestock species
		xiii.	Livestock by-products and value addition
		xiv.	Crops-livestock interaction and integration
		xv.	Zoonosis
7	Postharvest technology	i.	Postharvest technology of perishable and non-perishable agricultural products
		ii.	Technology for agro-processing and storage
8	Dairy Science and Technology	i.	Diary Technology
		ii.	Food processing and packaging solutions
9	Product development	i.	Food value addition
		ii.	Food processing and preservation
		iii.	Sensory Science
		iv.	Food and beverage Fermentation
10	Food safety and Quality management	i.	Food safety
		ii.	Food toxicology
		iii.	Food quality management system

11	Food and Human Nutrition/Functional foods	i. Health information and Communication systems ii. Food fortification and formulation
12	Microbiology and Biotechnology	i. Biological and diagnostic development ii. Microbiology iii. Nanotechnology iv. Plant and animal disease

Appendix 3: Research Themes for the College of Engineering Technology (CET)

S/N	Theme	Sub-themes
1	Medical and Health Systems	i. Infrastructure system development ii. Biomedical equipment and tools design innovation in biomedical materials iii. Innovation in service delivery iv. Biomechanical and biomedicine v. Bioengineering vi. Impact biomechanics vii. Mechanical Engineering applications to medical science
2	Irrigation, agro-mechanization, agro- processing and marketing	i. Development and maintenance of irrigation system (infrastructure development) ii. Innovation in irrigation system focusing on high water productivity, water saving technology iii. Agro-mechanization using green energy (planting, weeding, harvesting, post harvest processes, storage, processing)
3	Information and Communication Technology for	i. Infrastructure development, ii. Material science development iii. Digital transformation iv. Data analytics and industrial Internet of Things (IIoT) v. Big Data analytics

	Industrialization	vi. Artificial Intelligence (AI) vii. Cybersecurity viii. Robotics and automation ix. Robotics and intelligent mechanical systems x. Intelligent manufacturing systems xi. Artificial Intelligence applications in Mechanical Engineering xii. Cloud Computing and Edge Computing xiii. Sustainable and Green Technologies
4	Accessible and quality education	i. Offering of quality technology-based education ii. Infrastructure development iii. Material science development
5	Sustainable, Renewable & conventional energy	i. Development of green energy (solar power, hydropower, water to energy) ii. Development of need power storage system, iii. Recycling of e-waste iv. The use of natural energy
6	Water management	i. Development of rainwater harvesting technologies ii. Catchment management iii. River system management iv. Water quality issues v. Waste water management vi. Water supply system vii. Groundwater management viii. Improvement of water productivity ix. Sustainability of environment (air

		quality, integrated modelling, land use and changes, etc.)
7	Innovation, technology transfer and commercialization	i. Development of new technologies ii. Promotion of indigenous technologies iii. Transfer of technology iv. Involvement of communities in development of technologies
8	Construction and infrastructure development and management	i. Sustainable construction materials and practices ii. Sustainable materials and technologies iii. Resilient infrastructure systems iv. Geotechnical and geological investigations v. Construction automation and digitalization vi. Project management and risk assessment vii. Infrastructure asset management viii. Sustainable urban development ix. Construction safety and workforce health x. Sustainable transportation and mobility xi. Design and optimization xii. Sensor and actuator technology
9	Climate change adaptation and mitigation	i. Climate variability and climate change impact (infrastructure, water resources) ii. Migration measures iii. Adaptation

		iv.	Resilient systems and infrastructures
10	Land Management and Human settlement	i. ii. iii. iv.	Environmental management Land use change Air quality Land degradation
11	Exploration, mining, processing and marketing	i. ii. iii. iv. v.	Small scale mining schemes Exploration of minerals Safety management systems Processing of minerals Labour management Infrastructure development (tunneling, access roads and services)
12	Gender mainstreaming	i. ii.	Gender sensitisation for women in STEM related filed Affirmative action in enhance female participation in STEM related filed.

Appendix 4: Research Themes for the College of Humanities and Business Studies

S/n	Research Themes	Sub-themes
1	Business Management of Medical and Health Systems	i. Business management of medical and health systems
2	Irrigation, agro-mechanization, agro-processing and marketing	i. Agri-Business
3	Information and Communication Technology for Industrialization	i. Business information for industrialization ii. Business communication for industrialization iii. Business management technology iv. ICT in language teaching/learning (T/L)
4	Accessible and quality education	i. Business education environment ii. Relevance of business education iii. Business curricula development iv. Environmental-based business education provision v. Entrepreneurial education
5	Innovation, technology transfer and commercialization	i. Innovation management ii. Management of technology transfer iii. Management of technology transfer

6	Supply chain Management in Industry	i. Supply chain management in manufacturing industry ii. Supply chain management in commerce iii. ICT and supply chain management: adoption of ICT in supply chain management iv. Government industrial policy and entrepreneurship v. Entrepreneurial management and industrialization vi. Sustainable entrepreneurship
7	Gender mainstreaming	Gender language mainstreaming
8	Tourism development and management	Tourism development

Appendix 5: Research Themes for the College of Information and Communication Technology (CoICT)

S/N	Research Themes	Sub-Themes
1	Medical and Health Systems	i. Telemedicine
2	Irrigation, agro-mechanization, agro processing and marketing	ii. Tele agriculture
3	Information and Communication Technology for Industrialization	i. Research into evolving internet ii. Network economics iii. User Interfaces iv. Communications theory v. Digital transformation vi. Data analytics and Industrial Internet of Things (IIoT) vii. Big Data analytics viii. Artificial Intelligence (AI) ix. Network security and trust x. Robotics and automation xi. Intelligent manufacturing systems xii. Artificial Intelligence applications in Mechanical Engineering xiii. Cloud computing and edge computing xiv. Sustainable and green technologies
4	Innovation, technology transfer and	i. Network Economics ii. Sensors, video traffic, internet of

	commercialization	things, software defined networking, indoors versus outdoor multi-access, and 5G

Appendix 6: Research Themes for the College of Science and Technical Education

S/n	**Research Agenda**	**Priority Areas**
1	Medical and Health Systems	i. Medical diagnostics and biological development and product safety ii. Communicable diseases iii. Neglected tropical diseases iv. Health information and communication systems v. Disease models development and management of public health vi. Mathematics and health integration systems vii. Statistical Methods for Medical Data viii. Plant diseases ix. Zoonosis diseases x. Applications of fixed-point theorem xi. Maternal, new born, child, and adolescent health and diseases. xii. Virology xiii. Epidemiological studies xiv. Parasitology xv. Medical diagnostic and product safety xvi. Evaluation of natural products for drugs and vaccines
2	Irrigation, agro-mechanization, agro-processing and marketing	i. Mathematical Methods and Theories in Agricultural Research ii. Design and Analysis of Experiments iii. Technology for agro-processing and storage iv. Diary technology

3	Accessible and quality education	i. Statistical analysis for accessible and quality education ii. Quality and equity education iii. Performance management in schools, risky society towards a new modernity iv. Methods and techniques for science and technologies v. Educational project design, implementation and evaluation
4	Sustainable, Renewable & conventional energy	i. Network analysis in generation and supply of Energy ii. Green energy generation
5	Water management	i. Modelling of water system networks ii. Food safety(microbiology/toxicology) iii. Food quality management system
6	Biodiversity conservation and sustainable utilization	i. Bio-statistical analysis to conserve and sustain wildlife individuals ii. Optimal control of wildlife species iii. Wildlife diseases iv. Application of biodiversity to maintain human health v. Impact and management of alien invasive species vi. Impact of climate change and pollution on biodiversity vii. Ecosystem services and management viii. Application of artificial intelligence in biodiversity management ix. Interactions between human and natural systems x. Harnessing natural products from biodiversity

		xi.	Conservation genetics
7	Innovation, technology transfer and commercialization	i. ii. iii. iv. v. vi.	Food valorization (value addition) Postharvest technology of perishable and non-perishable agricultural products Nanotechnology Food processing, preservation, and packaging solutions Biological and diagnostics development Material sciences
8	Climate change adaptation and mitigation	i. ii. iii. iv. v. vi.	Modeling uncertainties for weather and climate change Ecosystem protection Ocean acidification The rise in global temperature Safety water biodiversity Astrophysics
9	Aquaculture, fisheries and related products quality and marketing	i. ii. iii. iv. v. vi. vii. viii.	Food quality management system Aquaculture economics Diet ingredients and additives Genetic breeding Enhancement of production systems and technological for inland and offshore productions. Climate change and sustainability. Aquaculture and internet of things and big data Aquaculture pollution, destruction of fish habitats, water abstraction and impacts on aquatic biodiversity
10	Supply chain management in industry	i. ii.	Food safety (microbiology/ toxicology) Food and beverage fermentation

11	Entrepreneurship for industrialization	Inventory management
12	Exploration, mining, processing and marketing	i. Geo-statistical modelling ii. Sensory science iii. Enology and brewing science iv. Plant tissue culture
13	Tourism development and management	i. Food and nutrition surveys ii. Food and nutrition security iii. Food and beverage fermentation

Appendix 7: Research Themes for the MUST Rukwa Campus College (MRCC)

S/N	Theme	Sub-themes
1	Medical and Health Systems	viii. Infrastructure system development ix. Biomedical equipment and tools design innovation in biomedical materials x. Innovation in service delivery xi. Biomechanical and biomedicine xii. Bioengineering xiii. Impact biomechanics xiv. Mechanical Engineering applications to medical science
2	Irrigation, agro-mechanization, agro-processing and marketing	iv. Development and maintenance of irrigation system (infrastructure development) v. Innovation in irrigation system focusing on high water productivity, water saving technology vi. Agro-mechanization using green energy (planting, weeding, harvesting, post harvest processes, storage, processing)
3	Information and Communication Technology for	xiv. Infrastructure development, xv. Material science development xvi. Digital transformation

	Industrialization	xvii. Data analytics and industrial Internet of Things (IIoT) xviii. Big Data analytics xix. Artificial Intelligence (AI) xx. Cybersecurity xxi. Robotics and automation xxii. Robotics and intelligent mechanical systems xxiii. Intelligent manufacturing systems xxiv. Artificial Intelligence applications in Mechanical Engineering xxv. Cloud Computing and Edge Computing xxvi. Sustainable and Green Technologies
4	Accessible and quality education	iv. Offering of quality technology-based education v. Infrastructure development vi. Material science development
5	Sustainable, Renewable & conventional energy	v. Development of green energy (solar power, hydropower, water to energy) vi. Development of need power storage system, vii. Recycling of e-waste viii. The use of natural energy
6	Water management	x. Development of rainwater harvesting technologies xi. Catchment management xii. River system management xiii. Water quality issues xiv. Waste water management

		xv. Water supply system xvi. Groundwater management xvii. Improvement of water productivity xviii. Sustainability of environment (air quality, integrated modelling, land use and changes, etc.)
7	Innovation, technology transfer and commercialization	v. Development of new technologies vi. Promotion of indigenous technologies vii. Transfer of technology viii. Involvement of communities in development of technologies
8	Construction and infrastructure development and management	xiii. Sustainable construction materials and practices xiv. Sustainable materials and technologies xv. Resilient infrastructure systems xvi. Geotechnical and geological investigations xvii. Construction automation and digitalization xviii. Project management and risk assessment xix. Infrastructure asset management xx. Sustainable urban development xxi. Construction safety and workforce health xxii. Sustainable transportation and

		mobility xxiii. Design and optimization xxiv. Sensor and actuator technology
9	Climate change adaptation and mitigation	v. Climate variability and climate change impact (infrastructure, water resources) vi. Migration measures vii. Adaptation viii. Resilient systems and infrastructures
10	Land Management and Human settlement	v. Environmental management vi. Land use change vii. Air quality viii. Land degradation
11	Exploration, mining, processing and marketing	vi. Small scale mining schemes vii. Exploration of minerals viii. Safety management systems ix. Processing of minerals x. Labour management Infrastructure development (tunneling, access roads and services)
12	Gender mainstreaming	ii. Gender sensitisation for women in STEM related filed v. Affirmative action in enhance female participation in STEM related filed.
13	Business Management of Medical and Health Systems	ii. Business management of medical and health systems

14	Irrigation, agro-mechanization, agro-processing and marketing	ii. Agri-Business
15	Information and Communication Technology for Industrialization	v. Business information for industrialization vi. Business communication for industrialization vii. Business management technology viii. ICT in language teaching/learning (T/L)
16	Accessible and quality education	vi. Business education environment vii. Relevance of business education viii. Business curricula development ix. Environmental-based business education provision x. Entrepreneurial education
17	Innovation, technology transfer and commercialization	iv. Innovation management v. Management of technology transfer vi. Management of technology transfer
18	Supply chain Management in Industry	vii. Supply chain management in manufacturing industry viii. Supply chain management in commerce ix. ICT and supply chain management: adoption of ICT in supply chain management

		x. Government industrial policy and entrepreneurship xi. Entrepreneurial management and industrialization xii. Sustainable entrepreneurship
19	Gender mainstreaming	Gender language mainstreaming
20	Tourism development and management	Tourism development