

MBEYA UNIVERSITY OF SCIENCE AND TECHNOLOGY



RESEARCH AGENDA

JULY, 2020

FOREWORD

Mbeya University of Science and Technology (MUST) is a higher learning institution, endeavouring to be leading 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 whereas research results improve livelihood in the society. Hence, MUST commitment to academic excellence will match with serious research activities to respond to the global challenges of science and technology.

To address this, the University through the Directorate of Postgraduate Studies, Research and Publications prepared a seminar in consultation with experts from the Commission of Science and Technology (COSTECH) for formulation of Research Agenda for the University.

The MUST Research Agenda and Priority Areas serves as a blueprint for all research executed by research stakeholders. Through this, 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 Research Agenda also seeks to contribute to the advancement of science and technology through scientific inquiry. We are looking for the transformation from being an agrarian society to become an industrial society. The MUST Research Agenda outlines areas of research and innovation deemed to be of priority and in line with the National Research Agenda, development priorities and strategies of the Tanzania Development Vision 2025.

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Vice Chancellor

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LIST OF ABBREVIATIONS AND ACRONYMS

CET	College of Engineering and Technology
CoACT	College of Architectural and Construction Technology
CoHBS	College of Humanities and Business Studies
CoICT	College of Information, Communication and Technology
CoSTE	College of Science and Technical Education
COSTECH	Commission for Science and Technology
ICT	Information and Communication and Technology
IPR	Intellectual Property Rights
GDP	Gross Domestic Product
GoT	Government of Tanzania
MRCC	MUST Rukwa Campus 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
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 you can decide what should be tackled now, and what should be deferred until another time.

(b) Research Theme

A research theme expresses the long-term goals of the University work. Themes are features of Participants/Departments or Colleges characterizing particular perceptions and/or experiences that researchers see as relevant to a research question from the prevailing problems.

(c) Research Priority Areas

Research priority areas are those identified research areas that will be invested in through research and development to address significant social and economic challenges facing communities and the nation at large so as to transform and improve livelihood.

(d) Research Goal

Research goal is an observable and/or measurable end result having one or more objectives to be achieved within a fixed timeframe.

(e) Research Philosophy

A research philosophy is a belief about the way data of a phenomenon should be gathered, analysed and used.

1.0 BACKGROUND INFORMATION OF THE UNIVERSITY

1.1 Introduction

The history of Mbeya University of Science and Technology (MUST) dates back from 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 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 lead to expansion of students' enrolment. Following these achievements, on 29th March 2012 after being issued with a Provisional Licence by Tanzania Commission for Universities (TCU), the Institute was transformed to 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 is endeavouring to lead in science and technology, become a centre of excellence for academics, research and consultancy and puts itself in a position where research results are meant for improving livelihood in the society. In order to develop professional skills in Science, Engineering, Social

Sciences and other related fields, MUST has to conduct research that reflect the National Research Agenda.

1.2 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.

1.3 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;
- (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.

1.4 Situational 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 developing technologies that would improve people's lives. The contribution of research in development is inevitable. At the institutional level, research can bring about product innovations and improvement, improved performance in product marketing and increased service efficiency and effectiveness.

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.

Currently, there is no well-established Research Agenda and its priority areas that reflect National Research Agenda that could guide research activities at Colleges level as well as at University level to take into consideration the ongoing University transformation. This Research Agenda intends to fill the aforementioned gaps so as to equip researchers with the University vision pertaining to research activities. It is for this reason that the University consulted Tanzania Commission for Science and Technology (COSTECH) for its expertise. As a result, on 17th -18th December, 2019 a workshop on formulating MUST Research Agenda and its priority areas was held. The formulation of Research Agenda took into consideration the National Research Agenda and University academic programmes. Through in-depth consultations and participation of Academic Staff as central research stakeholders, 17 priority areas were formulated.

1.5 Rationale of Formulating Research Agenda and its Priority Areas

Research Agenda and its priority areas for any institution is a guideline that provides directions based on its retrospective and prospective matters on research activities. The Research Agenda document intends to facilitate the integration of academic programmes with research to be conducted at the University. It ensures alignment with the National research priority areas and

thus giving direction to researchers, the academia and development partners on planning and funding research. Research and development partners and other stakeholders are therefore expected to plan, undertake and promote research that is in line with the MUST Research Agenda with national priorities.

1.6 Justification of Research Agenda and its Priority Areas

The ninth (9th) United Nations Sustainable Development Goals (SDGs) aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation by enhancing scientific research and upgrade the technological capabilities of industrial sectors in developing countries in particular. Accordingly, Tanzania Development Vision 2025 articulates that science and technology education and awareness of its applications for promoting and enhancing productivity should permeate the whole society through continuous learning and publicity campaigns. As a result, Research Priorities for Tanzania (2015-2020) articulate that research and development (R&D) activities are necessary in order to inform, lead and guide all that needs to be done to achieve the desired transformation of the socio-economic status of a nation. Moreover, Research Agenda contributes in transformation of Tanzania from being an agrarian society to become an industrial and manufacturing society (COSTECH, 2016). Thus, MUST Research Agenda aims to facilitate both basic and applied research to generate new knowledge and solutions to the challenges encountered by various sectors.

2.0 BACKGROUND INFORMATION ON RESEARCH AGENDA

2.1 Introduction

This part presents the vision, mission, goal, objectives, philosophy and scope of Research Agenda.

2.2 Vision for Research Agenda

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

2.3 Mission for Research Agenda

To develop a research system that will increase the outcome and efficiency of research and development (R&D) through participatory and collaboration of multidisciplinary participants (academicians, students, researchers and society).

2.4 Goal

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

2.5 Objectives of Research Agenda

2.5.1 The Main Objective of Research Agenda

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

2.5.2 Specific Objectives of Research Agenda

- (a) Facilitate basic and applied research activities;
- (b) Produce an inclusive and comprehensive Research Agenda to research stakeholders;

- (c) Align the research, development and publication efforts with the National Research Agenda;
- (d) Improve the effectiveness of research, development and publication in the University by setting realistic targets;
- (e) Guide the allocation of research, development and publication resources for the University use;
- (f) Create the participatory platform for shaping the direction of research, development and publication, and therefore enhancing its contribution to the National science, technology and economic development; and
- (g) Promote the culture among research stakeholders of conducting demand-driven research that address issues of national socio-economic importance.

2.6 Philosophy of Research Agenda

The research philosophy is to accept concepts which are relevant and support actions.

2.7 Scope of Research Agenda

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

3.0 PROCEDURES FOR IDENTIFYING RESEARCH THEMES

The participatory approach was employed, that involved stakeholders from all academic departments and consultative in the formulation of Research Agenda and priority areas. This included:

- (a) Assessing MUST current status and future research need;
- (b) Priority setting of Research Agenda in relation to the Tanzania Development Vision 2025 and National Research Agenda;
- (c) Participants' brainstorming of research themes and priorities for MUST in line with the National Research Agenda;
- (d) Compilation of research themes and sub-themes at College level as shown in Appendices 2 to 6; and
- (e) Compilation of research themes and sub-themes from Colleges to form a comprehensive University Research Agenda.

4.0 THE UNIVERSITY PRIORITY AREAS AND RESEARCH THEMES

The formulated Research Agenda reflect the current status of the research in the University to the National Research Agenda. The University Research Agenda summarizes 17 key research themes under 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; also tabulated in Appendix 1.

5.0 DESCRIPTION OF RESEARCH THEMES

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 formulated Research Agenda; research themes and subthemes are planned to guide academic staff and students in executing research activities. The Research Priority Areas are as detailed hereunder:

5.1 Medical and Health Systems

Advances in medical technology create opportunity for development of new courses with diagnostic kits, test existing biomarkers for enhancing early diagnosis to avert morbidity, promote better prognosis, hasten recovery and improve quality of life and increase survival in time. Research at MUST shall focus on the efficiency and impact of existing and new medical technologies to enhance disease prevention and treatment; identify the future need to selectively invest on specific diagnostic technologies that are contextually safe, cost-effective, and friendlier to the environment for diseases prevention and better health outcomes.

Thus, the need for robust research on health outcomes resulting from successful efforts to offer integrated care is important to relieve the overburdened health system. MUST Research therefore should focus on solutions to bridge the gaps pertaining to availability, access and delivery of health services within catchment areas by person (inclusive of emerging vulnerable populations) and time; innovative training systems for generating competent human capital resources for health, its deployment and retention; 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; developing and testing models for strong disease surveillance systems and maximizing use of health information systems for clinical decision

making; application of emerging technologies to improve preventive interventions and health promotion by measuring outcomes related to community interventions, anticipatory guidance; enhancing adoption of, adherence to health promotion; and disease prevention practices.

5.2 Irrigation, Agro-Mechanization, Agro-Processing and Marketing

Irrigation is essential for better crop yields and production. It mitigates vagaries of weather, which is becoming more frequent and intensive because of global climate change. Research for low productivity and holistic integrated planning in water resource utilization is inevitable. Furthermore, farm machinery, implements and equipment are important tools for increasing 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. MUST research on how to optimize the use of farm implements is crucial. Moreover, agricultural market infrastructure is crucial for the development of agricultural commodities and stimulating agricultural production. Consequently, research in supportive infrastructure from production, transportation, storage and processing is vital in enhancing agricultural marketing.

5.3 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 to realize that a nation's capability to accelerate its development processes and gain global competitiveness is in place to the extent which it can develop, use and exploit ICT in various forms. The Government of Tanzania (GoT) acknowledges a need 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. Consequently, MUST research shall focus on indigenous products commensurate with the modern industrialization drive, responding to the current mining industry, transportation, agriculture, health and education requires much attention. Research priority therefore shall be directed towards design and development of software tools for industrial control and service provision as well as cyber/digital security for these systems.

5.4 Accessible and Quality Education

Access to education, 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 resource capacity. Thus, MUST research on how to attain inventiveness, innovativeness and high-level quality education that will promote industrial based economy is inevitable.

5.5 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 maintain a buffer of at least 15% of the total capacity to contribute to 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 on improved access to modern energy sources is a priority for transforming rural areas. Potential sources for generation of affordable and reliable modern energy include renewable and non-renewable sources. Sustainable exploitation of renewable and non-renewable energy sources relies on clear understanding of the environmental and socio-economic issues for economic growth.

5.6 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 800mm 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 long distances of over 2 to 3 kilometres that people have to commute daily in search for water from public taps; and carrying heavy containers on their heads of about 20 to 25 litres per trip. MUST research therefore shall focus more on water sources and water harvesting techniques, appropriate and affordable technologies, and involvement of communities and extension of water supply networks infrastructure and equipment, which will then increase access to water in both urban and rural areas.

Water quality is a matter of great concern in many parts of the country. This is true for both point and non-point sources of water. Increased human activities including poor land use practices as well as uncontrolled abstractions and pollution of water bodies impact on the quantity and quality of the available water sources. Most villages share common point water sources, i.e. wells, which is a risk factor when contamination occurs. Water demand for domestic, industrial and public uses is increasing due to population growth, expansion of cities and urban centres, as well as establishment of new industries. While the government has put measures to address water conservation to reduce wastage arising from water leakages, little has been put in place to address domestic,

public and industrial wastage of water from inefficient uses. Therefore, MUST research on better approaches to improve water quality, quantity, harvesting, monitoring, purification, assessment as well as practical and cost-effective water quality and pollution control mechanisms are needed.

5.7 Biodiversity Conservation and Sustainable Utilization

Human activities (such as illegal fishing methods/gears, 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.

Marine resources are one of the Tanzania comparative advantages, with potential to boost tourism industry. Marine tourism takes place along the coast and in marine environments such as coral reefs, mangroves, coastal forests, sea, islands, islets and beaches. There is need to conduct research on the impacts of marine tourism on socio-economic development and environment; sustainable utilization of coastal and marine resources; and demand and supply of sea foods and marine resources to promote marine tourism and value chain analysis and improvement.

5.8 Innovation, Technology Transfer and Commercialization

Innovative and induced business cluster and incubation programme 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 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 would develop, consolidate and strengthen basic scientific research, technology and innovation. However, in Tanzania, technology transfer and commercialization have been inadequately exploited due to limited capacity in absorption, adoption and transferring of technology. There is also inadequate interaction between industry and research institutions and knowledge centres. Thus, there is need to research on better approaches for sustainable technology development and transfer, manufacturing systems, Intellectual Property Rights (IPR) framework and models for linking R&D Institutions with industries. The move from industrially weak and subsistence agriculture-based economy of Tanzania towards an information and knowledge economy is inevitable. Thus, there is need to develop Tanzania's information economy and society as part of the process of accelerating the nation's socio-economic development in the technological age.

5.9 Construction and Infrastructure Development and Management

The lack of infrastructure is hindering the economic growth in many developing countries. Infrastructure investment has effect of contributing to the increase of productivity. It is expected to contribute to future economic growth in developing countries and Tanzania in particular where infrastructure is still insufficient. Therefore, infrastructure development is one of the most integral part of the public policies in developing countries. Supporting infrastructure development through research is extremely important. However, the precise relationship between infrastructure and economic growth is still frequently debated therefore research is needed. Good infrastructure helps to raise productivity and lower costs in the directly productive activities of the economy, but it has to be expanded fast enough to meet the demand for

infrastructure in the early stage of development in both urban and rural areas. Thus, research in prediction of demand pattern and investment allocation, which are the key factors of infrastructure development planning based on a long-term economic development trend and land use planning, predicts the Country's temporal and spatial demographics and economic structure are inevitable.

5.10 Climate Change, Adaptation and Mitigation

Climate change has significant impact on the ecosystem. It modifies biological, chemical and physical conditions in the environments, which affect the sustainability of human uses of natural resources. As a result, the ecosystem is also negatively impacted by climate change in terms of physical and chemical conditions.

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 drought, floods, epidemics, windstorms, landslides, earthquake, pest infestation and volcanic eruptions are major types of natural disasters in Tanzania caused by climate change. Moreover, some of these disasters have resulted in loss of lives, displacement of victims, damage to properties and infrastructure consequently disrupting the development gains made over the years.

Floods have affected more people than all the other natural disasters in Tanzania except for drought. Increase in the frequency and magnitude of floods in some areas of Tanzania is attributed to climate change and variability. Frequency of extreme heavy rainfall is expected to increase in the wet seasons, which would imply greater flood risk. This leads to structural, behavioural and physiological adaptations of living things for sustainable survival. As a result, majority of population in the country are vulnerable to various disasters because prevention, mitigation, preparedness and response measures to

disasters are inadequate. Public resource paucity, low priority coupled with lack of knowledge and insensitivity or unawareness among most actors on matters pertinent to hazards and threats compound the problem further. Moreover, information on disasters and hazards (such as frequency, spatial distribution, losses, vulnerability levels and mitigation measures applied) is scarce, disjointed and unreliable thus making it difficult to put in place informed strategies to reduce disaster risks and respond effectively to disaster events caused by climate change. Consequently, research is needed for better understanding, detecting, and forecasting climate changes and providing scientific rationale for interventions. Thus, MUST shall carry out research on:

- (a) 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
- (b) Disaster risk reduction, geodynamics and geo-hazards, vulnerability and risk assessments, mitigating technologies and early warning systems.

5.11 Aquaculture, Fisheries and Related Products Quality and Marketing

With increasing fishing pressure and declining fish catches in the wild stocks, attention has now turned into developing aquaculture systems capable of meeting demand of growing human population. Therefore, there is need to carry out research on the development of high efficiency and environmentally friendly aquaculture technologies, availability of fingerlings, identify type of feeds and new species that can be efficiently cultured with consideration to effect of invasive species. The fisheries sector contributes to the economy mainly through capture fishery while 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 scientific information available. Thus, research shall encompass the status of fish

stocks, including their biology and ecology, exploitation patterns, gears, methods used and effect of alien species.

Fishery and fish products contribute to the socio-economic development of the Country. However, poor quality of fish and fish products lead to poor market. Therefore, the quality of fish and fish products should be improved to meet market standards. In order to improve quality, standards and hence values of fish and fish products, research is required to find ways that can address the existing challenges throughout fishery value chains by introducing new innovative technologies that can contribute to industrial processing and manufacturing of products.

5.12 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 the challenges faced by the sector so as to address: 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 settlement 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 an 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. Research in this area should be geared towards addressing land use and resources conflicts, rural-urban migration, and other issues that arise as a result of urbanization. Research should also focus on demographic studies, community innovation platforms and traditional approaches in conflict management.

5.13 Supply Chain Management in Manufacturing Industry

In the manufacturing industry the problem of setting up and managing supply chain relationships has recently become of an unprecedented complexity and importance. Today even the most common products are obtained through processes that are highly complex as regards the production technology, the required knowledge and the number of stages involved. The processes in the value chain are spread upon several 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.

Retrospective analysis of the evolution of managerial perspectives on supply-chain management (SCM) in industrial production is required. In the philosophy underlying the management of Purchasing and Supply (PS) in industrial firms has reflected, over time, the managerial paradigm at the basis of the strategic choice of the firm. Thus, as well as for all main firm's processes PS has evolved in order to provide an adequate response to 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 on:

- (a) The suppliers' potential for technological and innovation development;
- (b) The actual reversibility of investments on a specific technological trajectory; and
- (c) Risk associated with dependency on suppliers and the opportunities of multiple and/or parallel relationships.

5.14 Entrepreneurship for Industrialization

Economies of the developed world have benefitted from R&D investment in entrepreneurship, which focused on improving quality and standards to produce competitive products and services among other aspects of the value chains. More recently, developing countries such as Tanzania have likewise initiated R&D in entrepreneurship to stimulate industrial sector. MUST research shall focus on finding ways to improve entrepreneurial skills, linkages between academia and enterprises; technology transfer; start up financing; products and services competitiveness. Moreover, marketing systems and entrepreneurship of the local produce have not been exploited to its full potential. Agricultural research should develop innovative marketing systems that would enhance competitiveness through agro-based industries and value addition throughout the supply chain. Furthermore, MUST research shall seek to build capacity to supply agro-processed products among others in response to new opportunities in the domestic and export markets.

5.15 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. Therefore, MUST research in this area shall aim at promoting modern and affordable 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.

Moreover, extractives can be of large 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.

Thus, MUST research on technology development, optimization and adaptation, and technology deployment models to maximize productivity in mining is essential to make this sector achieve vital contribution to the sustainable economic development of the country. Research efforts should also be directed towards developing mining and mineral processing for value addition, improving geological information techniques, marketing and sustainable environmental management strategies to small and medium scale mines.

5.16 Gender Mainstreaming

Tanzania has made progress in attaining gender balance, including access to education at all levels; the proportion of women, physically challenged individuals, youth in decision making and representation in the National Parliament. Furthermore, the Tanzania Development Vision 2025 aims to attain gender equity and empowerment of women in all socio-economic and political relations. However, there are still wide disparities within the

population in terms of research opportunity, access to research resources, and the benefit of research findings. Major areas for MUST research on gender shall include; equitable access to STI processes, products and services; equality of opportunities in employment; addressing the existing imbalances pertaining to participation in STI and research processes and access to products; affirmative action in promoting research that address challenges facing both gender (violence is included); empowering all gender to benefit from research findings; and availability and quality of facilities to R&D Institutions so as to cater for equal opportunity for all gender.

5.17 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 this sector 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. Thus, this priority research area shall be to address the application of science and technology for tourism marketing and labour information, tourism socio-culture and environment, domestic tourism development, product development and diversification, and quality service delivery in the tourism industry.

RESEARCH AGENDA REVIEW AND AMMENDMENTS

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 should be reviewed after three years of being under operation as new knowledge emerges or as deemed necessary.

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7.0 LIST OF ATTACHMENTS

- Appendix 1: MUST Research Themes
- Appendix 2: Research Themes for the College of Architecture and Construction Technology
- Appendix 3: Research Themes for the College of Engineering and Technology
- Appendix 4: Research Themes for the College of Humanities and Business Studies (CoHBS)
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Appendix 1: MUST Research Themes

RESEARCH THEMES	
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

Appendix 2: Research Themes for the College of Architecture and Construction Technology

COLLEGE OF ARCHTECTURE AND CONSTRUCTION TECHNOLOGY (Co-ACT)		
S/N	RESEARCH THEMES	SUB-THEMES
1	Medical and Health Systems	Safety in Health buildings
2	Irrigation, agro-mechanization, agro-processing and marketing	Conjunctive Water Use Management for irrigation
3	Water management	<ul style="list-style-type: none"> i. Conjunctive Water Use and Management ii. Integrated water Resources Management iii. Groundwater Resource Management
4	Innovation, technology transfer and commercialization	<ul style="list-style-type: none"> i. Innovation, Technology and Commercialization in Construction and Infrastructure ii. Innovation and Technologies for Low Cost Housing Construction
5	Construction and infrastructure development and management	<ul style="list-style-type: none"> i. Housing and infrastructure development ii. Indigenous Knowledge in Construction and infrastructure iii. High Tech Construction and Infrastructure Management iv. Value for Money dimension in Construction Projects Management v. Low Cost Housing Construction Technologies
6	Climate change adaptation and mitigation	<ul style="list-style-type: none"> i. Indigenous Knowledge in Construction ii. Green Construction technology iii. Conjunctive Water Use and Management iv. Groundwater Resource Management
7	Land Management and Human settlement	<ul style="list-style-type: none"> i. Human settlements improvements ii. Architectural conservation iii. Urban design iv. Land Conflicts resolutions in Rural and Urban Areas v. Land management for sustainable

Appendix 3: Research Themes for the College of Engineering and Technology

S/N	COLLEGE OF ENGINEERING TECHNOLOGY (CET)	
	RESEARCH THEMES	SUB-THEMES
1	Medical and Health Systems	<ul style="list-style-type: none"> i. Infrastructure system development ii. Biomedical equipment and tools design iii. Innovation in biomedical materials iv. Innovation in service delivery v. Biomechanical and Biomedicine vi. Bioengineering vii. Impact Biomechanics, Mechanical Engineering Applications to Medical Science
2	Irrigation, agro-mechanization, agro-processing and marketing	<ul style="list-style-type: none"> 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 harvesting processes, storage, processing)
3	Information and Communication Technology for Industrialization	<ul style="list-style-type: none"> i. Infrastructure development, ii. Material science development
4	Accessible and quality education	<ul style="list-style-type: none"> i. Offering of quality technology-based education ii. Infrastructure development iii. Material science development
5	Sustainable, Renewable & conventional energy	<ul style="list-style-type: none"> 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 <p>Sub themes: Bioenergy, geothermal, photovoltaics, renewable fuels, solar thermal, wind, clean energy technology, energy conversion systems, energy storage devices, utilization of biogas, sustainable energy systems and energy efficient, biomass gasification, renewable energy sources, development of need power storage system and the use of natural energy.</p>
6	Water management	<ul style="list-style-type: none"> i. Development of rainwater harvesting

		<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> i. Material science and development of new material ii. Development of new construction technologies iii. Infrastructure development iv. Labour based technologies v. Construction management vi. Geological investigation vii. Material Characterization and Grinding of Ceramics viii. Processing of Polymers and Composites ix. Modelling of Material Behaviour x. Production and Materials Management, xi. Material Sciences xii. Metal Matrix Composites, xiii. Experimental Modal Analysis and Identification xiv. Finite Element Model Updating, xv. Advanced Materials Science and Engineering xvi. Analytics and Probabilistic Modelling xvii. Material Characterization and Grinding of Ceramics xviii. Processing of Polymers and Composites xix. Modelling of Material Behaviour, xx. Production and Materials Management, xxi. Material Sciences xxii. Metal Matrix Composites, xxiii. Experimental Modal Analysis and Identification

		<ul style="list-style-type: none"> xxiv. Finite Element Model Updating, xxv. Robotics and Intelligent Mechanical Systems xxvi. Intelligent Manufacturing Systems, xxvii. Automation and robotics xxviii. Artificial Intelligence Applications in Mechanical Engineering xxix. Sensors and Actuator Design Sub themes: Experimental Modal Analysis and Identification; Finite Element Model Updating; Mechanical System Design; Application of Multibody Dynamics in Design and analysis of Rural Engineering Systems; Computational Engineering; Engineering Education; Nano and Micro-scale Engineering; Nuclear and Radiation Engineering; Theoretical and Applied Acoustics; Thermal Fluids Systems and Transport; Phenomena; Design and manufacturing; Internal Combustions Engines; Optimization of power plants; Heat Exchangers and Heat Transfer; Computational Fluid Dynamics; Measurements and Metrology; Non-traditional Manufacturing Processes; Finite Element Applications in Manufacturing; Rapid Prototyping; Industrial Quality Control; Reliability and Maintenance; Supply Chain Management; Computer Integrated Manufacturing Systems; Business Process Reengineering; and Value Engineering.
9	Climate change adaptation and mitigation	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> i. Environmental Management ii. Land use change iii. Air quality iv. Land degradation
11	Exploration, mining, processing and marketing	<ul style="list-style-type: none"> i. Small scale mining schemes ii. Exploration of minerals iii. Safety management systems iv. Processing of minerals v. Labour management vi. Infrastructure development (tunnelling,

		access roads and services)
12	Gender mainstreaming	<ul style="list-style-type: none"> i. Gender sensitisation for women in STEM related filed ii. Affirmative action in enhance female participation in STEM related filed.

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

S/N	COLLEGE OF HUMANITIES AD BUSINESS STUDIES (CoHBS)	
	RESEARCH THEMES	SUB-THEMES
1	Medical and Health Systems	Business Management of Medical and Health Systems Sub themes: Cost Management; Cost-Benefit Analysis of Health Systems; Adoption of Medical and Health Systems; Evaluation of Medical and Health Systems.
2	Irrigation, agro-mechanization, agro-processing and marketing	Agri-Business: Sub-themes: Marketing of Agricultural Products; Management for Irrigation, Agro-mechanization; Agricultural Value Chain; Financial and Cost Management; Supply Chain Management
3	Information and Communication Technology for Industrialization	i. Business Information for industrialization Sub-themes: Information and Industrialization and Business information Management ii. Business Communication for Industrialization Sub-themes: Cost-Benefit Analysis of Business Communication and Business Communication Management iii. Business Management Technology Sub-themes: Technology and Financial Management; Cost-Benefit of Business and Technology; Adoption of Technology in Business; E-Business iv. ICT in Language Teaching/Learning (T/L) Sub-themes: Language Nature of Selected Software's for T/L; Dialects' Analysis in ICT for T/L; Symbolic and Pictorial used in ICT for T/L; and ICT Tools in Language 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	i. Innovation Management

	transfer and commercialization	<p>Sub themes: Innovation Eco-system; Commercialization of Business Ideas; Strategies for innovation</p> <p>ii. Management of Technology Transfer Sub Themes: Innovation Eco-system; Commercialization of Business Ideas; and Strategies for innovation.</p> <p>iii. Management of Technology Transfer Sub Themes: Technology Transfer Rate Management; Technology Life Cycle Management; and Technology Transfer and Cost Management</p>
6	Supply chain Management in Industry	<p>i. Supply chain Management in Manufacturing Industry Sub- themes: Determinants of Manufacturing Supply Chain; Layout of Manufacturing Supply Chain</p> <p>ii. Supply chain Management in Commerce Sub themes: Determinants of Supply chain Management in Commerce and Layout of Supply chain Management in Commerce</p> <p>iii. ICT and Supply chain Management: Adoption of ICT in Supply Chain Management</p> <p>iv. Government Industrial Policy and Entrepreneurship Sub themes: Government-Entrepreneurship Relationship and Cross-border Entrepreneurship for Industrialization</p> <p>v. Entrepreneurial Management and Industrialization Sub themes: Human Resource Management for Industrialization; Financial Management for Industrialization; Entrepreneurial Financing for Industrialization; and Service provision for Industrialization</p> <p>vi. Sustainable Entrepreneurship Sub-themes: Entrepreneurial Eco-system for Industrialization; Entrepreneurship innovation and education; Business growth and development; Social entrepreneurship and family business;</p>

		Corporate entrepreneurship; and Sustainable Agro-Entrepreneurship for Industrialization.
7	Gender mainstreaming	Gender Language Mainstreaming Sub- themes: Language use in prioritizing gender equality; Gender issues ignored in the early development of sociolinguistics; and Language and Sex: Difference and Dominance.
8	Tourism development and management	Tourism Development Sub-themes: Tourism integration; Tourism and socio-economic development; Tourism and cultural heritage; Tourism and the environment; Employment opportunities and staff retention in tourism; Marine tourism; Eco-tourism; Sports tourism; Tourism and Infrastructure; and Revenue collection and poverty alleviation in tourism

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

S/N	COLLEGE OF INFORMATION AND COMMUNICATION TECHNOLOGY (Co-ICT)	
	RESEARCH THEMES	SUB-THEMES
1	Medical and Health Systems	Research into telemedicine
2	Irrigation, agro-mechanization, agro-processing and marketing	Research into Tele agriculture
3	Information and Communication Technology for Industrialization	<ul style="list-style-type: none"> i. Research into Evolving Internet ii. Research on Mobile Computing iii. Network Economics iv. User Interfaces v. Network Security and Trust vi. Communications Theory
4	Innovation, technology transfer and commercialization	Network Economics

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

S/N	COLLEGE OF SCIENCE AND TECHNICAL EDUCATION (CoSTE)	
	RESEARCH THEMES	SUB-THEMES
1	Medical and Health Systems	<ul style="list-style-type: none"> i. Medical diagnostics and biological development and product safety ii. Diseases (infectious and non- infectious) iii. Health information and communication systems iv. Disease models development and management v. Mathematical modelling of public health diseases vi. Mathematics and health integration systems vii. Statistical Methods for Medical Data viii. Plant and animal diseases ix. Virology x. Epidemiological studies xi. Parasitology
2	Irrigation, agro-mechanization, agro-processing and marketing	<ul style="list-style-type: none"> i. Mathematical Methods and Theories in Agricultural Research ii. Design and Analysis of Experiments iii. Technology for agro-processing and storage iv. Dairy technology
3	Accessible and quality education	<ul style="list-style-type: none"> 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	Network Analysis in generation and supply of Energy
5	Water management	<ul style="list-style-type: none"> i. Modelling of water system networks ii. Food safety(microbiology/toxicology) iii. Food quality management system
6	Biodiversity conservation and sustainable utilization	<ul style="list-style-type: none"> i. Bio-statistical analysis to conserve and sustain wildlife individuals ii. Optimal control of wildlife species iii. Epidemiological studies

		iv. Application of biodiversity to maintain human health
7	Innovation, technology transfer and commercialization	i. Food valorisation (value addition) ii. Postharvest technology of perishable and non- perishable agricultural products iii. Nanotechnology iv. Food processing and packaging solutions v. Biological and diagnostics development
8	Climate change adaptation and mitigation	Modelling uncertainties for weather and climate change
9	Aquaculture, fisheries and related products quality and marketing	Food quality management system
10	Supply chain management in industry	i. Food safety (microbiology/ toxicology) ii. 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

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

MRCC shares Research Themes with CoHBS and CET in its respective Departments of Business Management and Mechanical Engineering.