



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



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FOREWORD

The Advanced Manufacturing Institute (AMI) at King Saud University (KSU) was established recently as an important expansion of the existing Program of Manufacturing Technology Transfer. The AMI serves the industrial sector, which undoubtedly represents a vital source of the national economy and provides important support to many other sectors, either civilian or military.

Consistent with King Saud University strategic vision for year 2030, AMI is set to undertake effective and mutually rewarding cooperation with community to achieve different aspects of development in all production sectors, and establish internationally recognized leadership in various higher education supported technologies. In this regard, advanced manufacturing was placed at a high priority in KSU's strategic vision. As a result, KSU has founded the Program of Manufacturing Technology Transfer in early 1429H. The Program houses several advanced labs in design, manufacturing and testing, as well as a set of advanced software and simulation tools used in analysis, design and manufacturing. With such powerful capabilities, the Program has – over time - contributed significantly to supporting the manufacturing sector, and has championed many innovative studies, academic and industrial contributions as well as pioneering national projects, including the design and manufacturing of the complex product

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prototypes, several spare parts projects, more than 60 engineering graduate projects, several engineering masters and many specialized workshops and training courses.

In order to meet the increased technological challenges and fulfill the growing demand for effective product design and manufacturing solutions, the AMI was established to expand the achieved technical capabilities and technological facilities in order to serve wider domain of industrial clients as well as provide enhanced training, student supervision, and research-based innovative solutions to various manufacturing, design and material processing problems.

The Strategic Plan presented in this document sets out the AMI aims and priorities for the period up to 1438 H (2017 G) as the Institute strives toward Leadership in Design and Manufacturing. The AMI will continue to carefully coordinate and monitor the implementation of the Plan and ensure full realization of the stated aims.

Dean of AMI

EXECUTIVE SUMMARY

An approval was granted by the Custodian of the Two Holy Mosques King Abdullah bin Abdulaziz Al Saud, Chairman of the Council of Ministers and Chairman of the Higher Education Council - may God protect him – of the decision by the Council for Higher Education at its sixty-seventh meeting to transfer the existing manufacturing technology transfer program at King Saud University (KSU) to the Institute for Advanced Manufacturing.

The Advanced Manufacturing Institute (AMI) was therefore established at KSU in order to serve a wide range of design and manufacturing disciplines within the civilian or military industrial sectors, as well as contribute to the education, research and training of engineering students in various technological areas pertaining to design, material processing and manufacturing.

The AMI supports long-term pioneering research and development initiatives leading to potential breakthroughs in areas related to product design/development and manufacturing. A key component in the establishment and growth of AMI is the development of its Strategic Plan, which outlines the Institute's strategic goals and objectives as well as the general scope of the Institute's activities envisaged during its foreseeable operating future up to the Year 2017.

The development of the Strategic Plan has, in part, taken into consideration the needs and requirements set forth in the Kingdom's developmental plans and the National Industrial Strategy, which aims to develop the industrial sector in the Kingdom as a strategic choice to be an important source of diversification of income sources. The Strategic Plan 2017 for AMI has been developed

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consistent with the Vision, Mission and Objectives outlined in the Strategic Plan 2030 of King Saud University, which defined nine Strategic Objectives for the University, namely 1) Good everywhere; Great in focus areas (Strengthen our comprehensive university with academic areas of research and teaching excellence), 2) Distinctive faculty (Attract and develop distinctive faculty), 3) Less is more (Reduce KSU's student volume, increase the share of graduate students and raise entry requirements), 4) Stronger graduates (Enable KSU students to learn hard and soft skills throughout their academic life), 5) Building bridges (Build bridges among KSU constituencies and externally with local and international groups), 6) Supportive learning environment (Create an engaging environment at KSU for faculty, students, and staff), 7) Sustainable future (Build KSU's endowment and diversity sources of funding), 8) Flexibility and Accountability (Create a performance contract between KSU and the government), and 9) Organizing for purpose (Establishing an organization and governance that supports KSU's goals).

The Strategic Plan 2017 for AMI consists of six main components. The first component describes the Strategic Aspects relating to AMI's existence and mandate. In this regard, the Strategic Thrust, Statement of Purpose, Best Practices and Benchmarking, Gap Analysis, Guiding Principles, and AMI Strategic Planning Tenets are defined in the beginning. The second component summarizes the main SWOT analysis results, which identifies and assesses AMI Strengths, perceived Weaknesses, existing Opportunities and potential Threats, and defines means and approaches to mitigate the weaknesses and threats while exploiting the existing strengths and windows of opportunity. The third component outlines the AMI Goals, the Strategies required to realize such goals and the Actions to be taken as part of executing the identified strategies. In addition, the main elements of AMI Roadmap toward

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its destiny are also outlined as part of this component. The forth and final component outlines the main guidelines and elements of the Strategic Plan implementation, including the revised Management Structure of AMI, Key Performance Indicators, Risk Management, Change Management Plan, and AMI Communication Plan.

Because of the wide range and diverse nature of the design and manufacturing research and training related to AMI's general domain of activities, the Institute has recognized from the start that research and technology focus is crucial to its evolution and survival as a leading Institute in product design/ development and manufacturing. Such focus shall be achieved by capitalizing on the existing strengths, building alliances and partnerships with end-users as well as recognizing the potential opportunities in the design and manufacturing research and development, which could promote the Institute's status to an international pioneering level. In this regard, AMI recognizes three pillars, which define its strategic path toward leadership in design and manufacturing, namely:

1. Research and development in advanced manufacturing through either AMI's own initiatives or through its participation in local and international research collaborative opportunities. This includes adoption and implementation of distinguished research projects in various disciplines supported by the Institute. It also includes continuous improvement and future expansion of the Institute's research programs and activities in response to new emerging needs in product design and development, manufacturing and engineering materials.

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- 2.** Professional development of students, researchers and technologists in the areas of advanced manufacturing technologies. This includes specialized training of University students in product design and development, manufacturing, and material processing, as well as contributions to academic courses, support of graduation projects and graduate theses of University students in the areas of advanced manufacturing.
- 3.** Collaborative and outreach activities in the form of research work and consulting services in advanced manufacturing. This includes consultancy and specialized technical studies, training workshops for industry engineers on new manufacturing technologies as well as technical services to the industrial civilian and military sectors in the form of laboratory testing of industrial products, processing and re-manufacturing of spare parts.

1. EVOLUTION AND DEVELOPMENT OF AMI

1.1 Historical Perspective:

In order to achieve its ambitious developmental plans, the Kingdom has called upon Saudi universities to support the industrial sector as a foundation for knowledge-based economy and to enhance its competitiveness and technology transfer capabilities.

King Saud University (KSU) has responded to such strategic national requirements and put the industrial research and development among its top priorities in the KSU Strategic Plan 2030. Engineering design and manufacturing has therefore emerged as a focus area of research and development in which technology transfer and innovation became a significant source of added value, and where effective technological support is provided to various industrial sectors in the Kingdom with many advanced products, materials and spare parts requiring processing and reverse engineering.

Consistent with King Saud University strategic vision for year 2030, the area of advanced manufacturing was placed at a high priority in KSU's strategic vision. As a result, KSU has founded the Program of Manufacturing Technology Transfer in early 1429H. The Program houses several advanced labs in design, manufacturing and testing, as well as a set of advanced software and simulation tools used in analysis, design and investigation. With such powerful capabilities, the Center has – over time - contributed significantly to supporting the manufacturing sector, and has championed many innovative studies, academic and industrial contributions as well as pioneering national projects, including the design and manufacturing of complex product prototypes, several spare parts projects, more than 60 engineering graduate projects, several engineering masters and many specialized workshops and training courses.

1. EVOLUTION AND DEVELOPMENT OF AMI

1.2 Looking Forward:

Recognizing the fact that there is currently no institute, center or program devoted to design and manufacturing in the Arab countries, and particularly, in the Kingdom, and in order to meet the increased technological challenges and fulfill the growing demand for effective product design and manufacturing solutions, the AMI was established to expand the achieved technical capabilities and technological facilities in order to serve wider domain of industrial clients as well as provide enhanced training and education, student supervision, and research-based innovative solutions to various design and manufacturing problems.

The AMI is set to undertake effective and mutually rewarding cooperation with community to achieve different aspects of development in all production sectors, and establish internationally recognized leadership in various higher education supported technologies. The AMI supports long-term pioneering research and development initiatives leading to potential breakthroughs in areas related to product design and manufacturing. The innovative research and development activities of AMI are expected to benefit a wide range of industries requiring advanced design and manufacturing support for their technology intensive products such as vehicles, airplanes and spare parts. Such technological support will also be offered to different sectors in the Kingdom that consumes complex and critical spare parts with high technical content requiring certain qualifications to identify their design and functional characteristics. With such advanced technology based solutions to various product design and manufacturing problems, AMI is expected to contribute to the establishment of open areas for new investments. In addition, the AMI is also expected to play an important role in providing advanced training and education for engineering students, as part of their academic courses, graduation projects, Master or Ph.D. research work, in various modern design and manufacturing fields.

1. EVOLUTION AND DEVELOPMENT OF AMI

This document presents the AMI Strategic Plan, which outlines the Institute's strategic goals and objectives as well as the general scope of the Institute's activities envisaged during its foreseeable operating future.

1.3 Management Structure of AMI

In order to better position AMI toward fulfilling its strategic mandate and strive for excellence, the AMI has established its initial organization as shown in Figure 1.1.

1. EVOLUTION AND DEVELOPMENT OF AMI

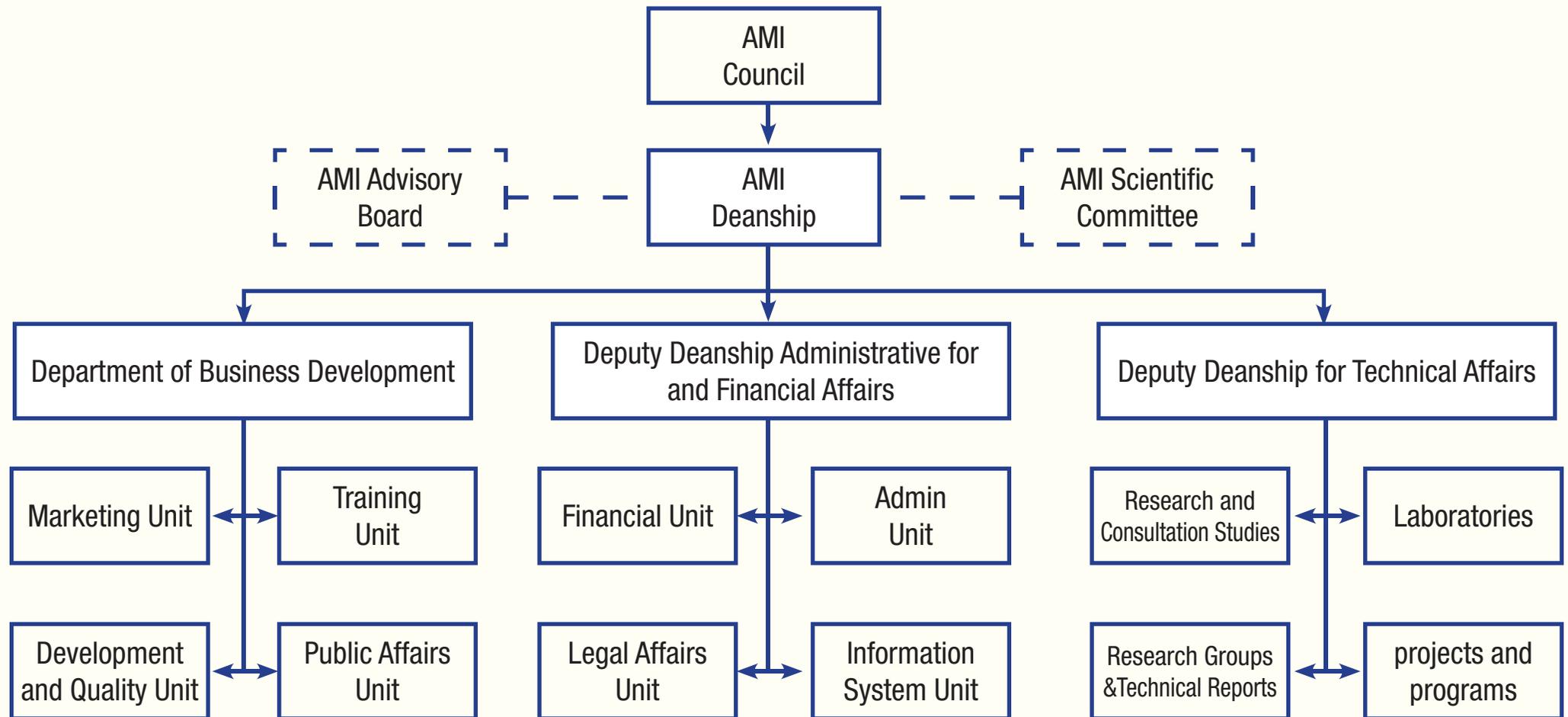


Fig. 1.1 Management Structure of AMI

2. BASIS FOR PREPARATION OF STRATEGIC PLAN

2.1 Introduction

The Kingdom of Saudi Arabia (KSA) has long recognized the importance of the industrial sector as a vital source of national economy and an important supporter for many other civilian and military sectors. Such emphasis on the industrial sector was clearly reflected in the amphibious KSA developmental plans and the National Industrial Strategy, which aims to develop the industrial sector in the Kingdom as a strategic choice to be an important source of diversification of income sources. The KSA developmental plans have recognized that the industry in the Kingdom has become one of the main tributaries of the knowledge-based economy in which the innovation based on modern technologies in the field of design and manufacturing has become an important source of value-added products. The vision of the industry in the Kingdom promotes competition with global industries on the basis of creativity and innovation in order to achieve the ultimate goal of converting national resources into sustainable wealth.

Consistent with King Saud University strategic vision for year 2030, AMI is set to undertake effective and mutually rewarding cooperation with community to achieve different aspects of development in all production sectors, and establish internationally recognized leadership in various higher education supported technologies. In this regard, advanced manufacturing was placed at

2. BASIS FOR PREPARATION OF STRATEGIC PLAN

a high priority in KSU's strategic vision.

The development of the Strategic Plan has, in part, taken into consideration the needs and requirements set forth in the Kingdom's developmental plans and the associated national strategy for the industry, which aims to develop the industrial sector in the Kingdom as a strategic choice to be an important source of diversification of income sources. The Strategic Plan 2016 for AMI has been developed consistent with the Vision, Mission and Objectives outlined in the Strategic Plan 2030 of King Saud University, which defined nine Strategic Objectives for the University, namely 1) Good everywhere; Great in focus areas (Strengthen our comprehensive university with academic areas of research and teaching excellence), 2) Distinctive faculty (Attract and develop distinctive faculty), 3) Less is more (Reduce KSU's student volume, increase the share of graduate students and raise entry requirements), 4) Stronger graduates (Enable KSU students to learn hard and soft skills throughout their academic life), 5) Building bridges (Build bridges among KSU constituencies and externally with local and international groups), 6) Supportive learning environment (Create an engaging environment at KSU for faculty, students, and staff), 7) Sustainable future (Build KSU's endowment and diversity sources of funding), 8) Flexibility and Accountability (Create a performance contract between KSU and the government), and 9) Organizing for purpose (Establishing an organization and governance that supports KSU's goals).

2. BASIS FOR PREPARATION OF STRATEGIC PLAN

2.2 Strategic Thrust

The Advanced Manufacturing Institute was established with a strong mandate to achieve excellence in performance as well as leadership status among regional and international research, technology development and training groups associated with product design and development, and manufacturing. Because of the wide range and diverse nature of research and development related to AMI's general domain of activities, the Institute has recognized from the start that research and technology focus is crucial to its evolution and survival as a leading Institute in design and manufacturing.

Such focus shall be achieved by capitalizing on the existing strengths, building alliances and partnerships with end-users as well as recognizing the potential opportunities in the design and manufacturing research and development, which could promote the Institute's status to an international pioneering level. In order to realize and maintain the strategic thrust it is very important for AMI to understand the aspirations and expectations of its stakeholders and end-users, and then translate such expectations into well-coordinated and effectively managed research projects, specialized technical studies and training initiatives. Such focused and disciplined research and technology development approach would help AMI better align and market its services and make notable contributions to advancing product design and manufacturing technologies in the Kingdom and elsewhere.

2. BASIS FOR PREPARATION OF STRATEGIC PLAN

In defining its strategic thrust, AMI recognizing the following needs and requirements consistent with the strategic direction of the University:

- 1)** Need to support the sustainable development of national industries and knowledge-based economy through the use of scientific methodologies and advanced research.
- 2)** Need to increase the skills and competencies of design and manufacturing engineers through development of a generation of competent researchers and graduate students in various areas of the advanced manufacturing technologies.
- 3)** The need to promote and disseminate the culture of innovation and creativity, as well as development and enrichment of knowledge in the fields of advanced manufacturing technologies and systems.
- 4)** The need to achieve international recognition through high-quality publications in reputable national and international specialized journals in advanced design and manufacturing.

2. BASIS FOR PREPARATION OF STRATEGIC PLAN

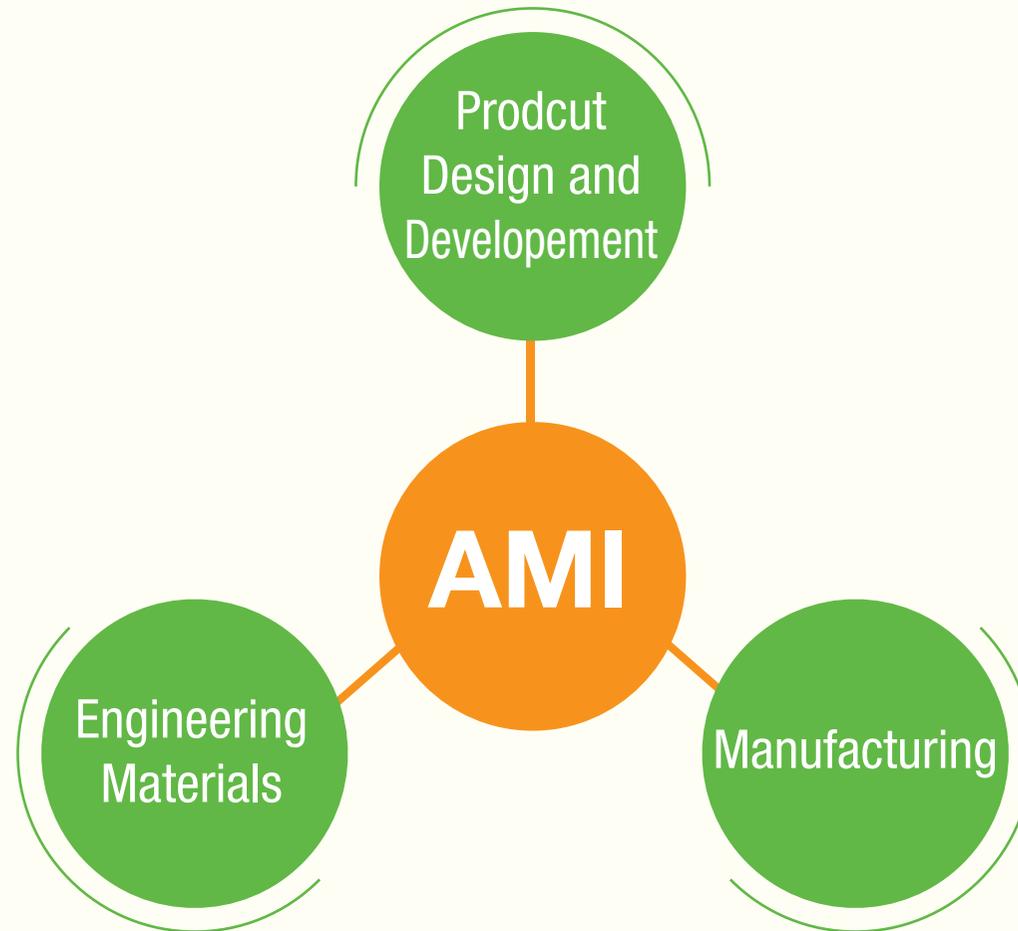


Fig. 2.1 AMI Technical Activity Areas

2. BASIS FOR PREPARATION OF STRATEGIC PLAN

2.3 Statement of Purpose

AMI has a principal role to play in undertaking research and development in order to keep pace with the technological changes and improvements in product design and manufacturing. AMI understands its purpose as being a recognized leader in design and manufacturing via executing three pillar components, as follows:

- 1.** Research and development in design and manufacturing through either AMI's own initiatives or through its participation in local and international research collaborative opportunities. This includes adoption and implementation of distinguished research projects in various disciplines supported by the Institute. It also includes continuous improvement and future expansion of the Institute's research programs and activities in response to new emerging needs in product design and development, manufacturing and engineering materials. This pillar supports KSU Strategic Objectives #1, #3, #5 and #6. It is also consistent with the strategic directions set in the Kingdom's developmental plans to discover and empower innovators with advanced knowledge.
- 2.** Professional development of students, researchers and technologists in the areas of advanced manufacturing and material processing. This includes specialized training of University students in advanced manufacturing, industrial design and

2. BASIS FOR PREPARATION OF STRATEGIC PLAN

material processing, as well as contributions to academic courses, support of graduation projects and graduate theses of University students in the areas of product design, manufacturing and material processing. This pillar supports KSU Strategic Objectives #2 and #4. It is also consistent with the strategic objectives in the Kingdom's developmental plans to foster a supportive environment for innovators and develop their skills and capabilities.

- 3.** Collaborative and outreach activities in the form of research work and consulting services in advanced manufacturing. This includes consultancy and specialized technical studies, training workshops for industry engineers on new manufacturing technologies as well as technical services to the industrial civilian and military sectors in the form of laboratory testing of industrial products, processing and re-manufacturing of spare parts. This pillar supports KSU Strategic Objectives #5, #6 and #7. It is also consistent with the strategic objectives in the Kingdom's developmental plans to activate the University's role in supporting the society development via adopting innovative works.

As outlined in Figure 21, the AMI encompasses three technical activity areas (Figure 2.1), namely:

- a)** Product design and development,
- b)** Manufacturing, and
- c)** Engineering materials.

2. BASIS FOR PREPARATION OF STRATEGIC PLAN

It is essential for AMI to maintain the delicate balance between a) serving the immediate needs of the students and its industrial stakeholders and end-users, and b) building strong long-term strategic capabilities to further enrich and advance research and development in design and manufacturing. Such a balance is necessary to maintain notable contributions in fulfilling industry needs and solving existing product design and manufacturing problems while conducting vigorous research to attain long-term improved design and manufacturing solutions as demanded by industry.

Furthermore, AMI intends to be a vehicle for supporting and enhancing rapid transfer of design and manufacturing knowledge and expertise gained from various research and development efforts across the Kingdom and worldwide. In order to realize and play such an important role, AMI will do its utmost effort in order to establish a strong capability in terms of high-caliber researchers in order to build and maintain a strong and self-evolving system of producing and disseminating design and manufacturing research results and outcomes to peers and collaborators through an effective network of contacts.

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

3.1 Gap Analysis

The Gap Analysis is performed in order to assess the current status of AMI as compared with the leading (benchmarking) advanced manufacturing institutes as outlined in Section 3.2, which exhibit the best performance in design and manufacturing practices worldwide. Recognizing that the King Saud University aspires to be a global leader in research, technology transfer and knowledge-based economy development, the AMI seeks to bridge the existing gaps as outlined in the following table:

#	Strategic Issue / Performance Domain	Target Performance and Best Practice	Current Status at AMI	Identified Gaps
1	Research Excellence in Advanced Manufacturing	Establish and continually improve advanced research and development capabilities, including notable scholars as well as modern laboratory and simulation tools, which enable pursuance of innovative and focused research and development in product design, manufacturing and material processing.	AMI was established recently as an important expansion of the previously existing Program of Manufacturing Technology Transfer at KSU. Although the Program already houses several advanced labs and simulation tools, more is needed to be done in order to equip the AMI with a comprehensive set of integrated laboratories for design, manufacturing and testing as well as state-of-the-art software tools and virtual reality and simulation capabilities, which enable advanced and innovative analysis, design and investigation activities to be carried out at the Institute.	Some gaps between best practice and current status at AMI still exist in certain research abilities, notably in regard to: <ul style="list-style-type: none"> a) Focusing more on the Institute’s strong areas of expertise, b) Implementing distinguished research projects in design and manufacturing disciplines. c) Customizing the Institute’s research programs and activities in response to new emerging needs in product design and manufacturing. d) Improving and expanding the Institute’s research capabilities, laboratory testing facilities and advanced simulation capabilities.

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

#	Strategic Issue / Performance Domain	Target Performance and Best Practice	Current Status at AMI	Identified Gaps
2	Student Education and Training in Design and Manufacturing	Initiate and carryout vigorous education, training and professional development programs for students, researchers and technologists in order to ensure competency and readiness of students to perform well upon graduation and entering the job market in industrial design and manufacturing.	While AMI is currently engaging in some form of student support including supervision of graduation projects and in-house training, much more needs to be done in terms of active participation in design and manufacturing curricula expansion and improvement to include the current trends and modern technologies required by today's industry. Also, AMI needs to expand its role in student education and training by organizing field trips, off-campus training and engagement in student exchange programs with leading academic institutions with expertise in design and manufacturing. AMI, also needs to run specific academic programs.	The following gaps are identified between best practice and current status at AMI in regard to student education and training in design and manufacturing: a) Focusing on the practical content of the specialized training offered to University students in design and manufacturing. b) Expanding supervision and support of graduation projects of undergraduate students in the areas of product design, manufacturing and material processing. c) Introducing and participating in academic courses in design, manufacturing and material processing at KSU. d) Supporting Master and Ph.D. theses of the University graduate students with emphasis on practical aspects and modern technologies in design and manufacturing. e) Introducing diploma, master, and Ph.D. programs.

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

#	Strategic Issue / Performance Domain	Target Performance and Best Practice	Current Status at AMI	Identified Gaps
3	Responsiveness to Industry Needs and Requirements in Design and Manufacturing	Actively promote outreach activities with national industrial sectors in the form of collaborative research as well as specialized consulting services, technical studies and customized user-oriented training in product design and manufacturing.	During the operation of the previously existing Program of Manufacturing Technology Transfer at KSU, some links with industry have been established. However, AMI needs to work more on strengthening and expanding such links with various civilian and military industrial sectors through collaborative research, consultancy services, training and technical studies.	<p>The following gaps are identified between best practice and current status at AMI in regard to outreach capabilities to respond to industry needs and requirements in design and manufacturing:</p> <ul style="list-style-type: none"> a) Taking the lead in approaching the industry and offering innovative solutions to existing problems as well as specialized consultancy and technical studies for various industrial sectors in the Kingdom. b) Offering specialized training workshops for industry engineers on new manufacturing technologies. c) Increasing engagement with local industry by opening the laboratory and simulation facilities at the Institute for testing, characterization and assessment of materials, spare parts and components as required by local industries.

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

3.2 Best Practices and Benchmarking

The AMI shall compare its performance in all research, training and administrative areas using a benchmarking system, which relates the identified key performance indicators to their best-practiced values that are observed at several leading manufacturing institutes worldwide. The model manufacturing institutes are selected using stringent comparative criteria, including their internationally recognized contributions to serving the industry in the areas of product design and manufacturing as well as their contributions in research and student education and training activities.

The following five key performance areas were identified for benchmarking the research, training, services and administrative performance of the AMI against international leading design and manufacturing institutes:

1. Internationally recognized Institute with high-quality cutting-edge research and technology development capabilities as well as publishing excellence via high quality international publications.
2. Quality supervision, training and education of students using advanced laboratory and simulation facilities and training aids relating to product design/development, manufacturing and material processing.
3. Strong collaborations with industry and on-going dialogues with end-users to provide effective and innovative solutions to various design and manufacturing problems.

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

4. Structured progressive organization that values high expectations, supports innovative ideas and respects diverse talents and learning styles.
5. Efficient and effective administration system with flexible budgeting system, delegated financial powers to facilitate budget planning and expenditure processing and efficient outreach and staff recruitment processes.

The above benchmarked key performance areas are examined and assessed against the Best Practices exhibited by various international leading design and manufacturing institutes in order to identify seven international leading institutes, which constitute benchmark models for the AMI. These seven leading advanced manufacturing institutes are:

1) **Advanced Manufacturing Institute, Sheffield University, United Kingdom**

This Advanced Manufacturing Institute was recently created by transforming the previously existing “advanced manufacturing center”, which was associated with Boeing since 2001, into an advanced manufacturing institute. The institute now contains several advanced manufacturing departments, and works closely with private sector and other universities.

The institute currently houses several land-mark facilities, including the “Factory of the Future”, expanded “Composite Centre”, a “Knowledge Transfer Centre” to present new manufacturing technologies to businesses, and a “Training Centre” which can take 200 apprentices a year. It also houses the landmark “Rolls-Royce Factory of the Future” opened in 2008 and now includes

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

workshop, laboratory, as well as office and conference space. The open-plan workshop is focused on machining research, housing an array of state-of-the-art machining centers, robotic cells, and other manufacturing equipment. The workshop is designed to allow member companies to try new technologies and processes before introducing them to their own factories. The “Factory of the Future” also includes several microscopy and metrology laboratories, a virtual reality room, and training facilities for the apprentices. The new “Composite Centre” includes a general workshop and a controlled environment including high-spec clean rooms. The production facilities include a range of large autoclaves and ovens, and a series of robots to support the research in automating the production of complex composites components.

2) Manufacturing Institute, Cambridge University, United Kingdom

This institute is one of the most famous institutes specialized in educational and multi-discipline research programs as it gathers different expertise in technology, economy and administration, and employs them in the field of advanced manufacturing. This institute was opened in year 2009 and it now houses eight research fields and offers different post graduate degrees in them. Research work at this institute is undertaken in close collaboration with companies, ensuring its relevance to industrial needs and the rapid dissemination of new ideas and approaches. The institute aims to develop practical solutions to current industrial issues and covers all areas from understanding markets and technologies, through product and process design to operations, distribution and related services.

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

The institute covers a wide range of research areas, including Design management, Distributed information and automation, Industrial photonics, Industry and government, International manufacturing, Production processes, Strategy and performance, and Technology management. The institute also administers a program for 3rd and 4th-year Cambridge engineering students that integrate management, business and interpersonal skills with engineering knowledge and industrial engagement. In addition, the institute also offers Masters Program in Industrial Systems, Manufacture and Management, which prepares graduates from various disciplines for fast track careers in industry through an intensive program of taught modules and industrial projects. Moreover, the institute also runs the so-called Knowledge Transfer Partnerships (KTP) program, which involves high caliber graduates who work in a company for two or three years to achieve strategic improvements in the company's operation.

3) Advanced Manufacturing institute, Kansas State University, USA

This institutes works on finding solutions for innovated products and manufacturing processes with efficient cost. It also works in grouping different specializations in design, business, and manufacturing to achieve particular goals.

The institute offers a range of services spanning Product development, Design verification, Custom equipment development, Manufacturing process development, and Bio-processing and chemical engineering. This institute employs many experts in engineering, product design, manufacturing and business, who can offer effective assistance with business planning and research, engineering and economic development to help entrepreneurs and businesses to be more competitive in the

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

marketplace. In addition, the institute provides design and engineering services to help develop products, validate product performance, optimize equipment design and improve manufacturing efficiency.

The institute also provides expert help and assistance in various industrial business support areas, including Intellectual property and risk assessment, Market research and competitive analysis, Business plan development, Financial modeling, Marketing strategy and assistance, Product launch and market testing, Technology commercialization. In addition, the institute also offers economic development services to help companies and communities identify business growth opportunities including new business ventures, products and services. Furthermore, the institute manages an intern program that allows students to gain real work experience and the opportunity to work with skilled professionals. Through our program, you will be introduced to potential employees who have the knowledge, experience and skills needed to be immediately productive.

4) Advanced Manufacturing Institute, Hong Kong University for Science and Technology, Hong Kong

This institute concentrates on research and application of advanced manufacturing techniques to satisfy the needs of local industrial companies.

The institute currently undertakes research and development that cover mass customization, network based design and

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

manufacturing, software development service, enterprise information integration, industrial product design and development, technological information data development, as well as science and technology consulting services.

5) Advanced Manufacturing Research Institute, National Institute for Advanced Industrial Science and Technology, Japan

This institute, which comprises some 120 researchers in 19 research groups at two Centers, develops environmentally conscious innovative manufacturing technologies to meet the critical needs of industry. Crucial for strengthening international competitiveness and establishing safety infrastructure, these needs include high-efficiency, functional creativity, flexibility, safety and reliability. The institute also develops application prototypes for commercialization. The institute strives to offer products based on strong industrial relationships, and to demonstrate both the usefulness of these innovative technologies, and provide guidance for the manufacturing industry.

The institute works on the vision that manufacturing technology is regarded as a series of processes to provide shape and function to materials and to convert them into commercial products. Therefore, several inter-related key points are considered critical to the work of the institute, namely: high-efficiency, functional creativity, flexibility, and safety and reliability. The institute comprises several research and technology groups, including Electro-ceramics Processing Group, Inorganic-Based Plastics

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

Group, Tailored Liquid Integration Group, Bio-Integration Processing Group, Integration Process Technology Group, Ingenious Micro-Manufacturing Systems Group, Low-Formability-Materials Processing Group, Flexible Chemical Coating Group, Ceramic Mechanical Parts Processing Group, Ceramic Structure Controlling Group, Tribology Group, Functional Integration Group, Crystal and Materials Processing Group, Thin Films Processing Group, Specific-Field Processing Group, Functional and Structural Damage Verification Group, Surface Interactive Design Group, System Functional Design Group, Manufacturing Information Group, Metal Processing Group, and Processing Fundamentals Research Group.

6) **Advanced Manufacturing Institute, Malaysia**

This institute is considered one of the pioneers in the field of space engineering. It offers advanced training, research and consultancy related to space and aviation engineering. It is recognized as one of the major contributors to the Malaysian economy. The institute, which was established in February 2002, is a recognized human capital development center as part of a consortium that encompasses eleven public universities in Malaysia. The institute focuses on catering Human Capital Development, Technology Services and Technology Management particularly in high technology-related industry. The institute research and business activities include the Capacity Building and Talent Development, Technology Application and Consultancy Services, and Management of the Aerospace Malaysia Innovation Center.

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

7) Manufacturing Research Institute, McMaster University, Canada

This institute was established in 2001 and is now the biggest manufacturing research institute in Canada. It is also considered by industrial experts as the most advanced institute in the field. It is also considered as an important bridge between university and industry. The institute provides a focus for high profile research activities in the field of manufacturing engineering. In this regard, the institute fosters long term, pre-competitive, fundamental research that will have universal applicability, free from restrictions related to ownership of intellectual property. The institute also provides a vehicle for university-industry interaction in the field of manufacturing engineering via aggressively promoting, encouraging, and performing fundamental and applied research, in cooperation with industrial partners. In addition, the institute supports Master and Ph.D. graduate students so as to satisfy the current and projected need for people with this type of training in industry. The Institute also provides significant support for the education of undergraduate B.Eng. and B.Tech. students.

Among its stated objectives, the institute aspires to provide systematic mechanisms for technology transfer and diffusion of knowledge and research results. These mechanisms include contractual research and development projects, research reports, short courses, workshops/seminars, and training facilities for industry employees to further their knowledge. Through such ambitious activities, the institute is well suited for providing a vehicle to enable industry and the community at large to become more fully aware of the unique capabilities and contributions of the involved research investigators in manufacturing. The institute

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

succeeded in securing a number of founding industrial sponsors, including Cobra Machine Tool Co. Inc., General Motors of Canada Limited, Husky Injection Molding Systems Ltd., Liburdi Engineering Limited, Orlick Industries Limited, Siemens Westinghouse Incorporated, Silicon Graphics Canada, Mechanical Dynamics Inc., Object Workshops, Inc., and Origin International. In addition, the institute collaborates with several government partners, including Canada Foundation for Innovation (CFI), Ontario Innovation Trust (OIT), Ontario Research and Development Challenge Fund (ORDCF), and Materials and Manufacturing Ontario (MMO).

The institute currently houses and operates several high-tech advanced laboratories, including 1) Centre for Advanced Polymer Processing and Design (Blown Film Extrusion, Injection Molding - Optimization of Cooling Circuits, Extrusion - Flat Die Design, Extrusion – Foaming, Extrusion – Micropelletization, Mixing, Powder Injection Molding, Rotational Molding), 2) Machine Systems Laboratory (Closed Loop Machining, Centre for Online Manufacturing Optimization, Face Milling, Fast Response Control, Design of High Bandwidth Feed Drives, Finite Element Simulation, Hexapod, Highspeed Machining of Advanced Materials, Highspeed Machining of Difficult to Machine Alloys, Laser Assisted Machining, Micro-Machining, Development of a Novel Modular and Agile Face Machining Technology, Characterization of Machine Tool Dynamics in High Speed Machining and Its Effects on Part Surface Quality), 3) Metal Forming Laboratory (Bending and Springback of Automotive Aluminum Sheet, Trimming of Automotive Aluminum Sheet), 4) Micro Manufacturing Laboratory (manufacturing small objects and components), 5) Robotics and Manufacturing Automation Research (Automated Inspection of Curved Surfaces for Subtle Defects, Robotic Deburring and Polishing), and 6)

3. ASSESSMENT OF CURRENT STATUS AND BENCHMARKING

Thermal Processing Laboratory (Determination of actual heat transfer rates during quenching processes using high velocity air jets, Plasma nitriding of stainless steels, Liquid jet impingement cooling and forced boiling heat transfer, Incipient Melting of Cast Aluminum Alloys, Numerical Modeling of Heat Treatment of Aluminum Castings, Use of Artificial Neural Networks Modeling in the Optimization of Thermal Processing Operations, Development of Methods for measuring actual heat transfer rates in industrial furnaces during thermal processes, Development of methods for accurate prediction of heat up and soak times of complex shaped parts, Numerical simulation of liquid motion in vibration suppressor tanks, Numerical simulation of convective heat transfer in inclined, complex, and rotating enclosures, Performance characterization of Liquid-Cooled Heat Sinks).

4. SWOT ANALYSIS AND STRATEGIC CHOICES

4.1 AMI Strengths

AMI recognizes the following areas of strength, which should be exploited and capitalized upon during the Institute's strive for achieving its strategic objectives:

- Strong technical and research expertise at KSU, which can be utilized by AMI.
- Availability of already trained engineering staff and technicians at AMI on advanced manufacturing technologies as part of the existing Program of Manufacturing Technology Transfer.
- Access to one of the best infrastructures and support systems provided by KSU, which would facilitate the establishment and operation of AMI.
- Strong interaction and integration with College of Engineering and easy access to the College's facilities and expertise.
- Availability of communication channels within KSU with national and international research institutions and global expertise.
- Strong partnership and interaction with the Ministry of Commerce and Industry as well as the military sector within KSA.
- Strong start with clear vision, and initial preparatory work in defining the AMI research priorities.
- The trust and respect of the Institute by its stakeholders and end-users.
- Strong harmony, cooperation and enthusiasm among the AMI technical team.
- The ability to secure sustained financial support from stakeholders through contractual agreements and cooperative efforts.

4. SWOT ANALYSIS AND STRATEGIC CHOICES

4.2 Perceived Weaknesses

AMI acknowledges the following weaknesses and vulnerabilities, which should be mitigated and dealt with as part of the Institute's business operations toward achieving its strategic objectives:

- Unavailable job allocations presently available for the Institute.
- Insufficient space currently allocated for the offices and laboratories associated with AMI.
- Low financial and technical support currently available for support of labs and simulation capabilities at the Institute.
- Insufficient technical expertise in some critical work areas at AMI.
- Currently non-existent organizational guidelines, operational policies and work procedures for the Institute.
- Currently non-existent work plans for executing work at AMI.
- Insufficient incentives for workers at AMI.
- Insufficient English language skills among workers at AMI.
- Currently non-existent marketing plan for the Institute's products and services.

4.3 Existing Opportunities

AMI sees the following windows of opportunities, which should be explored and utilized to the extent possible as part of the Institute's efforts to achieve its strategic objectives:

4. SWOT ANALYSIS AND STRATEGIC CHOICES

- Strong confidence of industrial sector and community in the currently existing capabilities at KSU.
- The large number of collaborative agreements between the University and national as well as international entities.
- The presence of King Abdullah Institute for Research and Consulting Studies, which acts as a gate for marketing the University research and development products.
- The presence of specialized institutes at KSU, which possess technical resources and capabilities that could be utilized by AMI.
- The current immense interest by the government in advanced manufacturing, as stated in the current national developmental plans and as stipulated in the National Industrial Strategy.
- Relatively small number of industry consulting houses, which currently operate in the Kingdom.
- The establishment of the Institute in the College of Engineering offers access to a wide network of contacts and academic departments.
- Strong interest of local industries in building national capabilities for spare parts manufacturing technologies.
- The presence of specialized patent office, Riyadh Techno-Valley and incubators' unit within KSU, which would facilitate commercialization of AMI products.
- Great potential for collaborative research with the world leading research Institutes and local business entities in the field of product design and manufacturing.
- Current vigorous recruitment and exchange programs at KSU can attract highly qualified researchers for AMI.
- Notable increase in interest of young engineers in studies and research related to design and manufacturing.

4. SWOT ANALYSIS AND STRATEGIC CHOICES

- Great potential for assuming a national and regional leadership in design and manufacturing as specialized organizations are rare in the region and do not exist in the Kingdom.
- Innovative research initiatives and activities currently exist that are well positioned for support from civilian and military sectors.
- Ease of accessibility to - and existing opportunity to utilize - the current infrastructure and facilities in KSU to advance research and development in product design and manufacturing.

4.4 Potential Threats

AMI perceives the following threats and potential risks, which should be mitigated and dealt with as part of the Institute's business operations toward achieving its strategic objectives:

- Lack of conviction among some industrial firms about the benefits and usefulness of collaborations with academic institutions.
- Insufficient communications with many of industrial entities outside KSU.
- Lack of awareness among many industrial establishments concerning the existence of AMI and the products and services which it can offer.
- While the AMI is currently a unique establishment in design and manufacturing in the Arab world, the Institute may – on the long run - face potential threats and fierce competition from regional competitors for leadership position in design and

4. SWOT ANALYSIS AND STRATEGIC CHOICES

- manufacturing.
- Uncertainty regarding the financial support and/or self-generated funds in AMI.
- Potential loss of faculty and researchers due to departures associated with a competitive job market. The Institute could lose several notable experts over the upcoming period to other institutions if sufficient incentives are not available for retaining high-caliber scholars and experts.

4.5 Assessment and Strategic Choices

A careful analysis of AMI strengths, weaknesses, opportunities and threats would reveal that AMI is both capable and well-positioned to tackle its weaknesses as well as exploit its strengths and potential opportunities. However, the threats pose real difficulties and challenges that ought to be overcome. In order to secure its survival and bolster the mandated strive for distinction and excellence, AMI shall state and observe the following assertions and guidelines, which are derived from the realization of the AMI strengths, and weaknesses in formulating its strategic goals and strategies:

4.5.1 Focused Research and Technology Development Strategy

AMI shall adopt a focused research and development strategy that ensures excellence and enables the Institute to undertake high quality research-based development work in product design/ development and manufacturing through its own initiatives or via

4. SWOT ANALYSIS AND STRATEGIC CHOICES

participation in local, regional and international research collaborative efforts. This would be accomplished by:

- i) Concentrating on the Institute's strong areas of expertise,
- ii) Avoiding invested efforts and/or funds in those areas that are likely to either dilute its quality of research or face non-interest of local industries.
- iii) Adopting and implementing distinguished research projects in various advanced manufacturing disciplines supported by the Institute.
- iv) Adapting and customizing the Institute's research programs and activities in response to new emerging needs in advanced manufacturing technologies.
- v) Continuously improving and expanding the Institute's research capabilities, laboratory testing facilities and advanced simulation capabilities.

The above approach is expected to yield the following SWOT actions:

- Capitalize on existing strengths relating to AMI's areas of strong expertise in design and manufacturing as well as its outstanding capability in assembling strong and competent research groups that could involve researchers from other universities. Also, capitalize on the existing accessibility of AMI to one of the best infrastructure for innovative research provided by KSU. In addition, utilize the strengths relating to the existing strong harmony, cooperation and enthusiasm among the AMI management team as well as the independence of the Institute in its technical decisions, which offers greater flexibility and operating effectiveness.

4. SWOT ANALYSIS AND STRATEGIC CHOICES

- Recognize and accommodate weaknesses relating to the limited available space within KSU as well as the limited number of available researchers and some advanced educational aids and equipment - that could possibly be available via collaboration with other international universities and institutes.
- Exploit opportunities for collaborative research with local and international research and technology expertise, and utilize available qualified researchers in the fields of advanced manufacturing. In addition, opportunities for innovative research initiatives and activities that are well positioned for corporate and private sector support shall be exploited by AMI, which currently represents the only institute for advanced manufacturing in the region.
- Mitigate the impacts of threats relating to existing limited interest and/or awareness of some local industries as well as the potential loss of scholars and researchers at AMI due to departures associated with a competitive job market.

4.5.2 Training and Professional Development of Students and Staff

AMI shall undertake vigorous training and professional development programs for students, researchers and technologists, aligned with its industrial stakeholders and end-user needs and requirements in order to ensure competency and readiness of students to perform well upon graduation and entering the job market in industrial design and manufacturing. This would be accomplished by:

- i) Conducting specialized training of University students and researchers in the areas of advanced manufacturing and material processing.
- ii) Supporting graduation projects of undergraduate students in the areas of product design/development, manufacturing and

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- material processing.
- iii) Contributions to introduction distinguished academic programs and courses, as well as curriculum in design, manufacturing and material processing at KSU.
 - iv) Supporting Master and Ph.D. theses of the University graduate students in the areas of advanced manufacturing technologies, innovative product design techniques and modern material processing methodologies.

The above approach is expected to yield the following SWOT actions:

- Capitalize on the trust and respect of the Institute and its graduating students by the stakeholders and end-users as well as the strengths of AMI's outstanding laboratory and simulation training capabilities for the purpose of delivering effective training of students, researchers and technologists in design and manufacturing.
- Exploit some opportunities for off-campus student training in industrial sites via utilizing the keen interest received from local industrial sectors as well as the opportunity to utilize the existing links with the Ministry of Commerce and Industry and other governmental authorities.
- Mitigate the impacts of threats relating to potential loss of innovative and high caliber researchers by investing more in the students and advancing their skills and abilities to be the researchers of the future.

4. SWOT ANALYSIS AND STRATEGIC CHOICES

4.5.3 Outreach Industry Collaborations and Consultancy

AMI shall promote outreach activities in the form of collaborative research with the national industrial civilian and military sectors as well as specialized consulting services, technical studies and customized user-oriented training in product design and manufacturing. This would be accomplished by:

- i) Conducting consultancy and specialized studies and technical support to the industrial sectors in the areas of advanced manufacturing technologies and material processing.
- ii) Offering specialized training workshops for industry engineers on new manufacturing technologies.
- iv) Opening the laboratory and CAX facilities at the Institute for testing, characterization and assessment of materials, spare parts and components as required by local industries subject to appropriate fees.
- v) Inviting factories and local manufacturing firms to try new technologies and enhanced designs developed by AMI prior to full-scale implementation.

The above approach is expected to yield the following SWOT actions:

- Capitalize on the trust and respect of the Institute by its stakeholders and end-users as well as the strengths of AMI's outstanding mutual interaction with local civilian and military establishments as well as the continual connections with prominent industrial figures for the purpose of delivering effective user-oriented innovative solutions to existing problems in product design and manufacturing.

4. SWOT ANALYSIS AND STRATEGIC CHOICES

- Exploit and utilize existing opportunities in view of the significant support available from the government, which promotes and encourages cooperation and exchange among all Saudi establishments and institutions. Also, exploit and expand the network of contacts of AMI and include new relationships and partnerships with civilian and military industrial sectors.
- Mitigate the impacts of some threats relating, for example, to insufficient communications with many of industrial entities, in addition to the threat posed by the uncertainty regarding the long-term financial support and fund raising. Such threats should be mitigated by working closely with stakeholders and end-users to formulate the best long-term partnership and collaboration strategies on training and professional development in various areas of design, manufacturing and material processing.

4.6 Guiding Principles

AMI will operate and undertake research and development work, while observing a set of guidelines that ensure steady progress toward fulfilling its objectives:

1. AMI shall adopt a number of core values and guidelines to ensure success including:
 - Commitment to work excellence and perfection consistent with Islamic values and traditions,
 - Commitment to teamwork and partnership approach,
 - Commitment to provide equal opportunities for all workers at AMI as well as equality in providing services to students and researchers associated with the Institute,

4. SWOT ANALYSIS AND STRATEGIC CHOICES

- Commitment to personal and scholarly integrity in all functions and activities in the Institute, and
 - Commitment to quality assurance measures and continuous improvement.
2. AMI understands “excellence” to also mean transparency, openness to criticism and subjectivity to strict performance evaluation and international benchmarking criteria.
 3. AMI shall ensure that the Institute applies ethics policies and strict code of conduct when undertaking laboratory experiments and tests, and in preparation and submission of international publications on design and manufacturing. The Institute shall also ensure the highest standards in respecting individual privacy.
 4. AMI is committed to creating and maintaining a productive and enjoyable work atmosphere within the Institute, which promotes constructive cooperation, partnership, loyalty and sense of ownership among various staff, researchers and management staff.

5. AMI STRATEGIC PLAN

5.1 Vision, Mission and Objectives

Vision of AMI

Become the leading institute and house of expertise in advanced manufacturing across the region with internationally recognized capabilities.

Mission of AMI

Advance the state-of-the-art in advanced manufacturing by means of conducting distinguished research and development work, collaborations, specialized consultancy and training activities, as well as professional development of engineering students, active engagement with industry and community to deliver high quality solutions to design and manufacturing problems.

Objectives of AMI

1. Achieve research and development excellence in advanced manufacturing via developing and utilizing advanced Computer Aided Systems capabilities and modern laboratory facilities for design, testing, manufacturing and quality assessment of manufactured products, spare parts and materials.
2. Contribute to the professional development of students and engineers via contributions to introduction distinguished academic programs and courses, as well as training, workshops, graduate thesis supervision, case-studies and projects relating to design, testing, manufacturing and material processing.
3. Maintain in-house high quality research and development capabilities by recruiting and retaining distinguished expertise in advanced manufacturing areas as well as collaborating and interacting with leading international expertise in the field.

5. AMI STRATEGIC PLAN

4. Actively engage in continual collaborations with local civilian and military industries and community partnership for the purpose of advancing the ease of knowledge-based economy and developing and delivering effective and innovative solutions to design and manufacturing problems, as well as opening new windows of opportunities in this regard.
5. Create and expand partnerships with national, regional, and International design and manufacturing institutions in order to build effective bridges and networks for the transfer of knowledge and technology, as well as research expertise.

The alignment between AMI and KSU objectives is illustrated in the following Table:

KSU Strategic Objectives	AMI Strategic Objectives				
	1	2	3	4	5
1	✓				
2			✓		
3		✓			
4		✓			
5				✓	✓
6	✓				
7					
8					
9					

5. AMI STRATEGIC PLAN

5.2 AMI Goals, Strategies and Actions

Goal # 1: Achieve and maintain research excellence in advanced manufacturing.

Strategies for Goal #1

S1.1 Establish research priorities for design and manufacturing in Saudi Arabia and expand the Institute's research capabilities in respond to industry needs and requirements.

Actions:

- A1.1.1** Conduct regular meetings with advisory staff, industry stakeholders and expert scholars in order to identify priorities for design and manufacturing.
- A1.1.2** Develop operating policies and guidelines to align the Institute's research programs according to industry and society needs as identified in consultation with national and international experts, practitioners in the field, and end-users.

5. AMI STRATEGIC PLAN

- A1.1.3** Develop a long-term research operational plan to establish and improve research-based capabilities in design and manufacturing and define the future batches of research projects to be undertaken by AMI.
 - A1.1.4** Develop a vigorous recruitment policy and acquire high-caliber and skilful researchers with international credentials to work at the Institute.
 - A1.1.5** Create and maintain a database of the competent researchers working on design and manufacturing in the region and worldwide.
 - A1.1.6** Initiate a vigorous recruitment process to attract competent and skilful researchers in design and manufacturing from all over the world to join AMI on a permanent or temporarily basis.
- S1.2** Conduct innovative, high-quality research in design and manufacturing in collaboration with regional and international research experts and scholars.

Actions:

- A1.2.1** Form pertinent research groups to work in specific design and manufacturing research themes at AMI.

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- A1.2.2** Launch an initial batch of innovative high-edge research projects, which respond to current industry needs and, at the same time, capitalize on the existing research, laboratory and simulation capabilities at AMI.
- A1.2.3** Maintain a minimum number of high-quality publications per year in notable and high-impact journals and proceedings of national, regional, and international conferences on design and manufacturing.
- A1.2.4** Arrange scientific workshops, discussion forums and technical seminars in order to advertise various AMI research products and capabilities.

S1.3 Encourage researchers and graduate students to conduct focused research of high-value in design and manufacturing.

Actions:

- A1.3.1** Establish an incentives and rewards policy to encourage researchers at AMI to conduct high-quality research.

5. AMI STRATEGIC PLAN

- A1.3.2** Create opportunities for graduate students to conduct high-quality research by involving them in international exchange programs as well as industry-supported research projects.
- A1.3.3** Develop means and procedures to assist researchers and graduate students to participate and present technical papers in local, regional, international conferences and forums.
- A1.3.4** Develop means and procedures to assist researchers at AMI to publish in notable international and regional journals.

Goal #2: Fulfill the national industry needs for competent and qualified engineering graduates and researchers in the fields of advanced manufacturing.

Strategies for Goal #2

- S2.1** Provide continual support to undergraduate students in the form of graduate project supervision, education and training in various areas of product design, manufacturing and material processing.

5. AMI STRATEGIC PLAN

Actions:

- A2.1.1** Organize and conduct specialized training courses for University students in the areas of advanced manufacturing technologies and material processing.
- A2.1.2** Develop a series of technology presentation modules aimed at acquainting students with advanced design and manufacturing means and technologies, including virtual-reality simulation modules, reverse engineering practice modules and laboratory assembled components manufacturing products.
- A2.1.3** Propose academic programs, courses and curriculum improvements to promote the areas of product design, manufacturing and material processing.
- A2.1.4** Allocate sufficient financial and technical support to graduation projects of undergraduate students in the areas of product design, manufacturing and material processing.
- A2.1.5** Continue to request and lobby for adequate extra space within KSU to house the Institute's administration.
- A2.1.6** Develop mechanisms to provide opportunities for development of researchers and graduate students through enhancing authorships and translations in related and updated topics in design and manufacturing.
- A2.1.7** Maintain and expand the Institute's web site as an important source of information and a knowledge-sharing platform for professional development of researchers.
- A2.1.8** Conduct regular research for the purpose of identifying existing gaps and potential issues that need to be tackled as well as the existing needs and requirements pertaining for design and manufacturing researcher professional development.

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A2.1.9 Apply a code of ethics and form a sub-committee to monitor work behavior and human ethics at AMI and ensure the highest standards in respecting individual privacy, rights of research subjects, accommodation of workers with special needs as well as equal opportunities for all workers at AMI.

S2.2 Build strong alliance and partnership with graduate students and research staff by contributing to their professional development as well as support of Master and Ph.D. theses pertaining to design and manufacturing.

A2.2.1 Allocate sufficient financial and technical support for Master and Ph.D. theses of the University graduate students in the areas of advanced manufacturing technologies, innovative industrial design techniques and modern material processing methodologies.

A2.2.2 Deliver professional development programs for AMI researchers and graduate students with participation from local and international experts.

Goal #3: Fulfill industry needs of innovative and workable solutions to existing design and manufacturing problems via vigorous outreach collaborative efforts and consultancy services.

5. AMI STRATEGIC PLAN

Strategies for Goal #3

S3.1 Promote collaborative activities and engage in research and development work with the national industrial civilian and military sectors in the area of design and manufacturing.

Actions:

- A3.1.1** Search and compete for obtaining industry-supported projects in design and manufacturing from civilian and military institutions.
- A3.1.2** Conduct regular open-house events to advertise AMI expertise as well as laboratory and simulation capabilities to local industry.
- A3.1.3** Offer the use of AMI laboratory and simulation facilities for testing, characterization and assessment of materials, spare parts and components by local industries subject to appropriate fees.
- A3.1.4** Invite factories and local manufacturing firms – on a regular basis - to try new technologies and enhanced designs developed by AMI prior to full-scale implementation.
- A3.1.5** Advertise AMI design and manufacturing services and capabilities to local industry via regular newsletters, website pages, exhibitions and information bulletins.

5. AMI STRATEGIC PLAN

S3.2 Provide specialized consulting services, technical studies and customized user-oriented training in product design and manufacturing.

Actions:

- A3.2.1** Offer and conduct consultancy and specialized studies and technical support to the industrial sectors in the areas of advanced manufacturing, technologies and material processing.
- A3.2.2** Conduct regular specialized training workshops for industry engineers on new design and manufacturing technologies.
- A3.3.3** Propose and oversee establishment of externally-funded research chairs in design and manufacturing through the Research Chair Program in KSU.

5. AMI STRATEGIC PLAN

5.3 AMI Roadmap

The roadmap for AMI highlights the key activity areas of AMI and maps the key activity areas into the actual business programs and projects in order to maintain an appropriate balance between serving the immediate needs of its end-users and building strong long-term strategic capabilities to further enrich and advance research in product design, manufacturing and material processing.

5.2.1 Activity Areas of AMI

Three key activity areas are identified, which shape the strategic outlook for AMI, namely:

- i)** Innovative research for the development in design and manufacturing, which ultimately advances the cause of attaining excellence in design methodologies and manufacturing technologies. This activity area is executed through either AMI's own initiatives or through its participation in local and international collaborations with leading research experts and scholars.
- ii)** Contributions to professional development, education and training of undergraduate and graduate students as well as AMI researchers in all areas relating to design and manufacturing.
- iii)** Engagement in outreach industrial collaborations and consultation activities in design and manufacturing with both civilian and military sectors.

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The above key activity areas are practiced at AMI through a set of technical and administrative delivery means, which extend beyond academic research and professional development to encompass a framework for communication and partnership with stakeholders and end-users. These product delivery means include:

Technical Products and Deliverables:

1. Intellectual property acquisitions and publication in respected international, regional and local journals
2. Industry supported research projects yielding innovative solutions to practical problems
3. Investigative technical studies in search of new innovative approaches to mitigate existing problems in design and manufacturing
4. Training and education courses of undergraduate students and technology acquaintance sessions
5. Support and supervision of students' graduating projects and theses
6. Technical supervision and financial support of graduate students' theses
7. Consulting services as part of regular partnership and outreach initiatives

5. AMI STRATEGIC PLAN

Policies and Administration:

8. Vigorous recruitment policies to acquire high-caliber and skilful researchers
9. Professional development for AMI staff
10. AMI business operations and administrative support
11. Quality assurance, performance assessment and evaluation

Interaction and Engagement:

12. Participation in local, regional and international conferences in the field
13. Discussion forums, meetings, workshops and symposia
14. Technology importation and knowledge transfer initiatives
15. User satisfaction surveys, fact finding, progress monitoring and information gathering

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The following table defines the interrelationship between key activity areas and product delivery means.

#	Activities Delivery Means	Innovative Research and Development	Training and Professional Development	Engagement in Outreach Activities
1	Intellectual property acquisitions and publication in respected international, regional and local journals	✓		
2	Industry supported research projects yielding innovative solutions to practical problems	✓		✓
3	Investigative technical studies in search of new innovative approaches to mitigate existing problems in design and manufacturing			✓
4	Training and education courses of undergraduate students and technology acquaintance sessions		✓	
5	Support and supervision of students' graduating projects and theses		✓	
6	Technical supervision and financial support of graduate students' theses	✓	✓	
7	Consulting services as part of regular partnership and outreach initiatives			✓
8	Vigorous recruitment policies to acquire high-caliber and skilful researchers	✓		
9	Professional development for AMI staff	✓		
10	AMI business operations and administrative support	✓	✓	✓
11	Quality assurance, performance assessment and evaluation	✓	✓	✓
12	Participation in local, regional and international conferences in the field	✓	✓	
13	Discussion forums, meetings, workshops and symposia	✓	✓	✓
14	Technology importation and knowledge transfer initiatives	✓		✓
15	User satisfaction surveys, fact finding, progress monitoring and information gathering			✓

5. AMI STRATEGIC PLAN

5.2.2 Research and Work Priorities of AMI

During its establishment stage, AMI shall conduct extensive discussions and deliberations with its technical advisors and industry partners in order to establish its research and work priorities. This could be achieved via a dedicated workshop as well as prepared questionnaires to experts, end-users and advisors of AMI. In addition, AMI shall review its work priorities every three years in order to accommodate any occurring changes in the future, especially in view of the current rapid advances in design and manufacturing research and technology.

The detailed scope of individual research projects under each of the established priority areas shall be determined by the appropriate subcommittees as part of developing the Operation Work Plan for the Institute, which spells out the work execution activities of AMI. As part of the Institute's work on these research projects, dedicated research groups are to be formed based on some stringent criteria developed by the Institute in order to ensure the quality of research outcomes and achievement of excellence. In this respect, the main role of AMI is to form the research groups within the Institute, provide the research groups with full-time researchers, assure the participation and recruitment of distinct part-time international researchers, guide and

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facilitate the work of these research groups, assume full control over the research work execution from start to end, and provide consultations and feedback to the researchers until the projects achieve their envisaged goals.

On the other hand, AMI shall also develop the necessary processes and procedures for conducting students' training and supervision as well as the specialized consultancy and technical support services to its industrial stakeholders and end-users.

6. IMPLEMENTATION AND ASSESSMENT

6.1 AMI Strategic Plan Implementation

A detailed Operation Work Plan shall be developed on the basis of the AMI Strategic Plan in order to define the set of actions and activities (with clear milestones, leading responsibilities and target dates) to be undertaken by the Institute over the next three years. In this section of the AMI Strategic Plan, the general implementation and assessment aspects are outlined. The information in this section shall be taken into account as a guideline for developing the detailed AMI Operation Work Plan.

In order to achieve the Institute's outreach objectives, AMI shall undertake appropriate steps toward developing a comprehensive business development and marketing plan for effective publicity and marketing of its products and services relating to design and manufacturing. Recognizing the fact that the design and manufacturing organizations are rare in the region, and that AMI represents a notable research institute for design and manufacturing in the Arab world, huge market share could be captured by AMI for marketing its design and manufacturing products and services in the region.

The management roles and responsibilities as well as the set of bylaws, which govern the Institute's operations shall be detailed in an Institute's Bylaws to be prepared as soon as possible. The following key information and remarks pertain to the management structure of AMI and the associated bylaws and operating procedures:

1. The set of Bylaws, which govern the Institute's operations describe the roles and responsibilities of the Institute's management entities and provide sufficient and clear authority and guidance to the Dean of AMI to effectively implement the plans

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and work programs and minimize inefficiencies and unnecessary delays in work program execution. They also spell out the domain of responsibilities, signing authorities and procedures for delegation of authorities.

2. Consistent with the Institute's basic law and regulations, major decisions concerning the establishment of the Institute's structure and development of its action plans shall be made by the AMI Council, which is required to meet at least twice per year.
3. The Advisory Board of the Institute shall meet at least once per year. Whenever necessary, indirect discussions and video-conference meetings shall be used to ensure continual and effective participation of the Advisory Board members in various debates concerning the Institute's operation and activities. The Advisory Board shall include the Dean of AMI, Dean of College of Engineering, Dean of Prince Sultan Institute of Advanced Technologies, two faculty members from KSU, one member from the Ministry of Commerce and Industry, one member from military sector, and two members from the industry sector.
4. The function of the Dean (full-time) is complemented and supported by three organizational bodies under two Deputy Deans, namely, the Deputy Deanship for Technical Affairs and the Deputy Deanship for Administrative as well as one Department for Business Development.
5. The Scientific Committee shall oversee the general directions for scientific and research activities at the Institute and assure

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the quality of its scientific and research products. The Scientific Committee shall include the AMI Deputy Dean for Technical Affairs, three faculty members from KSU, and three Ph.D. holders from outside KSU,

6. The functional responsibilities of all organizational units under each of the three Deputy Deanships shall be stated clearly and with sufficient details in the Institute's Bylaws and operating procedures.

6.2 Key Performance Indicators

AMI adopts a number of performance assessment criteria (measures of success) and strength measures to evaluate the Institute's performance and ensure that AMI is progressing towards meeting its strategic goals.

6.2.1 Assessment Criteria

- AC1.** Extent to which the Institute is contributing to the development and advancement of design and manufacturing capabilities in the Kingdom.
- AC2.** Extent to which the Institute is contributing to advanced research and development in product design, manufacturing and material processing through solid contributions to international publications in reputable journals,

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- AC3.** Extent to which the Institute is contributing to student education and training in design and manufacturing through training programs, academic courses and graduation project supervisions.
- AC4.** Extent to which the Institute is contributing to the development of design and manufacturing industry in the Kingdom by building effective partnership and offering technical studies and consultancy services to industry partners.
- AC5.** Extent to which the Institute is contributing to the continual process of knowledge transfer and importation of design and manufacturing technology into KSA.
- AC6.** Extent to which the Institute is interacting with leading regional and international institutions and expertise for the purpose of advancing the global state-of-the-art methods and technologies in design and manufacturing.
- AC7.** Extent to which the Institute is promoting its research capabilities in design and manufacturing through participation in local and international conference discussions, forums, workshops and symposia.
- AC8.** Extent to which the Institute is contributing to mitigating existing industry problems in design and manufacturing by offering effective and innovative solutions to various civilian and military sectors.
- AC9.** Extent to which the Institute is guiding and directing local research activities by encouraging researchers and graduate students to create and promote excellence in research and scholarship in design and manufacturing.

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- AC10.** Extent to which the Institute is maintaining a vigorous and continual professional development programs in design and manufacturing for students and researchers.
- AC11.** Extent to which the Institute is maintaining the highest standards in respecting individual privacy, rights of researchers, work and human ethics as well as equal opportunities for all workers.
- AC12.** Extent to which the Institute is maintaining high level of scientific and research skills and productivity of its researchers and graduate students through vigorous recruitment policies to acquire high-caliber and skilful researchers.
- AC13.** The extent to which the Institute is succeeding in marketing its activities and expanding its research outcomes and consultations work with the government and private institutions.
- AC14.** Extent to which the Institute is conducting its business operations and administrative processes in the most efficient and effective manner.
- AC15.** Extent to which the Institute is maintaining stringent procedures for quality assurance, performance assessment and evaluation
- AC16.** Extent to which the Institute is advertising for its achievements and contributions through newsletters, media articles, interview and website announcements.
- AC17.** Extent to which the Institute is monitoring its responsive to its stakeholders and end-users through user satisfaction surveys, fact finding, progress monitoring and information gathering

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6.2.2 Performance Indicators

1. Number of successfully completed research projects and technical studies in design and manufacturing per year.
2. Number of publications per year in respected International refereed journals stemmed from AMI's research work in design and manufacturing.
3. Number of researchers and graduate students participating in International, regional, and local conferences and forums per year.
4. Number of students' graduation projects supervised by the Institute per year.
5. Number of students trained by AMI per year.
6. Number of Master and Ph.D. students supported by AMI per year.
7. Number of graduate students and AMI researchers who receive professional development support and training per year.
8. Number of faculty members and researchers within the Kingdom and abroad who actively used – or benefited from - AMI established system of expertise and technological facilities for design and manufacturing per year.

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9. Number of workshops and seminars conducted by AMI per year in collaboration with national and international experts, practitioners in the field, and stakeholders attached to the field.
10. Absence of incidences of degraded work environment and/or violation of individual privacy, rights of research subjects, work and human ethics.
11. Number of consultancy services conducted by AMI to industrial entities in design and manufacturing per year.
12. Number of AMI patents registered per year.
13. Net AMI revenue from external sources per year.

Figure 6.1 shows an outline of interrelationships between various AMI strategic plan components.

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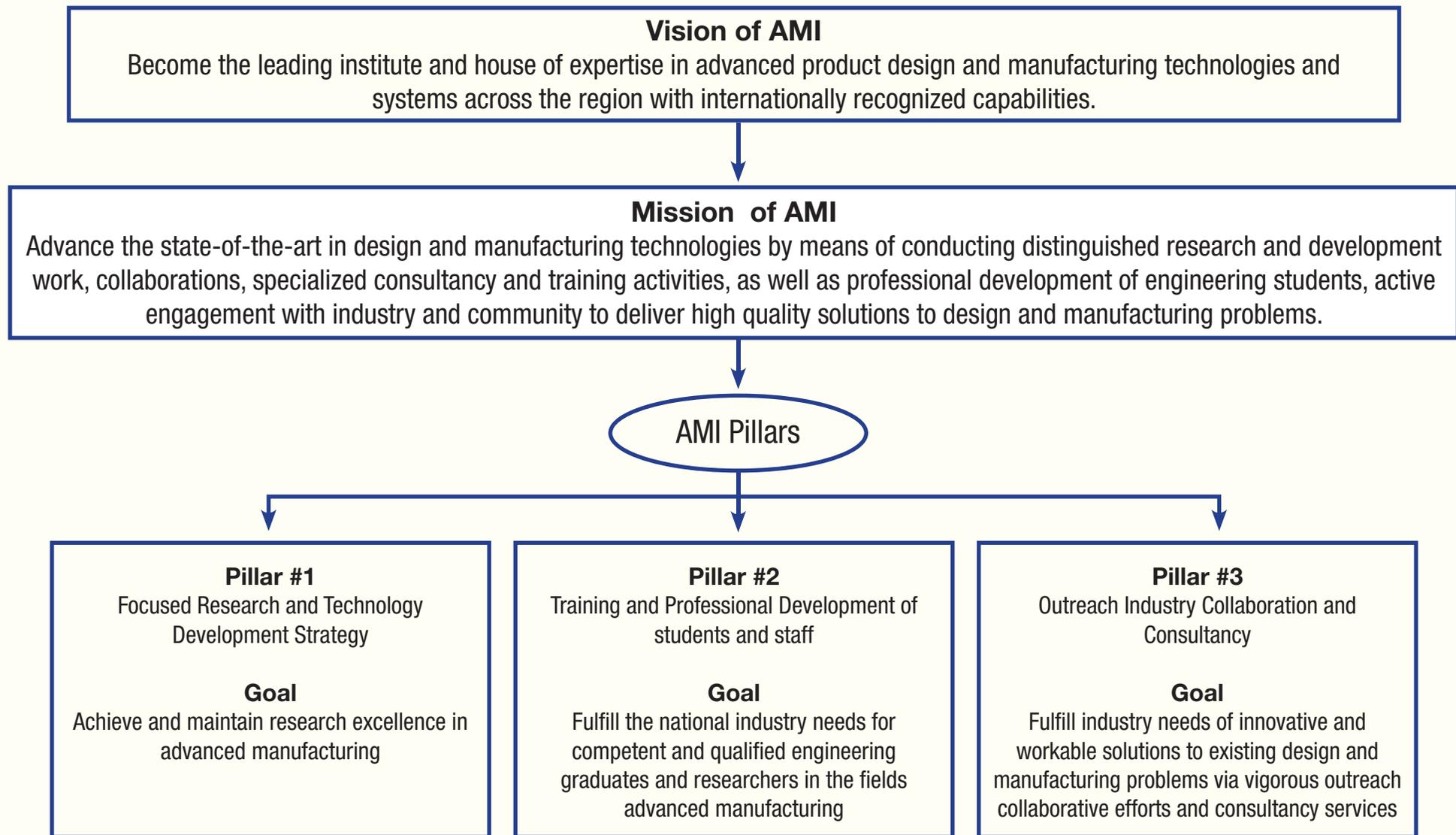


Fig. 6.1a Outline of Interrelationships between AMI Strategic Plan Components

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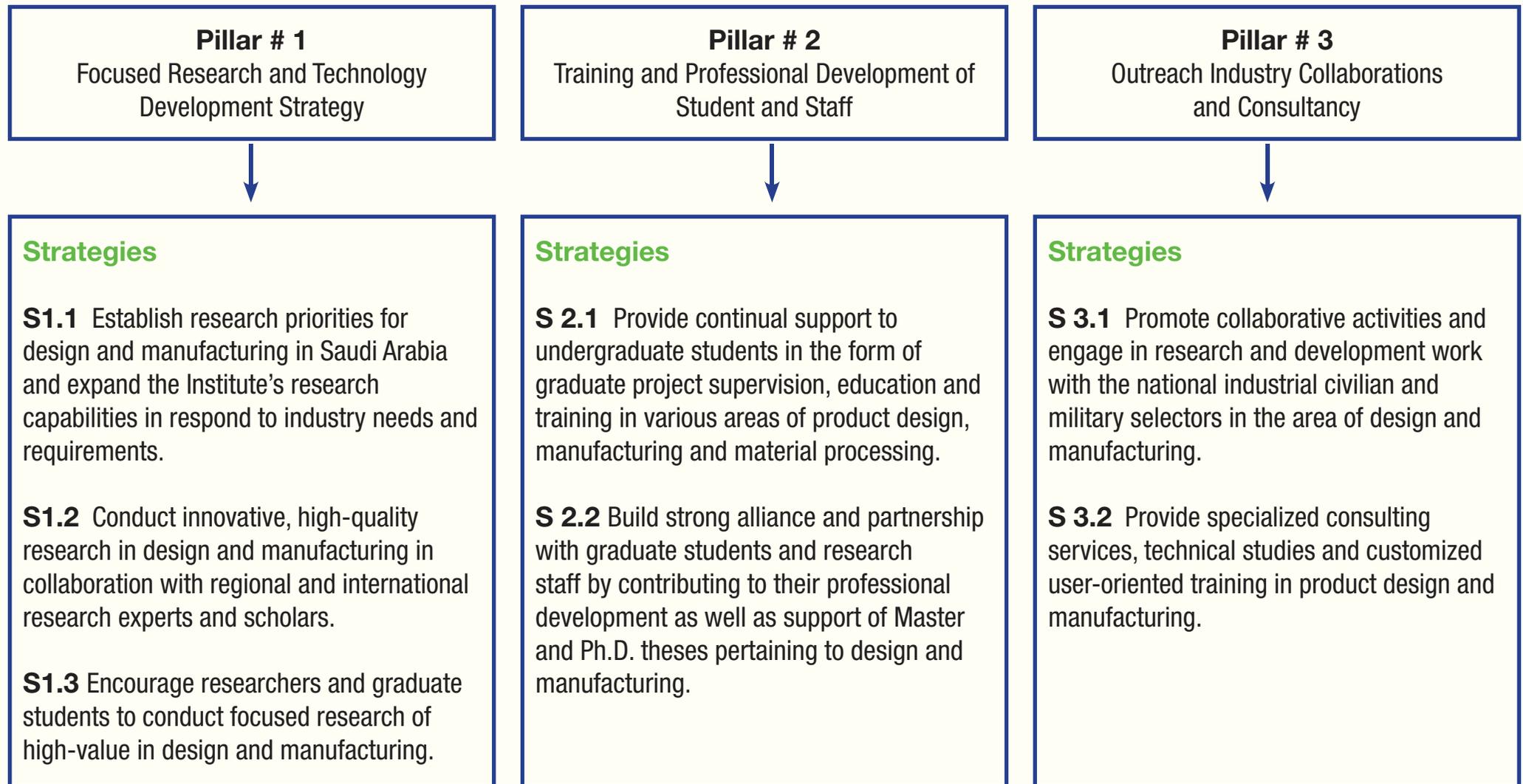


Fig. 6.1b Outline of Interrelationships between AMI Strategic Plan Components

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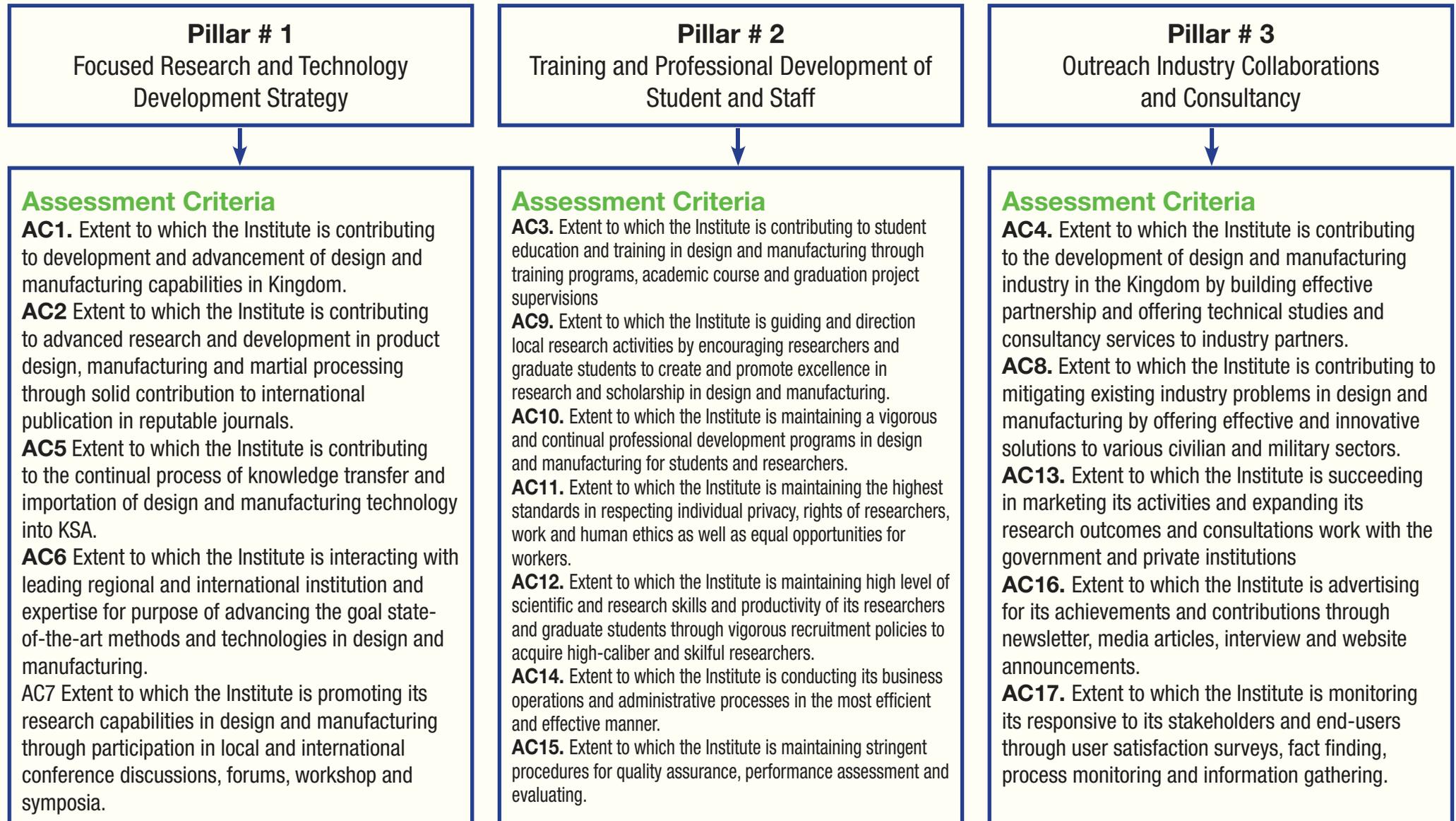


Fig. 6.1c Outline of Interrelationships between AMI Strategic Plan Components

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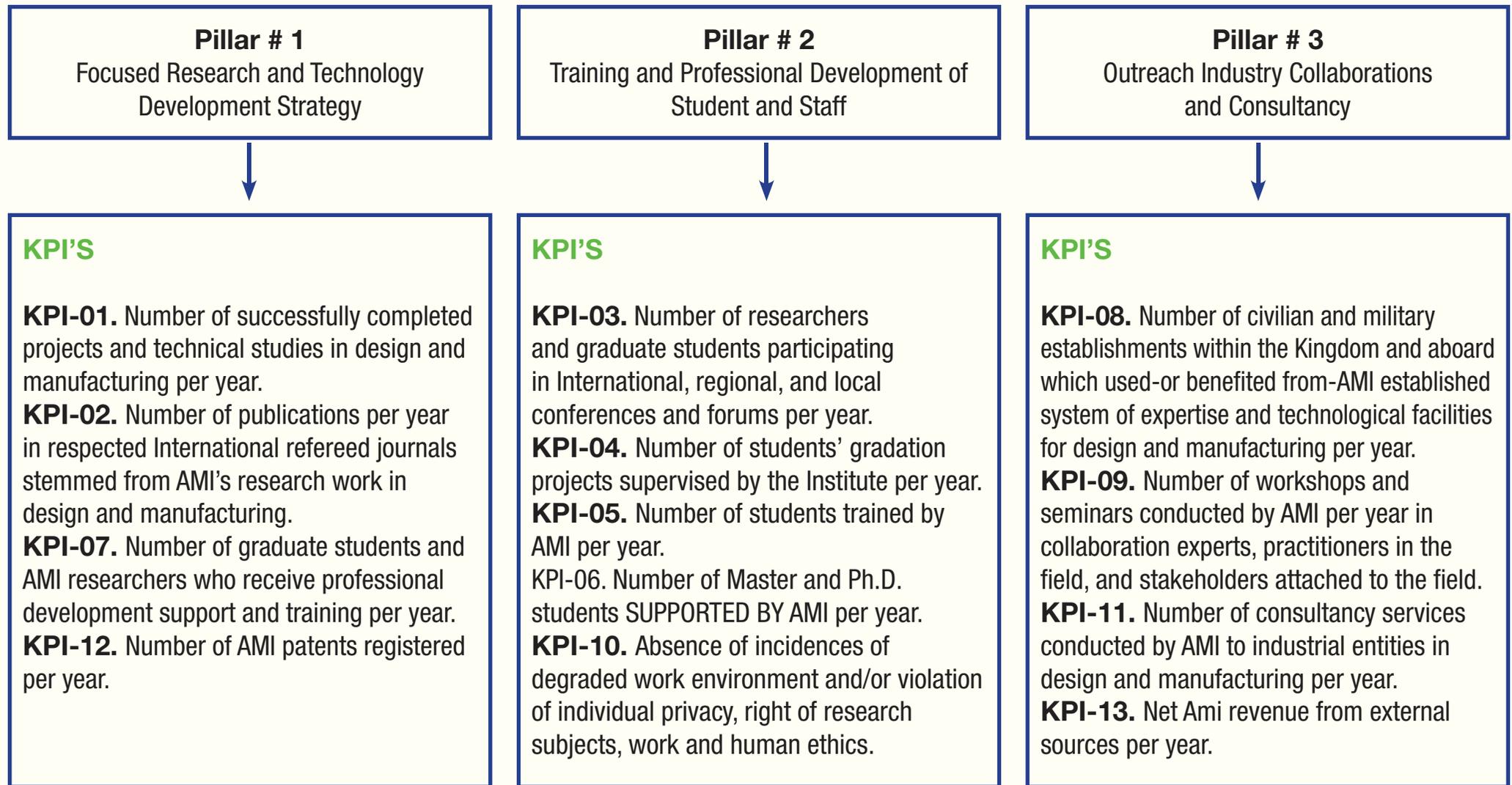


Fig. 6.1d Outline of Interrelationships between AMI Strategic Plan Components

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6.3 Risk Management

The followings table summarizes the perceived risks to the Institute's research, training, outreach and administrative activities. The table also shows the impact and probability of each risk factor as well as the mitigation actions to deal with the identified risks

#	Risk	Impact	Probability	Mitigation actions
R1	Inability to respond promptly to urgent short-notice requests for technical help from local industries.	Medium	Medium	Build sufficient scientific and technological capabilities at AMI and continually monitor industry status and needs in order to accurately anticipate urgent problems requiring fast solutions.
R2	Insufficient funds to cover the institute's program development needs, especially in the initial period before fund-generation initiatives take place.	High	Medium	Aggressively lobby the University for funds to AMI while vigorously exploiting external funding opportunities.
R3	Relative weakness of the academic level of the students who wish to enroll in AMI education and training programs.	Medium	High	Increase the academic standards for students wishing to enroll in AMI activities.
R4	Lack of sufficient in-house expertise and support technologists to provide experimental and simulation hands-on training to students in large numbers.	Medium	Medium	Enhance and expand the AMI in-house training facilities and recruit skillful training staff in design and manufacturing.
R5	Limited number of available high quality students for graduate education, especially in the area of design and manufacturing.	Medium	High	Actively offer Master and Ph.D. topics with high practicality and industry collaboration contents.
R6	Difficulty to recruit high-caliber international scholars in design and manufacturing due to insufficient incentives and complexity of recruitment system at KSU.	Medium	Medium	Continually lobby for simplified recruitment procedures for high-caliber scholars and experts as well as increase compensation packages for special hires.
R7	Loss of productivity of AMI researchers due to restricted access of personnel during off working hours (lack of proper access facilities).	Medium	High	Establish a secured entry access to AMI by researchers in consultation with KSU administration.

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#	Risk	Impact	Probability	Mitigation actions
R8	Insufficient interest in interaction between AMI researchers and faculty with other colleges both within KSU and outside.	Medium	Medium	Organize periodic seminars and interaction forums where scholars from other colleges can meet and interact with AMI staff.
R9	Insufficient interest and skepticism of industry in cooperating with academic institutions.	High	Medium	Strive – especially in the initial operating period of AMI – to engage with industrial establishments and offer workable innovative solutions to their immediate problems in order to gain their trust and long-term partnership.
R10	Reduced effectiveness of graduate program relating to design and manufacturing and limited ability for transfer of knowledge due to the small percentage of non-Saudi graduate students.	Medium	Medium	Lobby for sufficient number of visas and provide incentives for non-Saudi nationals to join graduate studies in AMI research fields as full time students.
R11	Lack of existing programs and strategies to market AMI research ideas and services to industry and public sectors.	High	Low	Develop a coherent Business Development and Marketing Plan for AMI consistent with the directions set in this Strategic Plan.
R12	Relatively limited space allocated to AMI at KSU, which may impede full utilization of the Institute's potential and slow its expansion plans.	Medium	High	Lobby for more space as well as restructure and re-organize the available space allocated for research, laboratory and training activities.
R13	Less than full utilization of AMI lab equipment functions due to difficulties of recruiting proper lab technicians.	Medium	High	Develop active recruitment procedures for AMI lab technicians and operators.
R14	Personnel injury due to unguided machinery operations at AMI labs and/or improper material handling and/or absence - or improper installation - of designated emergency escape routes and signs.	High	Low	Set stringent safety and security standards and requirements as part of the AMI operating procedures and code of conduct.
R15	Unawareness of potential hazards due to lack of proper documentations of lab equipment (manuals, calibrations, and maintenance procedures).	Medium	Low	Allocate a cabinet in each laboratory for instruction manuals and develop information databases containing documentation of all lab equipment at AMI.

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6.4 Change Management Plan

AMI shall manage change during the upcoming period in an orderly and structured manner in order to ensure successful achievement of its strategic objectives and to avoid confusion and disturbance to the on-going research and training activities at the Institute. The Change Management Plan for AMI constitutes two main components as follows:

1) Changes to the Strategic Plan:

Changes to the AMI Strategic Plan itself will not take place during its designated period unless there are essential and valid reasons for the change such as:

- a) Discovery of major new risks that could jeopardize the Institute's ability to achieve its strategic goals and would require devising improved strategies to deal with such risks.
- b) Requirement for major change or shift in the strategic direction of the Institute as directed by the Institute's Council or by KSU top management.
- c) Occurrence of unexpected major problems and/or obstacles that may impede the Institute's ability to proceed with implementing its planned strategies without adjustments to the existing strategies or introduction of new strategic initiatives to deal with – and mitigate – such major problems.

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- d)** Emergence of new important threats and/or windows of opportunities that could merit revision of the SWOT analysis and adjustment of some of AMI strategies.

Changes to the Strategic Plan shall be executed through the following sequence of steps:

- i.** The AMI Dean and Deputy Deans shall meet to discuss and evaluate – in consultation with the AMI Advisory Board - the emerging need for changes to the Strategic Plan.
- ii.** If a particular change to the Strategic Plan is indeed necessary, the AMI Dean shall raise the matter to – and get approval for the changes from – the AMI Council.
- iii.** The AMI Dean shall then submit a request to the University administration (Deanship of Development) detailing the required changes to the Strategic Plan and outlining the reasons for such changes.
- iv.** Following the approval of the University administration, the AMI Dean shall form a team to start the process of revising the Strategic Plan and producing a revised version in accordance with the approved changes.
- v.** The AMI Dean shall then submit the final revised Strategic Plan document to the University administration and obtain a final approval on the revised Strategic Plan.
- vi.** The revised Strategic Plan shall become effective upon final approval by the AMI Council.

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2) Management of Change during upcoming Operation Period of AMI:

In order to achieve the strategic objectives of AMI and to fulfill the required ambitious improvement obligations as stated in the Strategic Plan, the Institute is required to undergo significant structural and operational changes on various research, academic support and administrative fronts. In essence, the Institute recognizes the need to structure and empower its functional business units and have them ready for sustained operations as quickly as possible. In this regard, the Institute intends to manage the required change through four (4) main stages, namely:

1. First, a series of intensive information and awareness campaigns shall be launched within the Institute to bring its researchers and staff “on-board” during the upcoming operation period, which requires strong collaborative efforts by all AMI affiliates. During this stage, the Department of Business Development at AMI shall take the necessary steps to explain and discuss with various AMI business units the nature and extent of changes that would be required as well as the initiatives and projects to be undertaken in the upcoming period of the Institute’s operation in support of the Strategic Plan.
2. The AMI Dean shall then assess (with assistance from the Deputy Deans) the extent of readiness of various AMI business units for inducing the required change. Further iterative discussions with the business units may be necessary to improve the readiness and ability to change within the Institute if needed.

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3. Based on the assessment made in stage (2), the existing strategic initiatives (which are identified in the AMI Work Operation Plan) may be modified (in terms of content and/or priority) and new initiatives may be introduced in order to ensure that the required change is successfully done and to mitigate any “resistance to change” that might emerge during the assessment process. In such cases, the AMI Dean shall seek approval of the AMI Council for any changes and/or addition of strategic initiatives.
4. The process of change within the Institute shall be closely monitored by the Department for Business Development at AMI during the upcoming operation period of the Institute, and periodic status reports in this regard shall be submitted to the AMI Council for review and recommendations for further actions if necessary.

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6.5 Communication Plan

The following table outlines the plan for communicating the Institute's strategic mission and directives across various business units within AMI. The Communication Plan shall be executed and monitored by the Department for Business Development at AMI.

#	Objective	Target / Stakeholders	Purpose	Frequency	Method	Responsible
1	Maintain proper communication among AMI unit heads and with various stockholders	AMI unit heads (groups)	Improve and strengthen internal communication within AMI	weekly	Meetings, emails, and progress reports	Department for Business Development
2	Strengthen communications with students and faculty members	Students, researchers and faculty staff	Improve internal communication channels among students, researchers and faculty members within the Institute	monthly	Newsletters, magazines, AMI website, media-boards, student forums, and student committees	AMI Deputy Deans
3	Improve efficiency and effectiveness of administrative communication processes within the Institute	AMI administration staff, researchers, faculty and students	Reduce paper work and avoid loss of administrative data/information within the Institute	daily	Formal written policies and guidelines, interactive computerized system, and organized database	Department for Business Development

7. CONCLUDING REMARKS

Consistent with King Saud University strategic vision for year 2030, the Advanced Manufacturing Institute (AMI) is set to undertake innovative research, effective student training and mutually rewarding cooperation with its stakeholders and industrial partners. In its strive for excellence, AMI will spare no efforts to achieve its strategic goals and establish itself as an internationally recognized leader in product design, manufacturing and material processing. In order to meet the increased technological challenges and fulfill the growing demand for effective product design and manufacturing solutions, the AMI was established to expand the achieved technical capabilities and technological facilities in order to serve wider domain of industrial clients as well as provide enhanced training, student supervision, and research-based innovative solutions to manufacturing, design and material processing problems.

The Strategic Plan presented in this document sets out the AMI aims and priorities for the period up to 1436 H (2016 G) as the Institute strives toward “Leadership in Design and Manufacturing”. The AMI will continue to carefully coordinate and monitor the implementation of the Plan and ensure full realization of the stated aims. The Strategic Plan 2016 for AMI consists of four main components as outlined in this document. The first component described the Strategic Aspects relating to AMI’s existence and mandate. The second component summarized the main SWOT analysis results, which identifies and assesses AMI Strengths, perceived Weaknesses, existing Opportunities and potential Threats, and defines means and approaches to mitigate the

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weaknesses and threats while exploiting the existing strengths and windows of opportunity. The third component outlined the AMI Goals, the Strategies required to realize such goals and the Actions to be taken as part of executing the identified strategies. In addition, the main elements of AMI Roadmap toward its destiny were also outlined as part of this component. The fourth and final component outlined the main guidelines and elements of the Strategic Plan implementation, including the revised Management Structure of AMI, Key Performance Indicators, Risk Management, Change Management Plan, and AMI Communication Plan.

Because of the wide range and diverse nature of the design and manufacturing research and training related to AMI's general domain of activities, the Institute has recognized from the start that research and technology focus is crucial to its evolution and survival as a leading Institute in product design and manufacturing. Such focus shall be achieved by capitalizing on the existing strengths, building alliances and partnerships with end-users as well as recognizing the potential opportunities in the design and manufacturing research and development, which could promote the Institute's status to an international pioneering level.

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Therefore, in its Strategic Plan, AMI has recognized three pillars, which define its strategic path toward leadership in design and manufacturing, namely:

- 1.** Research and development in design and manufacturing through either AMI's own initiatives or through its participation in local and international research collaborative opportunities. This includes adoption and implementation of distinguished research projects in various disciplines supported by the Institute. It also includes continuous improvement and future expansion of the Institute's research programs and activities in response to new emerging needs in product design, manufacturing and engineering materials.
- 2.** Professional development of students, researchers and technologists in the areas of design, manufacturing and material processing. This includes specialized training of University students in advanced manufacturing, industrial design and material processing, as well as contributions to academic courses, support of graduation projects and graduate theses of University students in the areas of advanced manufacturing, industrial design and material processing.
- 3.** Collaborative and outreach activities in the form of research work and consulting services in product design and manufacturing. This includes consultancy and specialized technical studies, training workshops for industry engineers on new manufacturing technologies as well as technical services to the industrial civilian and military sectors in the form of laboratory testing of industrial products, processing and re-manufacturing of spare parts.

