INNOVATION READINESS ASSESSMENT

IN SELECTED APO MEMBER ECONOMIES

The Asian Productivity Organization (APO) is an intergovernmental organization that promotes productivity as a key enabler for socioeconomic development and organizational and enterprise growth. It promotes productivity improvement tools, techniques, and methodologies; supports the National Productivity Organizations of its members; conducts research on productivity trends; and disseminates productivity information, analyses, and data. The APO was established in 1961 and comprises 21 members.

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Bangladesh, Cambodia, Republic of China, Fiji, Hong Kong, India, Indonesia, Islamic Republic of Iran, Japan, Republic of Korea, Lao PDR, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Turkiye, and Vietnam.

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FOREWORD

With the advent of digital technologies, the drivers of productivity and competitiveness have shifted from efficiency and quality to innovation and entrepreneurship. For businesses and industries, innovation can relate to products, services, processes, tools and technologies, management methods, and business models. With rapidly shortening product life cycles, proactively encouraging, achieving, and managing innovation have become indispensable steps for sustained productivity enhancement. Innovation management is an important area that includes aspects such as organization, processes, strategies, and evaluation. Collaborations between individuals and teams is essential for organizations to succeed in innovation.

The COVID-19 pandemic has been the most difficult, challenging event in many people's lifetimes, leaving them struggling for food, jobs, and even safe air to breathe. At the same time, it has also offered opportunities in the form of innovations required to fight the pandemic, ranging from radical changes in products/processes/services to technological innovations. Many organizations committed to continuous improvement and found that the pandemic provided the right match between products/services and the market. Implementing innovation management activities is a new way for enterprises to achieve strategic goals, ensuring long-term prosperity. By applying the ISO 56000 Innovation Management System, enterprises can more easily adapt to changes in the environment, which is also a decisive factor in their global success.

The APO conducted research to examine innovation management capabilities in the selected member economies of Cambodia, the Republic of China, India, Indonesia, IR Iran, Pakistan, the Philippines, Singapore, Thailand, and Vietnam and analyzed their status and challenges. Based on that research, this publication recommends models and best practices for implementing, scaling up, improving, and evaluating innovation management systems at the organizational level and contributes to the strategic objective of promoting robust innovation ecosystems under the APO Vision 2025.

The efforts of the team of experts who conducted the research and wrote this publication are very much appreciated. The APO expects that the Innovation Readiness Assessment in Selected APO Member Economies will serve as a useful guide for readers in member economies and elsewhere to align with the latest innovation management standards and enhance their innovation-led productivity growth.

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Secretary-General
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Tokyo

ACKNOWLEDGMENT

Digital technologies advancement is transforming our society in a range of ways, bringing new opportunities and challenges for firms operating in this dynamic setting. This rapid technological advancement with digitalization is also changing the pace of innovation among businesses. It is unavoidable and inevitable now for enterprises to revisit assumptions relating to process, people, culture, systems, and technology to keep up with such a turbulent environment.

Innovation management is a relatively new field compared to other management areas such as quality management, which has established well-known methods and tools for organizations to effectively manage the quality of their output. Though knowledge on innovation management has increased in recent years, the field has not fully benefited from research because much of the work is limited and incomplete.

The Asian Productivity Organization (APO) held a kick-off meeting on the Research on Need Assessment on Innovation Management with the participation of leading industry experts from 10 member economies on 5 November 2021, in line with Vietnam's proposed initiative as the APO President for the 2020–21 term.

On the Vietnamese side, the Head of the Research Project (Chief Expert), Dr. Ha Minh Hiep, Acting General Director of the Directorate for Standards, Metrology and Quality gave an orientation presentation on the organization of the research. National experts came from 10 member economies.

The objective of the research project include; i) identifying the key needs and drivers for productivity growth in APO member economies through innovation management; ii) assessment of the current status of the application of Innovation Management System (ISO 56000) in APO member economies; and iii) support to promote the adoption of innovation management systems in member economies.

The survival of enterprises depends heavily on their ability to innovate. As the world becomes increasingly global and the development of new technologies is accelerating, the ability to innovate effectively will be more important in the future. However, innovation management can be difficult, and many managers feel frustrated that there is no clear method for doing so. The purpose of this study is to investigate the current state of innovation management of some enterprises in APO member economies and identify the main factors that affect innovation management in businesses. The reality of innovation management was analyzed through a survey on innovation management in businesses based on dimensions specified in the innovation management standard ISO 56002.

The result from the survey also confirms the importance of ISO 56002 in making accurate measurements when evaluating innovation. If respondents received the same reference value, as given in the question related to ISO 56002, the task of accurately assessing the current level of their business

would be much easier. This also reduces potential cognitive differences between respondents and researchers, allowing the researchers to interpret and analyze the results better. Using similar standards, enterprises can easily compare and learn from each other when applying the same innovation management assessment principle according to ISO 56002.

This research not only contributes insights into the academic field of innovation management but also to enterprises inside and outside of research. Since the innovation management approaches of enterprises are described in the study, enterprises can evaluate and draw inspiration from the cases described. These showcased practices are also supplemented with opinions and advice from business respondents, who have years of experience in different activities in innovation.

This initiative that has resulted in producing this publication owes its thanks to each and every organization and individuals who have participated with interest, knowledge, and expertise. Without them, this project would not have been possible.

EXECUTIVE SUMMARY

Innovation is a widely used term. It has been defined in various ways in the past decades, depending on the topic being discussed. From a technology perspective, innovation is the engineering, design, production, management, and commercial activities involved in the marketing of a new (or improved) process or device. From a process perspective, innovation is the introduction of a new product, process, or service into the market.

Innovation is not and should not be limited to product innovation. This is something enterprises are aware of but it leads to uncertainty because of the limited innovation resources in enterprises. Enterprises trying to use old structures and methods for product innovation will lead to a high chance of failure. Instead, a successful innovation management system should focus on all areas of enterprises and be systematically built to increase enterprises' likelihood of exponential success [1].

Innovation management is an important area that includes various aspects, such as organization, process, strategy, and evaluation. A collaboration between individuals and teams with deep expertise is essential for organizations to succeed in innovation. Such collaboration requires coordination, which poses a challenge for managers. These challenges are exacerbated by the increased pace of enterprises and the need for organizations to become faster and more agile, which has been covered in various literature over the past 20 years.

There are different reasons for enterprises to innovate. These can include increasing revenue, organizational growth, reducing waste, and creating additional value for stakeholders, among others. To seize these opportunities, enterprises use a variety of tools. However, the potential success may not only lie in tools alone, but also in the capabilities, approaches, directions, organizational structures, metrics, senior management commitment, and processes. Some researchers argue that a systematic approach to innovation management can, among other things, guide the organization to better identify innovation capacity gaps by evaluating innovation performance in different fields.

With the beginning of the fourth industrial revolution (IR 4.0), the orientation to improve productivity and competitiveness has shifted from production and business efficiency and quality to innovation and creative spirit. In businesses, innovation can be made to products, services, processes, equipment and technologies, management methods, business models, and virtually all aspects of production activities.

Innovation adoption can be small, disruptive, or radical. With product life cycles (PLC) getting increasingly shorter and business environments constantly evolving, innovation management has become integral to sustained productivity growth.

Pursuing innovation can be challenging without clear guidelines and standards. To support organizations to systematically promote innovation, the International Organization for Standardization (ISO) has since 2019, issued several standards related to innovation management, such as terminology, tools, and methods. These standards, among others, include providing a vocabulary base, basic concepts, principles of innovation management, and an approach to systematically implement innovation management. The ISO 56000 family of standards is a set of standard operating procedures designed to provide a common framework for all organizations, regardless of type, industry, region, maturity level, or size, to successfully implement, maintain, and carry out continuous improvement of the innovation management system.

The ISO 56000 standards are particularly useful to small and medium-sized enterprises (SMEs), which often lack the technological know-how, governance methods, and resources to carry out innovative activities. General guidance is also provided for all types of innovation such as in products, services, processes, business models, and methods. ISO 56000 allows for combination with management systems according to different ISO standards, such as ISO 9000 series of quality management systems or ISO 14000 of environmental management systems, etc.

The ISO 56000 series of standards was designed and drafted by the International Organization for Standardization - an international standard-setting body made up of representatives from national standards organizations. This organization sets industry and trade standards worldwide. Early access to ISO 56000 is an opportunity to create a first-mover advantage to make innovation management a core competency of an organization. Flexibility can be applied by organizations to support their innovative initiatives and goals while improving their management systems.

ISO 56000 provides all the information business leaders need to create an innovation system in their organizations. Planbox, a software used in innovation management platform which is commonly used by the industry, highlights that to achieve innovation management goals, businesses need to analyze their core competencies in the following five areas:

- **Strategy** - How do the missions align with the innovation goals of a business? How will projects support and nurture innovative ideas? Companies need a clear and specific strategy for innovation management.

- **Culture** - How does innovation play a role in the day-to-day works of a business? Is innovation part of a company's culture? Or just a fleeting thought?

- **Process** - Businesses need multiple assessments of their success to develop their innovation management strategies. Innovation should not be nurtured only at the brainstorming stage but throughout the design and development process right to the product launch.

- **Tools and techniques** - Businesses also need to use the right tools and techniques (and best practices) when managing innovation.

- **Metrics** - How will the organization measure and track its innovation management strategies? What KPIs will they use? What knowledge will be created?

ISO 56000 creates a single source of information for innovation management and helps organizations realize their innovation goals. However, as with other ISO standards, businesses need to take a proactive approach and find solutions that automatically execute their innovation strategies, whether that be governance, monitoring, management, or reporting.

CHAPTER 1

INTRODUCTION OF INNOVATION AND INNOVATION MANAGEMENT

The ISO Technical Committee TC279 developed a new set of guidance documents on Innovation Management Systems (IMS) with the participation and contribution of more than 40 countries in the development of the standard. The IMS is a new, standardized, and applied approach to innovation management guidance with terminology, tools, methods, and guidelines for managing interactions between partners, intellectual properties, strategies, and ideas. Implementing IMS standards enables businesses to position and sustainably support successful innovation, through leadership development, design compliance, and best practices. IMS consists of seven groups of standards with eight principles of innovation management to help businesses reap benefits from innovation activities. The application and implementation of IMS in enterprises depend on a certain degree of adaptation of the enterprise. Different businesses will have different levels of innovation, based on their organization and approaches. This poses a challenge to the successful adoption of a standardized system for enterprise innovation.

Rapid changes in the production and business environment and globalization have had a strong impact on the development of enterprises. Along with that comes the emergence of new technologies, new competitors, new legal prerequisites, and more stringent requirements for customers and consumers. In this environment, the ability to innovate is a critical and necessary success factor for most businesses. Enterprises introduce new products, services, processes, models, methods, or other types of innovation to create the most optimal values for the business. Innovation can help businesses increase revenue and profits, reduce costs, increase satisfaction, and meet the needs of customers and consumers. It also helps businesses gain new competitive edge, create new markets, attract sponsors from partners, use resources efficiently, reduce waste, and improve business reputation. Therefore, implementing innovative activities is the new way for an enterprise to effectively implement its strategic goals, ensuring its long-term prosperous existence in the future [2].

ISO 56000 SERIES

The benefit of an organization using the ISO 56000 series is to give customers, business partners, funders, and/or academia the confidence that an organization can consistently deliver innovation. A system is "a set of interrelated and interacting elements" and the elements are people, processes, and technology. W. Edwards Deming showed that 90% of the problems in a process are result of the system in which the process operates. In 1996, the environmental standard ISO 14001 introduced the first widely used ISO management system based on a plan, do, check, act (PDCA) cycle, and in 2000, ISO 9001 morphed from a product standard to a management system and standard, adhering to the PDCA cycle.

The new set of ISO 56000 guidelines for innovation management was developed by innovation experts from around the world. The standard provides information on the management of innovation activities in organizations and enterprises of all types (including SMEs) systematically and comprehensively. Organizations and businesses actively manage the innovation activities mentioned in the ISO 56000 series of standards to address customer needs, thereby promoting the sustainable growth of the business.

Innovation describes the development and change within enterprises (organization and operation), in addition to other activities, such as general improvement, sales, marketing, communication, cooperation, restructuring, new establishment, merger, and dissolution of member units. Possible innovations encompass:

- In all business organizations and processes (including strategy, sales, marketing, R&D, sourcing, service, support, and other activities)
- Between enterprises in the value chain (including suppliers, distributors, manufacturers, transporters, partners, customers, consumers)
- During all stages of the PLC (including research, design, production, distribution, marketing, support, maintenance, recall, recycling)

Targeted innovation activities serve different purposes in the overall strategy of an enterprise. The pursuit of innovation is a series of experimental activities in discovering new activities, thus characterized by "uncertainty" and different from other activities and processes of the enterprise. In addition, innovation activities are determined based on the needs, opportunities, challenges, or issues related to the service that stakeholders, trends, and other changes required by the market, schools, and customers. Innovation activities are challenged by the existing culture of the enterprise, facing "antagonism and inertia" from the current habits of the enterprise. Specific analysis of these factors helps enterprises clearly define the scope and method of managing innovation activities, building an innovation management system in the enterprise.

ISO 56000:2020 Innovation Management - Fundamentals and Vocabulary

The ISO 56000:2020 standard defines the vocabulary and terms used uniformly in innovation management. It also explains the core principles of innovation that helps organizations and businesses establish a common, consistent, and unified framework in:

- Understanding key concepts, principles, terms, and definitions of innovation management
- Supporting organizations and enterprises to set up, implement, maintain, and continuously improve IMS
- Enhancing and facilitating in raising awareness and promoting communication on innovation activities within and between organizations and businesses

The ISO 56000:2020 standard provides the basic concepts and principles of innovation management; describes why organizations and businesses should engage in innovation activities; introduce key concepts related to innovation; provides principles and foundations for effective management of innovation activities; and is the foundation of IMS in organizations and businesses.

ISO 56002:2019 Innovation Management System

The ISO 56002:2019 standard guides in setting up, implementing, maintaining, and continuously improving IMS for adoption in all organizations.

This general guideline is designed to be applied to all types of organizations and businesses with all types of innovation, for example in products, services, processes, business models, and organizations.

An organization or business can innovate effectively. Specifically, innovation is more effective if all other interactive elements are managed as a system. IMS guides organizations and businesses, especially SMEs, to define their vision, strategy, policy, and innovation goals. Simultaneously, it also establishes process support needed to achieve the desired results.

The potential benefits of implementing an IMS, according to IS0 56002:2019 include:

- Growth, increase in revenue, profit, and competitiveness
- Reduce costs and waste, increase productivity, and more efficient use of resources
- Increase the satisfaction of consumers, customers, and citizens as well as social benefits
- Making investments and sustainable innovation
- Strengthening decentralization and empowerment in enterprises
- Increase the ability to attract sponsors, partners, and collaborators
- Enhance the reputation and value of the business
- Strengthen capacity to comply with regulations and requirements

IS0 56002 is based on innovation management principles. These principles include basic perspectives; the reason the principle is important to the organization or business; benefits related to the principles, and ultimately, the organization's action plan to improve performance when applying these principles.

The following principles are the foundation of the IMS - realizing value; the future vision of the leader; strategic direction; culture; overall operations; risk management; adaptability; systems approach.

ISO 56003:2019 Innovation Management - Tools and Methods for Innovation Partnerships

The ISO 56003:2019 standard provides recommendations for entering into partnerships with external organizations to realize innovation. It describes an innovation collaboration framework and its corresponding tools to help organizations and businesses in considering some of the following issues:

- Decision on participating in innovation cooperation
- Identify, evaluate, and select partners
- Perception of the value and challenges of partnerships
- Managing partner relationships

Innovation partnerships are developed to create value for each partner when collaborating and working together. The benefits of innovation partnership include:

- Update knowledge, skills, technology, and other intellectual assets that are not available in the organization or business
- Increased use of resources and infrastructure, such as laboratories and testing equipment, to develop or improve new products and services

The ISO 56003:2019 standard guides the types of partnerships and cooperation applicable to all organizations and businesses of different types, sizes, products, and services.

ISO/TR 56004 Assessment of Innovation Management

The ISO/TR 56004 standard looks into innovation management assessment (IMA); expected results from IMA; action plan, and ways to implement the results of the IMA.

The standard aims to help organizations and businesses in understanding the:

- Values and benefits of implementing IMA
- Principles of IMA implementation methodically and synchronously
- Different approaches to IMA in organizations and businesses
- Implementation process and impact of IMA on organizations and businesses
- Potential for improvement for IMA

The ISO/TR 56004 standard used to assess all types of organizations and businesses, regardless of industry, age, size, and country.

ISO/DIS Standard 56005 Innovation Management - Intellectual Property Management

Effective management of intellectual property (IP) is key to supporting the innovation process. IP management plays a necessary role in the sustainable development of organizations and businesses while also acting as one of the competitive drivers. IP management is becoming increasingly important globally in today's knowledge-based economy - not only for large organizations but also for start-ups and SMEs. This is attributed to IP management that captures the benefits of innovation.

ISO/DIS 56005 recommends guidelines for effective IP management in an IMS. This standard is intended to address issues related to IP management at both strategic and practical implementation levels, as highlighted in the following:

- Develop and implement an IP strategy to support innovation in an organization or business
- Establish IP management in the innovation process of organizations and businesses
- Apply IP management tools and methods in the innovation process

This standard applies to all types of innovative activities.

ISO/CD Standard 56006 Innovation Management - Smart Strategic Management

Intelligence is an important role that helps organizations determine their ability to respond to changes in the external environment. Smart strategic management supports risk reduction and is also a factor in promoting strategic growth for organizations and businesses.

ISO/CD 56006 guides leaders and senior management on ways to implement intelligent strategic management in making decisions that impact vision, mission, and innovation activities. Smart strategic management is part of IMS.

The ISO 56006/CD standard helps organizations and businesses in:

- Providing methods for obtaining information from internal and external sources or collaborate with stakeholders in the use of relevant tools and methods (e.g., data mining, analytics, prediction, etc.)
- Define activities to acquire, collect, interpret, analyze, evaluate, apply, and disseminate data, information, and knowledge needed by decision-makers and stakeholders
- Consider the needs and factors promoting innovation activities, such as legal requirements, international standards, and innovation ecosystem

General guidance in ISO/CD 56006 can be applied to all organizations and businesses interested in establishing an internal culture of intelligent strategic management, which requires planning, implementation, measurement, and continuous improvement that can be applied to all types of organizations and businesses, immaterial of industry, age, size, or country.

ISO/AWI Standard 56007 Innovation Management - Idea Management

The basic foundation of innovation is the creation, selection, and development of new ideas. New ideas help make improvements to increase the efficiency of an organization or business, thereby promoting a reevaluation of the organization's entire business model.

The ISO/AWI 56007 standard provides guidelines for managing ideas and delivering benefits that aim to address idea management at both strategic and practical levels through:

- Culture and leadership of an organization or business
- Opportunity and risk management
- Problem-solving
- Tools and methods to manage ideas and creativity

ISO/AWI 56007 standard applies to all organizations and businesses regardless of size and activity. It supports more effective IMS-building for organizations and enterprises, according to ISO 56002:2019 Innovation Management System.

Innovation Management Principles

The principles are the foundation of IMS and serve as a transition between the fundamental concepts in ISO 56000 and the system described in ISO 56002.

The principles are:

- Realization of value
- Future-focused leaders
- Strategic direction
- Culture
- Exploiting insights
- Managing uncertainty
- Adaptability
- Systems approach

The above principles are “open principles” that are integrated and regulated in the enterprise.

IMS consists of a collection of interrelated and interacting elements, aimed at realizing value in the enterprise. The IMS forms the basis for implementing innovation activities and evaluating the performance and outcomes of the innovation system. The elements of IMS are applied and implemented according to a roadmap suitable to the specific context and conditions of the business.

The effective implementation of the IMS is based on a strong commitment from the top management to promote innovation capabilities and a culture of supporting innovation activities in the enterprise.

The PDCA cycle enables continuous improvement of the IMS to assist businesses in identifying and managing opportunities and risks with innovative initiatives and processes.

Innovation is targeted at helping businesses deal with high volatility and risk management problems, especially in the early stages of innovation. During the deep stage of innovation activities, along with successes, the uncertainties and risks in innovation activities in enterprises will gradually decrease.

Further, innovation initiatives are also "risky", meaning that not all initiatives lead to innovation. However, the disruption or failure of an innovation initiative will become the “input” for innovations in the future.

Risk levels of innovation activities depend on the innovation “ambition”, the type of innovation, and the ability to carry out innovative activities of the enterprise. Innovation risks will be managed by different methods, such as knowledge enhancement, internal or external cooperation, and portfolio diversification (where risk levels are clarified).

Innovation can be managed through a process that includes identifying opportunities, creating, validating, developing, and implementing solutions. The innovation process is flexible, adapting to the innovative types of enterprises.

Depending on the top management, capacity, and culture of the enterprise, the enterprise can build a separate management system to manage innovation activities. IMS implementation will help businesses manage uncertainties and risks more effectively by establishing assumptions and organizational models of the business.

Innovation management applies to:

- Enterprises to develop the ability to effectively manage innovation activities to achieve desired results
- Customers to find the innovation ability of a business
- Stakeholders to improve communication through a common understanding of IMS
- Provider of training, consulting, and innovation assessment activities
- Policymakers to develop programs to support the innovation of enterprises

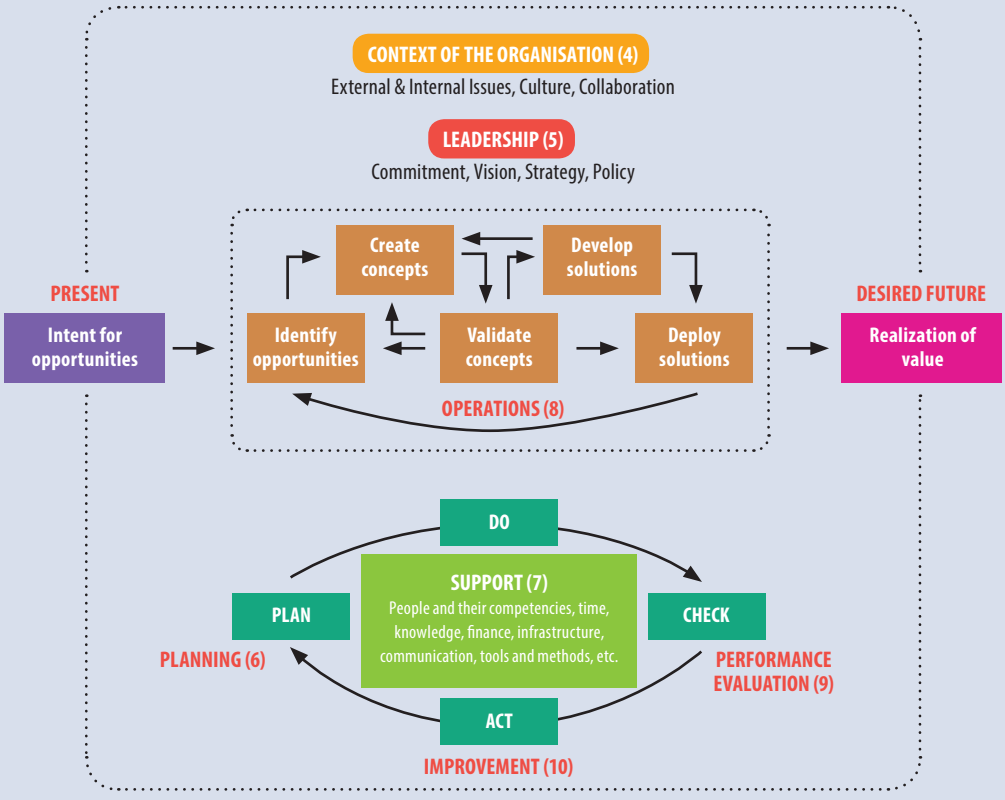
Innovation management applies to all types of businesses of different sizes and sectors (especially start-ups); applicable to all types of innovations (such as innovation of products, services, processes, models, and methods); and applicable to all kinds of methods (such as internal innovation, user-oriented innovation, and market).

ISO 56002

When ISO 9001:2000 was published in 2000, it was a compromise in addressing both quality assurance (QA) and quality management (QM), and many countries stayed in the old world of QA. Post-2000, the

FIGURE 1.1

INNOVATION MANAGEMENT MODEL ACCORDING TO ISO 56002



ISO Central Secretariat created a task group to develop a common, high-level structure for all management system standards. This group comprised representatives from all the major ISO technical committees. The result was a consensus on a common structure for management system standards (MSSs). Early users were ISO 27001 on information security and ISO 39001 on traffic safety. ISO 9001 adopted the structure in 2015, and the new ISO 56002 on innovation management is written with this same structure. ISO 56002 was preparing the business sector for ISO 56001, which will be the requirements standard (Figure 1.1).

Part 1 of the standard is on the scope it covers. In ISO MSSs, this explains that the standard is not prescriptive and can be applied to any organization. Part 2 is normative references, which indicate other standards that are essential to using this standard. Part 3 is terms and definitions. The terms and definitions used in ISO 56002 are available in ISO 56000 [3].

Part 4 - Context of the Organization

A business is not an island, and it interacts with many outside forces that affect the strategy of the business. Part 4 looks into identifying the external and internal issues that affect an organization. The risks related to these issues will be evaluated in Part 6. These are the first steps taken in both quality and innovation strategies that demonstrate ways the ISO 56002:2019 structure is integrated with ISO 9001:2015 [3].

Businesses may have initially conducted a SWOT (strengths, weaknesses, opportunities, and threats) analysis and if they have then the ISO 9001 quality management system (QMS), the focus was probably on the weaknesses and threats that identify risks. Opportunities and threats are the drivers for innovation.

The strategic challenges identified in Part 4 provide the fuel for the organization's innovation engine. Which products are declining? Which customers are going quiet? Opportunities arise when identifying needs that are not being previously met. Innovation addresses those unmet needs and is critical for future competitive edge in the market.

Part 5 - Leadership

The innovation principles in ISO 56000 speak of the need for leaders who have curiosity, are courageous, and look to the future. Leaders will certainly be responsible for developing a culture of innovation and developing a strategy. Businesses will also want to build innovation into their policy or mission [3].

Clause 5.3 addresses roles and responsibilities, which are often skipped through and seen as a "given" in ISO 9001. Businesses will need a champion, and if innovation is something that's new, change agents and a change of plan may be needed.

Part 6 - Planning

In Clauses 6.1 and 6.2, the risks that come with opportunities and set innovation objectives are addressed [3]. The output derived from 6.2 will be the innovation plan in which businesses identify whether to focus on their product, process, or business model. In Clause 6.3 on Structure, businesses will reflect on ways to structure innovation into the organization while Clause 6.4 is where the innovation portfolio is initiated. The portfolio will be further analyzed in Part 8 - Operation.

Part 7 - Support

Part 7 provides everything needed to enable innovation. Businesses are used to managing the resources of time, money, and people, but may be unaware on how to manage knowledge, which is the lifeblood of innovation. Knowledge is a short clause in ISO 9001, but receives more in-depth attention in ISO 56002. Linking closely to this is the need to have an IT infrastructure that enables the management of knowledge [3].

Clause 7.2 is Competence, where while many human resource functions have included innovation in their list of competencies for performance assessment but are unclear on what exactly they are. In reality, they list out creativity, which is only one of the competencies in innovation. This clause provides the details on the competencies required. Awareness is encompassed in Clause 7.3 that engages people while Communication in 7.4 provides the framework for delivering information.

Clause 7.5 details on documentation. Although the most frequently used management system standards (MSSs) do not require a manual, most organizations are continuing to use one, and this is where businesses can capture their innovation practices, as many will be new.

Clause 7.6 is Tools and Methods while 7.7 encompass Strategic intelligence that feeds the knowledge base. New products and services will have intellectual property (IP) related to them, and this will need protecting. IP is Clause 7.8.

Part 8 - Operation

It is important to initiate change by getting an early win, and businesses and enterprises can achieve that in Part 8 by using their innovation process. This is the heart of an organization's IMS. It is important to start drafting strategies and planning the culture change. Businesses will gain insights on innovation during the process and be aware to not fall into the trap of being overambitious and settle on a product that is fading or a process that is failing [3].

The standard explains "innovation initiatives" in clauses 8.1 and 8.2. It is recommended that businesses and enterprises have just one initiative while the innovation process is made into a prototype. Clause 8.2 on managing innovation initiatives provides a comprehensive checklist of what to consider as plans and initiatives.

Clause 8.3 provides the process elements, and it is very similar to the model used by the writer for many years. The main difference from the "project perspective" is that the writer's model sees the innovation process as a continual cycle rather than a linear process that starts and stops. It is similar to the PDCA model.

- **Opportunity** - The innovation process begins in clause 8.3.2 by identifying opportunities. If a business chooses to work on process innovation, it will probably start with a walkabout to understand what is happening or not happening in the process. If it is a product the business is trying to innovate, one will speak with the customer and ask questions, such as "Where do you waste time?" or "What are the biggest hassles?".

- **Create concept solution** - Techniques, such as creative problem solving, often called "ideation," are used to find concept solutions. This is where divergent thinking creates radical new solutions and creative problem solving discovers an entirely new product or process. Albert Einstein famously said, "No problem can be solved with the same level of consciousness that created it." This is where "stepping out of the box" ideology comes in.

- **Validate concepts** - The innovator's maxim is "fail early and fail fast," and this happens before incurring significant costs. Time, cost, and risk data are analyzed, and tested whether the solution can be copied. At this point, businesses may choose to protect the IP they have created. One famous example is Zappos. The founder photographed shoes in a store, posted the photos on his website, and when he got online orders, he bought the shoes from the store and shipped them to the customer. He was testing his innovative business model with almost no cost.

- **Develop working solutions** - Ease of use and the emotion of user experience are the maxims here. A business develops its validated solution by working closely with its target customers and evaluate their emotional reaction. PepsiCo paid a lot of attention to user emotion. Mountain Dew Kickstart, which has more juice and fewer calories, comes in a slim can, conveying intuitively "slim." Too often, developers try to add their pet ideas instead of going back to the user needs collected in the opportunity step. This is where business partner relationships are solidified. Clauses 8.3.4 and 8.3.5 in ISO 56002 will have significant alignment with Clause 8.3 in ISO 9001:2015.

- **Deploy solutions** - It would be apt to name this part as "deliver solutions". Features are switched into benefits at this point by using the value proposition. Downstream risks, such as the user budget cycle, need to be addressed. Adoption rates and feedback are monitored, and the solution is continuously improved with new knowledge. When the 4-inch Galaxy S phone and 9-inch Galaxy Tablet were introduced, Samsung noticed the wide use of wallet-size notepads in conjunction with its phones. As a result, it developed a 5-inch "phablet" with a pen interface called the Galaxy Note. Samsung is perpetually learning. When businesses become successful, they look at scalability issues.

Part 9 - Performance Evaluation

Metrics matter and they can be different in the early creative steps of innovation. The metrics may be binary by simply saying "go" or "no go." First, at the creative end of the innovation process, softer issues are measured, such as the number of ideas created. Then the speed of development is measured and, finally, at the output to measure results too. Part 9 also includes the internal audit of the IMS, called "self-assessment." Both this and the management review are quite similar to ISO 9001:2015.

Part 10 - Improvement

Once a solution is delivered, there is always learning to be gained. The impact on the user may not be what was anticipated, and weaknesses and gaps should be dealt with. This is where the strength of system thinking in an ISO management system strikes home. The system forces one to take action. The systems approach enables a business or enterprise to become a serial innovator and not just a "one-hit-wonder".

The aim here is to introduce the structure and thinking in ISO 56002 and show the opportunity to move beyond quality management to innovation management. To quote a popular saying, "Innovation is quality for tomorrow".

MANAGING INNOVATION IN THE ENTERPRISE

Creative Innovation Process

The innovation process consists of a set of interactive activities that are repeated in a nonlinear order to achieve an innovation goal. For example, the process of identifying opportunities, creating, validating, developing, and implementing solutions.

In some cases, innovation is also the result of activities and processes that do not have innovation goals. Innovation can also be achieved through random activities (not through a systematic innovation process). The innovation process must be flexible and adaptable to the innovative types of enterprises.

The innovation process can be done:

- Independent or partially integrated with other processes in the enterprise, such as product development process and sales process
- Through connection with internal and external processes of the enterprise, such as the process of cooperation, merger, and intellectual property management
- In the enterprise or with the participation of stakeholders outside the enterprise, such as open innovation process and collaborative innovation process

The innovation process is a discovery procedure characterized by the search, experimentation, learning, and "failure" activities of the enterprise.

The innovation process is designed to identify and test corporate risks in a new context. In it, business decisions must be based on assumptions rather than on available knowledge (or current events). Risks depend on the type of innovation of the enterprise. For example market risks, legal regulations, technology, and corporate resources.

Thus the hallmark of the innovation process is risk taking. Not all ideas, concepts, or solutions lead to innovation. Disruption or failure in innovation is an integral feature of the innovation process. Thereby, enterprises continue to learn in the implementation of innovation processes in the future.

Taking risks depend on the innovation goal and the type of innovation that the business is aiming for. For example, radical innovation and disruptive innovation typically carry a higher level of risk. The level of risk associated with enterprise innovation can be managed by implementing an Innovation Portfolio. This category represents different levels of risks. The ability to take risks and fail in the innovation process depends on the innovation culture of the enterprise.

Innovation Management

In general, not all innovation processes require management. Enterprises that proactively manage innovation activities will seize opportunities faster, respond promptly to related challenges and risks, and promote sustainable growth and development [2].

Managing innovation activities and processes is essential to:

- Ensure the alignment of innovation activities with the strategic direction of the business, including resource allocation, indicators, and tracking
- Ensure the flexibility and adaptation of innovation strategy and goals in connection with innovation opportunities and prospects in the enterprise
- Balancing and optimizing the performance of existing processes while at the same time "exploring" opportunities for innovation in the enterprise
- Promote a culture that supports innovation activities, creating the right conditions for businesses to effectively innovate

- Remove barriers and "restrictive" thinking to initiatives and innovations in enterprises
- Ensure innovative activities based on the needs and desires of society, the market, customers, and consumers

It can be said that innovation management is the foundation for setting policies, goals, strategies, processes, etc. to support the achievement of an enterprise's innovation goals through activities, such as planning, operating, and performance evaluation.

Innovation management is considered an important, integrated part of the overall management of an enterprise. Innovation policies, goals, and strategies will be the driving factors for the overall strategic direction of enterprises.

Innovation Management System (IMS)

The processes and activities that support innovation in the enterprise can be managed in a unified system. In it, elements of the innovation management system can effectively interact with each other [2].

Innovation management has the following roles:

- Guide enterprises to focus on implementing the most important innovation-supporting activities based on the common goals and strategies of the enterprise
- Allow the top management to define an innovation vision and optimize resources in the business
- Create awareness about innovation activities (inside and outside the enterprise) based on common unified perspectives throughout the enterprise
- Facilitating assessment of innovation management in enterprises and identifying factors and "bottlenecks" to promote innovation
- Compatible and can be integrated with other management systems of the enterprise

IMS includes all the elements and interactions necessary to establish a business' ability to innovate to achieve effective and sustainable innovation. The basic elements of an IMS system include:

- **Context of the business** - The business identifies internal and external issues that are consistent with its goals. These factors include opportunities that can "trigger" innovation activities, stakeholder needs, and a culture that supports innovation.
- **Leadership** - In the corporate context, top management demonstrates a commitment to the IMS, which establishes an innovation vision, strategy, and policy, and defines the roles and necessary responsibilities of the parties involved.
- **Planning** - The vision and commitment of the top management of the business identifies specific activities to address opportunities and risks. Thereby, enterprises establish innovation goals and plans to achieve them, including an organizational model of the enterprise and innovation portfolio.

- **Support** - The necessary support must be provided to set up the IMS. For example, human, financial, and other resources as well as cognitive capabilities, tools and methods, and intellectual property strategy.

- **Implementation activities** - Develop projects, programs, or other activities to deploy appropriate innovation processes in enterprises.

- **Performance evaluation** - Evaluate the performance of IMS by relevant innovation indicators according to the business plan, vision, and goals.

- **Improvement** - Based on the performance evaluation of the IMS, the enterprise makes continuous improvements, focusing on improving the "deviations" related to factors, such as context, leadership, planning, supporting, and implementing activities.

An effective IMS can be influenced by other management systems in the enterprise. Therefore, IMS can be integrated at different levels with other MSS in helping businesses balance exploitation of existing products, services, and operations, and with exploration and discovery of new products and services through innovation activities.

Various elements of an enterprise management system, including an IMS, can be integrated into a single management system, also known as an integrated management system.

CHAPTER 2

NATIONAL POLICIES ON INNOVATION AND INNOVATION MANAGEMENT

This chapter focuses on presenting guidelines and policies of some economies on innovation and innovation management. Each economy has proactively introduced policies to help their organizations and businesses improve their innovation capacity, along with their competitiveness. However, APO member economies generally do not have specific mechanisms and policies to promote ISO 56002. Vietnam and Thailand are two countries that have actively promoted, disseminated, and carried out trainings on ISO 56002. Through research, the research team concludes that the APO needs to continuously focus on carrying out programs and projects to support member economies to apply the ISO 56002 series of standards, thereby, improving the innovation capacity of organizations and enterprises of APO member economies.

CAMBODIA

National Institutions

Innovation is a widely used term in current literature, particularly on socioeconomic development and industrial policies. It is the core foundation attributed mainly to the market. Theoretically, innovation has taken place on context, culture, history, education, geography, political condition, managerial design, and others [4]. The overall reform efforts of the Cambodian government in the past decade have yielded the country a robust economic growth with an average annual GDP of about 7% before the COVID-19 pandemic, supported by a stable and low rate of consumer price inflation over the same period [5]. However, relying on foreign direct investment (FDI)-led growth from its labor-intensive industry can be challenging as the trade preferences that Cambodia enjoys has lessened while labor cost increases [6]. Thus the government understands that the growth will not be inclusive and sustainable, unless the country transforms its economic structure from a low or unskilled labor in the labor-intensive industry to an economy with better labor productivity with a skilled and knowledge-based workforce [7]. The Industrial Development Policy 2015–2025 was consequently laid out in the same year. The policy's core foundation relies on high-skill human capital, especially professionals that have fundamental background in science, technology, and innovation (STI). This is a primary contributor to the realization of the government's vision to become an upper-middle-income country by 2030 and a high-income country by 2050. There is little literature on innovation development in Cambodia. It is proposed that the investment in innovation should be in high consideration due to the reluctance to invest in the creation and materialization of knowledge. The open innovation paradigm was one of the options for Cambodia to quickly adjust to economic competitiveness [8]. This study provides a systematic analysis of system dynamics and concludes that Cambodia's National Science and Technology Master Plan is one of the strategic documents to spur knowledge and technologies for production, distribution, and consumption.

The Rectangular Strategy-Phase IV - the country's political development strategy - was adopted by the government of Cambodia in the Sixth Legislature of the National Assembly as the principal socioeconomic policy agenda. It has four strategic goals: (i) maintaining sustainable economic growth of around 7% per year; (ii) generating more and decent employment; (iii) reducing poverty headcount to below 10%; and (iv) enhancing the capacity and governance of public institutions [9]. Some officially-referred documents are laid out from this political platform, which includes Industrial Development Policy (IDP) 2015–2025, Science, Technology, Engineering & Mathematics (STEM) Education Policy 2016, Small and Medium Enterprises (SMEs) development policy 2017–2021, Technical and Vocational Education and Training (TVET) Policy 2017–2025, Modernized TVET Strategic Action Plan 2019–2023, Education Strategic Plan 2019–2023, Cambodian Higher Education Roadmap 2030 and Beyond, National Science, Technology & Innovation Policy 2020–2030, Cambodia's Science, Technology & Innovation Roadmap 2030, and Cambodia Digital Economy and Society Policy Framework 2021–2035. These policy documents are the backbone of the innovation system in the country.

The National Science, Technology & Innovation Policy 2020–2030 was adopted by the council of ministers in 2019. This long-term policy aims at strengthening the foundation and improving the environment for STI toward sustainable socioeconomic development. The main strategic goals of this policy include human resource development in the framework of STI, and strengthening the STI ecosystem to upgrade the country's competitiveness in industries and services [10]. At the same time, implementing this far-reaching policy requires systematic participation from all relevant government stakeholders, academia, and private sectors as well as development partners.

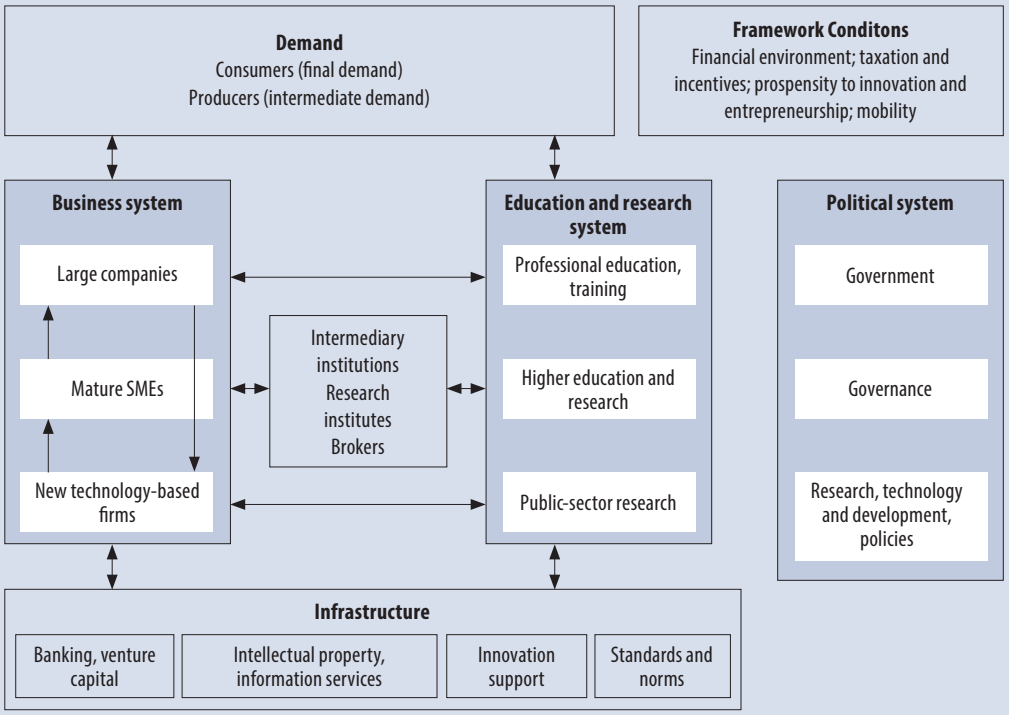
To realize results from the aforementioned policies and strategies, the government has designed various interventions to promote national innovation. And, they are mostly, but not limited to, associated with mentorship, technical assistance, training program, skills development, SMEs' access to finance and digital transformation, and promotional activities related to innovation. Many of the open innovation programs mentioned earlier are the main government interventions to nurture the ecosystem of STI in Cambodia. Different forms of institutions were established, including the Techno Startup Center in 2020 with the aim to nurture start-ups to grow into successful businesses by enhancing talents, entrepreneurship, and innovation capacities through well-supported programs. To promote SMEs' access to finance, the government released sub-decree 68 in 2019 on the establishment of the SME Bank of Cambodia with an initial investment capital of about USD100 million [8]. The initiative aims to assist enterprises in agro-processing and SMEs that are linked to FDI, the tourism sector, and tech start-ups through the credit guarantee schemes and concessional loans to qualified SMEs [11]. The major structure to support innovation is the Ministry of Industry, Science, Technology & Innovation (MISTI), formerly the Ministry of Industry and Handicrafts (MIH) on 6 April 2020, via sub-decree No. 48 (RGC, 2020b). The newly established ministry allows the government to mobilize the human resources in STI to cultivate and nurture a sound and inclusive development through cohesive coordination among governmental agencies, academia, research institutions, the private sectors, and development partners. The restructuring of the National Council of Science, Technology & Innovation (NCSTI), placed under the leadership of MISTI through royal decree ទស/រកត/1020/1073 dated 10 October 2020 indicates the nationwide role as a coordinating body on STI.

National Innovation System (NIS)

In principle, the NIS is the key feature to assess the developmental status of the STI ecosystem. The specific indicators must be built from the beginning for ease of monitoring and evaluation. The demand and supply side of the STI sector is critical to be formulated with sufficient support from the policy framework and infrastructure, as seen in Figure 2.1 from Kuhlmann and Arnold (2001). Particular focus is on the sufficiency of both quality and quantity of science, technology, engineering, and mathematics (STEM) graduates who must be ready for the business sector, namely industries or SMEs that demand highly skilled force. Further, promoting open innovation is another catalyst to strengthen NIS by efficiently materializing the knowledge (Figure 2.1) [12–13].

FIGURE 2.1

CAMBODIA'S NATIONAL INNOVATION SYSTEM FRAMEWORK [14]



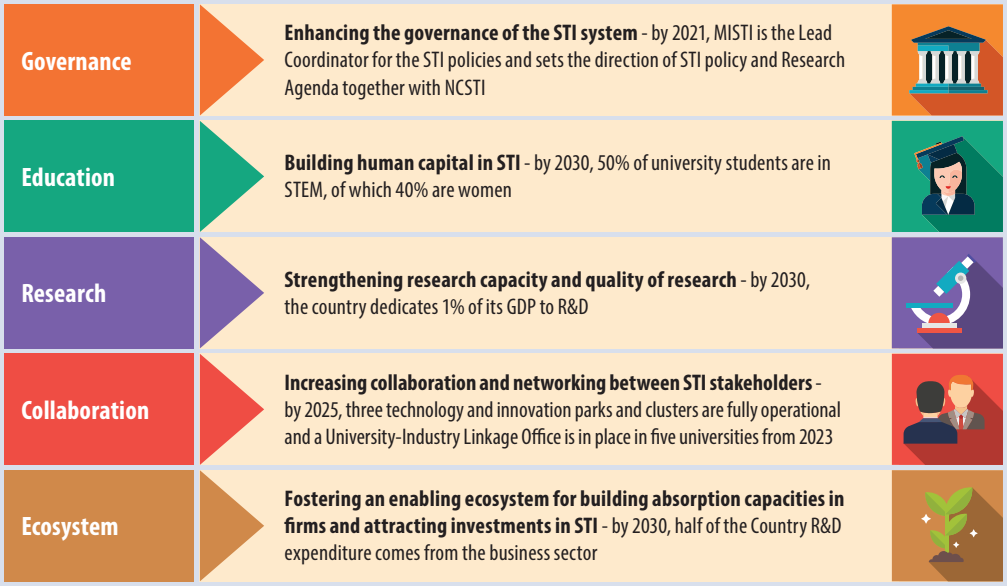
The Prime Minister's approval of the National STI Policy 2020–2030 in 2019 is the first foundation of government support to promote the STI ecosystem in the country. With this continuous support from the government, Cambodia's STI Roadmap 2030 was laid out as direct strategy for government ministries and relevant institutions to formulate short- and medium-term action until 2030. Cambodia's STI Roadmap 2030 operationalizes the National STI Policy by setting clear objectives, defining a set of key actions within a time horizon, and specific targets to achieve by 2030. It gives MISTI a clear role to oversee and coordinate the implementation of the National STI Policy across ministries [15]. Five pillars are important to implementing the National STI Policy. These keys pillars are to be strengthened with the following short description:

- **Governance** - MISTI, having NCSTI as the national coordinating body in guiding interministries-related jobs, must be enhanced in the mandates for the crosscutting nature of STI activities
- **Human Capital** - Human resources of both quality and quantity in STEM must be produced for top priority sectors for socioeconomic development
- **R&D** - Investment in R&D must be made on time for knowledge creation to support the demand of the private sector
- **Collaboration** - Breaking the silo and ensure synergistic working environment among government institutions/agencies, academia, and the private sector
- **Ecosystem** - Favorable ecosystem to have both domestic and foreign investments from the synergy of sufficient highly skilled labor, attractive investment policies, and critical infrastructure

The roadmap also highlights the important indicators to be realized by 2030 as to achieve the government's vision. The main indicators for 2030 are summarized in Figure 2.2 that showcases an ambitious plan. They are, however, critical in making it possible for achieving the country's ambitious vision of upper-middle-income by 2030 and high income by 2050. The infographic roadmap reveals the required effort from relevant stakeholders to collectively work together for the common goal to shed the least developed country status. The monitoring and evaluation frameworks are also being developed by MISTI's General Department of Science, Technology & Innovation (GD/STI) to support the implementation of the roadmap (Figure 2.2).

FIGURE 2.2

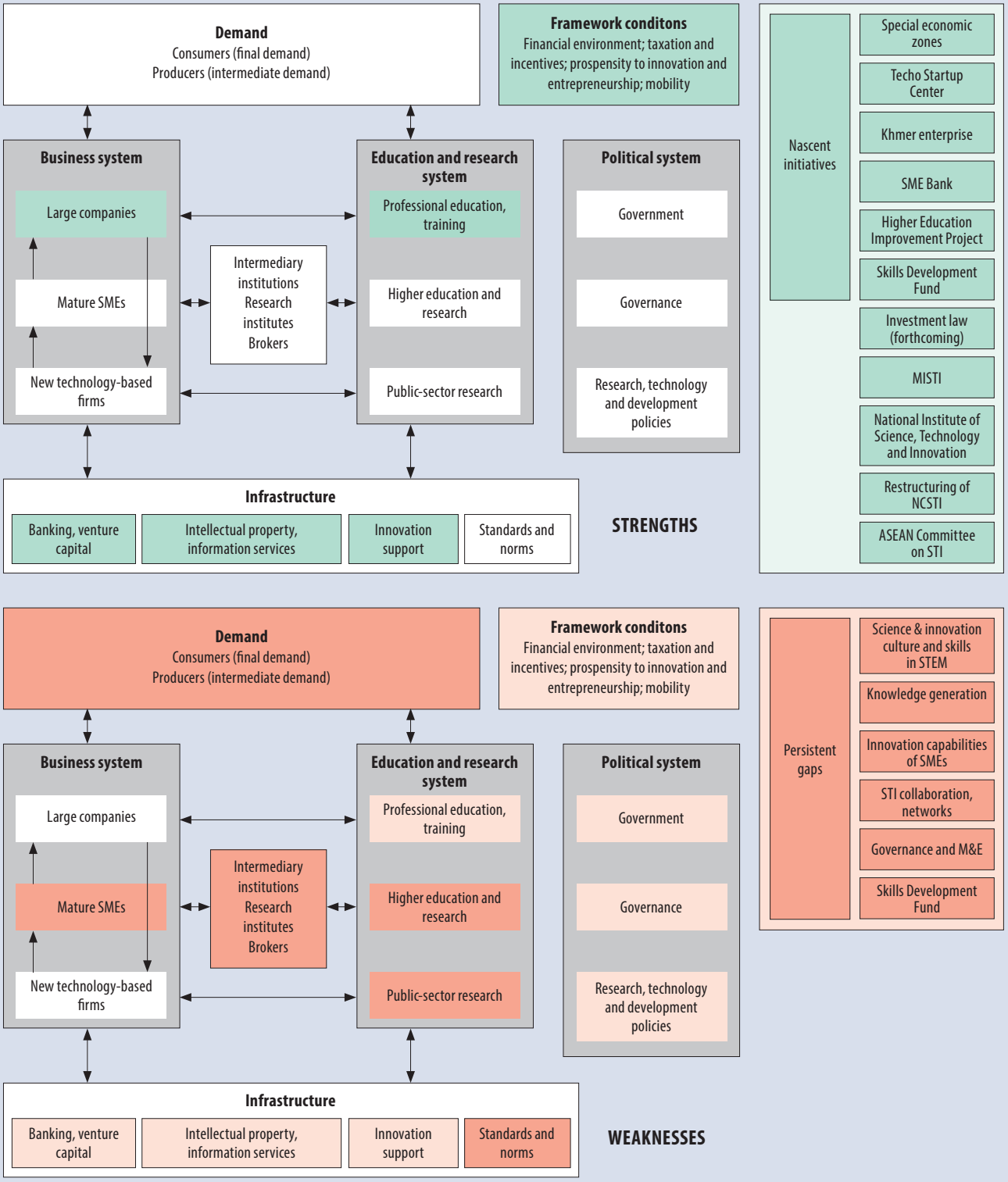
CAMBODIA'S STI ROADMAP 2030 [15]



The government's strong commitment to the STI structuring has been more visible in the last few years. The Kingdom's decision to establish MISTI during the pandemic is an undeniable dedication to STI. In addition, other legal instrumental tools were also adopted in 2021. MISTI, in collaboration with other relevant national institutions, is developing the National Research Agenda to get priority sectors and the Global Observatory of STI Policy Instruments (GO-SPIN) for inventorying the first ever STI system in the country. These two documents will be concrete policy tools to support government institutions to implement the STI activity properly. One of the most important tools is Cambodia Digital Economy and Policy Framework 2021–2035 [16]. The policy aims to harness the potential of ICT and digital technologies to increase production, economic efficiency, and develop civilized society. This typical nascent development ecosystem is a positive sign of STI. Despite this opportunity, there are several challenges facing the development. They include investment in R&D, enforcement of legal framework, promoting STEM education, and the triple helix model. More details on the strengths and weaknesses of the National Innovation System of Cambodia are given in Figure 2.3 [17].

FIGURE 2.3

CAMBODIA'S NATIONAL INNOVATION SYSTEM ON ITS STRENGTHS AND WEAKNESSES [17]



These challenges are overcome through synergized efforts among STI players. The theory explains that critical tools are made available to drive National Innovation System. These could be relevant policies, procurement programs, regulations, legal systems, and management systems. In general, a good trading system and active collaboration are fundamental keys to success in national innovation, in addition to good universities, strong intellectual property rights regime, proper investment in R&D, and a lively trading system. Table 2.1 provides comprehensive tools for supporting National Innovation System. It has noted, however, that a few advanced innovation communities, such as the Republic of China (ROC) or Republic of Korea, are investigating beyond the concept given in Table 2.1 [18].

TABLE 2.1

CAMBODIA'S IMPORTANT TOOLS AFFECTING NATIONAL INNOVATION SYSTEM [18]

Financial Systems	Antitrust Policy	Government Procurement Program	Science Policy
Defense policy	Industrial relations	Environmental regulations	Labor policy
Space policy	Food policy	Government budget procedures	Energy policy
Exchange rate regimes	Legal systems	Health policy	Lands management
Zoning laws	Telecommunications policy	Transportation policy	Tech transfer policy
Agricultural subsidies	Tax policy	Safety regulations	Immigration policy

Soft Infrastructure

Infrastructure is the foundation for the improvement of any innovation system. The development of soft infrastructure in developing nations is generally seen as challenging in terms of resource allocation, prioritization, and collaboration. Cambodia faces the same challenges. However, the economic growth in the last decade with timely policy intervention could be an evident means for the country to harness the next cycle of growth. In addition, the timely intervention of the government in vaccinating its population against COVID-19 was positively impactful. This action to prevent severe illness of the disease allowed almost full operation of business activities. Other activities relating to STI, education, and intellectual property should be on the priority list of interventions for the country to catch up with the full potential of innovation [12].

Nationwide, the innovation system requires sufficient legal backup, including system-based collaboration and mechanism, trading policy, norms and standards, technology transfer, a good pool of human resources, and well-enforced laws related to the business ecosystem. Legally, the innovation ecosystem is driven mainly by various responsible institutions including MISTI, Ministry of Education, Youth and Sports (MoEYS), Ministry of Labour and Vocational Training (MoLVT), and Ministry of Posts and Telecommunications (MPTC) [15]. Table 2.2 provides a more detailed institutional structure supporting the innovation ecosystem of Cambodia.

TABLE 2.2

CAMBODIA'S STI INFRASTRUCTURE [15]

STI Domain	Authorization	Establishment	Coordination	Implementation
SCIENCE AND STI EDUCATION				
Science landscaping and access to publications	NCSTI	MoEYS, MoLVT, MoH, MAFF, MISTI, CDRI, AVI	MoEYS, MISTI	MoEYS, CDRI
Support to scientists or R&D activities	NCSTI	MoEYS, MISTI, MAFF, MEF, MoH	NCSTI, MEF	MoEYS, MISTI, MAFF, MoH, Private research centers, and companies
STEM education and TVET	NCSTI	MoEYS, MoLVT, MAFF, MoH, MISTI, MPTC	MoEYS, MoLVT	MoEYS, MoLVT, MAFF, MoH, MPTC, Private Institutions
TECHNOLOGY				
Technology-intensive infrastructure	NCSTI	MISTI, MoEYS, MAFF, MPTC	NCSTI, MEF	MISTI, MoEYS, MAFF, MPTC, relevant ministries/companies
Industry-scale technologies	NCSTI	MISTI, CDC	MISTI	MoEYS, Industries
Small-scale technology	NCSTI	MISTI	MISTI	MoEYS, Companies
eGovernment, ICT in public administration	NCSTI	MEF, MPTC, MISTI, MEF	NCSTI, MEF, MPTC	MPTC, MISTI, MEF
INNOVATION				
Innovation policy and ecosystem	NCSTI	MISTI	NCSTI, MISTI	MISTI, MoEYS, MAFF, MPTC
Specific innovation support systems	NCSTI	MISTI, MoEYS, MAFF, MPTC	NCSTI, MISTI	MISTI, MoEYS, MAFF, MPTC
Social or inclusive innovation	NCSTI	MISTI	MISTI	MISTI

Note: Refer to ABBREVIATIONS for full names of organizations.

REPUBLIC OF CHINA (ROC)

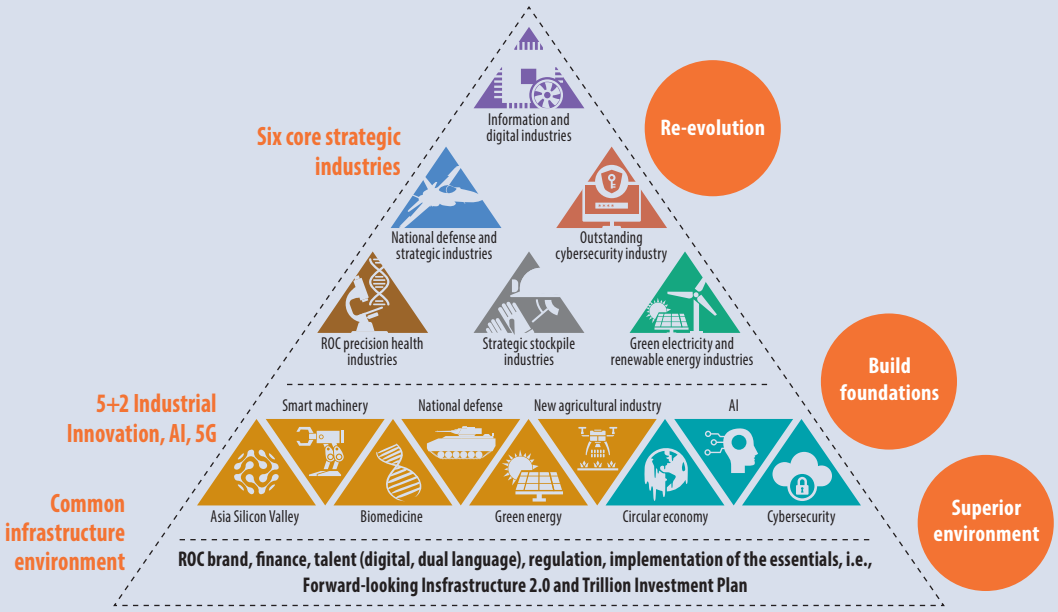
To accelerate ROC's industrial transformation and upgrading, the government has created a new economic model that pursues sustainable development with "innovation, employment, and distribution" as its core values and stimulates industrial innovation through the three strategies of "connecting the future, connecting the world, and connecting the local". The government puts forward 5+2 industrial innovation plans, such as "Smart Machinery", "Asia Silicon Valley", "Green Energy Technology", "Biomedical Industry", "Defense Industry", "New Agriculture" and "Circular Economy" as the driving force. The core of ROC's next-generation industrial growth has injected new momentum into economic growth.

The 5+2 Industrial Innovation Plans

As illustrated in Figure 2.4, the ROC government has established a common infrastructure environment, such as branding, funding, talents, and regulation, to provide a superior environment for the cultivation of the 5+2 industrial innovation plans. The 5+2 industrial innovation plans then further pave the foundation for the six core strategic industries, namely information and digital industries, national defense and strategic industries, cybersecurity industries, precision machinery industries, strategic stockpile industries, and green electricity and renewable energy industries.

FIGURE 2.4

ROC'S ADVANCED DEPLOYMENT ON THE FOUNDATION OF 5+2 INDUSTRIES



Source: National Development Council, ROC

The ROC's system integration capabilities are expected to be strengthened through the deployment of key forward-looking technologies and the introduction of high-level talents as well as the upcoming formation of its industrial innovation cluster.

It will also attract domestic and foreign investment, and global innovation energy will be connected to enhance ROC's industry international competitiveness and people's quality of life. The country also works to realize green silicon islands and smart countries, and balance the goals of regional development and job creation.

Smart Machinery Industry Promotion Program

The Ministry of Economic Affairs has been promoting the Smart Machinery Industry Promotion Program since 2016, integrating ROC's abundant new creative energy, establishing technology applications and service capabilities that meet market needs, upgrading ROC from precision machinery to smart machinery, and cooperating with industrial investment and development. The policy results are highly recognized by the industry. Combining strategies with cross-domain cooperation between industry, government agencies, public associations, academia, and nongovernment organizations, ROC has promoted the intelligent upgrading and transformation of the industry to achieve the goal of "smart machinery industrialization" and "industrial smart mechanization". The main achievements include smart machine box (SMB), value-added application of AI, smart machinery industry pilot, smart manufacturing, key teaching materials, coaching group, and international cooperation on smart manufacturing, etc.

Asia Silicon Valley Promotion Program

To take advantage of ROC's existing hardware manufacturing advantages, such as information and communications and semiconductors, and simultaneously, link the global advanced technology R&D capacity, promote domestic capabilities to enter software applications, and lead ROC's future new economic development model, the National Development Council, the Ministry of Economic Affairs, the Ministry of Science and Technology, the Ministry of Transportation and other related ministries and committees have jointly implemented the Asia-Silicon Valley Promotion Plan (referred to as Asia-Silicon Valley 1.0) since September 2016. The plan takes "promoting the development of the Internet of Things" and "improving the innovation and entrepreneurship ecosystem" as the two main pillars. It is expected to use the Internet of Things (IoT) to promote industrial transformation and upgrading as well as innovation and entrepreneurship to drive economic growth. The aim is to assist ROC in seizing the next generation of digital innovation business opportunities and accelerating the transformation and upgrading of domestic industries.

Green Energy Technology Industry Innovation Promotion Plan

The Green Energy Technology Industry Innovation Promotion Plan takes "energy creation, energy storage, energy saving, and system integration" as the main subject. The key projects include the Solar Photovoltaic Two-year Promotion Plan, Green Energy Rooftop Public Participation, Four-year Wind Power Generation Promotion Plan, Smart Electricity Demonstration Site, and the Shalun Smart Green Energy Science City. The overall plan is to develop distinctive industries based on domestic demand, introduce large-scale domestic and foreign investment, and increase high quality employment. It is expected to generate 32,000 jobs and a cumulative investment of TWD1,817.5 billion.

Biomedical Industry Innovation Promotion Plan

The Biomedical Industry Innovation Promotion Plan is based on the President's policy blueprint to "drive the growth of ROC's next-generation industry" and proposed the biomedical industry promotion plan. Since 2017, industrial innovation has been promoted through the four main pillars of improving the ecosystem, integrating innovative clusters, connecting international market resources, and promoting distinctive key industries. Relevant ministries and committees, e.g., the Ministry of Science and Technology, the Ministry of Health and Welfare, the Ministry of Economic Affairs, the Ministry of Education, the National Development Council, the Financial Management Committee, etc., have worked together to promote the plan and achieved concrete outcomes, including database integration, talent and start-up team cultivation, innovative clusters establishment, and new drugs and new medical materials obtaining international marketing approvals, and many more.

National Defense Industry Promotion Plan

To implement the national defense independent policy, effectively integrate civil organizations, build the defense industry, and to simultaneously take into account the needs of national defense security and economic development while considering the defense industry's high-tech, smart, intelligent, and market segmentation characteristics, the ROC's Ministry of National Defense has formulated a special bill to create "Establishing National Defense on the foundation of Economy, and utilizing National Defense to support Economy" virtuous circle. The bill focuses on establishing an evaluation mechanism, strengthening security control, attracting investment from manufacturers, expanding market scale, assisting in R&D and trial production, and fostering cross-domain talents.

New Agriculture Promotion Plan

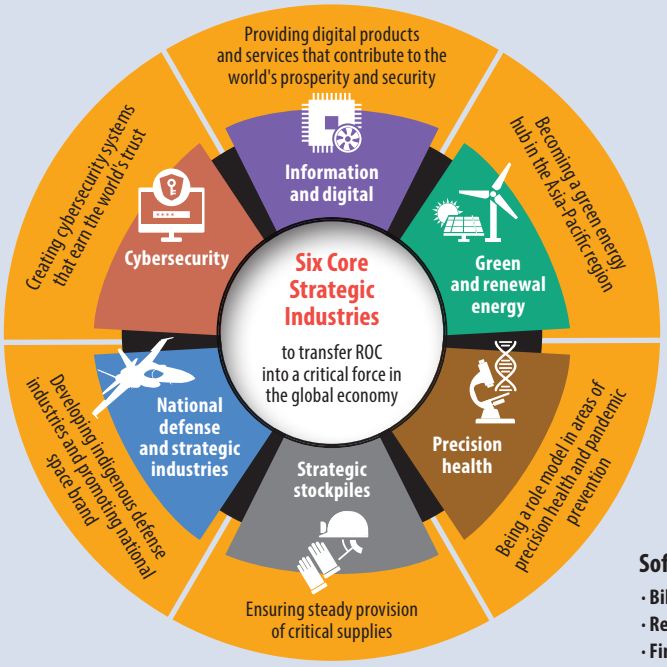
There are three main thrusts in the New Agriculture Promotion Plan - establishing a new model of agriculture, constructing an agricultural safety system, and enhancing agricultural marketing capabilities. The plan covers 10 key policies and implementation strategies; (i) promoting green payments to the land, (ii) stabilizing farmers' income, (iii) enhancing the competitiveness of the livestock and poultry industry, (iv) promoting friendly farming, (v) sustainable use of agricultural resources, (vi) strengthening technological innovation, (vii) improving food security and ensuring agricultural product safety, (ix) increase multiple channels for domestic and foreign sales of agricultural products, and (x) increase the added value of agriculture.

Circular Economy Promotion Plan

ROC's manufacturing industry has recently faced challenges, such as resource shortages, high energy consumption, and environmental protection disputes. To create a win-win situation for the economy and environmental protection, this plan integrates the concept of circular economy and sustainable innovation into various economic activities and is specifically implemented in production, consumption, recycling, reuse, etc. It also takes the materials industry as the starting point to cultivate relevant talents, transform the industrial development from a linear economy to a circular economy, and create new impetus for industrial development.

FIGURE 2.5

ROC'S SIX CORE STRATEGIC INDUSTRIES



Source: National Development Council, ROC

Program for Promoting Six Core Strategic Industries

The promotion of Six Core Strategic Industries was announced by President Tsai in her inaugural address on 20 May 2020. These industries, as illustrated in Figure 2.5, include information and digital industries,

the cybersecurity industry, precision health industry, green and renewable energy industry, national defense and strategic industries, and strategic stockpile industries. By moving early with preparations and building on the foundations of the 5+2 Innovative Industries Program, ROC will gain a first-mover advantage to capitalize on opportunities in the post-pandemic era created by the reorganization of global supply chains.

The Promotion Program of Six Core Strategic Industries was presented and approved at the 3,730th Cabinet meeting on 10 December 2020. The promotional strategies of the program are outlined below:

- **Information and digital industries** - R&D on next-generation semiconductor technology will be conducted, artificial Intelligence of Things (AIoT) applications will be promoted, and a 5G national team will be organized. This is intended to maintain ROC's leading position in ICT technology, export AIoT solutions to the world, and secure a key role in the 5G global supply chain.

- **Cybersecurity industry** - R&D into such protective technologies as 5G and semiconductors will be conducted, five solutions on AIoT and healthcare will be developed, and an organization for cybersecurity defense and cross-country collaboration will be established. The strategy is to enhance the protection of these emerging areas and forge high-end testbeds.

- **Precision health industry** - A platform that integrates materials of the Taiwan Biobank and National Health Insurance Research Database will be established, systems of precision prevention, diagnosis, treatment, and care will be built, precision epidemic prevention products will be developed, and international biomedical business opportunities will be explored. This approach will promote ROC as a role model in the area of epidemic prevention around the world.

- **National defense and strategic industries** - The indigenous naval vessel and aircraft industries will be promoted, 10 key technologies, including aircraft engine production, and eight-core technologies, such as marine propulsion system building will be developed while a national defense supply chain will also be established. For the space industry, low earth orbit satellites and ground equipment will be developed, and the ROC national space brand will be promoted.

- **Green and renewable energy industry** - ROC will build a renewable energy industrial zone and R&D base, strengthen the cybersecurity of renewable energy certificate transactions, and create an offshore wind power national team. The country will also attempt to gain a crucial role in the Asia-Pacific wind power supply chain, enabling local wind power products to export to other countries.

- **Strategic stockpile industries** - The steady provision of critical supplies will be ensured by stabilizing main supply chains including energy, food, daily necessities, medical supplies, disaster relief, sand, gravel, etc. This will also involve controlling such critical raw materials for semiconductor materials and equipment, automotive batteries, active pharmaceutical ingredients, and 15 additional important industrial materials.

The Program will be jointly promoted by the Ministry of Economic Affairs, Ministry of Science and Technology, Ministry of Transportation and Communications, Ministry of Health and Welfare, and the National Development Council. It will accelerate the upgrading and transformation of ROC's local industries and transform this country into a critical force in the future global economy.

INDIA

There have been four national Science and Technology (S&T) policies - Scientific Policy Resolution 1958 (SPR1958), Technology Policy Statement (TPS) 1983, STP2003, and STIP2013 - so far that have guided the

evolution of India's STI ecosystem. From 2000 onwards, India focused on the conversion of knowledge into wealth and value, addressing the socioeconomic needs of the country, and amalgamating STI. The key features of this policy were to promote a S&T-led innovation ecosystem in the country, attract the private sectors into R&D, and link STI to socioeconomic priorities. The twelfth Five-year Plan (2012–17), among others, focused on the creation and development of R&D facilities, building technology partnerships with state governments, and large scale investment in mega science projects. India is rapidly evolving with changing national and international dynamics. The facilitation of the "Internationalization of R&D" in India was carried out to foster brain gain. More innovative programs in line with Visiting Advanced Joint Research (VAJRA) and GIAN (Global Initiative of Academic Networks) are to be introduced and their scope may be widened for international faculty as well as students. Collaborations will be promoted especially across the global south as well as to create an environment for global citizenship education.

The policy instrument, in its design and objectives, aims to be evidence-driven, inclusive, and bottom-up for the well-being of the nation and its people with socioeconomic and environmental considerations.

The main points of the Science, Technology, and Innovation Policy (STIP) are as follows:

- The Development of a National STI Observatory that will act as a central repository for all types of data related to and generated from the STI ecosystem. It will encompass an open centralized database platform for all financial schemes, programs, grants, and incentives existing in the ecosystem.

- An Open Science Framework will be built to provide access to scientific data, information, knowledge, and resources to everyone in the country and all who are engaging with the Indian STI ecosystem on an equal partnership basis. Strategies will be developed to improve STI education, making it inclusive at all levels and more connected with the economy. The society will be developed through processes of skill-building, training, and infrastructure development. Engaged universities will be created to promote interdisciplinary research to address community needs. The policy recommends representation of the ministries of S&T in the working groups constituted for the revision of the National Curriculum Framework (NCF) of National Education Policy (NEP) 2020. This would ensure designing appropriate curricula for promoting science education early in school. Similarly, the curricula of the teacher education programs must be synced appropriately to the new learning paradigm.

- The financial landscape of the STI ecosystem will be expanded. Each department/ministry in the central, state, and local governments, public-sector enterprises, private-sector companies, and start-ups will set up an STI unit with a minimum earmarked budget to pursue STI activities. Extramural funding will be diversified and enhanced to double the share of extramural R&D support of the central government agencies in the Gross Domestic Expenditure on R&D (GERD) in the next five years. The ADMIRE - Advanced Missions in Innovative Research Ecosystem - program is envisaged to achieve greater socioeconomic self-reliance and STI leadership. It will be characterized by portfolio-based funding mechanisms that support distributed and localized collaborative mission-oriented projects through a long-term investment strategy with Key Performance Indicators (KPI). All stakeholders of the STI ecosystem including public, private (local and MNCs), academic, and other nongovernmental sectors will be impactfully engaged in the program to ensure holistic participation and development of interlinkages. The program will extend to cross-cutting and critical domains that include, but are not limited to (with special emphasis on critical infrastructure support) strategic areas, areas of economic and social security, emerging, sustainable, and indigenous technologies, and traditional knowledge. The program will also assist and direct public-private partnerships for the development of STI knowledge-based infrastructure and creative assets. Under the aegis of ADMIRE, industry-led R&D with government support wherever necessary, will be introduced. A ministry or a group of ministries in consultation with industry/industry bodies will design and execute projects through co-funding mechanisms where they participate equally. National laboratories and academia will be made part of the engagement.

The policy aims to create a fit-for-purpose, accountable research ecosystem promoting translational as well as foundational research in India, in alignment with global standards. Research and Innovation Excellence Frameworks (RIEF) will be developed to enhance the quality of research along with the promotion of engagements with relevant stakeholders. A dedicated portal, the Indian Science and Technology Archive of Research (INDSTA), will be developed to provide access, specifically, to the outputs of all publicly funded research (including manuscripts, research data, supplementary information, research protocols, review articles, conference proceedings, monographs, book chapters, etc.).

The policy envisions strengthening the overall innovative ecosystem, fostering S&T-enabled entrepreneurship, and improving participation of the grassroots levels in the research and innovation ecosystem.

The policy will promote technological self-reliance and indigenization to achieve the larger goal of "Atmanirbhar Bharat". A two-way approach of indigenous development of technology as well as technology indigenization will be adopted and focused upon in alignment with national priorities, such as sustainability and social benefit as well as resources. S&T-enabled entrepreneurship-technology-driven, innovation-focused enterprises is critical for creating, shaping, and sustaining the future industrial sectors of the country as well as delivering the benefits of scientific research for the socioeconomic development of the society. An enabling ecosystem for seeding, sustenance, and growth of S&T-enabled entrepreneurship calls for investing in basic, foundational, and reliable physical and social infrastructure for S&T-enabled entrepreneurship to thrive. This includes investments in key infrastructure in higher education institutions (HEIs), scientific R&D laboratories, hospitals, ICT across the country as well as complementary mission-driven investments in R&D with S&T-enabled entrepreneurship in critical technology areas. This also includes promoting entrepreneurship education programs across the country by involving local communities, i.e., schools, higher educational institutions, nonprofit organizations, scientists, entrepreneurs, and other stakeholders. An overarching body, Strategic Technology Board (STB), will be constituted to act as a connecting bridge between different strategic departments and to monitor and recommend technologies to be bought or indigenously made with the mentioned organizations, in line with self-reliant India. The Board will have the responsibility to prepare a roadmap for the strategic requirements of the country and also monitor its implementation. The roadmap will guide the development processes leading to technology development.

The policy provides renewed impetus to the mainstreaming of equity and inclusion within the STI ecosystem. An India-centric Equity & Inclusion (E&I) charter will be developed for tackling all forms of discrimination, exclusions, and inequalities in STI, leading to the development of an institutional mechanism. Statistics will be collected on dropout rates of women, the *Divyangjan* community, socially and economically backward communities, individuals from remote areas, and other marginalized groups in science education and research. E&I data will include, but not be limited to, sex-disaggregated data on STI, data on suicide rates, and mental health issues in STI.

The policy will also work toward mainstreaming science communication and public engagement through the development of capacity-building avenues through creative and cross-disciplinary platforms, research initiatives, and outreach platforms. Locally relevant and culturally context-specific models will be developed along with promoting cross-disciplinary research in science communication.

STIP charts pathways to a dynamic, evidence-informed, and proactive international S&T engagement strategy. Upcoming and existing innovation-related programs, such as Atal Tinkering Labs and Million Minds Augmenting National Aspirations and Knowledge (MANAK)] will be developed synergistically across schools for better results. Such programs will be scaled up with a 10-year strategy. These networked initiatives should focus on addressing different concerns of the society.

A decentralized institutional mechanism balancing top-down and bottom-up approaches, focusing on administrative and financial management, research governance, data, and regulatory frameworks, and system interconnectedness will be formulated for a robust STI governance. Mission mode programs with deliverables for technology and innovation will be established in priority sectors, such as agriculture, water, health, energy, and environment while also identifying the challenges and opportunities based on current and future needs. Pathways to leverage the resources to achieve the goals will also be identified.

Institutional mechanism for STI policy governance along with the implementation strategy and roadmap and monitoring and evaluation framework will be outlined for the policy, programs and their interlinkages. Major projects in key areas having larger societal impacts will be thoughtfully planned as medium- and long-term home-grown projects in target-specific indigenous developmental areas, like food and water security; health care; clean and affordable energy, rural, and urban amenities; and communication and connectivity. This will be attained by leveraging the expert base of many research areas, who could engage in collaborative and cooperative work to achieve a well-defined goal. The policy will enable innovation for better health outcomes and assured universal healthcare that is responsive to the needs of the people and ensures the health security of the nation. These will also strengthen India's domestic supply chain management system to reduce its reliance on imports of goods and services, improve its exports capacity, and ultimately improve its global value chain. It further aims at providing seed, fund, and foster suitable and robust initiatives at HEIs, including collaborations with the government and industries.

The STIP will be guided by the following broad vision:

- To achieve technological self-reliance and position India among the top three scientific superpowers in the decade to come
- To attract, nurture, strengthen, and retain critical human capital through a 'people-centric' STI ecosystem
- To double the number of full-time equivalents (FTE) researchers, GERD, and private-sector contribution to the GERD every five years
- To build individual and institutional excellence in STI with the aspiration to achieve the highest level of global recognition and awards in the coming decade

INDONESIA

Business development of SMEs in embracing the IR 4.0 also ensures the readiness of an organization in facing many risks. According to Lai, Kan, and Ulhas [19], the meaning of readiness is a concept of change that focuses on development and movement. The concept of readiness is not only about physical maturity but also the combination of emotional stress and situation as a result of the learning process environment and the results of the new operation. Assessing the readiness of an SME in adopting innovations is an important condition for developing and keeping up with market developments alongside ICT. E-readiness is one of the tools used to evaluate the readiness of a business or industry to integrate and to adopt technical information so that it can be developed in rationalizing an action, improving competitiveness, and managing resources more efficiently.

According to Urata in Sulistyastuti [20], Indonesian SMEs play important roles in:

- Being the main actor in economic activities in Indonesia
- Providing job opportunities
- Creating markets and innovations that are flexible
- Contributing to regional/local economic development and community development
- Increasing exports in the non-oil and gas sector

Tambunan in Sulistyastuti also stated that SMEs are capable of reducing income inequality, especially in developing countries.

According to the Directorate General of Small and Medium Enterprises in 2006, the characteristics of Indonesian small and medium industries are microscale which are labor intensive with relatively small investments that generate high added-value by using simple technology until it needs changing, does not require high skills, can create new sources of entrepreneurship, have a high degree of flexibility in anticipating market changes, and being resistant to crises in the existing economy. According to Irianto [20], industry challenges of IR4.0 are in the (i) diversification and job creation; (ii) industrial readiness; (iii) reliable workforce; and (iv) ease of sociocultural arrangements.

As for IR 4.0 opportunities, they are in (i) investment in technology; (ii) SMEs' integration and entrepreneurship; (iii) competitive industrial base; and (iv) ecosystem innovation. According to the Coordination of the Creative Economy, Entrepreneurship, and Competitiveness Cooperatives, in facing the IR 4.0, SMEs require superior and reliable human resources in accordance to business and industry needs as well as to adapt to the changes accordingly [21–23]. The use of IT that may be a failure will be financially burdensome and affect the sustainability of the business operation itself [24]. Reasons for readiness and the significant role of the use of IT in various types of industries will be a new challenge for SMEs.

Standardization in Innovating Marketing Assessment Based on ISO 56002:2019

The emergence of online business actors with technological developments in information and communication reveals the excellent use of good marketing strategies. To enhance competitiveness, MSMEs must be agile and innovative in this era of disruption. Products related to the social media and technology are fast widespread in almost all industries, including SMEs [25]. SMEs have shown to survive longer and better from the economic crisis by being flexible and have the ability to rely on local resources. Among the 64 million MSMEs (2018) in Indonesia, only 17.1% of MSMEs use digital systems, which indicate that a huge majority are still running their businesses conventionally. However MSME actors must use the digital platform to prevent any disruptions. The key is to innovate so that the MSMEs can increase their competitiveness and keep up with the market competition. Two factors that may solve the problem in MSME development [26] are (i) to carry out capacity building and MSME productivity; and (ii) prioritizing related entrepreneurship motivation, commitment, skills, and business network.

Importance of Managing Innovation in the Era of Competition

In today's globally competitive world, companies need to innovate to produce new ideas, new processes, new products as well as improve their current business conditions. From innovation activities, companies will need to carve out the advantage, not just to remain competitive but also to thrive and contribute to the national economic development. Enterprises need to manage their innovation activities according

to the structure, culture, and logic of the organization by using the right strategy [27]. The innovation process also needs to be monitored and evaluated by the company to ensure that innovation will have a positive effect on their performance, and not reduce the company's performance. The process of putting new ideas into practice is one of the definitions of innovation. Before innovation is carried out, it is necessary to discover the science that can then be applied to innovation. SMEs must also allow for varying time lags to see the result of innovation that may take a few months (short term) to a longer period of time. Companies that invent and/or innovate usually experience self-discovery within the company as well as externally.

SMEs also have the option to innovate by applying the inventions of other companies through acquisition activities in new products or services. Innovations and inventions are vital as without innovation, inventions may not be useful in the real world, and without invention, innovation will not happen. There are four categories of innovation, namely process innovation, organizational innovation, marketing innovation, and product innovation [28].

Process innovation is an innovation activity that focuses on changing for better production or distribution methods than before. Organizational innovation looks into changing organizational systems to improve efficiency and performance. Marketing innovation means that new marketing strategies are implemented and aimed at increasing the company's sales figures while product innovation focuses on creating new products or new services that are of higher quality and attract consumers' interest.

Innovation and competition are two factors that cannot be separated. Competition can motivate companies to innovate while innovation can create tougher and more interesting competition. Overall, competition and innovation tend to elevate industrial levels due to increased quality and reduced prices of products and services in the industry. To be able to compete in the market better, a company can use the strategy that focuses on innovation which makes it easier for the company to make strategic decisions on innovation. For example, a company can allocate most of its revenue to R&D to gain the technological advantage needed to innovate.

Develop a Common Framework Conducive to Innovation

The main objective of this agenda is to develop a general framework that is conducive to the development of innovation. The first part that needs to be addressed at the national and regional level is related to the basic framework for the development of innovation systems. The right institutional arrangement, in a broad sense, is important for solving problems. The advancement of innovation does not only encourage increased R&D, diffusion of results, or private-sector innovation activities, but also innovation or improvement in governance environment and policy improvement. One of the priorities of the Indonesian government is to implement the National Social Security System (SJS) to ensure that the community has access to social and health care services without financial difficulties. The SJS is to be managed by the Social Security Administration (BPJS) for Employment and Health in accordance to the governance of global standards. The trend of increasing economic uncertainties that hit all countries globally post-COVID-19 has made the government's efforts to equalize the situation all the more difficult. This is especially seen in managing the spread of COVID-19 by the Indonesian government, compared to other neighboring countries neighbors, such as Singapore and Vietnam [29]. Until mid-2020, community awareness and compliance with physical distancing was still low and not accompanied with sanctions for the violator.

Meanwhile, the impact of stagnant pandemic governance in Indonesia has also exacerbated social inequality. Along with the enactment of large-scale social restrictions (PSBB) in mid-April 2020, the Ministry of Manpower recorded 449,500 people on unpaid leave while July 2020 showed that 50% of people lost their jobs. Vulnerable groups, such as women, are increasingly at risk of losing their jobs.

The innovation agenda is essentially related to the goal of creating a climate (at the national level and regions) that is conducive, especially for businesses as well as developing innovation systems. These directly correlate to the macroeconomic context, fiscal policy, and several other things that are the 'domain' of the central government. However, in certain contexts, local governments play a very important role, such as providing business and investment licensing, provision of basic infrastructure, support accessibility, quality of life, and more. Further, it is necessary to develop a special legal basis concerning the development of the respective regional innovation systems as an integral part of the system of national innovation.

Inventions and innovations are prerequisites for the creation and adaptation of good jobs, accompanied by social welfare and improved quality of life. The quantity and quality of research are managed on a multiyear basis [30] which encourages greater autonomy for researchers to be able to produce research works according to the needs of the nation.

At the same time, clear priorities on the equity agenda and efforts to address worrying concerns are also critical. These include the inclusion of vulnerable and marginalized groups such as women, people with disabilities, minorities, and indigenous peoples. The Indonesia Vision 2045 document launched by the Ministry of Development Planning National and the National Development Planning Agency put forward four development goals that need to be designed properly and as early as possible. They are (i) Indonesian people are cultured with the ability to master S&T; (ii) advanced and sustainable economy; (iii) equitable and inclusive; and (iv) a democratic country that is clean and strong in development. The first three points rely heavily on knowledge-based development and innovation. Thus the strategy is best built on a foundation of science and technological innovations. Included are also innovation and knowledge as important components to development planning. Two example policies are highlighted.

The first policy example is the National Research Master Plan (NRMP) (also Rencana Induk Riset Nasional or RIRN) that was initiated through the Presidential Regulation Number 38 in 2018. The road map is designed to realize the national vision by 2045 in creating an Indonesian society that is innovation driven based on S&T and holds a research-based competitive edge globally [31].

RIRN has identified that countries with high economic growth are generally supported by contributions and technologies demonstrated by multifactor productivity. In this regard, Indonesia needs to increase its contribution to science and S&T to advance the country's economy. The development of S&T in the long term needs to be directed at improving quality and usefulness, and to support increased competitiveness globally by improving the quality and quantity of human resources. In the National Long-Term Development Plan (RPJP), several initiatives must be implemented to encourage the use of S&T improvements. The need for institutional reform for the knowledge, research, and innovation ecosystem is supported by funding for research and innovation activities, strengthening the system recognition of findings (royalties, patents, intellectual property rights), and product quality (SNI, ISOs). It is also necessary to apply quality standards that refer to the measurement system, standardization, testing, and quality (MSTQ), application of appropriate technology in production systems, implementation of total quality management (TQM) as well as the linkage of functional system to innovations in encouraging its institutionalization as an integral part of developing business activities [32].

The second policy is Law Number 11/2019 on National System of Science and Technology (UU Sisnas Science and Technology) that focuses on the needs of the research ecosystem to support Indonesia's institution and networks for invention and innovation development. The masterplan for the advancement of S&T is an instrument for realizing the objectives of the new regulation and serves as a reference for the S&T development. S&T institutions must work synergistically in creating and implementing inventions and innovations for the development and interests of the community. However, the lack of research puts a spotlight on the lack of literature on its enterprises [33]. This is yet another challenge in the implementation of various policies on science and S&T. However, an important note here is that the understanding of ecosystems is not yet complete to drive a knowledge-based

economy. As evidenced in the National Medium-Term Development Plan 2020–2024 and the RIRN, Indonesia is more concerned with commercialization and/or downstream of innovation and knowledge rather than effort. These stressed on the people to carefully build a knowledge and innovation ecosystem itself [34].

Weaknesses also include the lack of involvement of non-state actors in interpreting knowledge-based development and innovation. Technocratic perspective in the form of government policy needs to be coupled with the involvement of knowledge actors institutionally. According to the Indonesian Academy of Sciences (AIPI), Indonesia needs knowledge not only as a complementary tool to policy but rather as the core in the way of thinking about the society, environment, past, present, and future. The author selects the use of the terms knowledge, research, and innovation (not research, development, assessment, and application) as they are more general and already understood by the public. The Minister of Research and Technology/Head of the National Research and Innovation Agency also encouraged the simplification of terms into research and innovation in the Working Meeting Ministry at the end of 2020.

Borrowing the perspective offered by AIPI, the characteristics of useful knowledge appear in three ways: (i) science as a method or tool to find solutions for various problems in our lives; (ii) science as a frame of mind that elevates the human condition and capabilities; and (iii) science as a culture that provide a valuable foundation for human civilization [35]. All three act as a framework for knowledge-based economic development. In short, knowledge and innovation are needed as a fulcrum to ensure the achievement of Indonesia's Vision 2045. By using it optimally, the vision of shifting the extractive economy into a knowledge-based inclusive economy can be achieved. Moving forward toward knowledge-based economy, an innovation ecosystem and knowledge itself need to be recognized and its role clarified.

ISLAMIC REPUBLIC OF IRAN (IR IRAN)

Top Policies in S&T

S&T policies issued by the Supreme Leader of the Islamic Revolution Ayatollah Ali Khamenei in September 2015 is used as the roadmap for long-term plans at the national and sectoral levels. These policies are:

- Continuous scientific jihad to gain scientific and technological authority in the world with emphasis on:
  - Generating original scientific breakthroughs and development of innovation and theorizing
  - Promoting the country's global position in S&T and turning IR Iran into the focal point of S&T in the Islamic world
  - Developing basic sciences and basic research
- Transformation and promotion of humanities, especially deepening of religious knowledge and the principles of the Islamic Revolution by:
  - Strengthening the status and prestige of these sciences
  - Attracting talented and motivated people

- Correcting and revising texts, programs, and educational methods

- Improving the quantity and quality of centers and related research activities

- Achieving advanced sciences and technologies with special policies and plans

- Optimizing the performance and structure of the educational and research system of the country to achieve the goals of the National Vision and scientific prosperity with an emphasis on:

  - Knowledge and research management as well as integration in policymaking, planning, and strategic supervision in the field of S&T and continuous improvement of indicators and updating the comprehensive scientific map of the country, according to scientific and technical developments in the region and the world

  - Reforming the student admission system and paying special attention to the talent and interest of students in choosing the field of study and increasing the number of students entering postgraduate courses

  - Organizing and strengthening monitoring, evaluation, accreditation, and ranking systems in the fields of S&T

  - Organizing a comprehensive and efficient national system of statistics and scientific information, research, and technology

  - Supporting the establishment and development of S&T-centric areas and parks

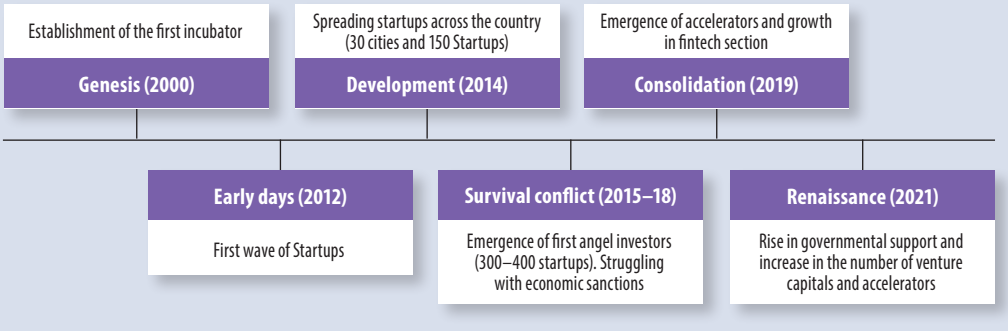
  - Fair distribution of opportunities and facilities for education and research in higher education throughout the country

Innovation Ecosystem in IR Iran

The first incubator in IR Iran was established in 2000 and although the progress in the past two decades has some flaws, the current innovation ecosystem in IR Iran has come a long way. This is achieved despite IR Iran's deep financial woes and political sanctions from western countries. The pressure has affected almost all aspects of the lives of the Iranian people as well as S&T. However, as shown in Figure 2.6, the innovation ecosystem in IR Iran has passed its initial life-cycle stages and is now ready to play a pivotal role in the national and regional economy.

FIGURE 2.6

IR IRAN'S INNOVATION ECOSYSTEM DEVELOPMENT JOURNEY

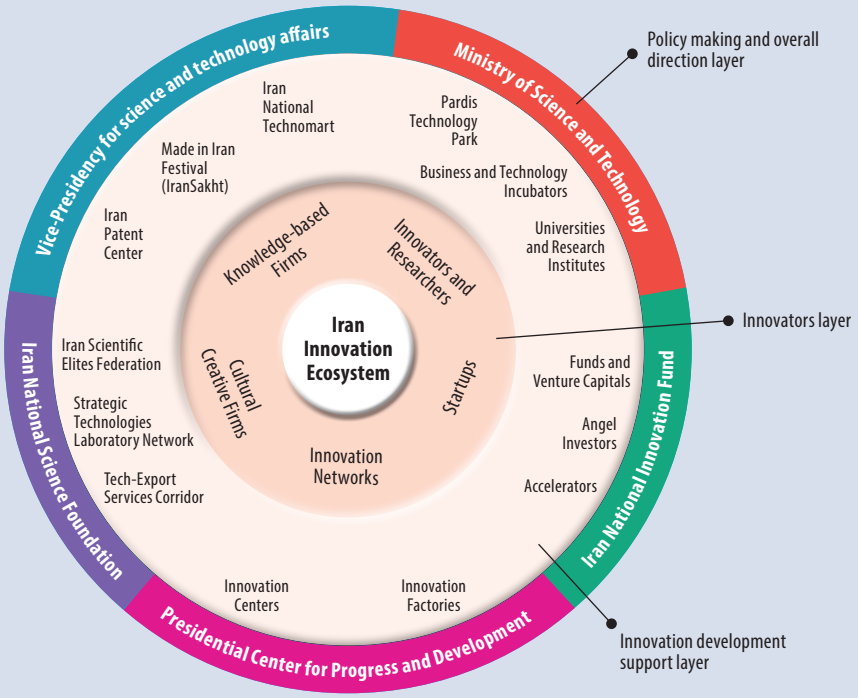


Elements of an Innovation Ecosystem in IR Iran

Elements of the innovation ecosystem in IR Iran is shown in Figure 2.7.

FIGURE 2.7

IR IRAN'S ELEMENTS OF INNOVATION ECOSYSTEM



PAKISTAN

After gaining independence in 1947, Pakistan had put forward two policies regarding S&T and innovation. The first policy was formulated in 1984 and the second in 2012. However, the extent of the policy implementation in the economy remains largely undocumented due to the lack of a monitoring mechanism. Hence a policy is under review to enhance the role of STI [36].

The government of Pakistan is determined to provide a conducive environment in which an innovation-led culture may flourish. Formulating innovation policy, establishing infrastructure and funds for R&D, start-up policy, technical standards and training systems, technology regulations, industrial policy, ease of doing business, energy policy and infrastructure, communication and transport infrastructure, trade policy, effects of globalization, international obligations and agreements are some of the major hard-pressed issues addressed by the government.

Realizing the importance of STI for the sustainable development of the country, the government has decided to include it in the main body of the constitution of Pakistan. Subsequently, a national STI management information system will be established.

Pakistan has prioritized UN's 17 Sustainable Development Goals (SDGs) as a member state and has targeted to achieve the ninth goal (i.e., industry, innovation, and infrastructure) in phase two through the interventions of STI [37].

Pakistan has improved its ranking marginally on the Global Innovation Index from 107th place in 2020 to 99th in 2021 [38]. However, Pakistan must apply policies that will address the weaknesses of its NIS [39].

The Intellectual Property Organization of Pakistan (IPO Pakistan) was strengthened in 2016 and Trade Marks Registry, Copyright Office, and the Patent & Design Office were brought under an integrated management system. In a landmark achievement, Pakistan signed a Service Level Agreement (SLA) with the World Intellectual Property Organization (WIPO) on 7 March 2022, which enables IPO Pakistan to have access to more WIPO facilities for improvement of its service delivery to intellectual property rights (IPR) applicants. It will be helpful for effective and efficient processing and examination of IP applications at IPO-Pakistan [40].

To promote technology-based innovation and entrepreneurship among students and professionals, the Higher Education Commission has taken the initiative to facilitate the establishment of ORICs (offices of research, innovation, and commercialization) and BICs (business incubation cells) in universities to promote research for transforming invention (knowledge) into innovation (product/process) and to create entrepreneurs (job creators instead of job seekers) for social uplift [41].

The outbreak of the COVID-19 pandemic brought enormous challenges to Pakistan's healthcare system, particularly the rising demand for ventilators. Pakistan Engineering Council (PEC) took the lead in indigenously developing innovative electromedical devices. Pakistan Innovation and Testing Center (PITC) was established to facilitate the product development process as well as to act as a creative hub to design, innovate, and incubate engineering goods and solutions. PITC initiated its first project called Pakistan Manufactured Ventilators System (PMVS) and provided a platform for engineers where they could register their designs for low-cost ventilators. PITC expedited the development process while ensuring the ventilator's quality through standardization and testing as well as articulated Acceptance Test Procedures (ATP) in collaboration with Drugs Regulatory Authority Pakistan (DRAP). Out of 57 designs received, 17 prototypes were shortlisted for evaluation, and seven ventilators were approved by PEC for industrial-grade production [42].

Collaboration between private firms and universities especially in the manufacturing sector remains low as firms generally develop very few new products. The situation is changing gradually as entrepreneurial initiatives are growing. Firms that are offering services in the field of computer-aided design (CAD), computer-aided manufacturing (CAM), computer-aided analysis & engineering (CAE), 3D printing/rapid prototyping, 3D scanning/reverse engineering, etc. are gradually increasing. Organizations, like Trojans (www.trosol.com), Quality Solutions (www.qualitysolutions.pk), Grit3D (www.grit3d.com), and ultimate CAD solutions (www.ucs-int.com), to name a few, are promoting innovative solutions through digital manufacturing.

Realizing the need to generate funds for assisting start-ups and encourage innovation, the government of Pakistan also established a national technology fund called "IGNITE" in 2007 which is funded by private telecom firms. IGNITE is a nonprofit organization that has established National Incubation Centers across all major cities of Pakistan to support and facilitate entrepreneurial initiatives in the health, education, energy, agriculture, telecom, and finance sectors [43].

There is a realization in the industry on the importance of innovation. But when it comes to managing innovation, there are no SOPs to guide players on how to launch, manage, measure, and learn from their investments in innovation.

ISO 56002 - Innovation Management Systems consultants are required in Pakistan. To overcome this, a firm offering consultancy and training services in Innovation Management System has been established. The firm is headed by a qualified and experienced professional with over 30 years of experience, having completed the first major training course on ISO 56002 Innovation Management Systems that was conducted by EICORN Academy in Sweden [44].

PHILIPPINES

Philippines recognizes S&T as "essential for national development and progress" that prioritizes "research and development, invention, innovation, and their utilization," as highlighted in Section 10 of the Philippine Constitution [45].

"SECTION 10. Science and technology are essential for national development and progress. The State shall give priority to research and development, invention, innovation, and their utilization; and to science and technology education, training, and services. It shall support indigenous, appropriate, and self-reliant scientific and technological capabilities, and their application to the country's productive systems and national life [46]".

Laws on Innovation

Recognizing the importance and role of innovation in driving national development and promoting sustainable economic growth and national competitiveness, the government has also written several laws on innovation.

Philippine Innovation Act (RA 11293): An Act Adopting Innovation as Vital Component of the Country's Development Policies to Drive Inclusive Development, Promote the Growth and National Competitiveness of MSMEs, Appropriating Funds Therefor, and for Other Purposes

The Philippine Innovation Act authorizes the government to adopt innovation policies according to Section 10, Article XIV of the Constitution [47]. The policies to be adopted include placing innovation at the center of the State's development policies; promoting a culture of strategic planning and innovation; investing in education, STIP; and engaging the business sector, academe, scientific community, and research institutions in innovation efforts for economic growth, among others.

The law creates the National Innovation Council (NIC), which will be responsible for developing the country's innovation goals, priorities, and long-term national strategy. NIC is composed of the president as chairperson, director general of the National Economic and Development Authority (NEDA) as vice chairperson, and other department secretaries as members.

Their tasks include developing a National Innovation Agenda and Strategy Document, which will establish the country's vision and long-term goals for innovation and provide a road map and strategies for improving innovation in government.

The Act, which was signed into law in July 2019, harnesses innovation efforts to help the poor and the marginalized, and enable MSMEs to be part of the domestic and global supply chain. The Philippine Innovation Act enhances the competitiveness of MSMEs as it will champion technological advancements in the country.

Among the salient features of its implementing rules and regulations (IRR) are the following [48]:

i) Promote a culture of strategies, planning to encourage creative thinking and monitoring of economic competitiveness; ensure effective coordination of innovation policies and programs; strengthen the position of MSMEs in the innovation ecosystem; suppress bureaucratic hurdles; encourage entrepreneurial attitude; strengthen partnerships between the public and private sectors, academe, MSMEs, and R&D institutes.

ii) Establish a national innovation council that serves as the policy advisory body in formulating and monitoring the country's innovation goals.

Philippine Technology Transfer Act of 2009 (RA 10055): An Act Providing the Framework and Support System for the Ownership, Management, Use, and Commercialization of Intellectual Property Generated from R&D Funded by Government and for Other Purposes

The Philippine Technology Transfer Act of 2009, which took effect in May 2010, makes R&D institutions the default owner of IPR, arising from the results of government-funded research [49].

This means scientists are now allowed to create, manage, or serve as consultants to companies that can commercially exploit technology arising from their government-funded research. Ownership of IPR in the Philippines has been subject to debate among scientists, their institutions, and funding agencies. RA 10055 is intended to clear up this ambiguity over the ownership of IPR to publicly funded research. It provides a financially rewarding environment for both the research institution and scientists.

The content of this law was largely inspired by the 1980 US Bayh-Dole Act. The act allowed universities and other institutions, rather than the government, to patent publicly funded research. Its supporters say it spurred innovation and led to the licensing of countless technologies that would otherwise have been ignored.

Critics have warned that the wholesale adoption of such legislation may not be appropriate for developing countries. One concern was that it might not be possible for innovations to be made accessible to the poor if exclusive marketing rights for a product are granted to a single firm. Safeguards should be included in similar legislation in developing countries to ensure that it works in the public interest. RA 10055 features safeguard mechanisms. This law specifically provides for government funding agencies, or for that matter, the government, to take control of the technologies or intellectual property rights if national interest is at stake.

Innovative Startup Act (RA 11337): An Act Providing Benefits and Programs to Strengthen, Promote, and Develop the Philippine Start-up Ecosystem

Signed into law on 26 April 2019, the Innovative Startup Act (RA 11337) provides benefits and programs to strengthen, promote, and develop the Philippine start-up ecosystem [50].

At the heart of this law is the creation of the Philippine Startup Development Program (PSDP) which is "composed of various programs, benefits, and incentives for start-ups and start-up enablers." The program is spearheaded by three government agencies: the Department of Science and Technology (DOST), the Department of Information and Communications Technology (DICT), and the Department of Trade and Industry (DTI).

The program covers start-ups that will develop "innovative product, process, or business model", indicating that while not necessarily limited to tech start-ups, it seems to lean toward this sector.

The law defines innovative products as "a good or service that is new or significantly improved," whether in terms of technical specifications, component materials, or product software. On the other hand, innovative processes include improvements in production or delivery methods, whether through technique, equipment, and/or software. Lastly, an innovative business model is defined as "a new organizational method in business practices, workplace organization, or external relations."

The program also covers start-up enablers, defined as the people who "provide goods, services, or capital identified to be crucial in supporting the operation and growth of start-ups."

In implementing rules and regulations (IRR), DICT, DOST, and DTI released a joint administrative order (JAO) in March 2021 on creating a steering committee for the implementation of the Innovative Startup Act and its IRR.

The committee, composed of a total of nine representatives from DICT, DOST, and DTI, will provide strategic guidance and oversight in the formulation, implementation and development of the Philippine Startup Development Program.

With the Covid-19 pandemic, even well-thought business continuity plans were not spared, demonstrating the need for innovation for businesses to survive. The Philippine Startup Development Program however will support start-ups from the formation of ideas and product development to marketing and expansion.

DICT, DOST, and DTI are authorized to provide the following benefits and incentives to start-ups and start-up enablers who have passed the selection and application process [51]:

- Full or partial subsidy for the registration and cost in the application and processing of permits and certificates required for the business registration and operation of an enterprise with the appropriate local or national government agencies
- Endorsement of the host agency for the expedited or prioritized processing of applications with other government agencies
- Endorsement to the Intellectual Property Office of the Philippines or IPOPHL for appropriate assistance and expedited intellectual property registration and protection, consistent with the law and existing rules and regulations
- Endorsement to the Department of Foreign Affairs for the expedited processing of appropriate travel visas
- Full or partial subsidy for the use of facilities, office space, equipment, and/or services provided by government or private enterprises or institutions
- Full or partial subsidy in the use of repurposed government spaces and facilities of the host agencies as the registered business address
- Grants-in-Aid or GIA for research, development, training, and expansion projects

Programs on Innovation

DOST-TAPI's Technology Innovation and Commercialization (TECHNICOM)

Technology Innovation for Commercialization (TECHNICOM) is one of DOST's flagship programs and implemented by the Technology Application and Promotion Institute (TAPI) [52]. It aims to fast-track the transfer and commercialization of locally developed innovations and technologies through financial and technical support from DOST and TAPI.

The program funds and assists R&D projects geared toward market readiness of local innovations and technologies. Priority for support has been given to pre-commercialization activities of technologies generated from DOST-funded R&D breakthroughs.

TECHNICOM hopes to stimulate technological innovation, strengthen capacity in pursuing pre-commercialization activities, increase private-sector adoption and commercialization of government-initiated R&D outputs, and maximize benefits from government investments in R&D activities. As a holistic approach of packaged assistance for local innovations and technologies, TECHNICOM envisions:

- A S&T community motivated to innovate
- Increased commercialization and industry adoption of generated technologies
- Maximized benefits from government investments in S&T activities
- Contribution to the country's sustainable economic progress and development

DOST-TAPI's Venture Financing Program (VFP)

TAPI's VFP aims to accelerate the commercialization of innovative technologies/inventions by providing the necessary funding support to startups, SETUP beneficiaries, and other MSMEs [52]. The program shall determine and package the commercialization activities needed for a particular technology.

The Program has the following special facilities that provide distinct services to MSMES:

- **VFP for Start-up Companies** - Utilizing emerging technologies and/or innovative technologies to improve production efficiency, increase income and sales, and improve product quality through the acquisition of required production equipment
- **Venture Financing for Environmentally Sound Technologies (VFEST)** - For the utilization of cleaner production technologies and/or equipment to comply with the environment-related clearances/permits, such as Environmental Clearance Certificates, Health and Safety Clearances, Sanitary Permits, Clean Air Act Certificate, Laguna Lake Development Authority Clearance, etc.
- **Support for Adoption of DOST-Generated Technologies** - Acquisition of required production equipment needed by the technology transferee to commercialize its adopted DOST-generated technologies
- **Purchase Order Financing** - Acquisition of raw materials needed to produce the required quantity/volume of products/goods, as reflected on the irrevocable POs submitted by the SETUP and TAPI beneficiaries
- **Fees for Certification of Local/International Standards** - To enter the local and international market for DOST-funded technologies only

Fairness Opinion Report

According to the Revised Implementing Rules and Regulations of Republic Act 10055 or the Technology Transfer Act of 2009, the Fairness Opinion Board (FOB) is lodged at DOST's regional offices. FOB provides the DOST Secretary with a Fairness Opinion Report (FOR), an assessment on whether a proposed technology transfer agreement between a R&D institute (RDI) and a technology adopter or business is fair to the government. A FOR is done whenever publicly funded R&D outputs are commercialized [52].

The RDI or the government funding agency (GFA) that is the owner of the technology will apply for a FOR to the DOST Regional Director. The RDI can be a state university or college, a government research center, or even a private research institute that received government funds for the generation of the subject technology [53].

SINGAPORE

Smart Nation Initiative 2030 and Digital Economy Framework for Action

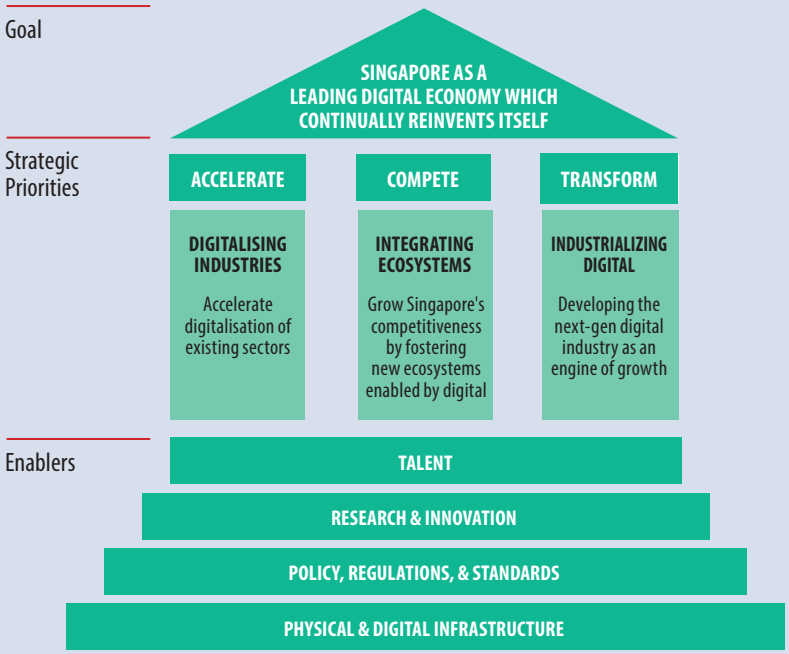
Smart Nation 2030 is the key initiative by the government in utilizing technology in all areas of life. It was launched in 2014 and is coordinated by the Smart Nation and Digital Government Group (SNDGO) and the government technology agency which both operate under the Prime Minister's Office. By 2017, a total budget of SGD2.4 billion had been allocated toward the purchasing of services offered by tech start-ups. This approach thus does not leverage the usage of grants to these companies, but rather through the assignment of tenders.

It ties in with the Green Plan 2030, which covers sustainability and the fight against a changing climate. The pillars of Smart Nation are the digital proficiency of all members and stakeholders of society, the economy, and the government [54].

The digital society and government form the inclusive basis of digital competency and foresighted policies to ensure that the economy can enhance technological infrastructure and drive business growth. The latter is to be achieved following the "digital economy framework for action" to accelerate and transform industry digitization and integrate competitive ecosystems. Acceleration of industry transformation is guided through Industry Transformation Roadmap. This will be further expanded in Figure 2.8.

FIGURE 2.8

SINGAPORE'S INDUSTRY TRANSFORMATION ROADMAP [55]



The key enablers of this development, as seen in Figure 2.9, are the upskilling and increasing the competence of local and internal talent, policies/regulations and standards ensuring global competitiveness, a robust physical and digital infrastructure, and lastly, research and innovation as well as the fostering of an innovation community.

Notable innovations which have been implemented successfully in the community are the utilization of smart and digital payment methods for public transportation and hawker centers, tracking (Trace Together) and monitoring infrastructure (Vigilant Gantry), and digitizing of medical data (HealthHub) and remote medical consultation (Telehealth) that were introduced and implemented to tackle the COVID-19 pandemic and any further health crisis in the future [56].

Singapore's Industry Transformation Map (ITM)

Singapore's Future Economy Council (FEC) spearheaded the launch of 23 Industry Transformation Maps (ITMs) in 2016. Under the SGD4.5 billion Industry Transformation Programme, roadmaps are developed to address issues within each industry and deepen partnerships between government, firms, industries, trade associations, and chambers (Figure 2.8) [57].

FIGURE 2.9

SINGAPORE'S INNOVATION ECOSYSTEM

Rationale for ITMs

Externally, Singapore faces challenging economic conditions, rising competition, and disruption from technological advances. Domestically, land and manpower constraints grow more pressing. While the government will continue its support at the enterprise and worker levels, a more intensive attention was needed to look into industry-centered strategy in making it more systematic and coordinated.

The integrated approach is necessary as:

- Increasingly complex challenges will require cross-cutting solutions from multiple agencies and stakeholders working together
- Strategies that can upgrade a significant proportion of the industry, to move the productivity and innovation needle needs to be developed
- The industry itself, both the corporates and unions/workers, needs to take ownership of the transformation effort and sustain it

Under the program, there are ITMs developed for 23 industries under six clusters that cover over 80% of Singapore's GDP [58]:

1. Manufacturing
    - Precision Engineering
    - Energy & Chemicals
    - Marine & Offshore
    - Aerospace
    - Electronics
2. Built Environment
    - Construction
    - Real Estate
    - Security
    - Environmental Services
3. Trade and Connectivity
    - Air Transport
    - Logistics
    - Land Transport
    - Sea Transport
    - Wholesale Trade
4. Essential Domestic Services
    - Healthcare
    - Education
5. Modern Services
    - Professional Services
    - Financial Services
    - ICT & Media

6. Lifestyle

   - Food Manufacturing
   - Food Services
   - Hotel
   - Retail

Integrated Approach to Develop Skills, Innovation, and Productivity

Each ITM will consist of a growth and competitiveness plan, supported by four pillars:

- **Productivity** - Strategies to support companies especially the SMEs to move to higher value-added (VA) activities and raise operational efficiency
- **Jobs & Skills** - Investing in the people, to equip them with deep skills to support the shift to greater value creation
- **Innovation** - Strategies to leverage R&D to develop new products and services
- **Trade and Internationalization** - Supporting companies in expanding to overseas markets

The ITMs will also address the government's role as facilitator and enabler of industry upgrading. For example, by creating a regulatory environment conducive to innovative business models or a set of national standards to promote technology adoption.

ITM 2025

The FEC, chaired by Heng Swee Keat, Deputy Prime Minister, Coordinating Minister for Economic Policies, and Minister for Finance, convened the first meeting on 30 April 2021 to embark on ITM 2025 to refresh ITMs and develop new strategies for a post-COVID-19 world [59].

Since the launch of the ITMs in 2016, the transformation efforts have achieved good results. Singapore's overall labor productivity increased by 2.7% per annum from 2016 to 2019, compared to 2.2% per annum in the preceding three years. This has translated into the creation of quality jobs and higher wages with real median income from the work of full-time Singaporeans increasing by 3.7% per annum for the same period, compared to 3.2% in the preceding period.

However, the progress has been disrupted by COVID-19. The pandemic has also accelerated longer-term structural trends, such as a changing global order, reconfiguration of supply chains, digital and technological transformation, changes in consumer preferences, and an increased focus on sustainability. To address the systemic shifts and seize new opportunities brought about by COVID-19, the FEC will build on the progress of the past five years, to chart a new way forward for the next five years, through ITM 2025.

Under ITM 2025, each of the 23 items will be refreshed, by reviewing the existing ITMs and updating the sectoral strategies, to meet the accelerated changes arising from the changing operating environment. The FEC will work closely with its tripartite partners on ITM 2025, which will be strengthened by three new thrusts.

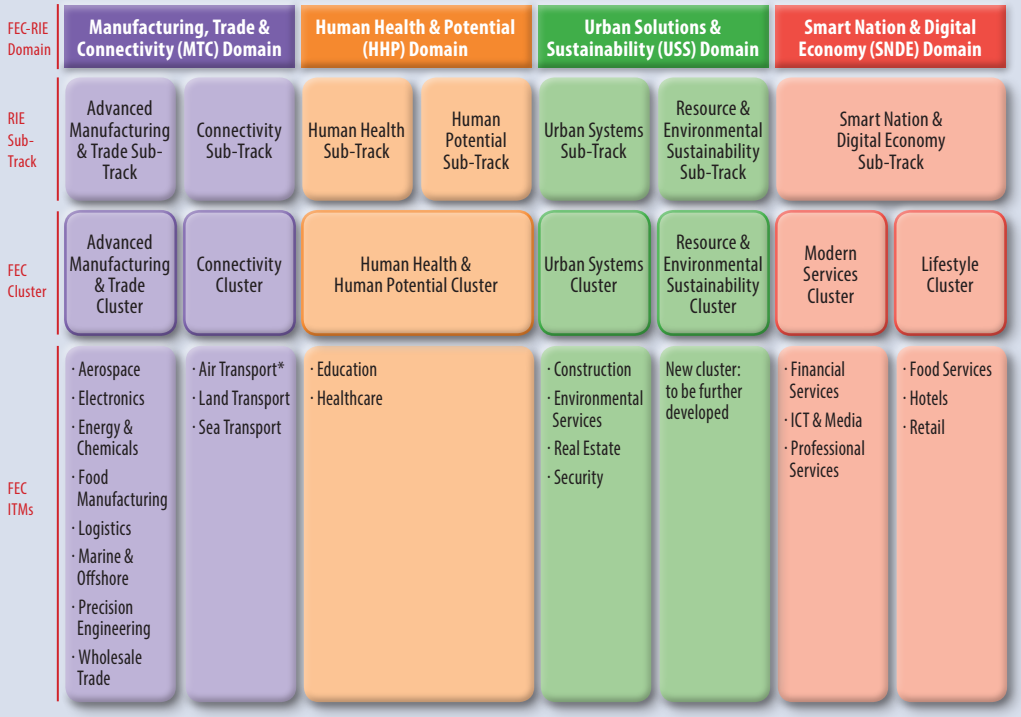
First, recognizing that innovation is and will continue to be critical to the next round of Singapore's industry transformation and economic growth, the work of the FEC will be closely integrated with the Research, Innovation, and Enterprise (RIE) 2025 Plan. To that end, the FEC structure has been reviewed to foster greater alignment between the RIE investments in national priorities, such as healthcare and education as well as industry needs identified by the FEC, to better translate its R&D efforts into meeting the national needs and to create economic opportunities for all.

Under this new structure, the FEC will be supported by seven FEC Clusters, aligned to the four RIE domains (Figure 2.10). The seven FEC Clusters are [59]:

- Advanced Manufacturing and Trade, comprising the Aerospace, Electronics, Energy and Chemicals, Food Manufacturing, Logistics, Marine and Offshore, Precision Engineering, and Wholesale Trade ITMs
- Connectivity, comprising the Air Transport, Land Transport, and Sea Transport ITMs
- Human Health and Potential, comprising the Education and Healthcare ITMs
- Urban Systems, comprising the Construction, Environmental Services, Real Estate, and Security ITMs
- Resource and Environmental Sustainability, a new Cluster which is being further developed
- Modern Services, comprising the Financial Services, ICT and Media, and Professional Services ITMs
- Lifestyle, comprising the Food Services, Hotels, and Retail ITMs

FIGURE 2.10

SINGAPORE'S FEC-RIE STRUCTURE [59]



**Reflected as Aviation for RIE2025.*

Second, ITM 2025 will build on the work of the Emerging Stronger Taskforce (EST), in forging Singapore's path toward post-pandemic recovery. In particular, the EST's Singapore Together Alliances for Action (AfAs) have demonstrated the strength of a new and more nimble form of partnership, underpinned by a boldness to experiment and a bias to action. For example, to enable Singapore to reconnect with the world safely and progressively, the AfA on Enabling Safe and Innovative Visitor Experiences brought together government and industry stakeholders to develop a prototype for safe business events for up to 2,500 attendees. The AfA also developed safe leisure itineraries, introduced enablers, such as an inbound travel insurance product, and a digital concierge to facilitate safe travel.

Third, ITM 2025 will see a greater focus on jobs and skills, supported by initiatives, such as the Next Bound of SkillsFuture. The FEC will continue to strengthen its partnership with tripartite partners. Through this, ITM 2025 aims to uplift the productivity and wages of the workers, create good jobs for Singaporeans in the years ahead, and prepare the workforce to take on such roles. More details will be announced as the refreshed ITMs are gradually rolled out.

Singapore's National Research Foundation - Research, Innovation and Enterprise 2025 Plan

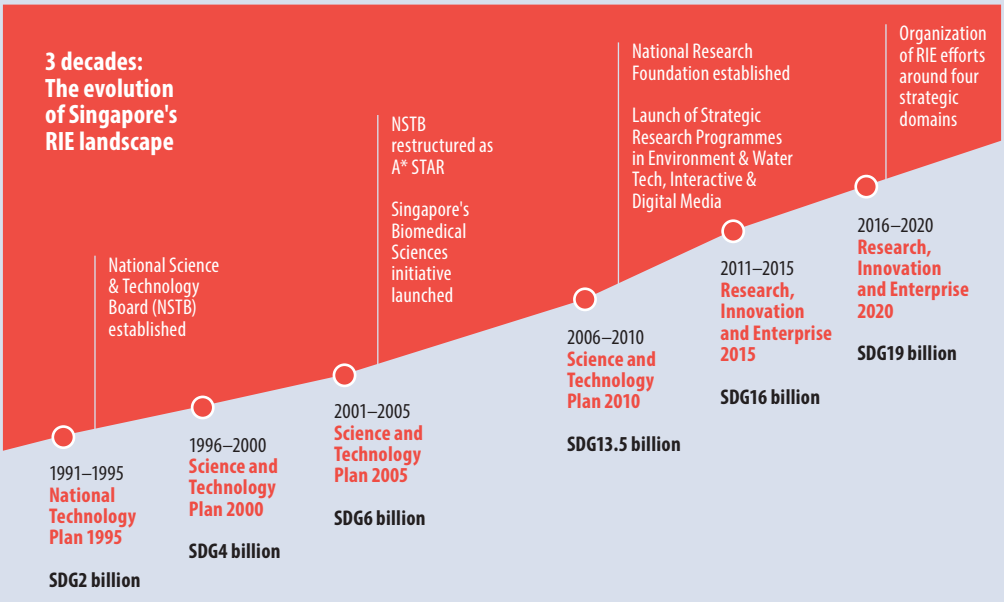
The National Research Foundation, Singapore (NRF), set up on 1 January 2006, is a department within the Prime Minister's Office. The NRF sets the national direction for R&D by developing policies, plans, and strategies for research, innovation, and enterprise. It also funds strategic initiatives and builds up R&D capabilities by nurturing research talent.

S&T are instrumental to Singapore's survival and success and have helped Singapore to overcome the constraints of its small size and limited resources.

Singapore's R&D journey started in 1991, with the establishment of the National Science and Technology Board, and the launch of the first five-year National Technology Plan. The aim was to develop high technology activities that would move the country up the economic value chain and build a strong base

FIGURE 2.11

SINGAPORE'S LANDSCAPE [60]



of scientists, engineers, and technologists who would help to drive economic and enterprise transformation. These plans would be refreshed every five years to position Singapore as an innovation-driven, knowledge-based economy.

In 2010, Singapore's R&D strategy was expanded to span RIE. The RIE2015 and RIE2020 plans included translation, commercialization, and innovation strategies to tap on the growing pipeline of promising research outputs and support its enterprises [60].

Given the rapidly evolving global and technology landscape, RIE plans have also evolved to include White Space funding for unanticipated needs and opportunities. This has enabled Singapore to respond nimbly to new priorities, and seed capabilities in critical, but then-nascent technology areas, such as cybersecurity and food (Figure 2.11).

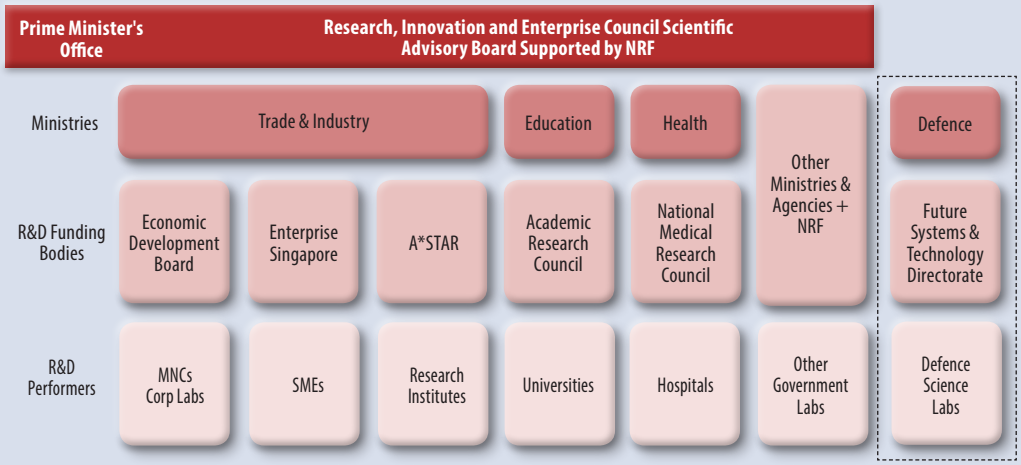
The Research, Innovation, and Enterprise (RIE) Ecosystem

The RIE ecosystem in Singapore comprise various ministries, R&D funding bodies, and R&D performers.

At the top is the Research, Innovation and Enterprise Council (RIEC), chaired by the Prime Minister, which oversees the long-term strategy to transform Singapore into a knowledge-based society, with strong capabilities in research and technology. The RIEC is supported by the NRF Board, which is responsible for the formulation of the five-year plans and policies to grow Singapore's research capability, support economic growth, and meet Singapore's future national challenges (Figure 2.12).

FIGURE 2.12

SINGAPORE'S RIE HIERARCHY [60]



Vibrant and Dynamic Innovation & Enterprise (I&E) Ecosystem

Singapore has a vibrant and dynamic I&E ecosystem. Since 2014, Singapore has maintained its position as the top innovative nation in the Asia-Pacific on the Global Innovation Index, an annual ranking of 130 economies compiled by the World Intellectual Property Organization, Cornell University, and INSEAD. Private-sector R&D activity has increased steadily, with annual business expenditure on R&D growing from SGD1.5 billion in 1998 to SGD5.6 billion in 2018.

Global companies have invested strongly in Singapore, creating vibrant industry clusters, enabling knowledge transfer to local enterprises, and creating good jobs for Singaporeans. 80 of the world's top 100 tech companies have established a presence here, including Google and Facebook. Through platforms, such as corporate laboratories and technology consortia, RIE capabilities have also helped to hone the competitiveness of Singapore's local enterprises in the global economy through the development of differentiating capabilities. For example, local engineering companies, such as Abrasive Engineering and 3D Metalforge have tapped on RIE partnerships to digitalize their capabilities and provide new service offerings to their customers. The country's start-up ecosystem has also grown in vibrancy, with about 36,000 start-ups choosing to locate themselves in Singapore. Many of these tech start-ups have formed strong RIE partnerships to build deep technology capabilities and access a skilled workforce and international networks of partners and markets.

Focus Areas in RIE2025

Expand RIE Mission to Tackle a Broader Spectrum of National Needs

Ongoing RIE efforts are coordinated under four domains to achieve a better pull-through of S&T to specific industry sectors, such as manufacturing and healthcare. With S&T becoming more pervasive across the economy and society, the scope of the four RIE domains include:

- Manufacturing, Trade, and Connectivity, which will expand beyond the manufacturing sectors to raise capabilities in the trade and connectivity sectors (e.g., aviation, sea transport, logistics, and wholesale trade)

- Human Health and Potential, which will expand to include Human Potential, with a focus on enhancing development during pregnancy and early childhood, augmenting learning outcomes, and fostering healthy and meaningful longevity

- Urban Solutions and Sustainability, which will address new challenges in sustainability and resilience, including climate change, decarbonization, healthy cities, and transformation of the country's built environment

- Smart Nation and Digital Economy will develop capabilities to prepare people for opportunities in the digital space and transform the enterprises. Efforts are also made to further the country's strengths in strategic technologies to enhance resilience and anchor Singapore's position as a trusted digital innovation hub

Enrich Singapore's Scientific Base

Sustained investment in scientific excellence is essential to growing Singapore's base of capabilities. RIE2025 aims to maintain Singapore's strong support for basic research. This will allow the country to build up a critical mass of top research talent working on challenging research questions, forming a strong base of knowledge and capabilities for transformative innovations.

RIE2025 will also continue to take a portfolio approach to research funding to ensure targeted support for the various segments of the research ecosystem. In RIE2025, the government will increase support for investigator-led grants to encourage bottom-up research ideas and sustain a healthy research ecosystem. They will also increase funding for medium-sized grants to bring together capabilities that have sufficient scale for impact. They will strengthen interdisciplinary research needed to address complex challenges, such as climate change, and in novel and emerging areas, such as materials informatics, nanoelectronics, and nutri-epigenetics.

Scale-up Platforms to Drive Technology Translation and Strengthen the Innovation Capabilities of Singapore's Enterprise

I&E platforms have been effective in supporting industries to translate R&D into new products, services, and solutions for the market. For example, the Diagnostics Development Hub at the Agency for Science, Technology, and Research accelerated the development and regulatory approval of novel diagnostics solutions for global market adoption, such as the Resolute series test kits for COVID-19. The National Additive Manufacturing Innovation Cluster has also engaged over 1,800 organizations and catalyzed over 230 projects, to accelerate additive manufacturing applications across many industry sectors, including aerospace, maritime, and logistics.

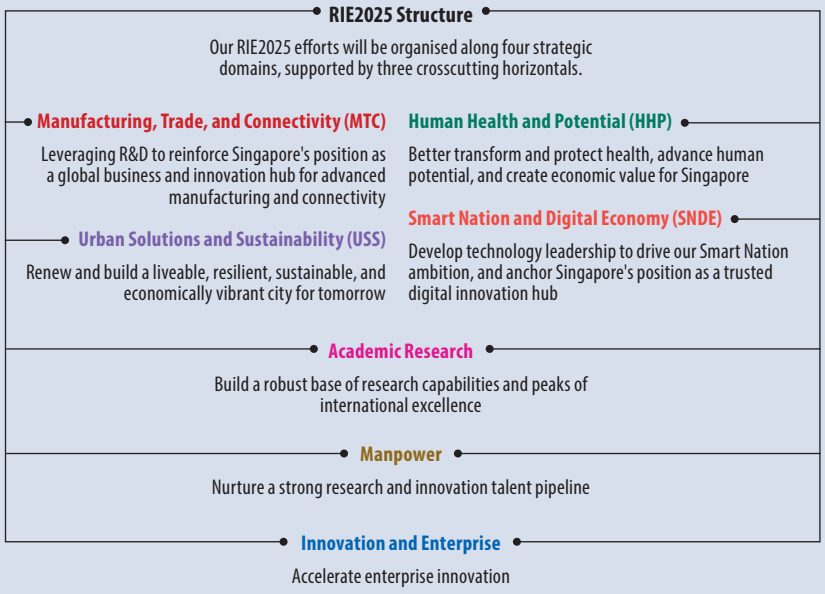
RIE2025 aims to scale up these I&E platforms to expand its reach and support local enterprises in technology translation and commercialization, and support existing platforms to move into adjacent areas with high growth potential.

New platforms will also be established to tap into Singapore's deep R&D strengths and bridge ecosystem gaps. These platforms will complement other initiatives, such as technology consortia and corporate laboratories, to increase the base of enterprises engaging in RIE, and strengthen their innovation capabilities.

The RIE2025 plan also targets to grow the pool of talent in Singapore who can help bring nascent technologies to market and enhance the innovative capacities of the enterprises. RIE manpower schemes will be enhanced to gather and nurture 'bilingual' talent who have both technical and business expertise. Opportunities for on-the-job training through internships and traineeships in A*STAR Research Institutes and corporate laboratories sited in Singapore's autonomous universities will further develop their knowledge and skills, and facilitate strong networks across industry, academia, and government (Figure 2.13).

FIGURE 2.13

SINGAPORE'S RIE2025 [60]



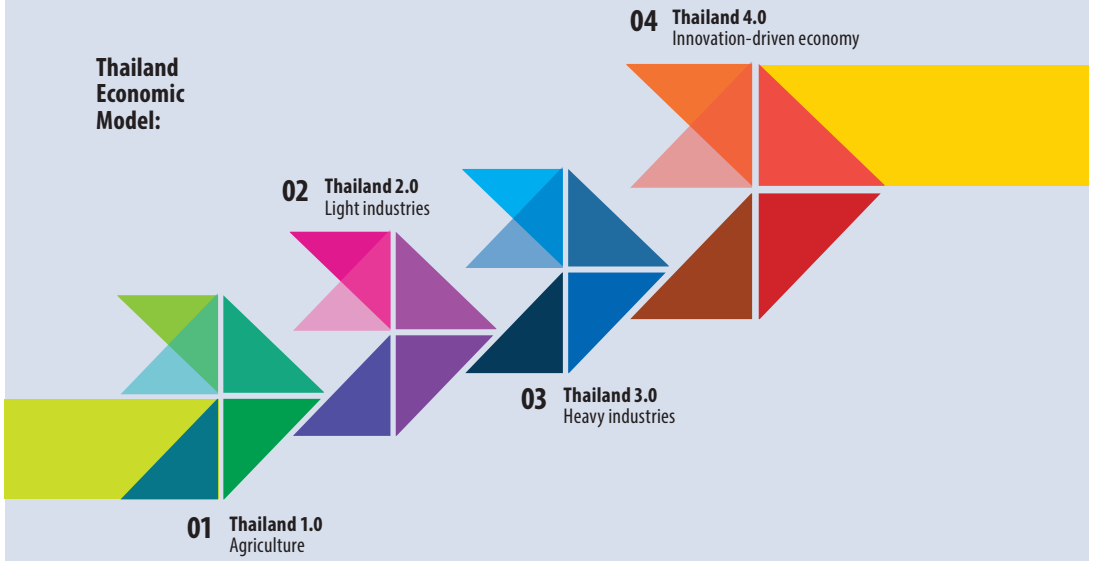
THAILAND

Thailand 4.0 and National Strategy 2018–2037

In 2016, the Thai government announced a new plan called "Thailand 4.0" which is an economic framework and goals aiming to transform the Thai economy from heavy industries (Thailand 3.0) into an innovation-driven economy (Figure 2.14) [61]. The plan consists of several policies and initiatives including the designation of 10 targeted S-curve industries, development of the Eastern Economic Corridor (EEC), and promotion of R&D investment and proper environment for the promotion of science, technology, research, and innovation [62].

FIGURE 2.14

THAILAND 4.0



Source: The Board of Investment of Thailand

In 2018, under the new Constitution of Thailand, the National Strategy Committee chaired by the Prime Minister developed the National Strategy (2018–2037), which became the first national long-term strategy for Thailand. It stipulates the country's vision as "to become a developed country with security, prosperity, and sustainability following the Sufficiency Economy Philosophy". It consists of six key strategies; (i) national security; (ii) national competitiveness enhancement; (iii) human capital development and strengthening; (iv) social cohesion and just society; (v) eco-friendly development and growth; and (vi) public-sector rebalancing and development [63]. These strategies, especially on national competitiveness enhancement, provide the basis for other national policies and strategies on innovation and innovation management.

Current Status on STI

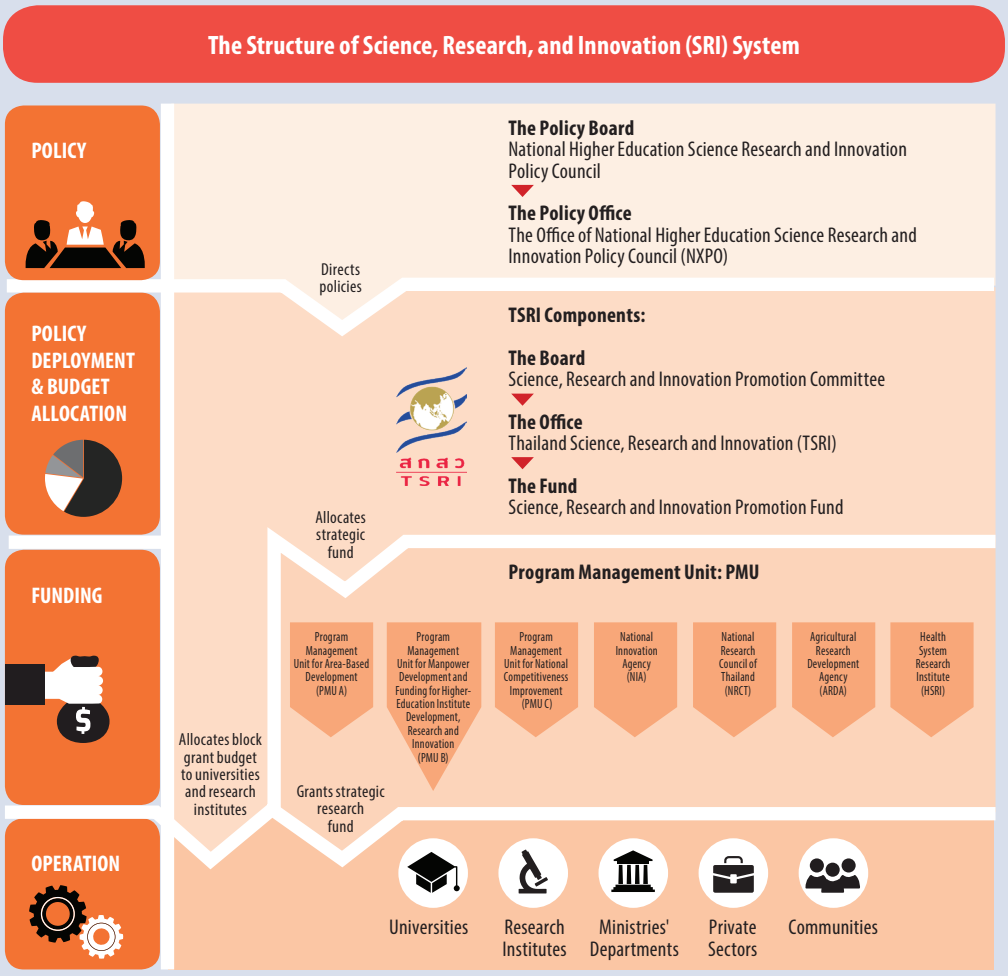
In 2021, Thailand improved a rank to the 28th position out of 64 countries for national competitiveness, according to International Institute for Management Development (IMD). In terms of scientific infrastructure competitiveness, which is one of the criteria in the overall ranking, Thailand was in the 38th position with these performance indicators, among others [64]:

- Total R&D expenditure as a percentage of GDP (GERD): 1.14% (2020: 1.11%)
- Total R&D expenditure from private sector: USD4,807 million (2020: USD4,426 million)

In terms of GERD, it should be noted that Thailand has seen a substantial growth in the last decade. GERD during 2000–2009 was stagnant at around 0.25% but increased rapidly within 10 years to 1.11% in 2020. This growth resulted mainly from the increased investment from the private sector, which grew 15 folds from 2009 to 2018 and now accounts for about 80% of all R&D expenditure in Thailand. The public-sector R&D investment, on the other hand, increased at a slower rate and now accounts for only 20% of all R&D investment [65].

FIGURE 2.15

THAILAND'S CURRENT STRUCTURE OF SCIENCE, RESEARCH, AND INNOVATION (SRI) SYSTEM



Source: Thailand Science Research and Innovation

Higher Education, Science, Research and Innovation System Reform 2019

In 2019, the Thai national innovation system underwent a major system reform with the formation of the Ministry of Higher Education, Science, Research and Innovation (MHESI), which is the merger of the

Ministry of Science and Technology, universities (formerly under the Ministry of Education), and several funding agencies. This reformation aims to streamline and improve the national policy and budgeting system on higher education, science, research, and innovation by reassigning roles and responsibilities of various related agencies into four main roles: policy, policy deployment & budget allocation, funding, and operation (Figure 2.15) [66].

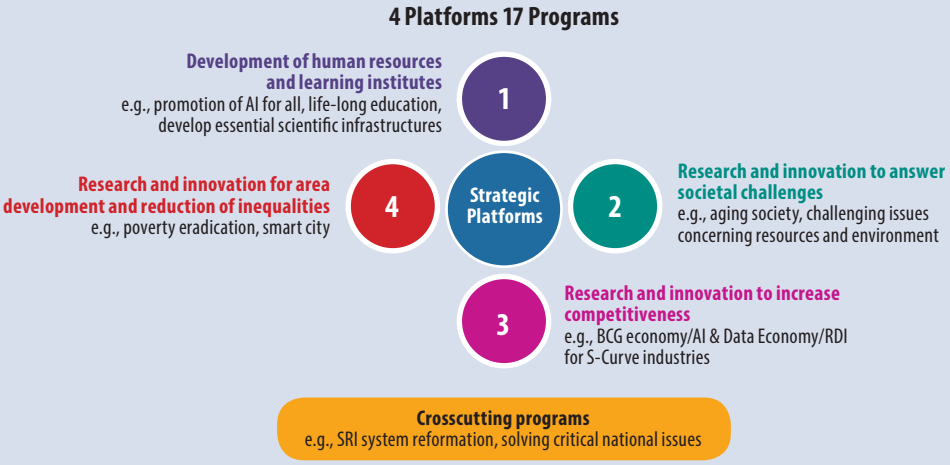
The reformation also created the Higher Education, Science, Research and Innovation Council, which is chaired by the Prime Minister and joined by 10 other ministers. The aspiration for this Council is to promote better collaboration between ministries and strengthen the national innovation system to be more unified and streamlined. The early result suggests that although there have been many improvements in place, there are still other major issues that must be addressed, such as clear communication between agencies, development of shared database systems, and better relationship between the higher education institutes and STI agencies [65].

Science, Research, and Innovation (SRI) Plan 2020–2022

SRI Plan 2020–2022 is the main document regarding public policy on innovation and innovation management in Thailand. The plan is for three years but is revised every year. Currently, it consists of four platforms and 17 programs, as shown in Figure 2.16 [66]. The plan had 16 programs originally but after COVID-19 in 2020, the 17th Program "Solving critical national issues" was added to address the pandemic.

FIGURE 2.16

THAILAND'S SRI PLAN 2020–22 - FOUR PLATFORMS AND PROGRAM EXAMPLES



Source: Thailand Science Research and Innovation

ISO 56002:2019 in Thailand

Since the ISO 56000 Standards series are still relatively new, most companies are still in the process of learning about them or applying to be certified. As of December 2021, two Thai organizations have received ISO 56002:2019 certification. The first is Charoen Pokphand Foods Public Company Limited or CP Foods, which is a leading company in the agro-industrial and food industries. CP Foods received certification on 30 October 2020 and became the first organization in Thailand to do so [67]. The second organization is the School of Integrated Innovation, Chulalongkorn University (ScII), receiving ISO 56002:2019 certification on 23 October 2021 for its BAScii (Bachelor of Arts and Science in Integrated Innovation - four-year courses) that started in 2019 and Student Innovation Projects of BAScii [68].

VIETNAM

In Vietnam, the Law on Technology Transfer and Decree 76/2018/ND-CP stipulated content on:

- Supporting creative start-up ideas
- Recognizing property rights to ownership, right to use, and other rights arising from the results of scientific research and technological development, and permit the use of this right as security for investment loan transactions and investment for innovative start-ups
- Organizations and individuals investing in and supporting innovation start-ups are entitled to tax incentives
- Policies to promote individuals and groups of individuals to start up innovation
- Organizations to support start-ups and use the results of scientific research and technological development
- Building technical infrastructure and supporting the operation of the national technology start-up support center

In the period 2011–2015, the number of applications for patents and utility solutions increased by about 1.75 times compared to the period 2006–2010, exceeding the target set out in the government strategy. Specifically, the number of applications for registration of inventions and utility solutions in 2011–2015 was 2,196 and 1,174 (total is 3,370), compared to 1,927 in 2006–2010. The number of patents and utility solutions was 243 and 331, respectively (total is 574).

In 2016–2020, the number of applications and patents, and utility solutions increased by 1.6 times and 1.7 times, respectively, in comparison to the 2011–2015 period. Specifically, the number of applications for registration of inventions and utility solutions for the period 2016–2020 was 3,538 and 1,849 (total is 5,387) while the number of patents and utility solutions was 698 and 953 (total of 1,651).

The 10-year socioeconomic development strategy 2021–2030, Resolution 23-NQ/TW dated 22 March 2018, is to formulate the national industrial development policies to 2030, toward vision 2045. Resolution 20-NQ/TW looks into S&T development to elevate the industrialization and modernization of the industrial sector of the country. The aim is also to escalate the socialist-oriented market economy's total industrial output while encouraging international integration. The Conclusion 50-KL/TW is to continue the implementation of Resolution 20-NQ/TW. The mechanisms and policies to actively participate in IR 4.0 make up Resolution 52-NQ/TW. The target is for the digital economy to contribute 30% to the GDP by 2030. The Resolution also incorporates the National Strategy on Industry 4.0, Strategy on Intellectual Property and National Digital Transformation Program to be realized by 2030. The Decision 681/QD-TTG dated 4 June 2019 promulgates a roadmap for the implementation of Vietnam's sustainable development goals until 2030.

By 2030, the number of international publications in Vietnam will double compared to 2020. The number of patent applications and patent protection titles is expected to increase by an average of 16%–18% per year; the number of applications for plant variety protection to go up by an average of 12%–14% a year, out of which 10%–12% are registered for protection abroad. The rate of commercially exploited inventions should be at 8%–10% from the total number of patents granted protection titles. Vietnam has developed a national quality infrastructure (NQI) to meet the requirements of strong international integration on quality measurement standards, belonging to the top 50 countries in the world.

The government is building and developing innovation ecosystems in the industries, agriculture, and services sectors that are associated with domestic and global value chains as well as industry clusters, in which large enterprises play a significant role in leading innovation activities. State management agencies have the role in creating a favorable institutional environment, policies, linkages between enterprises, production organizations, research institutes, universities, and supporting organizations to promote research, application, and innovation activities.

Building and developing a system of innovation centers including the National Innovation Center, regional and industry innovation centers, and innovative start-up support centers are also part of the country's agenda. These centers are to be integrated to form clusters of innovation links with high-tech zones, residential areas, financial centers, venture capital funds, universities, and research institutes.

Vietnam also actively deploys open innovation platforms and open innovation networks to attract investments from domestic and foreign resources for basic and applied research works as well as for the creation, experimentation, and implementation of new technologies and new products, including forming of new businesses.

The focus is also to establish cooperation and communication, carry out promotional activities, strengthen the connection of innovation networks at home and abroad, and a link between innovation centers and R&D centers at home and abroad.

Under the Department of Science and Technology, functions and tasks are to be improved while efforts are directed to increase investment in human resources, financial, and infrastructure for the centers for advanced application of S&T in the effort to transform the centers in becoming the focal points to support and promote technology transfer and innovation activities in various localities.

The main tasks and solutions consist of nine segments:

i) Revamp the mechanism of STI activities and improve the state management capacity in STI

ii) Build a national innovation system

iii) Attract and effectively using all investment resources for STI

iv) Develop research institutions, universities, and other S&T organizations into becoming strong research actors

v) Develop human resources for STI with high qualifications and creative capacity

vi) Attract investment and effectively utilize STI infrastructure

vii) Promote STI activities in enterprises

viii) Actively promote international cooperation and integration in STI

ix) Strengthen activities to honor, communicate, and raise awareness about STI

CHAPTER 3

ASSESSMENT OF INNOVATION MANAGEMENT CAPABILITIES

In this Chapter, the assessment of innovation management capabilities that were conducted through surveys in 10 selected APO member economies is described with descriptive and inferential analysis. Different aspects of the assessment analyzed by national experts are discussed and key findings are presented.

METHODOLOGY

With the ISO 56002 standard on innovation management, it is now easier to measure the standard's highlighted elements with the actual practice of enterprises in innovation management. Based on the scope of the standard, it is partly used to assess an organization's ability to innovate while the content of the standard can be used to conduct qualitative surveys to derive information on an enterprise's activities in innovation management.

The research process is based on the following methods: document study, analysis, and survey. The surveys are structured around eight areas identified by the ISO 56002 standard. Participants will rate the importance and performance of each type of innovation. There are 24 criteria in total. The surveys conducted are semi-structured with open-ended questions based on the survey guidelines in Appendix 1.

The survey guide has eight principles that form the foundation for managing innovation activities in organizations. They are:

i) **Realization of value** - Value, financial or nonfinancial, is realized from the deployment, adoption, and impact of new or changed solutions for interested parties

ii) **Future-focused leaders** - Leaders at all levels, driven by curiosity and courage, challenge the status quo by building an inspiring vision and purpose, and by continuously engaging people to achieve those aims

iii) **Strategic direction** - The direction for innovation activities is based on aligned and shared objectives and a relevant ambition level, supported by the necessary people and other resources

iv) **Culture** - Shared values, beliefs and behaviors, supporting openness to change, risk taking, and collaboration enable the coexistence of creativity and effective execution

v) **Exploiting insights** - A diverse range of internal and external sources are used to systematically build insightful knowledge, to exploit stated and unstated needs

vi) **Managing uncertainty** - Uncertainties and risks are evaluated, leveraged, and then managed by learning from systematic experimentation and iterative processes within a portfolio of opportunities

vii) **Adaptability** - Changes in the context of the organization are addressed by timely adaptation of structures, processes, competences, and value realization models to maximize innovation capabilities

viii) **Systems approach** - Innovation management is based on a systems approach with interrelated and interacting elements and regular performance evaluation and improvements of the system

For each area, there are between one to five questions covering key points of interest. The survey begins by briefly stating the research objectives as well as the content of the survey. In these cases, for each question, survey content instructions are sent to the respondents. The time frame of each survey is 60 minutes although the average length of the survey is 45 minutes. The vast majority of surveys are conducted online, with only a small number of surveys conducted by phone or via internet-based meetings.

The results of each survey are coded to allow for analysis and comparison by creating a matrix in Excel where each column represents a survey and each row represents an enterprise. That way, the data are used to perform the cross-sectional analysis. The analysis of information extracted from surveys was carried out row-by-row with a focus on finding unique practices that are of interest to many enterprises or that are shared by many enterprises. An Excel file for data collection was distributed to national experts (NEs) for inputting in a common format.

SURVEY

The objective of the survey in this study is to collect data on the importance enterprises place on various elements of ISO 56002 as well as their current performance in each factor. The survey was designed with a total of 24 questions linked to ISO 56002 (see Appendix 1 for the survey). The 24 questions were designed on research by Magnus Karlsson, who was a key contributor to the development of ISO 56002 and is also the president of Innovationsledarna, an organization for innovation managers in Sweden. These questions have been adjusted in line to assess innovation management capacity for enterprises in Vietnam. Each of the 24 questions is based on factors from ISO 56002, where respondents rank the current level of business and the importance of each factor based on five statements: Level 1 - Nothing, unofficial; Level 2 - Managed at the basic level; Level 3 - Identified and manage; Level 4 - Systematic manage; Level 5 - Optimization.

The survey was sent and conducted to respondents via an online link, where the estimated time required to answer all the questions thoroughly was approximately 45 minutes.

The questionnaire used for the survey includes six aspects and 24 criteria (Table 3.1). In each question, participants are asked to assess their organization and present the maturity level of their organization in the criterion in question. To avoid misunderstanding and preparing common literature, each question is preceded by a short description of the criterion. To facilitate the survey, NEs made some additional explanations (IR Iran), translation to local language (Cambodia, IR Iran, Thailand, Vietnam), amendments (Singapore, India), or add an additional question (IR Iran, the Philippines) to the questionnaire and made it suitable to the online survey which is in line with their surveying tools.

TABLE 3.1

ASPECTS AND CRITERIA OF SURVEY

Aspect	Criteria
Contexts	1. Understanding external trends and drivers for innovation 2. Understanding of internal capabilities and assets 3. Culture that supports creation and implementation of innovative ideas 4. External and internal innovation cooperation
Leadership	5. Commitment of top management 6. Focus on value realization 7. Vision and strategy for innovation 8. Innovation policies 9. Roles and responsibilities for innovation
Planning	10. Innovation goals and operation plans 11. Organizational structure for innovation activities 12. Organizational innovation portfolio
Support	13. Resources necessary to support innovation activities 14. Abilities, capabilities, and competencies necessary for innovation activities 15. Communication and awareness 16. Innovation tools and methods 17. Intellectual property management
Activities	18. Innovation initiatives and projects 19. Innovation Process Model 20. Processes for identifying opportunities 21. Processes for creating and validating concepts 22. Processes for solution development and implementation
Evaluation and Improvements	23. Advanced performance indicators 24. Performance evaluation and improvement

SURVEY DATA ANALYSIS

Survey and Results

Within the time frame of the research, NEs sent questionnaires to targeted organizations and collected responses. Table 3.2 shows the number of organizations that participated as respondents in each country. In this initial study, the survey was open to all sectors and industries of any size.

TABLE 3.2

NUMBER OF ORGANIZATIONS PARTICIPATED IN SURVEY IN EACH COUNTRY

Country	Surveyed Organizations	Percentage
Cambodia	22	5%
ROC	20	4%
India	70	16%
Indonesia	20	4%
IR Iran	97	22%
Pakistan	29	7%
Philippines	24	5%
Singapore	20	4%
Thailand	33	7%
Vietnam	110	25%

To analyze the survey results, both descriptive and inferential statistics were used. Descriptive statistics are used to provide a detailed view of how each survey question is answered using a descriptive graph. It is a good method for summarizing data in a compact form to allow ambiguity to be found in the raw data as well as the discovery of new hypotheses that can be tested through inferential statistics.

The demography of participating organizations in each country was analyzed by NEs, showing a diversification of the samples.

In Cambodia, out of 22 surveyed organizations, three were from government, 10 from academia, and nine from the private sector.

Meanwhile, in ROC, most of the respondents in this survey of IMS were from manufacturing industries. 19 responses were received from non-state-owned companies and one from a nonprofit organization, giving a total of 20 responses. The background of these participating companies/organizations are as follows:

- **Types of Businesses** - The main respondents were from the 'private limited' and only one nonprofit organization, which can be categorized as semi-government, has participated in this survey.

- **Number of Employees** - The participating respondents demonstrated a wide range of employees with an average number of 25,273.38 employees. Among the participating companies/organizations, six have over 1,000 employees, including three with over 10,000 employees. The smallest respondent has 20 employees while the largest employs 85,000 staff.

- **Industry Sectors** - Almost all of the participating companies were from different industry sectors, except for three that were from chemical. The participating industry sectors included steel, water filter, gas stove, sewing machine, gripper, automotive testing, consumer electronics, cellular phone shell, microphone, medical, home product, footwear, automobile electronic parts, pharmaceutical packaging equipment, computer numerical control (CNC) machine, etc.

In India, the profile of organizations participating in the survey (adapted from NEs) are categorized as the following:

TABLE 3.3

INDIA'S PARTICIPATING INDUSTRY SECTORS

Sector	Frequency	Percentage
IT	35	50%
Banking	20	28%
Consultancy	10	14%
Others (food, shoe, apparel, etc.)	5	8%

TABLE 3.4

INDIA'S DISTRIBUTION OF SIZE OF COMPANIES

Type	Frequency	Percentage
Small	25	35%
Large	45	65%
Total	70	100%

TABLE 3.5

INDIA'S ORGANIZATIONAL RESPONDENTS BASED ON NUMBER OF EMPLOYEES

Employee Strength Class	Frequency	Percentage
0–500	30	43%
500–1,000	20	29%
1,001–1,500	10	15%
More than 1,500	10	13%

In Indonesia, the researcher took data from 20 MSMEs who filled out the survey provided. The respondents represented the areas of activities from power electronics, health and medical services, information technology (IT), food and beverage (F&B), textiles and footwear, automobiles and automobile parts, and others (mainly services). The identity of the respondents was also asked in the survey, such as name, position, department, and the number of employees. The result is highlighted in Table 3.6.

TABLE 3.6

INDONESIA'S PARTICIPATING INDUSTRY SECTORS

Industry	Quantity	Percentage
IT	5	25%
Healthcare and Medical Services	4	20%
Construction	2	10%
F&B	2	10%
Power Electronics	2	10%
Automobiles and Automobile Parts	1	5%
Banking	1	5%
Hospitality	1	5%
Loan	1	5%
Textile and Footwear	1	5%
Grand Total	**20**	**100%**

Figure 3.1 shows that MSMEs engaged in the technology and information industry occupy the highest number of respondents in this study. This is followed by the health industry while the textile and automobiles industries occupy the lowest level with only 5%. In addition, the researchers also calculated the number of employees in each industry. The results are shown in Figure 3.1.

In IR Iran, a total number of 97 organizations/companies participated in this survey. The sample population of the organizations consisted of 58 from the governmental sector (59.2%), 23 public sectors (23.5%), and 17 private sectors (17.3%) (Figure 3.2). These organizations have 79,582 employees with an average of more than 820 employees per organization with a maximum of 9,000 and a minimum of 14 employees.

FIGURE 3.1

INDONESIA'S NUMBER OF EMPLOYEES

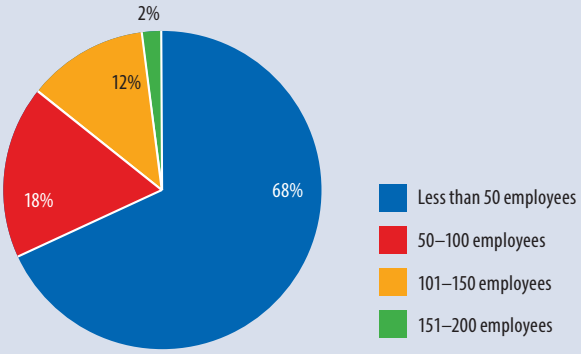
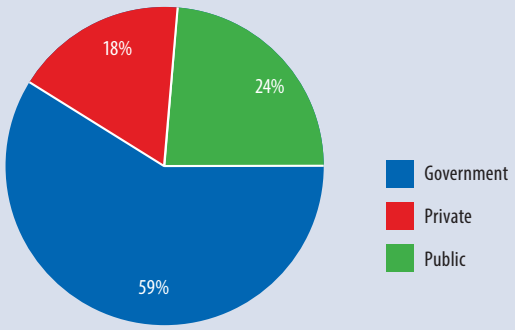


FIGURE 3.2

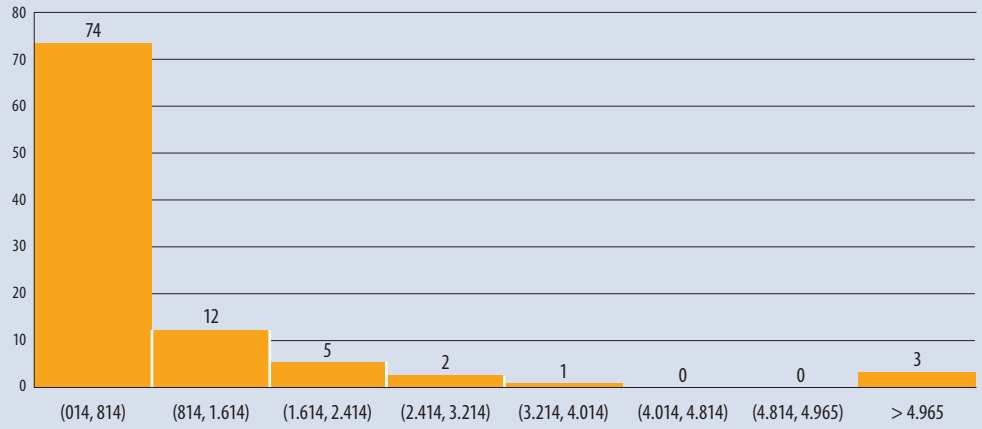
IR IRAN'S PARTICIPATING ORGANIZATIONAL SECTORS



As shown in Figure 3.3, more than 8% of the organizations have 1,000 employees. Thus it can be assumed that this survey generally represents the Iranian SME sector.

FIGURE 3.3

IR IRAN'S ORGANIZATIONAL RESPONDENTS BASED ON NUMBER OF EMPLOYEES



Participants were from various industries, where water, energy, and environment had the largest number of participants (77.6%), as shown in Figure 3.4. It is reasonable to perceive that this report mainly represents the current situation in the water, energy, and environment sectors of IR Iran.

In Pakistan, the survey questionnaire was circulated to more than 100 potential leads across multiple sectors, including public and private firms. A total of 29 organizations were selected as respondents for the survey.

FIGURE 3.4

IR IRAN'S PARTICIPATING INDUSTRY SECTORS

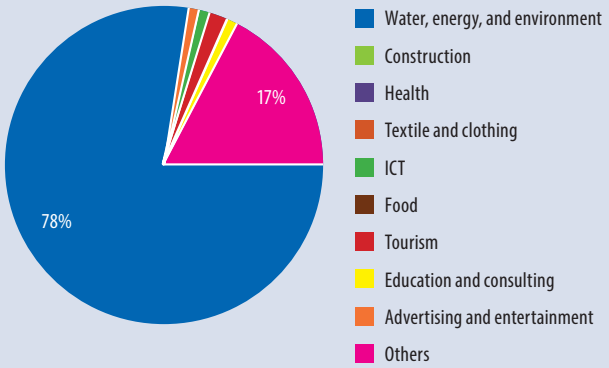
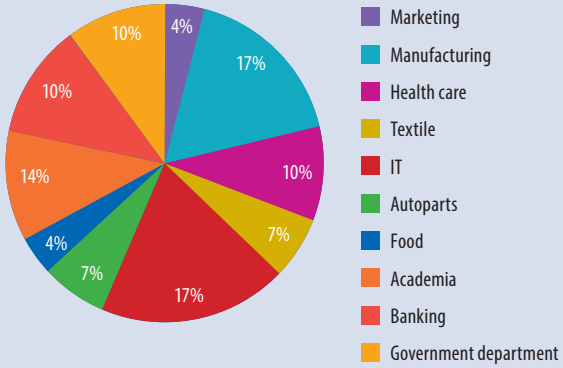


FIGURE 3.5

PAKISTAN'S PARTICIPATING INDUSTRY SECTORS



Percentage contributions of each sector in the survey are shown in Figure 3.5.

The contributions of public, private, and multinational firms in the survey are shown in Figure 3.6.

FIGURE 3.6

PAKISTAN'S PARTICIPATING ORGANIZATIONAL SECTORS

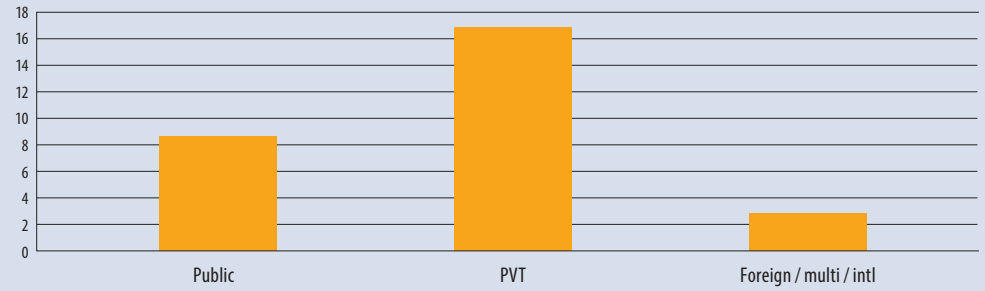


FIGURE 3.7

PAKISTAN'S ORGANIZATIONAL RESPONDENTS BASED ON NUMBER OF EMPLOYEES

The strength of employees in organizations participating in the survey is shown in Figure 3.7.

In the Philippines, the NE conducted surveys on 24 selected organizations in the country through a questionnaire provided by the chief expert to assess the innovation management capacity of these various organizations according to ISO 56002:2019, and to get insights on the adoption of the IMS.

Figure 3.8 shows that the distribution of respondents by type of organization was 12 or 50% state-owned enterprises and the balance were non-state-owned enterprises.

FIGURE 3.8

PHILIPPINES' TYPE OF ORGANIZATION RESPONDENTS

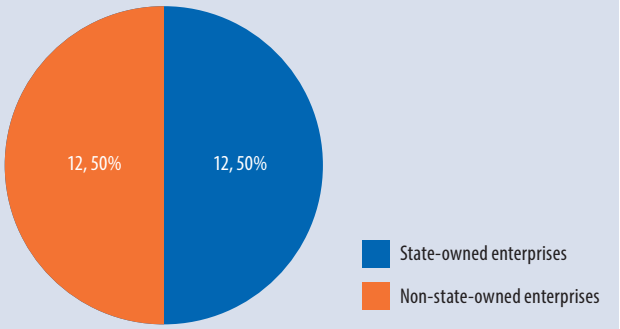
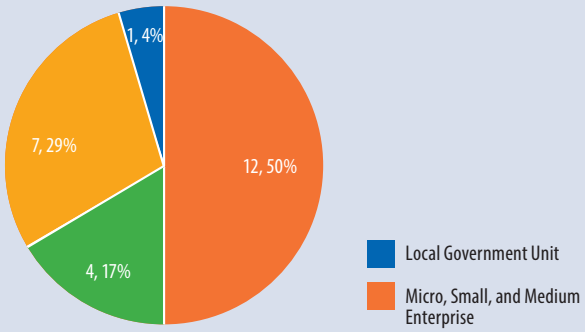


FIGURE 3.9

PHILIPPINES' CLASSIFICATION OF RESPONDENTS



Respondents comprised 12 or 50% MSMEs, seven or 29% state universities and colleges (SUCs), four or 17% national government agencies (NGAs), and one or 4% local government unit, as shown in Figure 3.9.

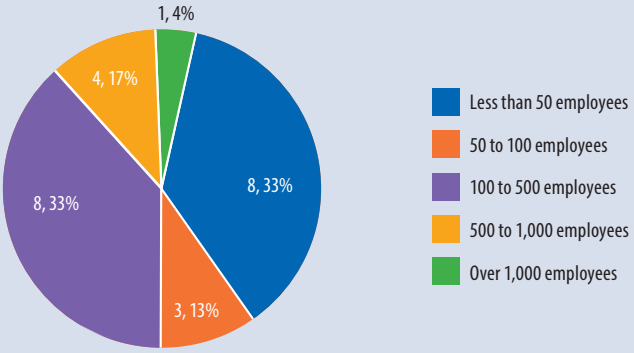
A micro enterprise may have an asset size of PHP3 million or less while a small enterprise has PHP3 million–PHP15 million. There are less than 90% of micro and small business enterprises in the Philippines and about 99% of them are MSMEs.

Out of the 12 MSMEs respondents, nine were from F&B, two from agribusiness, and one from cosmetics.

FIGURE 3.10

PHILIPPINES' ORGANIZATIONAL RESPONDENTS BASED ON NUMBER OF EMPLOYEES

Total organizations = 24



As shown in Figure 3.10, most of the respondents fall into two groups which have less than 50 employees (33%) and 100–500 employees (33%). Eight MSMEs respondents have less than 50 employees while eight respondents that are NGAs, MSMEs, and LGU have 100–500 employees.

In Singapore, 20 organizations participated in the survey and were classified based on industries by the NE.

FIGURE 3.11

SINGAPORE'S INDUSTRY BREAKDOWN OF RESPONDENTS

Total organizations = 20

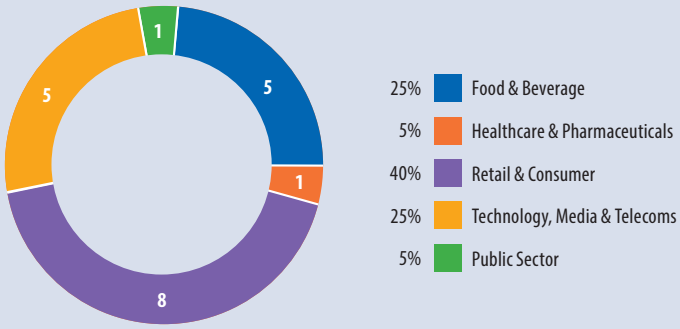


Figure 3.11 depicts the industry group breakdown of the 20 survey respondents. Only two respondents were from multinational corporations (MNCs) and the rest were made up of SMEs. A large portion of the respondents came from the F&B, retail and consumer, and technology, media and telecoms industries. They form the bulk of the analysis in the subsequent chapters.

In Thailand, all of the survey respondents were from non-state-owned enterprises (private sector) of various sizes and industries, as shown in Figure 3.12 and Table 3.7. In terms of the size of the organization (number of employees), 40% of the main participants were from organizations with 101-500 employees while only 15% have more than 500 employees. It should be noted that only one organization has more than 1,000 employees.

FIGURE 3.12

THAILAND'S ORGANIZATIONAL RESPONDENTS BASED ON NUMBER OF EMPLOYEES

Total organizations = 33

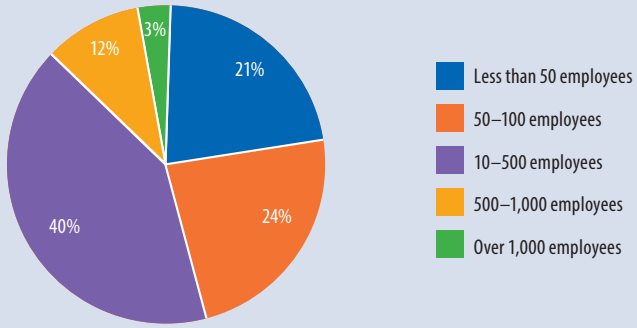


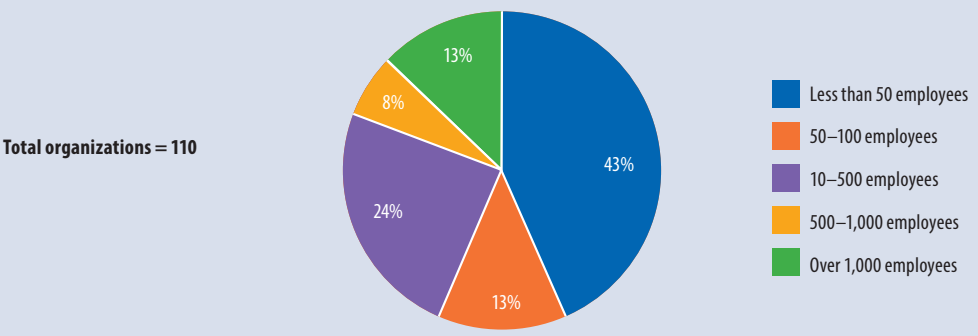
TABLE 3.7

THAILAND'S PARTICIPATING INDUSTRY SECTORS

Industry	Number of Org.	Percentage
Automobile and Automobile Parts	6	18%
Construction	5	15%
Textile and Footwear	4	12%
Chemical	3	9%
Materials	3	9%
F&B	2	6%
Power Electronics	2	6%
Others	8	24%
Total	**33**	**100%**

FIGURE 3.13

VIETNAMS'S ORGANIZATIONAL RESPONDENTS BASED ON NUMBER OF EMPLOYEES



In Vietnam, 110 organizations participated in the survey and were categorized in accordance to type, size, and industry to get a general demographic picture. The respondents consisted of 30% state-owned enterprises, 45% non-state-enterprises, 6% FID enterprises, and the rest were enterprises. Most of the

TABLE 3.8

VIETNAM'S PARTICIPATING INDUSTRY SECTORS

Industry	Number of Organizations
Power Electronics	20
Construction	12
Health and Medical Services	1
Textile and Footwear	3
IT	21
Automobile and Automobile Parts	8
Food	3
Others (mainly services)	42
Total	**110**

surveyed enterprises have less than 50 employees (accounting for 43%), 50–100 employees were 13%, 100–500 employees accounted for 24%, 500–1,000 employees were 8%, and over 1,000 employees at 13%, as shown in Figure 3.13.

The respondents represented diverse industries, as shown in Table 3.8.

Assessments of Innovation Management Capacity

NEs have analyzed the collected data to assess the innovation management capacity of organizations from different angles that contribute to the research and make it more comprehensive. NEs applied the same method that was instructed by the Chief Expert, analyzing results in a group of six aspects - Contexts, Leadership, Planning, Support, Activities, Assessment and Improvement - with 24 detailed criteria (IR Iran, Thailand, Singapore, Cambodia, Pakistan). Some NEs clustered respondents by the size of organizations (Thailand), the industry of organization (Singapore), and area of location of organizations (the Philippines) to have more insights into the clusters. Almost all NEs use average value while some use mean, mode, and median values to do the comparison analysis. All these methods are valuable and enrich the research.

With the variety of samples and analysis methods, NEs have discovered interesting results.

Cambodia

With 22 respondents divided into three main groups (government, university, private sector) and using average values, the researcher evaluated the innovation management capacity of participating organizations, as in Table 3.9.

TABLE 3.9

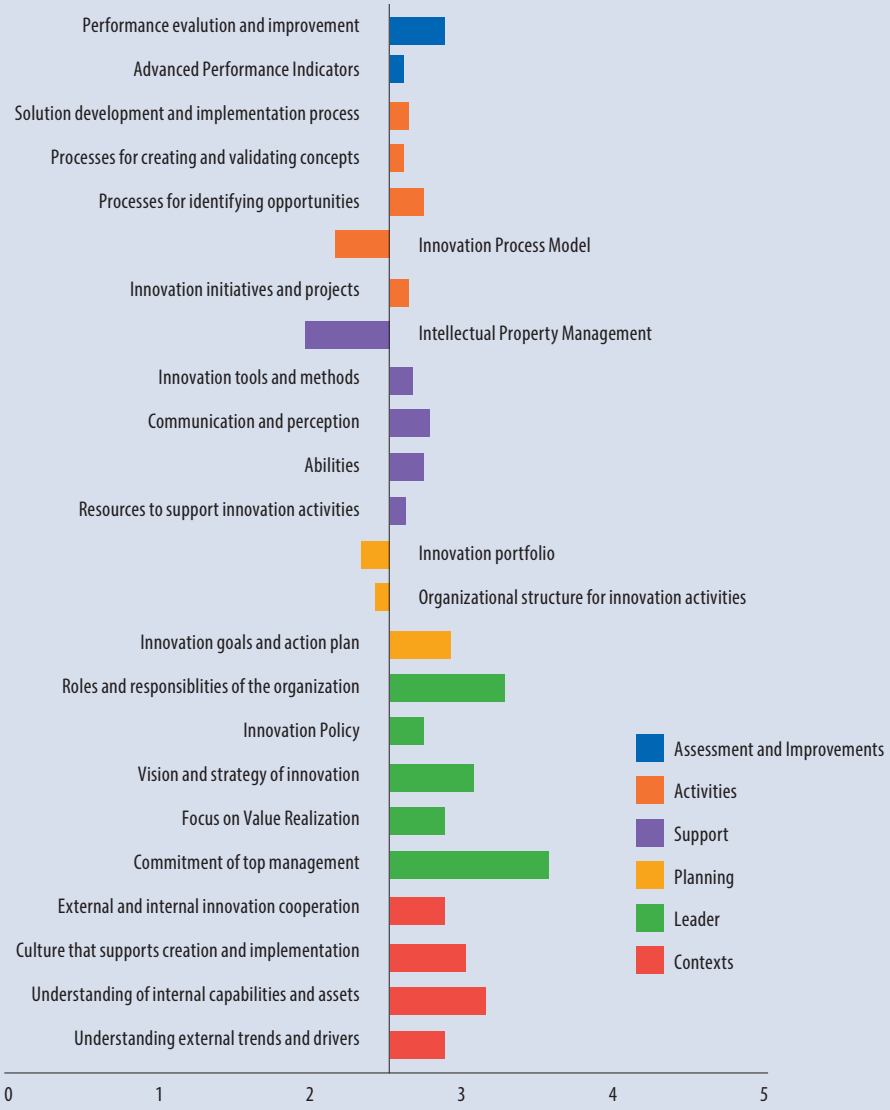
CAMBODIA'S AVERAGE BY INDICATORS FOR INNOVATION MANAGEMENT

	Indicators						
	Context	Leader	Planning	Support	Activities	Assessment and improvements	Average
Overall	3	3.1	2.5	2.5	2.5	2.7	2.7
Government	3.2	3.2	2.4	2.6	3.3	3.3	3.0
University	2.8	2.9	2.4	2.2	2.1	2.2	2.4
Private sector	3.1	3.2	2.8	2.9	2.8	3.1	3.0

The results showed planning, support, and activities were just on the passing levels of 2.5. Other indicators including context, leader, and assessment and improvements were around level 3. The private sector scored better performance in terms of innovation management characteristics. The score level for all indicators of private sectors was around 3 while university was at the lowest performance, at around 2. Although a small sample size could not reflect an exact picture, it revealed something at this initial study.

FIGURE 3.14

CAMBODIA'S OVERALL INNOVATION MANAGEMENT SCORE



Republic of China

Data collected from the survey, shown in Table 3.13, indicated that Taiwanese companies on average have relatively higher scores in questions related to common business practices or required by other management standards, such as question one (mean value is 3.35) and question two (3.30) while having lower scores in questions related solely to ISO 56000 standard, such as questions seven (2.60), eight (2.50), 19 (2.45), and 23 (2.15). This result implied local companies showed either a low awareness of or low engagement in implementing the IMS, as specified in the ISO 56000 standard.

TABLE 3.10

ROC'S SUMMARY OF RESPONDING FIGURES OF 20 SAMPLE COMPANIES

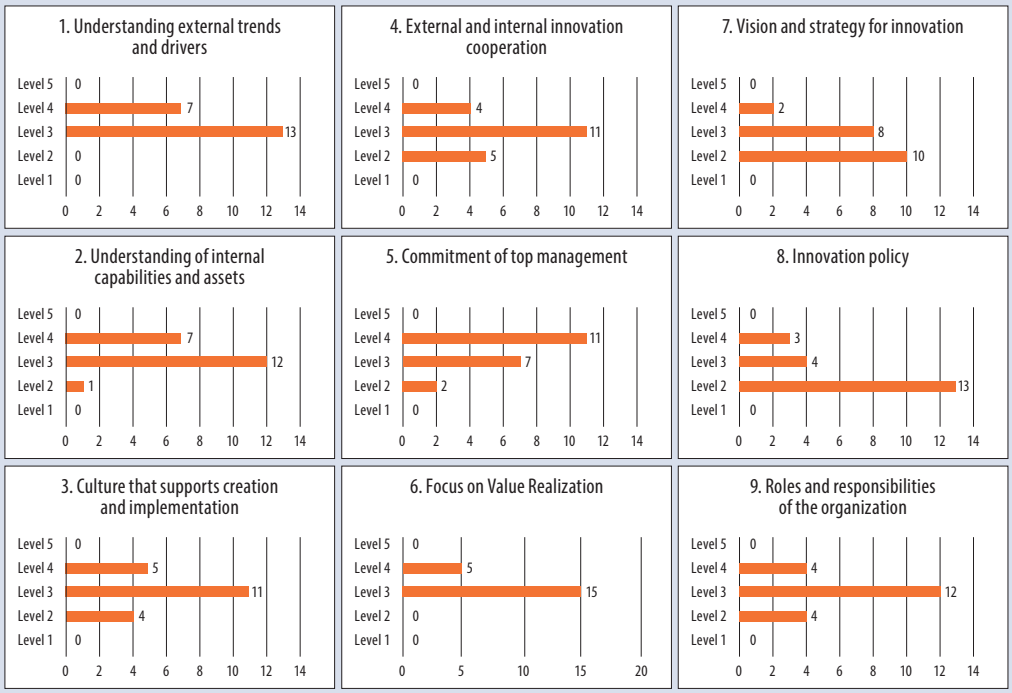
Questions	Mean	Min	Max	STD
1. Understanding external trends and drivers	3.35	3	3	0.49
2. Understanding of internal capabilities and assets	3.30	3	3	0.57
3. Culture that supports creation and implementation	3.05	3	3	0.69
4. External and internal innovation cooperation	2.95	2	3	0.69
5. Commitment of top management	3.45	3	2	0.69
6. Focus on value realization	3.25	3	3	0.44
7. Vision and strategy for innovation	2.60	3	3	0.68
8. Innovation policy	2.50	3	4	0.76
9. Roles and responsibilities of the organization	3.00	2	4	0.65
10. Innovation goals and action plan	2.60	3	4	0.82
11. Organizational structure for innovation activities	3.15	3	4	0.59
12. Innovation portfolio	2.70	3	4	0.86
13. Resources to support innovation activities	3.15	3	4	0.67
14. Abilities	3.10	3	4	0.64
15. Communication and perception	2.75	3	3	0.44
16. Innovation tools and methods	2.60	2	3	0.82
17. Intellectual property management	3.15	3	4	0.67
18. Innovation initiatives and projects	3.10	3	4	0.64
19. Innovation process model	2.45	2	3	0.69
20. Processes for identifying opportunities	3.05	3	3	0.39
21. Processes for creating and validating concepts	2.75	3	4	0.79
22. Process of developing and implementing solutions	3.10	3	3	0.55
23. Advanced performance indicators	2.15	2	3	0.49
24. Performance evaluation and improvement	2.85	2	3	0.59

It was found that Taiwanese companies on average put more effort into understanding external trends and drivers (3.35) and understanding internal capabilities and assets (3.30). Local companies also received a higher commitment from top management (3.45) and showed a higher focus on value creation (3.25). In regard to the implementation of innovation activities, Taiwanese companies emphasized more on organizational structure for innovation activities (3.15) and resources to support innovation activities (3.15). They also put more endeavors on intellectual property management (3.15) which was consistent with the finding of the third Technological Innovation Survey (TIS3), i.e., ROC's large original design manufacturing (ODM) and original equipment manufacturing (OEM) manufacturers tend to use patents as a resource for "obtaining customer orders".

Additional to the findings of the researcher in ROC, when compiling and combining data from NEs, it was interesting to find that answers from companies in ROC were very focused with very few scores at Level 1 and none at Level 5. For example, see Figure 3.15 with nine criterial frequency combinations. All other criteria had the same pattern of answers.

FIGURE 3.15

ROC'S FREQUENCY OF COMPANIES IN NINE CRITERIA

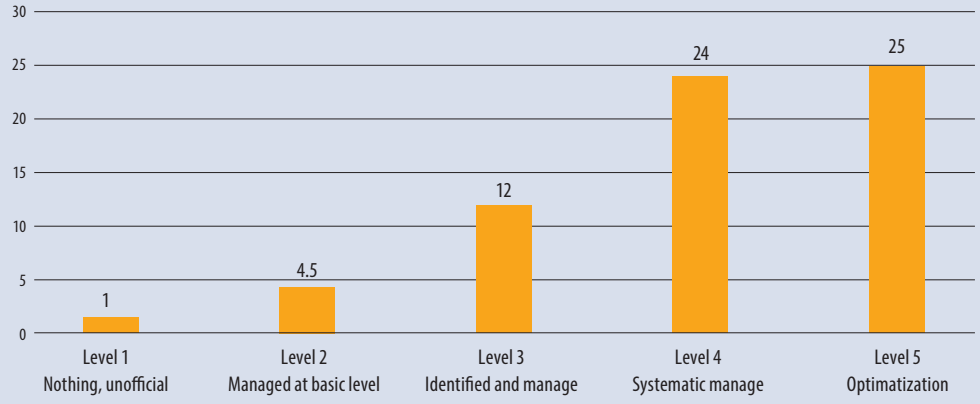


India

Analysis of data collected from 70 respondents in India showed a rather high score in all 24 criteria. As shown in Figure 3.16, many companies in India choose the level of maturity at Level 5 and Level 4, far more than choosing Level 3 and lower.

FIGURE 3.16

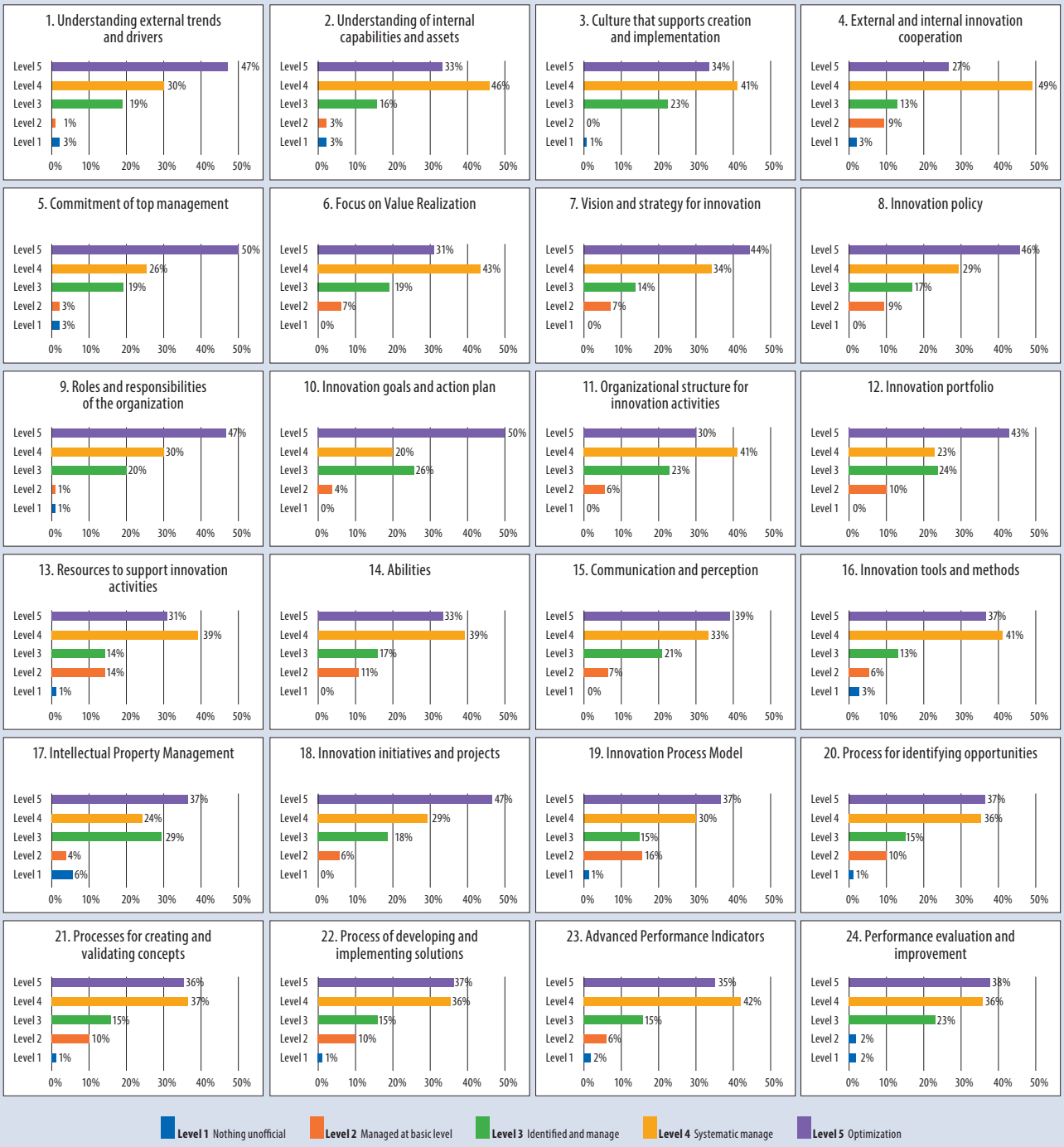
INDIA'S AVERAGE FREQUENCY OF ORGANIZATION IN CHOOSING LEVELS (USING MEDIAN VALUE)



It would infer that participating organizations in India have a high capacity in Innovation Management. To have a more detailed picture, the frequency in the percentage of all 24 criteria is depicted in Figure 3.17.

FIGURE 3.17

INDIA'S FREQUENCY IN THE PERCENTAGE OF ORGANIZATIONS IN ALL 24 CRITERIA



The study in India presents interesting insights on the topic of innovation management and shows a strong base to assess the innovation management capacity of organizations according to ISO 56002:2019. It is observed that firms from the knowledge-intensive sector were active and open-minded in sharing innovation-related data. On the other hand, labor-intensive firms were hesitant in sharing the concerned data and have a limited approach to innovation management. Though all enterprises in the two cases acknowledged the importance of innovation and innovation management, there was a difference in approach that the firms used in implementing innovation management practices or techniques.

Some organizations have innovation policies and well-defined systems in place for procedures and policies, but it did not reflect well in the innovation portfolio. Also, the commitment of the top management played a big role or a deciding factor in the adoption of innovative practices within the organizations. Firms with full support from the top management tend to excel better as opposed to the other organizations with less support from top management. Some organizations have a well-defined structure for implementing innovation management standards while some are yet to adopt and learn them.

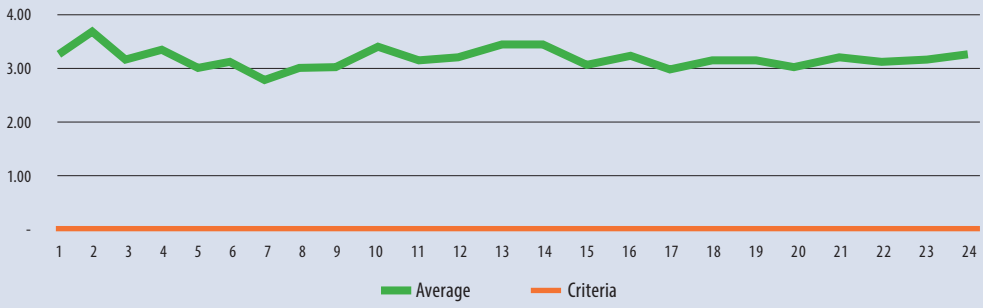
Most of the enterprises tend to do regular scanning of the internal and external environment but due to short-term view, few firms ignore the long-term benefits of the innovation. Those with well-defined innovation policies were managing innovation better as compared to those with not well-defined innovation policy. Innovation support also depended on the commitment and clearly identified policy on innovation management. Performance indicators were well-defined and implemented better in innovative firms than in non-innovative firms.

Indonesia

The NE of Indonesia surveyed 20 MSMEs using the structured questionnaire provided by the Chief Expert. Overall, the researcher found that most of the MSME industries were still in the general average - not too low but not too high, as in Figure 3.18.

FIGURE 3.18

INDONESIA'S AVERAGE VALUES OF 24 CRITERIA



IR Iran

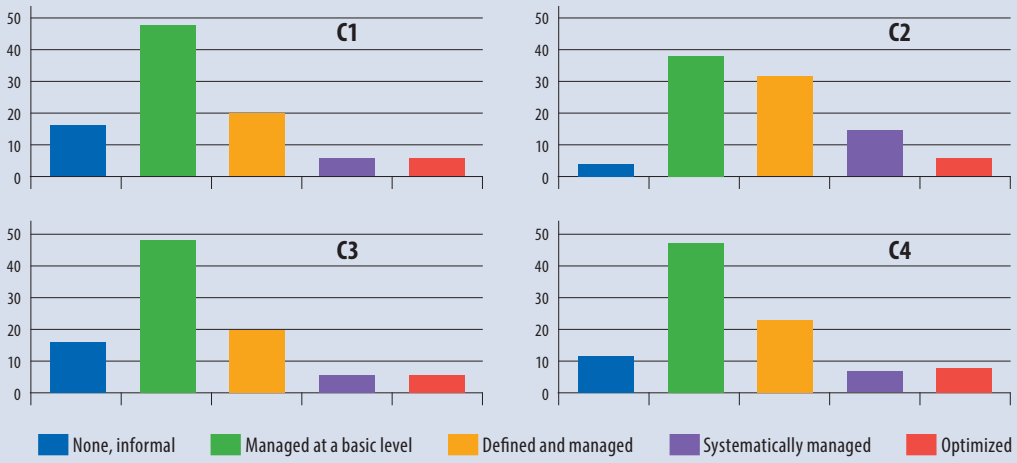
Criteria results were thoroughly analyzed by the NE of IR Iran in six aspects - Context, Leadership, Planning, Support, Activities, and Evaluation and Improvement.

- **Context**

The Contexts aspect includes: Understanding external trends and drivers for innovation (C1); Understanding of internal capabilities and assets (C2); Culture that supports creation and implementation of innovative ideas (C3); and External and internal innovation cooperation (C4). As shown in Figure 3.19, the majority of participants stated that the context criteria were either not managed or managed very basically in their organizations (73% in C1, 67% in C3, and 61% in C4). There was an exception for criterion C3 2 which showed that most of the organizations (73%) have to manage their internal capabilities and assets in an almost formal and well-established way.

FIGURE 3.19

IR IRAN'S FREQUENCY OF EACH CONTEXT CRITERION IN ORGANIZATIONS

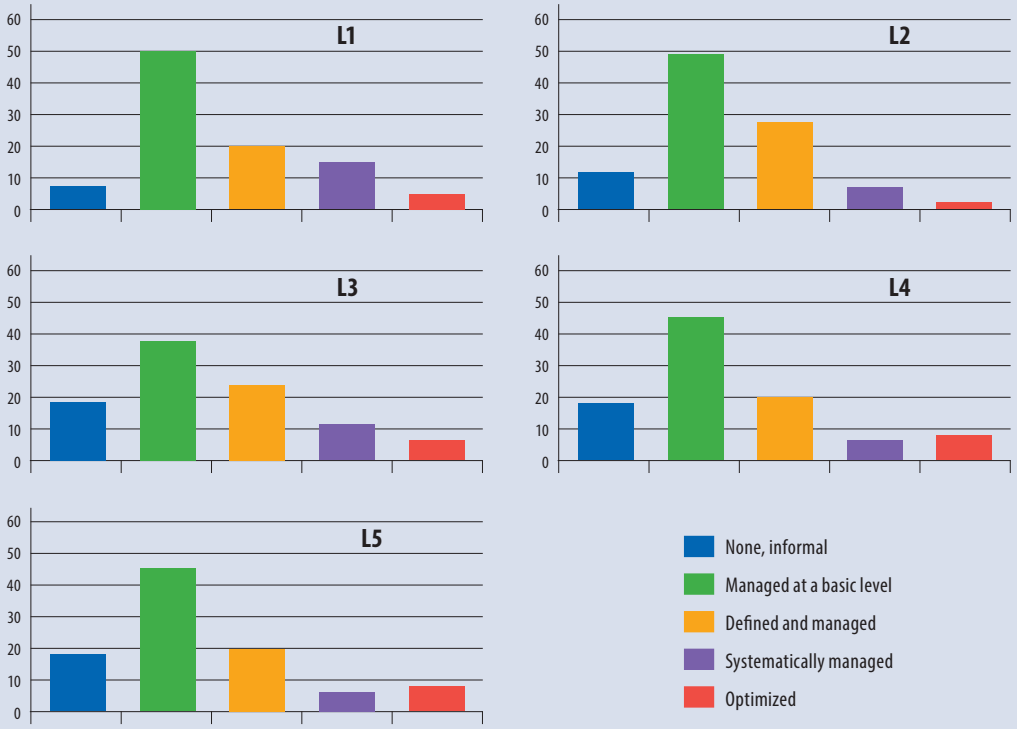


- **Leadership**

The Leadership aspect includes: Commitment of top management (L1); Focus on value realization (L2); Vision and strategy for innovation (L3); Innovation policies (L4); and Roles and responsibilities for innovation (L5). As shown in Figure 3.20, despite the context aspect, most of the participants in the Leadership aspect assessed their organizations in the second and third level of maturity, meaning that the criterion questioned was either informally or formally managed. This was 73% in L1, 78% in L2, 63% in L3, 67% in L4, and 69% in L5. However, for the fourth and fifth criteria, a noticeable number of participants has also assessed their organization in the non or informal level (i.e., 19% in C4 and 17% in C5) which can be assumed as a sign of discrepancy in the judgments.

FIGURE 3.20

IR IRAN'S FREQUENCY OF EACH LEADERSHIP CRITERION IN ORGANIZATIONS



- **Planning**

The Planning aspect includes: Innovation goals and operation plans (P1); Organizational structure for innovation activities (P2); and Organizational innovation portfolio (P3). Figure 3.21

FIGURE 3.21

IR IRAN'S FREQUENCY OF EACH PLANNING CRITERION IN ORGANIZATIONS

highlights that in this aspect most organizations were in the first two maturity levels - 70% in P1, 63% in P2, and 76% in P3. The criterion "organizational innovation portfolio is among the top two criteria with the highest frequency in level 1, meaning that a majority of organizations seem to suffer from not having a portfolio for their innovation activities."

- **Support**

The Support aspect includes: Resources necessary to support innovation activities (S1); Abilities, capabilities, and competencies necessary for innovation activities (S2); Communication and awareness (S3); Innovation tools and methods (S4); and Intellectual property management (S5). As shown in Figure 3.22, the situation was not the same in all criteria in this aspect. First, there were criteria in which organizations were assessed in the first two maturity levels (i.e., 74% in S5). Then, the criteria of which participants expressed to be in organizations that have either basically or formally management practiced (i.e., 70% in S2 and 66% in S4). And finally, in two criteria in the Support aspect, the results showed that the difference between level 1 and level 3 was not noticeable, thus might need further investigations (0 in S1 and 4% in S3).

FIGURE 3.22

IR IRAN'S FREQUENCY OF EACH SUPPORT CRITERION IN ORGANIZATIONS

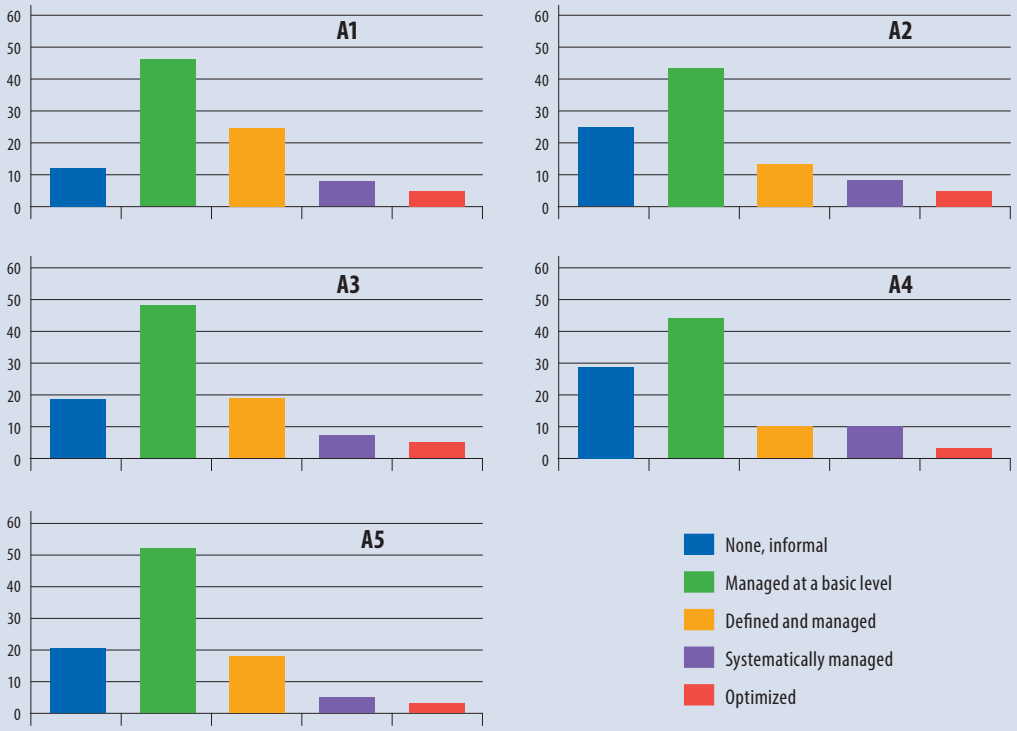
- **Activities**

The Activities aspect includes: Five criteria as Innovation initiatives and projects (A1); Innovation Process Model (A2); Processes for identifying opportunities (A3); Processes for creating and validating concepts (A4); and Processes for solution development and implementation (A5). Activities aspect, as shown in Figure 3.23, have different conditions in different criterion. In the

first criterion, the majority of participants (i.e., 73%) expressed that their organization has some sort of management (either basically or formally) on the innovation initiatives and projects, thus are assumed to have maturity levels 2 and 3. However, in A2 and A4, this is shifted toward the first and second maturity levels (71% in A2 and 75% in A4). Finally, the assessment showed that the two criteria have the same frequency of 20% for both level 1 and level 3, but the frequency at around 50% for level 2 firmly asserted that in these two criteria (i.e., A3 and A5), the majority of organizations were managing them at the basic level.

FIGURE 3.23

IR IRAN'S FREQUENCY OF EACH ACTIVITIES CRITERION IN ORGANIZATIONS



- **Evaluation and Improvement**

  The Evaluation and Improvement aspect includes two criteria as Advanced performance indicators (E1) and Performance evaluation and improvement (E2). As shown in Figure 3.24 in the first criterion, the majority of organizations either have or otherwise the performance indicators at the basic level (74% in E1). This trend was the same in the second criterion as 77% of the participants assessed their organizations at the first two maturity levels in evaluating and improving innovation performance. The point that is worth paying closer attention to is that E2 is the criterion in which the highest frequency of organizations are in level 1 (36%).

The overall analysis shows that the majority of organizations (37%) appear in the third maturity level which means they have a defined and managed IMS. The second place is for maturity level 2 with 29%. Surprisingly, no organization assessed itself as not having or having an informal IMS and 20% of the participants believed that their organizations have an optimized and well-monitored and evaluated IMS (Figure 3.25 and Figure 3.26).

FIGURE 3.24

IR IRAN'S FREQUENCY OF EACH EVALUATION AND IMPROVEMENT CRITERION IN ORGANIZATIONS

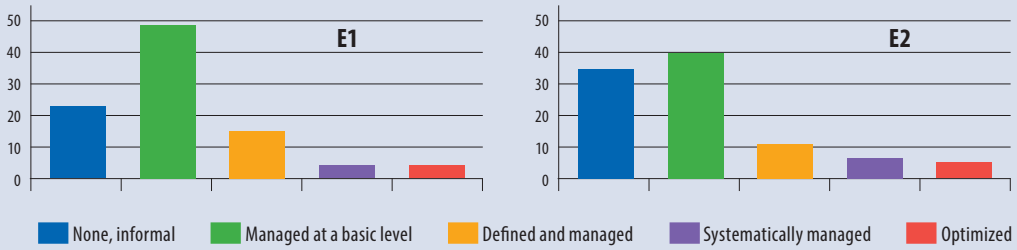


FIGURE 3.25

IR IRAN'S OVERALL SCORE FOR EACH ORGANIZATION

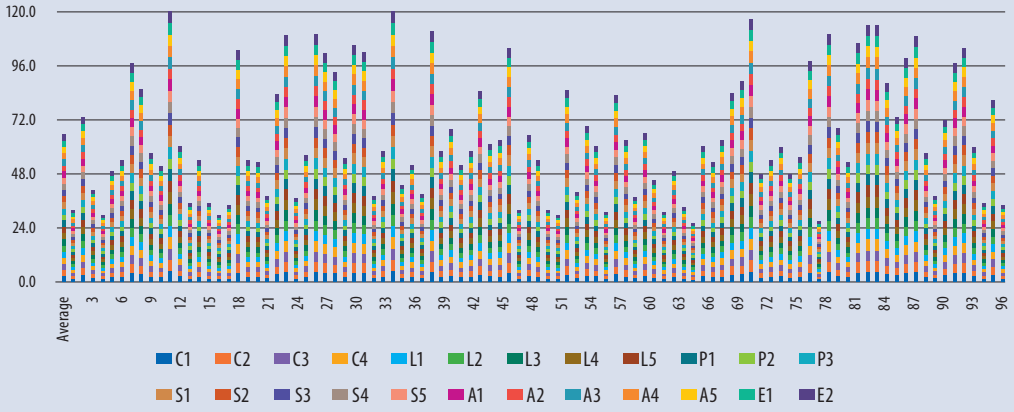
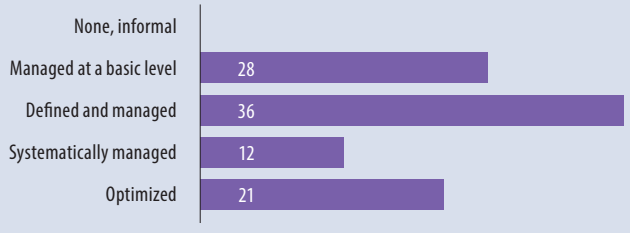


FIGURE 3.26

IR IRAN'S FREQUENCY OF EACH MATURITY LEVEL IN ORGANIZATIONS



Among the six aspects, Evaluation and Improvement scored the lowest, as seen in Figure 3.27.

Analyzing the data shows that for the exception of C2 criteria (i.e., Understanding external trends and drivers for innovation), the overall score of the organizations in this survey hardly passes level 3 maturity. On the other hand, the average score of the organizations is not less than 2, showing that not all criteria are 'at least managed' in the organizations in this study (Figure 3.28).

FIGURE 3.27

IR IRAN'S SUMMARY OF SCORES IN EACH ASPECT

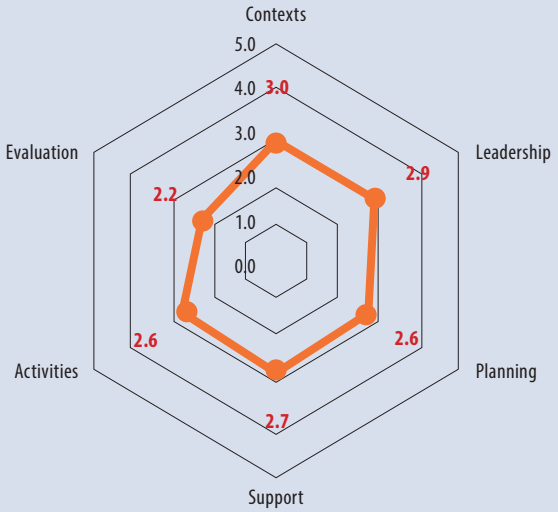
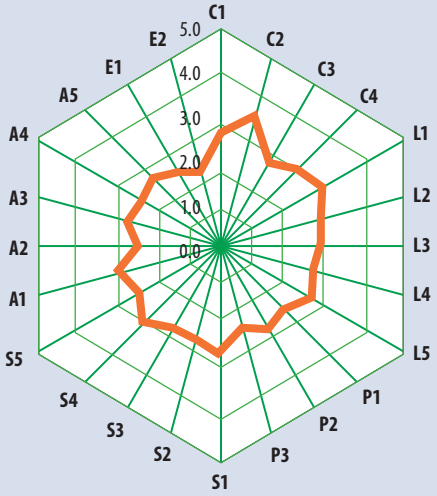


FIGURE 3.28

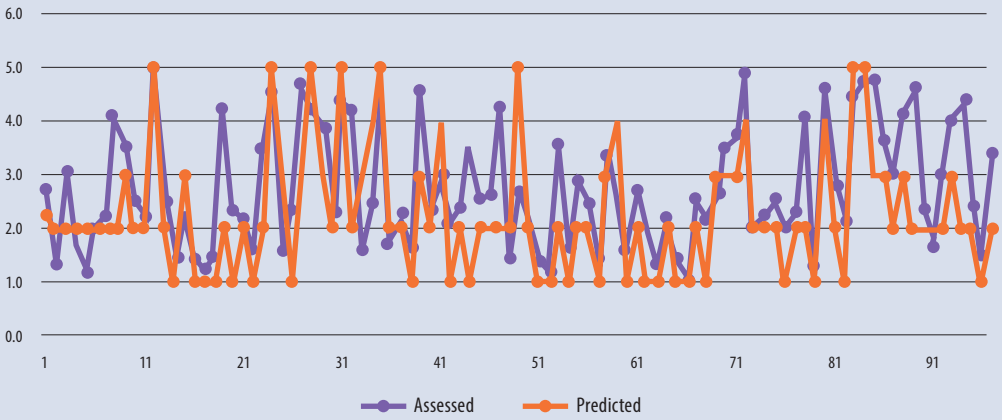
IR IRAN'S AVERAGE SCORE OF EACH CRITERION



The NE has asked participants to assess the maturity of their IMS before completing the questionnaire to observe the differences. However, Figure 3.29 shows that there is not that much difference between these two evaluations of the maturity level.

FIGURE 3.29

IR IRAN'S ASSESSED VS PREDICTED OVERALL MATURITY LEVEL



Pakistan

The NE of Pakistan assessed the innovation management capacity of 29 organization respondents using the groups of six aspects with 24 criteria by using a method of calculation to make the gap of frequency bigger. The NE multiplied the frequency number by the respective levels (level 1 equal to 1, level 2 equal to 2, level 3 equal to 3, level 4 equal to 4, and level 5 equal to 5) to illustrate in the bar chart (Figure 3.30).

FIGURE 3.30

PAKISTAN'S ASPECT OF CONTEXT

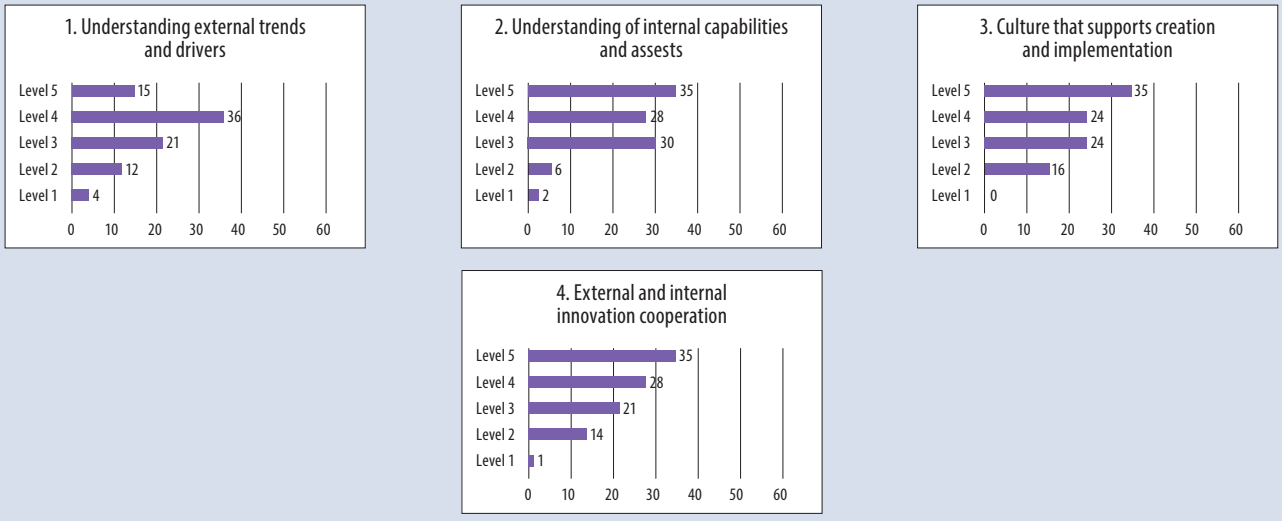
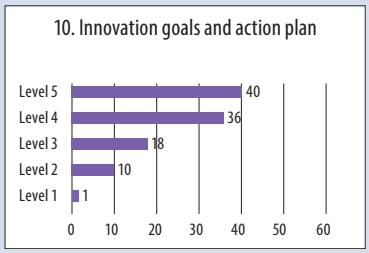
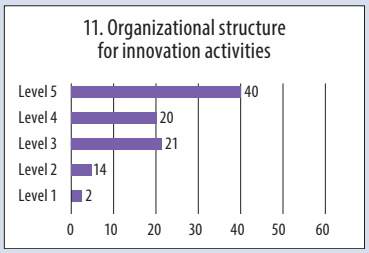


FIGURE 3.31

PAKISTAN'S ASPECT OF PLANNING





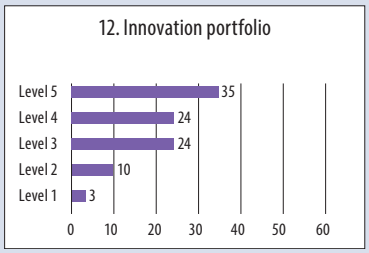
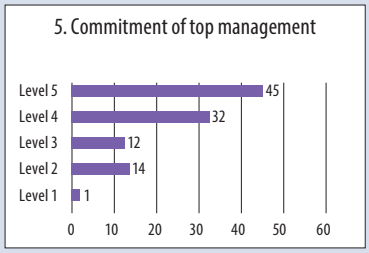
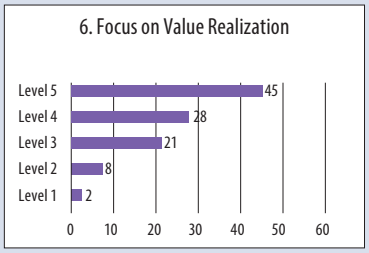
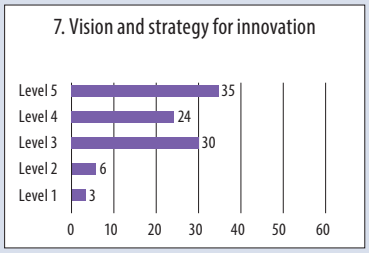


FIGURE 3.32

PAKISTAN'S ASPECT OF LEADERSHIP







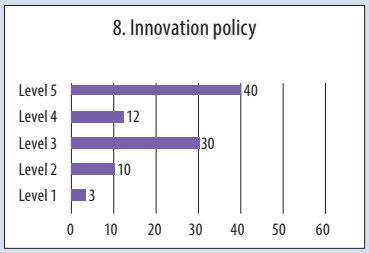
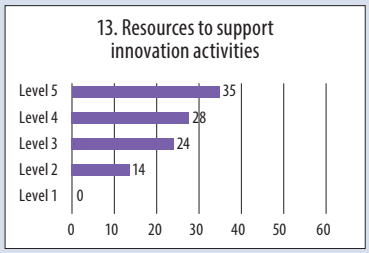
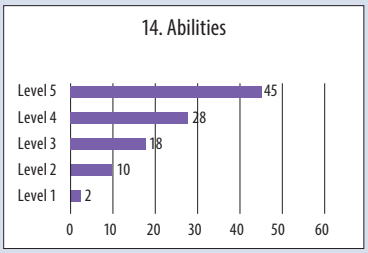
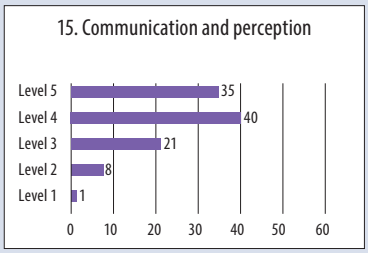


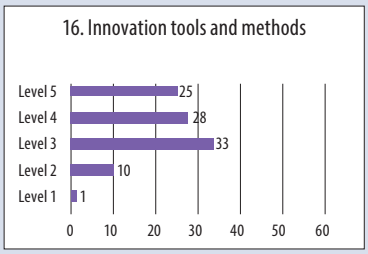
FIGURE 3.33

PAKISTAN'S ASPECT OF SUPPORT









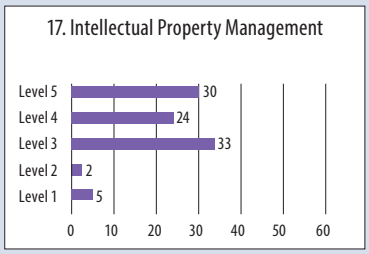


FIGURE 3.34

PAKISTAN'S ASPECT OF ACTIVITIES

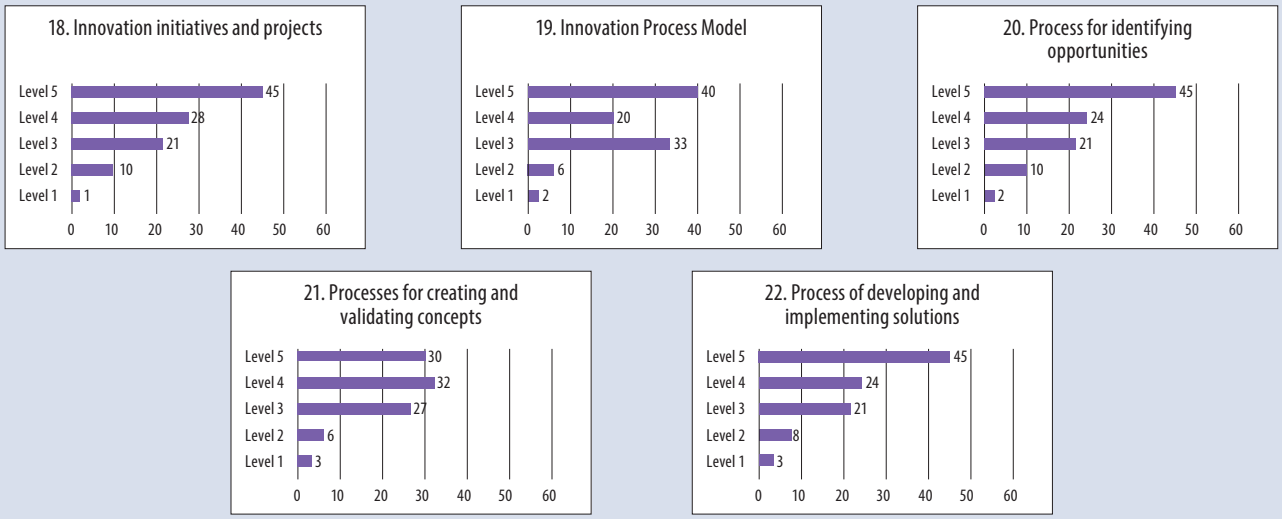


FIGURE 3.35

PAKISTAN'S ASPECT OF ASSESSMENT AND IMPROVEMENT

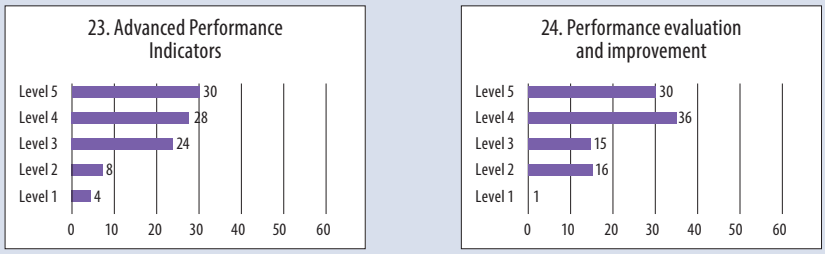
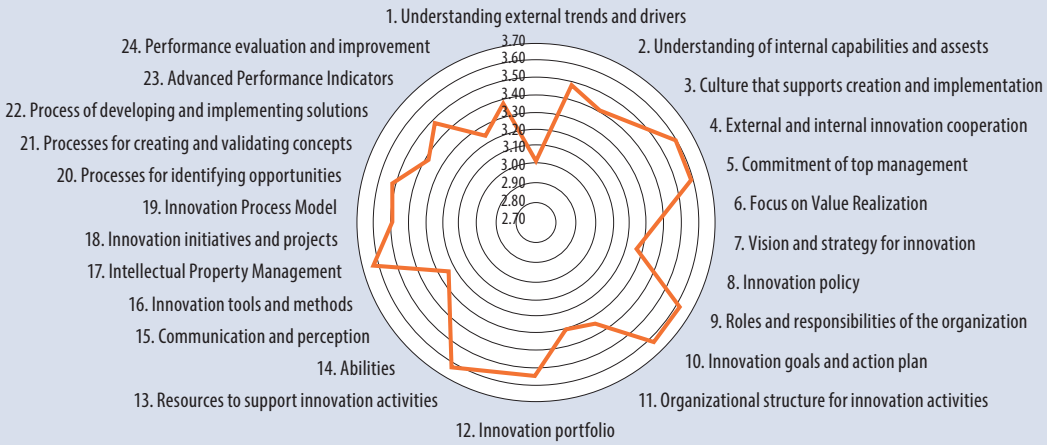


FIGURE 3.36

PAKISTAN'S AVERAGE OF 24 CRITERIA



Based on the raw data provided by the NE, a general outlook of the innovation management capacity assessment is put together in Figure 3.36. On average, all criteria are in the range between 3.0–3.7.

The NE conducted a SWOT analysis and assessed 24 questions against the five defined levels, then categorized based on the maximum score obtained against the survey, as in Tables 3.11–3.12.

TABLE 3.11

PAKISTAN'S ASSESSMENT LEVELS

	Assessment Levels	Code	Score Categorization		
Level 5	Optimized	L5			
Level 4	Systematically managed	L4	Strength (>45)	-	-
Level 3	Identified and managed	L3	-	Opportunity (>30)	Weakness (>22)
Level 2	Managed at basic level	L2	Threat (< 22)		
Level 1	Nothing, Informal	L1			

TABLE 3.12

PAKISTAN'S SWOT ANALYSIS RESULTS BASED ON ONLINE SURVEY

	Helpful Strengths	Harmful Weaknesses
Internal	5. Commitment of top management	2. Understanding of internal capabilities and assets
	6. Focus on Value Realization	7. Vision and strategy for innovation
	14. Abilities	12. Innovation portfolio
	18. Innovation initiatives and projects	13. Resources to support innovation activities
	20. Processes for identifying opportunities	23. Advanced performance indicators
	22. Process of developing and implementing solutions	-
	Opportunities	**Threats**
External	1. Understanding external trends and drivers	3. Culture that supports creation and Implementation
	9. Roles and responsibilities of the organization	4. External and internal innovation cooperation
	10. Innovation goals and action plan	8. Innovation policy
	15. Communication and perception	11. Organizational structure for innovation activities
	16. Innovation tools and methods	
	17. Intellectual Property Management	
	19. Innovation Process Model	
	21. Processes for creating and validating Concepts	
	24. Performance evaluation and improvement	

Philippines

The Philippines NE carried out a survey with the convenience sampling technique and received 24 respondents. The distribution of these respondents is illustrated in Figures 3.8–3.10. Dividing respondents into different subgroups by certain criteria, the NE analyzed the collected data from various angles and found interesting findings. Some statistical tools were used, such as the Kendall Tau Correlation, to determine the degree of association between the 24 criteria and innovation management.

TABLE 3.13

PHILIPPINES' CRITERIA WHERE SUCS AND MIMAROPA SUCS FARED BETTER THAN THE OVERALL AND MSME SUBGROUPS

Criteria	Rating	Overall	SUC	MIMAROPA SUC	MSMEs	MIMAROPA MSMEs
7. Vision and strategy for innovation	5 – Optimization					
	4 – Systematically managed		●	●		
	3 – Defined and managed	●			●	
	2 – Managed at a basic level					●
	1 – None, informal					
9. Roles and responsibilities of the organization	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed		●	●		
	2 – Managed at a basic level	●			●	●
	1 – None, informal					
10. Innovation goals and action plan	5 – Optimization					
	4 – Systematically managed		●	●		
	3 – Defined and managed					
	2 – Managed at a basic level	●			●	●
	1 – None, informal					
19. Innovation Process Model	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed		●	●		
	2 – Managed at a basic level	●			●	●
	1 – None, informal					
23. Advanced Performance Indicators	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed		●	●		
	2 – Managed at a basic level	●			●	●
	1 – None, informal					

The mode was the measure of central tendency used in interpreting the perception of the respondents. The modal values per criterion were determined for all the respondents, and four subgroups emerged, namely, SUCs, MIMAROPA SUCs, MSMEs, and MIMAROPA MSMEs. MIMAROPA is the Southwestern Tagalog region of the Philippines.

Based on the results, interesting findings emerged in the perceptions of the subgroups:

- **Criteria where SUCs and MIMAROPA SUCs fared better than the overall and MSME subgroups**

  The SUCs and MIMAROPA SUCs subgroups had higher ratings on vision and strategy for innovation; roles and responsibilities of the organization; innovation goals and action plan; innovation process model; and advanced performance indicators, as highlighted in Table 3.13. This finding could be supported by the fact that SUCs formally conduct Strategic and Action Planning as part of their management system.

- **Criteria where MIMAROPA SUCs rated higher than the overall and other subgroups**

  MIMAROPA SUCs had the highest rating on innovation policy, organizational structure for innovation activities, innovation portfolio, and innovation tools and methods (Table 3.14). This can be attributed to the efforts not just of the MIMAROPA SUCs, but also to the strong support, guidance, and assistance of DOST-MIMAROPA, in enhancing the innovation ecosystem in the MIMAROPA region. Here, the culture and spirit of innovative and entrepreneurial thinking are inculcated among the faculty-researchers through activities, such as technopreneurship training, knowledge sharing and mentoring sessions with SUCs, and intellectual property-related capacity building. It is expected that SUCs, in general, would generate higher ratings as compared to other subgroups as they are being required by the Commission on Higher Education (CHED), the government agency in the Philippines overseeing higher education institutes (HEIs) to have innovation policies (i.e., IP Policy Manual and Technology Transfer Policy).

TABLE 3.14

PHILIPPINES' CRITERIA WHERE MIMAROPA SUCS RATED HIGHER THAN THE OVERALL AND OTHER SUBGROUPS

Criteria	Rating	Overall	SUC	MIMAROPA SUC	MSMEs	MIMAROPA MSMEs
8. Innovation policy	5 – Optimization					
	4 – Systematically managed			●		
	3 – Defined and managed					
	2 – Managed at a basic level	●	●		●	●
	1 – None, informal					
11. Organizational structure for innovation activities	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed			●		●
	2 – Managed at a basic level	●	●		●	
	1 – None, informal					
12. Innovation portfolio	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed			●		
	2 – Managed at a basic level	●	●			
	1 – None, informal				●	●
16. Innovation tools and methods	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed			●		
	2 – Managed at a basic level	●	●		●	●
	1 – None, informal					

- **Remarkable findings on MSMEs and MIMAROPA MSMEs**

  The MSMEs and MIMAROPA MSMEs subgroups had the highest rating on the "focus on value realization" criterion but had low ratings on resources to support innovation activities and abilities, as shown in Table 3.15. The results would suggest that value proposition is indeed a big part of MSMEs' existence as it is a manifestation of the latter's high regard for customer focus and how they can effectively define the genuine and significant value offered by their products or services. For the government (NGA) and SUC respondents, this criterion has a comparatively lower rating for the possible reason that these institutions have relatively more customer segments and correspondingly offer various programs and services to match the respective needs of such. For the government agency respondents, as a public-service sector organization, the scope cuts across several sectors and areas of interest in the public domain. This is also parallel to that of the SUC respondents as their mandate for R&D, teaching/instruction, and extension are likewise extensive.

TABLE 3.15

PHILIPPINES' REMARKABLE FINDINGS ON MSMES AND MIMAROPA MSMES

Criteria	Rating	Overall	SUC	MIMAROPA SUC	MSMEs	MIMAROPA MSMEs
6. Focus on Value Realization	5 – Optimization					
	4 – Systematically managed				●	●
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level					
	1 – None, informal					
13. Resources to support innovation activities	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●		●		
	2 – Managed at a basic level		●			
	1 – None, informal				●	●
14. Abilities	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level					●
	1 – None, informal				●	

TABLE 3.16

PHILIPPINES' CRITERIA WITH SIMILAR RESPONSES ACROSS SUBGROUPS

Criteria	Rating	Overall	SUC	MIMAROPA SUC	MSMEs	MIMAROPA MSMEs
2. Understanding of internal capabilities and assets	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●	●	●
	2 – Managed at a basic level					
	1 – None, informal					
4. External and internal innovation cooperation	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●	●	●
	2 – Managed at a basic level					
	1 – None, informal					
5. Commitment of top management	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●	●	●
	2 – Managed at a basic level					
	1 – None, informal					
18. Innovation initiatives and projects	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed					
	2 – Managed at a basic level	●	●	●	●	●
	1 – None, informal					

- **Criteria with similar responses across subgroups**

  Similar responses were recorded in the overall and among the subgroups on an understanding of internal capabilities and assets; external and internal innovation cooperation; commitment of top management; and innovation initiatives and projects, as shown in Table 3.16.

This could be due to institutionalized organizations are long established and it is expected that both the government agencies and MSMEs have achieved a certain level of comprehension of their internal capabilities and assets, established partnerships with internal and external stakeholders, and committed leaders who initiate innovation projects for the organization.

- **Criteria with differences between government and MSMEs**

Table 3.17 shows that there are criteria where differences between government agencies (NGAs, SUCs, MIMAROPA SUCs) and industry (MSMEs and MIMAROPA MSMEs) can be identified. As expected, government agencies had higher ratings on understanding external trends and drivers, a culture that supports creation and implementation; communication and perception; intellectual property management; processes for identifying opportunities; processes for creating and validating concepts; solution development and implementation process; and performance evaluation and improvement.

For the case of MSME respondents, relatively lower ratings were gathered. Though they may be aware or have a minimum understanding of such processes or standards (e.g., ISO, Quality Management System), their organization and operation may still need to comply with other basic requirements to fully qualify for certification. According to the manager of Rejano's Bakery, the employment-related initiatives in its business operation were not fully documented or missing. The good thing though is that as part of government advocacy, DOST in particular, is to promote to its MSME stakeholders the fundamental concepts and value of basic quality management systems.

TABLE 3.17

PHILIPPINES' CRITERIA ON DIFFERENCES BETWEEN GOVERNMENT AND MSMES

Criteria	Rating	Overall	SUC	MIMAROPA SUC	MSMEs	MIMAROPA MSMEs
1. Understanding external trends and drivers	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level				●	●
	1 – None, informal					
3. Culture that supports creation and implementation	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level				●	●
	1 – None, informal					
15. Communication and perception	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level				●	●
	1 – None, informal					
17. Intellectual Property Management	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level				●	●
	1 – None, informal					
20. Processes for identifying opportunities	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level				●	●
	1 – None, informal					

Criteria	Rating	Overall	SUC	MIMAROPA SUC	MSMEs	MIMAROPA MSMEs
21. Processes for creating and validating concepts	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level				●	●
	1 – None, informal					
22. Solution development and implementation process	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level				●	●
	1 – None, informal					
24. Performance evaluation and improvement	5 – Optimization					
	4 – Systematically managed					
	3 – Defined and managed	●	●	●		
	2 – Managed at a basic level				●	●
	1 – None, informal					

The NE of the Philippines also carried out some in-depth analysis regarding the subgroup of respondents in comparison with the overall sample. Descriptive analysis was used in analyzing ratings of 24 aspects. The author concluded with some findings. After the criteria with at least 50% of responses below level 3 were extracted, five out of 24 criteria were identified as factors that the MSMEs can vastly improve on. Out of the 12 respondents who rated innovation policy, innovation goals, and actions plans at below level 3, eight were MSMEs. Nine out of 13 respondents who rated their organizational structure for innovation activities below level 3 were MSMEs. Similarly, eight of the 13 respondents who rated their innovation portfolio below level 3 were MSMEs. Nine out of the 12 respondents who rated their innovation tools and methods below level 3 were also MSMEs.

Singapore

Using mean scores and analyzing data per industry, a researcher in Singapore revealed some interesting findings. They are discussed below.

Performance per industry group

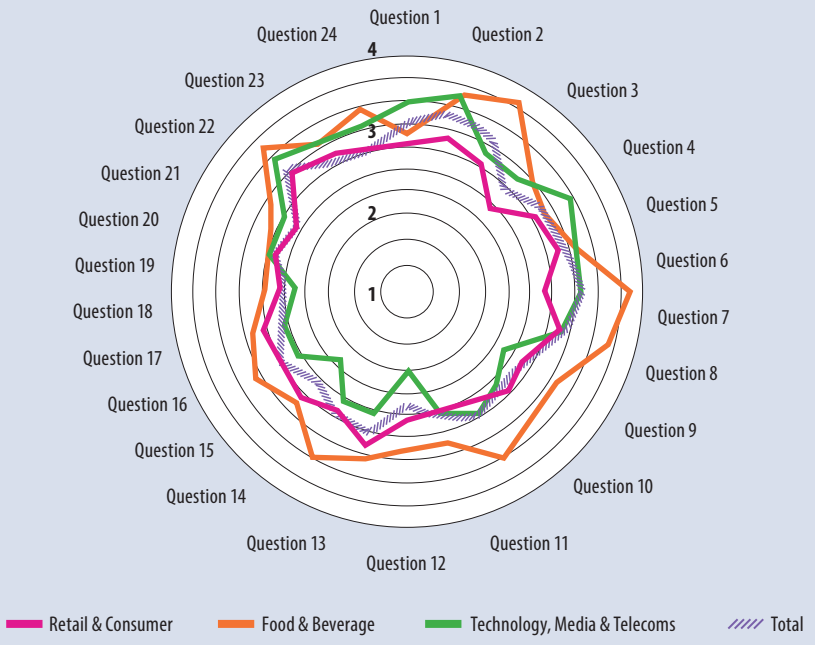
Figure 3.37 is a graphical representation of the mean scores of the three industries that were analyzed. The F&B industry scored the highest in multiple questions while the retail and consumer industry was the poorest performing industry. The technology, media, and telecoms industry scored very similarly to the average of the 20 surveyed companies.

The F&B respondents mainly comprised food production companies whereas the other industries were significantly from consultancy services. This could be an indicator that innovation in a production setting is easier to achieve. The innovation of production processes in these settings stems from Lean Manufacturing and Six Sigma methodologies. Lean Manufacturing is largely based on maximizing productivity and reducing waste while Six Sigma is based on a set of techniques and tools for process improvement. Such methodologies are highly prevalent in manufacturing or production settings and serve as the foundation of innovation. Additionally, companies are moving toward digitalization and adopting IR 4.0 concepts which would further proliferate innovative practices.

Many production and manufacturing companies in Singapore are encouraged by the government to digitalize. The Singapore government has come up with multiple initiatives to educate local companies on the importance and benefits of digitalization, with grants and subsidies also made available to companies to further motivate them to digitally transform.

FIGURE 3.37

SINGAPORE'S MEAN SCORES PER INDUSTRY



Overall results of top three industries is illustrated in Table 3.18.

The retail and consumer industry performed the best in question 22 (solution development and implementation process). This could be highly attributed to the fact that the survey respondents were mainly made up of consultancy firms and solution providers. The poorest performing area of this industry was in question four (external and internal innovation cooperation). This proves that there is limited cooperation with internal or external parties, and this is aligned with the results of many companies in Singapore that took the Smart Industry Readiness Index (SIRI). In SIRI, companies are assessed on the Inter and Intra Company Collaboration dimension, which looks into how companies can work together, through cross-functional teams and with external partners, to achieve a shared vision and purpose.

The F&B respondents had low standard deviation values across all the questions which suggests an accurate insight into the industry. They performed well in most areas except for the Activities pillar which contains some of their lowest scores. This indicates a lack of knowledge or defined processes for identifying, analyzing, and coming up with a solution.

The technology, media, and telecom industry performed well in the Assessment & Improvements pillar. However, it also has a large standard deviation value which reflects a disparity in the results. This is attributed to the different sectors that the respondents serve which range from Web Design to Manufacturing Consultancies.

From the results of the survey, most companies fared better in the Contexts and Leadership pillars. This indicates that they have a good understanding of the trends, drivers, and requirements of innovation. However, the survey does not indicate a benchmark or specific requirements for each level of understanding. Therefore, the understanding of these concepts is highly subjective and may not reflect the true understanding of innovation within their respective industries.

TABLE 3.18

SINGAPORE'S OVERALL RESULTS AND THE TOP THREE INDUSTRIES

Pillar	CONTEXTS				LEADERSHIP					PLANNING			SUPPORT					ACTIVITIES					ASSESSMENT & IMPROVE-MENTS	
Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
20 respondents																								
Average	3.15	3.35	3.20	2.75	3.05	3.05	3.20	3.05	2.70	2.70	2.80	2.70	2.45	2.85	2.80	2.60	2.80	2.70	2.55	2.70	2.65	3.20	2.90	2.90
Median	3.00	4.00	3.50	3.00	3.00	3.00	3.50	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	2.50	2.50	3.00	2.50	2.50	3.00	3.50	3.00	3.00
Standard Deviation	1.23	1.09	1.11	1.12	1.15	1.28	1.11	1.28	0.80	0.98	1.11	0.98	1.05	1.14	1.15	1.19	1.24	1.22	1.05	1.08	1.14	1.15	1.48	1.41
Retail & Consumer																								
Average	2.88	3.00	2.88	2.50	2.88	3.00	2.75	3.00	2.75	2.75	2.63	2.63	2.63	3.00	2.75	2.88	2.88	2.88	2.63	2.75	2.63	3.13	3.00	2.88
Median	2.50	3.50	3.00	2.50	3.00	3.50	3.00	3.50	3.00	3.00	2.50	2.50	2.50	3.50	3.00	3.00	3.00	3.00	2.50	2.50	2.50	3.50	3.00	3.00
Standard Deviation	1.36	1.20	1.46	1.20	1.46	1.51	1.28	1.51	1.04	1.28	1.30	1.41	1.30	1.51	1.39	1.55	1.55	1.55	1.41	1.49	1.41	1.36	1.69	1.55
Food & Beverage																								
Average	3.00	3.60	3.80	3.20	3.00	3.20	3.80	3.60	3.20	3.20	3.40	3.00	3.00	3.20	3.40	3.00	3.20	3.00	2.80	2.80	3.00	3.60	3.20	3.40
Median	3.00	4.00	4.00	3.00	3.00	3.00	4.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	3.00	3.00
Standard Deviation	0.71	0.55	0.45	0.84	0.71	0.84	0.45	0.55	0.45	0.45	0.55	0.71	0.71	0.45	0.55	0.71	0.84	0.71	0.45	0.84	0.00	0.55	0.84	0.55
Technology, Media, & Telecom																								
Average	3.40	3.60	3.00	3.00	3.40	3.20	3.20	3.00	2.40	2.60	2.80	2.60	2.00	2.60	2.60	2.20	2.60	2.60	2.40	2.80	2.80	3.40	3.20	3.20
Median	3.00	4.00	3.00	4.00	4.00	4.00	3.00	3.00	2.00	3.00	3.00	3.00	2.00	3.00	2.00	2.00	2.00	3.00	2.00	3.00	3.00	4.00	4.00	4.00
Standard Deviation	1.52	1.52	1.00	1.41	1.34	1.64	1.30	1.58	0.55	0.55	1.30	0.55	0.71	1.14	1.34	0.84	1.34	1.14	1.14	0.84	1.30	1.34	1.64	1.64

Companies performed poorly in the Planning, Support, and Activities pillars indicating that while they are aware of the requirements and concepts of innovation management, many are still lacking the knowledge of carrying out innovation processes and practices. They are not comfortable in planning for innovation, allocating resources for innovative projects, and ultimately driving them. While there are many government initiatives and drivers for innovation, embarking on such projects is still deemed to be new territory for most companies in Singapore.

Thailand

Responses for each question in the survey from all respondents are shown in Figures 3.38–3.43, grouped into the corresponding six capacity factors (Contexts, Leader, Planning, Support, Activities, and Assessment and Improvements). The average capacity level of each criterion and aspect are also displayed in Table 3.19.

FIGURE 3.38

THAILAND'S INNOVATION MANAGEMENT CAPACITY OF RESPONDENTS: CONTEXTS (CRITERIA 1–4)

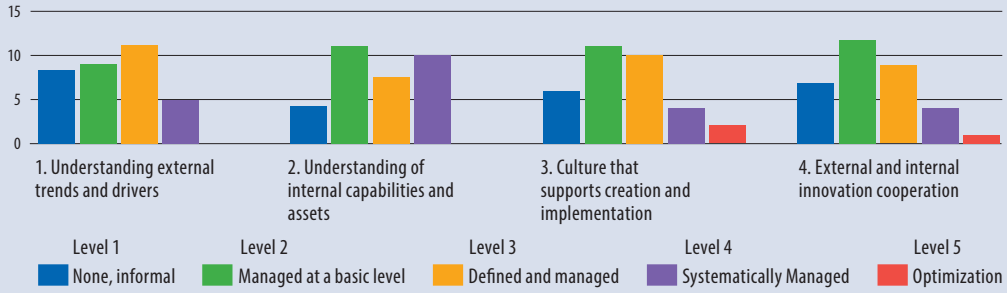


FIGURE 3.39

THAILAND'S INNOVATION MANAGEMENT CAPACITY OF RESPONDENTS: LEADER (CRITERIA 5–9)

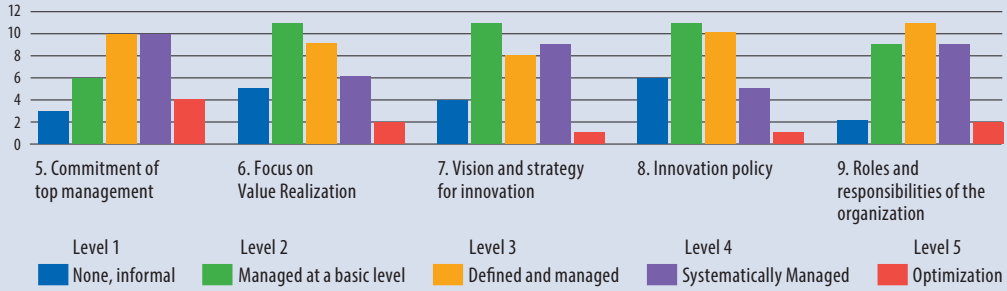


FIGURE 3.40

THAILAND'S INNOVATION MANAGEMENT CAPACITY OF RESPONDENTS: PLANNING (CRITERIA 10–12)

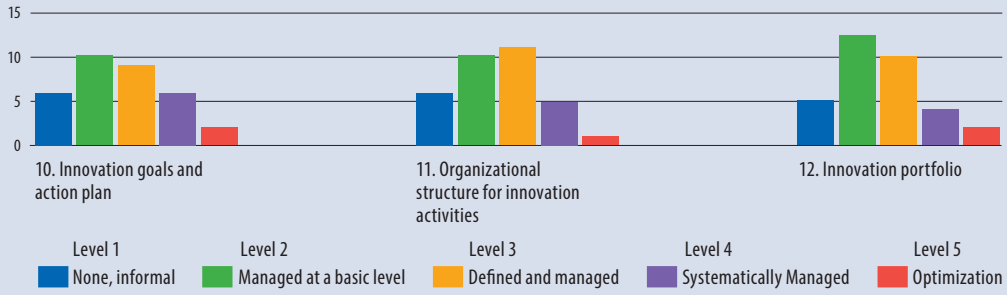


FIGURE 3.41

THAILAND'S INNOVATION MANAGEMENT CAPACITY OF RESPONDENTS: SUPPORT (CRITERIA 13–17)

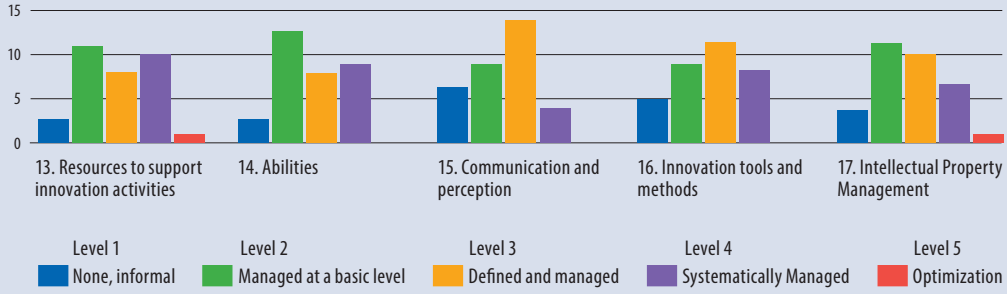


FIGURE 3.42

THAILAND'S INNOVATION MANAGEMENT CAPACITY OF RESPONDENTS: ACTIVITIES (CRITERIA 18–22)

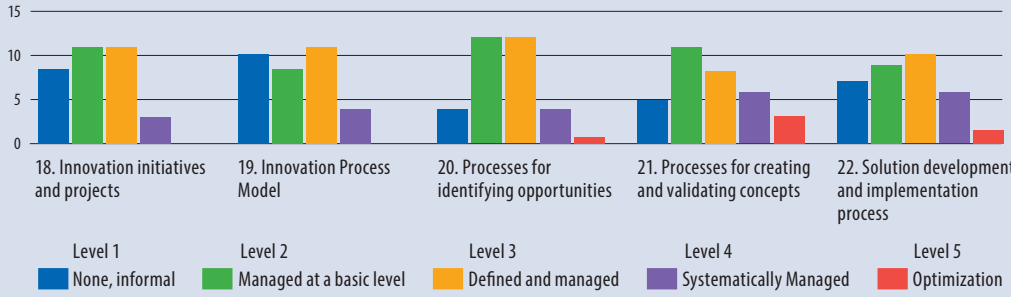
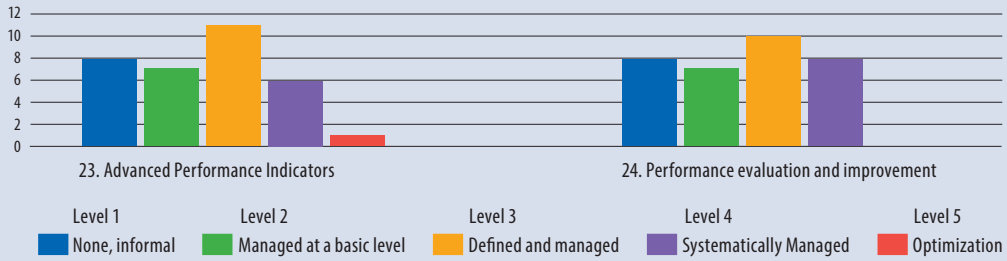


FIGURE 3.43

THAILAND'S INNOVATION MANAGEMENT CAPACITY OF RESPONDENTS: ASSESSMENT AND IMPROVEMENTS (CRITERIA 23–24)



In most criteria, the organizations of survey respondents generally have the capacity levels of 2–3, followed by level 1, level 4, and level 5 which correspond to the average capacity level of 2.62 for all criteria. The top 3 criteria with the highest average capacity levels are the commitment of top management (3.18), roles and responsibilities of the organization (3.00), and resources to support innovation activities (2.85) while the bottom three criteria are innovation initiatives and projects (2.27 - tied), innovation process model (2.27 - tied), and external and internal innovation cooperation (2.39). Also, the capacity aspects can be ranked as followed: Leader, Support, Planning, Assessment and Improvements, Contexts, and Activities (Table 3.19).

TABLE 3.19

THAILAND'S OVERALL RESULTS OF SURVEY

Capacity Aspects	Criteria	Average	
Contexts	1. Understanding external trends and drivers	2.39	**2.52**
	2. Understanding of internal capabilities and assets	2.73	
	3. Culture that supports creation and implementation	2.55	
	4. External and internal innovation cooperation	2.39	
Leader	5. Commitment of top management	3.18	**2.82**
	6. Focus on Value Realization	2.67	
	7. Vision and strategy for innovation	2.76	
	8. Innovation policy	2.52	
	9. Roles and responsibilities of the organization	3.00	

Capacity Aspects	Criteria	Average	
Planning	10. Innovation goals and action plan	2.64	**2.59**
	11. Organizational structure for innovation activities	2.55	
	12. Innovation portfolio	2.58	
Support	13. Resources to support innovation activities	2.85	**2.68**
	14. Abilities	2.70	
	15. Communication and perception	2.48	
	16. Innovation tools and methods	2.67	
	17. Intellectual Property Management	2.70	
Activities	18. Innovation initiatives and projects	2.27	**2.50**
	19. Innovation Process Model	2.27	
	20. Processes for identifying opportunities	2.58	
	21. Processes for creating and validating concepts	2.73	
	22. Solution development and implementation process	2.64	
Assessment and Improvements	23. Advanced Performance Indicators	2.55	**2.55**
	24. Performance evaluation and improvement	2.55	
Total		**2.62**	

It should be noted that most of the survey respondents were from middle to top management. Therefore, there could be a possible bias when answering questions about leadership, which makes the leader aspect come out at the top. Another explanation could be that many criteria in this aspect are mostly about policy and strategy, which are not activity-based. This is a direct opposite of the activities criteria, which rank last and requires the organization to put plans into action. Together with the score for other aspects, it can be suggested that these organizations are more likely to have processes for the early stage and supporting part of innovation management but are still lacking when it comes to managing actual innovation projects (Activities and Assessment and Improvements).

TABLE 3.20

THAILAND'S RANKING OF CAPACITY LEVEL ON ASPECTS OF INNOVATION MANAGEMENT

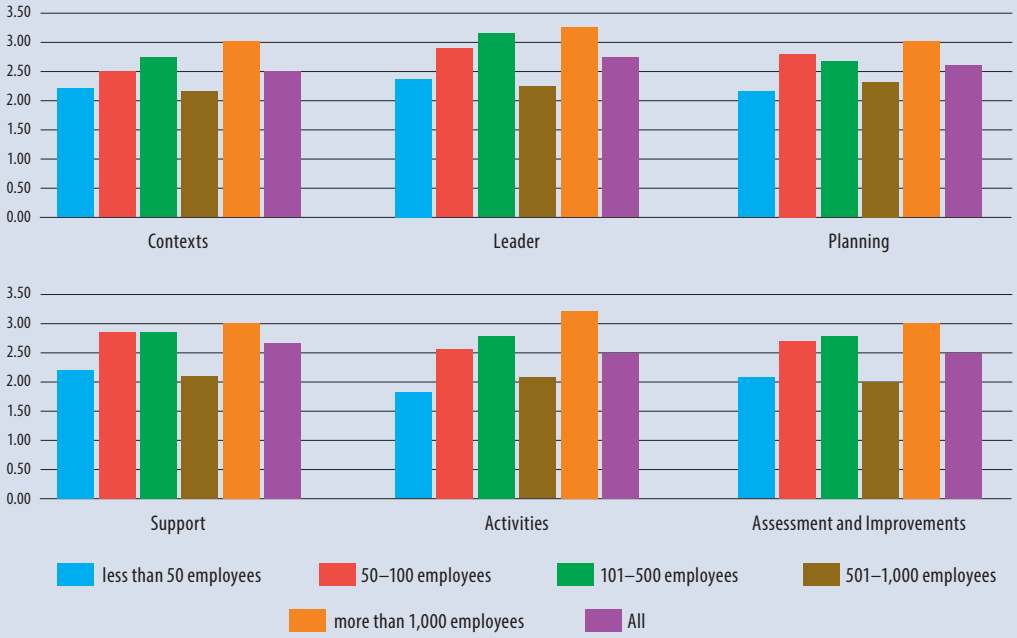
Rank	Capacity Aspects	Level
1	Leader	**2.82**
2	Support	**2.68**
3	Planning	**2.59**
4	Assessment and Improvements	**2.55**
5	Contexts	**2.52**
6	Activities	**2.50**

Organization Size and Innovation Management Capacity

Figure 3.44 shows the six aspects of innovation management capacity for each group of organizations according to their sizes (number of employees) compared to the average of all organizations.

FIGURE 3.44

THAILAND'S INNOVATION MANAGEMENT CAPACITY OF RESPONDENTS ACCORDING TO ORGANIZATION SIZE



In general, it can be seen that as the number of employees of the organization goes up, the innovation management capacity also goes up. Organizations with less than 50 employees score the least in two out of six capacity aspects while an organization with more than 1,000 employees scores the most in all six capacity aspects. This is expected as small companies may not yet require proper systematic management for many of the innovation activities. On the other hand, large companies with a large number of employees would have many more innovation initiatives or projects, and it would be more likely and more crucial for them to have some form of management.

It is interesting to note that organizations with 501-1,000 employees seem to break this general trend, having capacity levels similar to those of organizations with less than 50 employees. As there is a lack of other information regarding these firms except for the industry they are in, a further study with larger sample size or with other information about these firms may help to explain this result better.

Vietnam

The survey results of 24 aspects are analyzed based on the six aspects of ISO 56002, including Context, Leadership, Planning, Support, Activities, and Performance Evaluation and Improvements, as shown in Figure 3.45 [1].

Context encompasses to criteria of Understanding external trends and drivers; Understanding internal capabilities and assets; Culture that supports creation and implementation; and External and internal innovation cooperation. Survey data shows that more enterprises have priority and interest in 'understanding internal capabilities and assets' at level 4 and level 5 (51 enterprises) than 'understanding external trends and drivers' (31 enterprises). Enterprises participating in these two-dimensional surveys at level 4 and level 5 focused on collecting feedback from employees and customers combined with annual reviews to determine the focus areas for improvement.

FIGURE 3.45

VIETNAM'S SURVEY RESULTS ON 24 ASPECTS OF INNOVATION MANAGEMENT FOR ENTERPRISES [1]

Fourteen enterprises had formed and demonstrated a strong innovation-promoting culture in their organizations. Some enterprises meanwhile have tried to promote a culture of internal relations to generate more effective ideas. Other supporting functions such as innovation leadership and innovation coaching were also mentioned as contributors to creating a culture that fosters innovation and internal relations. Some enterprises have innovation departments where processes are continually improved

using consensus-based decisions to drive entrepreneurship. One enterprise had hired outside consultants so that innovation management improvements can be made. However, the 'external and internal innovation cooperation' of enterprises is not high. Most of the enterprises participating in the survey only identified and started to manage some issues related to 'external and internal innovation cooperation' and have not yet applied methodical management systems. Although the type of partnership varies between enterprises, sharing financial and human resources to develop something that benefits both parties is viewed as an effective driver for innovation. For some enterprises, getting customers involved in the development process is crucial, especially when it comes to digitizing their product offerings. Although there are different ways to achieve customer engagement, the design thinking process has been mentioned by many enterprises as a good tool for meeting customer needs and creating new services that customers value [1].

Aspects of Leadership are linked to Commitment of top management; Focus on value realization; Vision and strategy for innovation; Innovation policy; and Roles and responsibilities of the organization. The 14 enterprises came with their leaders' full interest in IMS. As part of enterprise innovation strategy to achieve innovation goals and overall innovation vision, establishing partnerships is a key component. In this respect, there were 11 enterprises with optimal strategic IMS, level 5. Some have created structures specifically for implementing innovation management, such as an innovation department or in partnership with innovative start-ups. Six participating enterprises in the survey have built an optimal process to assign units and departments in the organization to manage innovation management, thereby increasing the speed of innovation and reducing the time in the decision-making process. With the right organization and take up of new emerging ideas, decisions to invest time and other resources can be quickly made by having an investment committee that meets regularly and make decisions in a short period [1].

Planning incorporates three criteria: Innovation goals and action plan; Organizational structure for innovation activities; and Innovation portfolio. The innovation goals and methods for choosing them vary among the surveyed enterprises. The enterprises' general impression in the survey is although they are interested in innovation goals, they do not have a specific method to integrate their business with the innovation vision and strategy. Only two participating enterprises have an optimal 'Innovation goal and action plan' management system' while 21 others have built their management system in this respect. On business goals, some correlate directly with financial performance indicators while others relate to different areas, such as the number of customers with access to the offering of the enterprise's current product line. In some cases, there are no innovation goals while several focus on other goals and see innovation as just a means to achieve them. While some innovation goals are independent, others are more interconnected with different business goals. Some enterprises set a long-term innovation strategy as the designated choice; others highlight the potential dangers it can pose when the market changes rapidly [1].

To implement IMS, Support includes five important concerns: Resources to support innovation activities; Abilities; Communication and perception; Innovation tools and methods; and Intellectual Property Management. Only four enterprises participating in the survey have an optimal management system for 'Resources to support innovation activities'. In general, surveyed enterprises mentioned courses, programs, and seminars to develop competencies related to innovation management. Of these, some enterprises have career development roadmaps on specific industry and training in the region. Many enterprises already have innovative leadership training programs. Another solution for capacity building is to have an internal unit of the enterprise that can research and train innovation managers and employees on the ISO standards based on innovation management. On the aspect of 'Communication and perception', 24 participating enterprises have systematically managed to motivate employees to develop new ideas. A number of enterprises, especially those with a small workforce, give employees some degree of freedom to develop their ideas. Many enterprises have also implemented small innovation projects initiated by employees. In contrast, some large enterprises have sizable R&D funds to develop the idea, although initially, the idea needs to be presented to the responsible manager(s) to

qualify for access to the funding resources. The 'Intellectual property management' process received great attention from enterprises participating in the survey with 17 enterprises having an optimal system for IP management; 25 enterprises have managed IP systematically, and 28 enterprises have begun to identify IP as important to start having management [1].

One of the most important aspect is Activities. Five criteria of Activities include: Innovation initiatives and projects; Innovation process model; Processes for identifying opportunities; Processes for creating and validating concepts; and Solution development and implementation process. On the innovation process, there are nine enterprises on the 'Processes for identifying opportunities' management system that works at an optimal level. On the criterion 'Processes for creating and validating concepts' management system, eight enterprises are at an optimal level, but only two enterprises have an optimal level on 'Solution development and implementation process' management system. This is one of the limitations of enterprises when facing difficulties in the management of 'Solution development and implementation process', thereby limiting the commercialization of new products and services enterprises. Enterprises in Vietnam are only proficient with quality management systems, such as ISO 9001, environmental management systems ISO 14001, and management systems ISO 50001. With innovative management processes, although it may appear like a linear process, it is all part of innovation. The basic steps of the process need to be iterative. Therefore, it is not possible to do linear innovation. If innovation management is linear, it is a development process, not an innovation process [1].

Performance evaluation and improvements include two criteria: Advanced performance indicators and Performance evaluation and improvement. According to the survey data, not many surveyed enterprises have a method to evaluate the effectiveness and efficiency of their IMS systematically, although some enterprises try to improve every year. Notably, some enterprises use customer tracking as a form of evaluation - if the technology is implemented effectively and the customer feedback is positive, the innovation has been successful, and therefore no need for improvement in terms of innovation management. Only five enterprises in the survey optimized to make improvements to their IMS. For

FIGURE 3.46

VIETNAM'S AVERAGE RANKING OF ENTERPRISES FOR ASPECTS RELATED TO ISO 56002 [1]

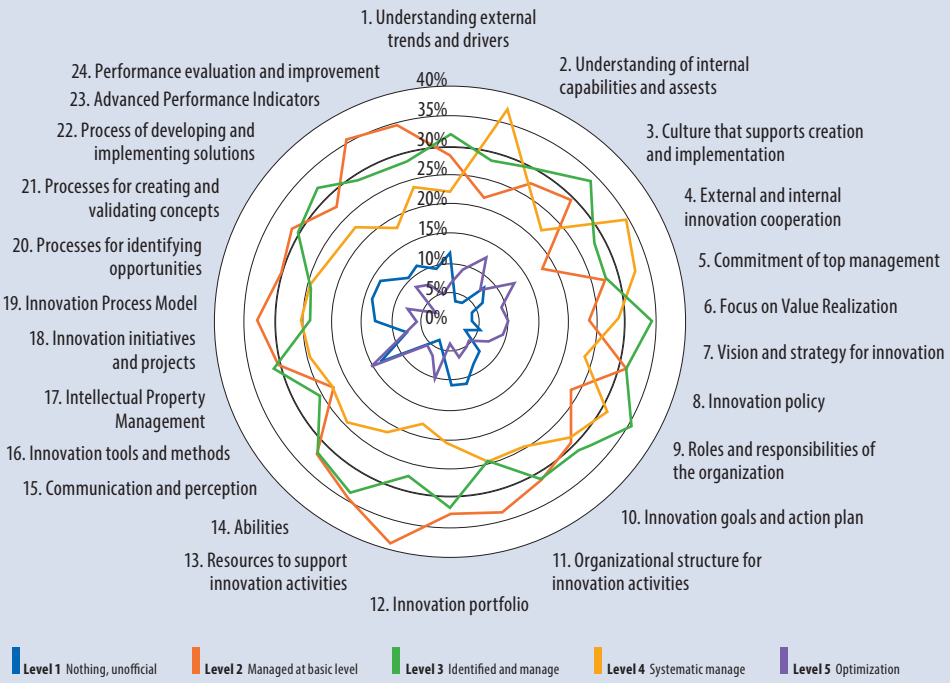
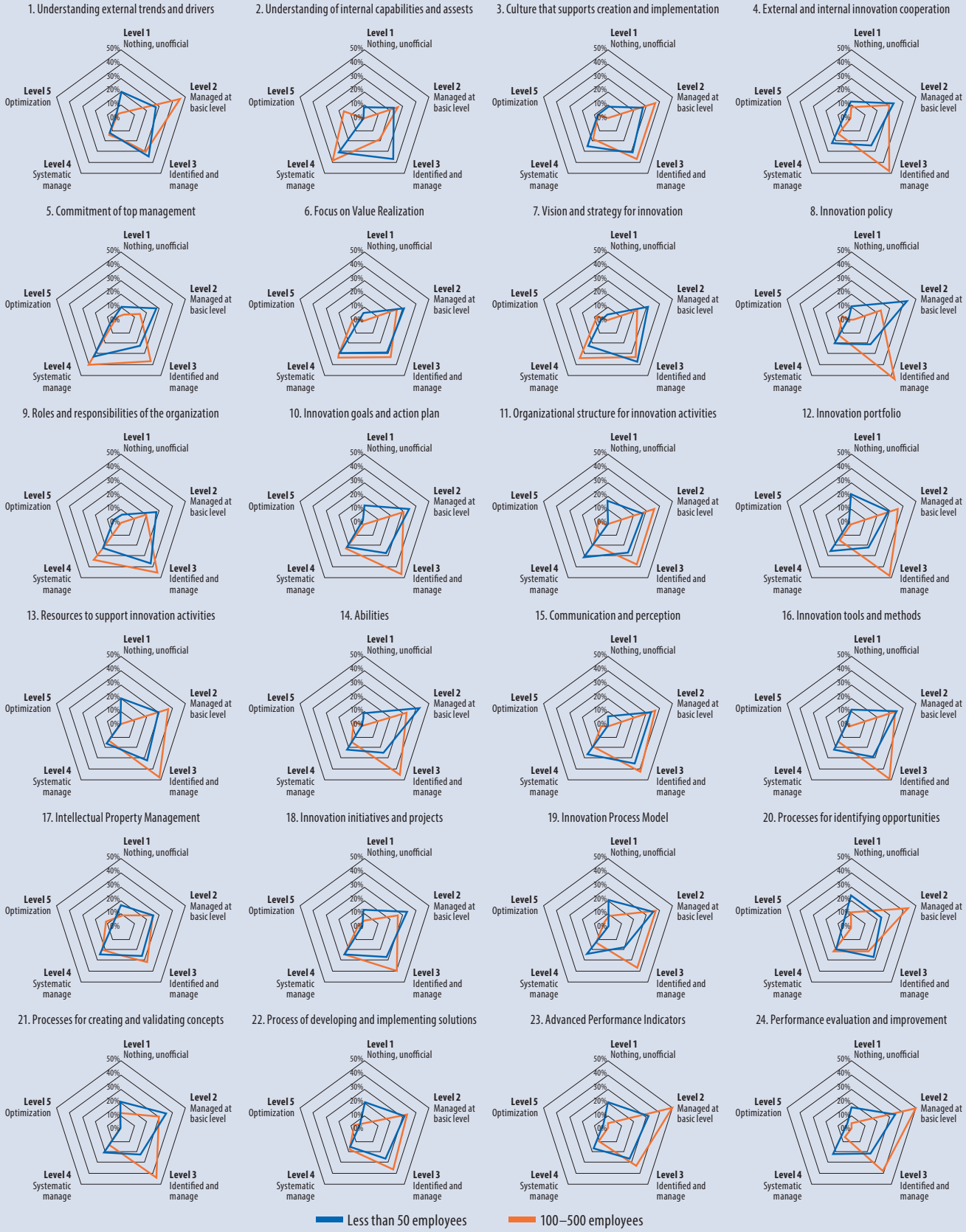


FIGURE 3.47

VIETNAM'S ENTERPRISES COMPARISON ON ISO 56002 INNOVATION MANAGEMENT CAPACITY BY LABOR SIZE



example, holding sessions with middle management from one of their core departments to review and improve their processes [1].

The average ranking of enterprises in terms of the current level for each question related to ISO 56002 is shown in Figure 3.46. Three questions have many enterprises participating in the survey to assess their current level. The highest are Culture that supports creation and implementation; Commitment of top management; and Intellectual property management. There are three questions that the few surveyed enterprises rated their current level the highest: Resources to support innovation activities; Communication and perception; and Processes for creating and validating concepts. These aspects will also become inputs to identify specific objectives to be addressed in the innovation policy [1].

In this study, the innovation management capacity of surveyed enterprises with less than 50 employees and those between 100–500 employees were compared. It is found that enterprises with fewer than 50 employees have better innovation management capacity than enterprises with 100–500 employees in the following criteria: Culture that supports creation and implementation; External and internal innovation cooperation; Commitment of top management; Innovation goals and action plan; Innovation portfolio; Innovation tools and methods; Processes for identifying opportunities; Advanced performance indicators; and Performance evaluation and improvement. In contrast, enterprises with a size of 100–500 employees will have better innovation management capacity than enterprises with fewer than 50 employees in the following aspects: Understanding external trends and drivers; Understanding of internal capabilities and assets; Vision and strategy for innovation; Innovation policy; Intellectual property management; Innovation initiatives and projects; and Solution development and implementation process (Figure 3.47) [1].

Overall Data Results Comparisons

To have an overall comparison of data results on 10 APO member economies, averages of all 24 criteria of 10 surveys are calculated from raw data and shown in bar charts. Figure 3.48 shows differences in the perception of participating organizations in 10 countries at each criterion of innovation management. In criteria "1. Understanding external trends and divers", organizations in India have a rating score of 4.17 while those in Thailand and IR Iran have rating scores of 2.39 and 2.75, respectively. In this same criterion, participating companies in ROC rated scores at 3.35 (the highest score among 24 scores in ROC). The NE in ROC explains, "The reason why participating companies (in ROC) exhibit a higher score in average compared with other questions is that scanning external environment is a common practice when companies are either conducting strategic planning or implementing annual planning". Sampled organizations in other countries rated scores at an equal level in this criterion and far different from India. Similarly, criteria numbers 9, 10, 12, 13, 14, 15, 18, 19, 20, 21, 24 have the same gap of scores between organizations in India and Pakistan and others in the remaining countries.

A noted common tendency is organizations in India and Pakistan rated higher than other countries in almost every criterion while participating organizations in Thailand seem to rate modest scores. Figure 3.49 shows this tendency clearly with a Radar chart. It is quite different from others in that participating organizations in India to have far high scores on all criteria. It may infer that participating companies in India have high innovation management capacity.

At the second level, organizations in Pakistan have only one criterion (criterion number one) that has a score lower than those from ROC and Singapore (and of course India). All other criteria scores are just lower than those of India.

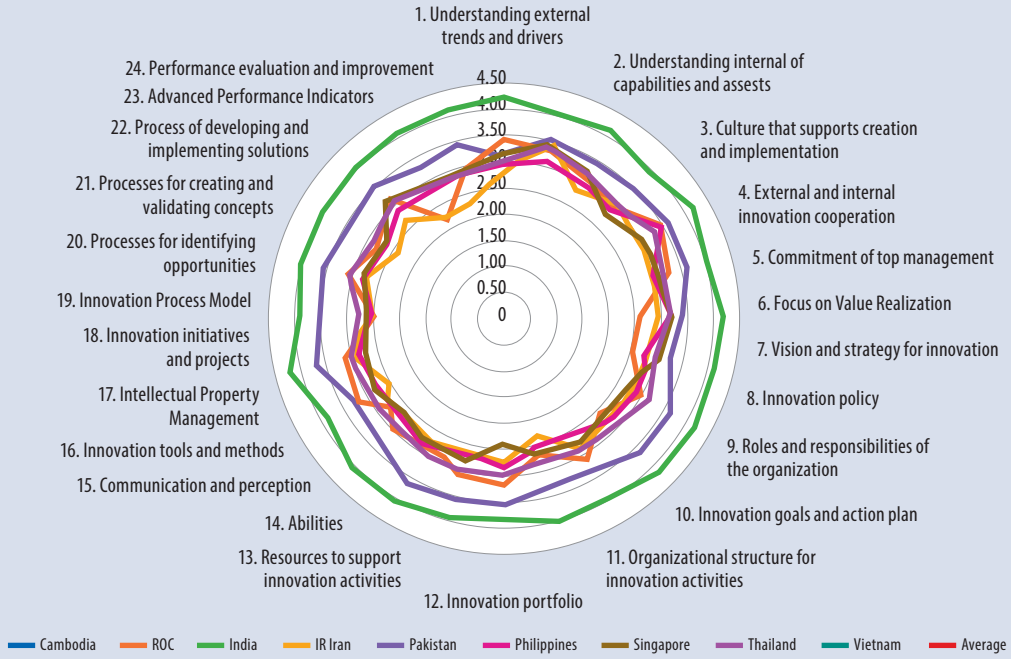
The remaining seven countries have rating scores of organizations at similar levels in all criteria.

FIGURE 3.48

OVERALL COMPARISON OF 24 CRITERIA AMONG 10 APO MEMBER ECONOMIES

FIGURE 3.49

AVERAGE OF 24 CRITERIA AMONG 10 APO MEMBER ECONOMIES



CHAPTER 4

CASE STUDIES

Case studies were developed by NEs in six countries to get insights and the real context of the innovation management capacity in specific organizations, as discussed in this chapter. Some case studies are highlighted quite elaborately based on detailed research and information exchange while others are presented in the form of face-to-face interviews and recorded information. Case studies assess the level of awareness of organizations on innovation management based on ISO 56002 and examine organizations' innovation management capacity through their self-assessment in accordance to the 24 criteria.

ONE SHOOT MEDIA (INDONESIA)

The company interviewed for this case study is One Shoot Media. It offers creative products and services, such as illustrations, typography, photography, and motion graphics for both publishers and print and electronic media. The information featured here is obtained from the owner/director.

The results of the interview:

Q1: Currently, with various digital developments, what do you think about ISO in this digitalization era?

A1: In my opinion, applying standards to a performance system is important. Each ISO has different rules for each number and changes, or revisions occur every five years according to needs. So each company will continue to run on axis and orderly fashion.

Q2: What is your opinion on ISO 56002 - Innovation Management that is currently in effect?

A2: I think ISO 56002 innovation management system guide was issued at the right time to support global value chain disruptions that are currently complicated, and it started in 2020.

This standard may be a suitable set of regulations to be intensified post-COVID.

Innovation is something that must be owned by business actors, regardless by implementing ISO or otherwise. However, by adopting the ISO 56002 concept, manufacturing companies and institutions can go a step further and start their efforts to innovate and transform. It also adds new value to the supply chain that is being reshaped and allows more focus on technical uncertainties.

Q3: How has the pandemic damaged your company's supply chain and how can you recover from it?

A3: The effects of the pandemic have exposed existing vulnerabilities in supply chain services, processes, and product supply. Thus the industry needs to unite with the interdisciplinary

community to take action and create new solutions and collaborations that were not considered before. We can't just do more than what we're used to. There is a need to train all available workforces to collaborate in parallel with a high degree of automation and flexibility and, where value chains are digitized, using innovations enabled by 5G, virtual and augmented reality, artificial intelligence (AI), and various digital technologies.

Q4: In the post-COVID recovery, how can ISO 56002 maintain its role as a key driver of sustainable growth and value?

A4: The increasing need and the need to manage innovation in this era of accelerated digitization can be partially understood by looking back at the life cycle of software products and solutions in the telecommunications and software industry.

Running a business in this era requires a strong business model, stability in core processes and knowledge, and a very high degree of flexibility to respond and adapt when volatility strikes.

With COVID-19 and its impacts are at the top of the corporate governance agenda in every business, every country, and all levels of public-sector organizations, one thing is clear: they don't want to be unprepared and reactive when the crisis occurs. Owners, investors, and boards want to make sure their organizations are ready, and not just for reactive mobilization and mitigation.

Resilience, adaptability, and sustainable profitability are words often associated with withstanding volatility and uncertainty, but how do you become fit for the future when you are stuck in the existing structure? Now we can certainly confirm that the COVID-19 pandemic ensured that we explore future sources of income in parallel.

Q5: What do you see as lessons and opportunities from the global health crisis and how does ISO 56002 ensure that its systems can be used for recovery?

A5: The challenges and uncertainties caused by the pandemic have been a wake-up call, and representatives of owners and directors are now calling for new ways to ensure resilience and long-term growth.

However, taking full advantage of new opportunities is not just a matter of expanding perceptions or mindsets. We also need active engagement to identify and address the challenges ahead. In the absence of an agreed-upon way of working, there is now a need for support and follow-up system, which may take years to get approved and implemented. However, there will be nothing for sure if no plan is put in place.

Q6: How can ISO 56002 help restore sustainable economic growth?

A6: The vulnerability of communities exposed to pandemics both at macro and micro levels, not only leads to country and border lockdowns, causing economic losses, but it also clearly demonstrates what we can achieve as a community when we collaborate toward a common goal.

Q7: How is ISO 56002 implemented in your company?

A7: Our company implements ISO 56002 by saving costs and reducing risks by innovating and collaborating across borders. We improve the organization's ability to make decisions; test and try, fail quickly, have the ability to take reasonable risks, face challenges and changes in the world; and improve the results of the innovation process and contribute to monitoring the return on investment made in innovation.

All the collaborative efforts to mobilize the production and procurement of protective equipment and development, for example, by distributing vaccines to all workers have also been carried out at tremendous costs, efforts, and considerable pressure on society and the economy which we cannot afford from time to time.

Q8: How does your company measure ISO 56002?

A8. To obtain a certificate of conformity according to ISO 56002, a company must be able to evaluate its company profile and issue a commercial proposal. We conduct an initial audit with QMS which is divided between document audit and innovation process audit. We received ISO 56002 conformity certificate and maintain an active management system with an annual internal audit. We will ensure QMS makes annual audits to maintain the certificate of conformity.

QUALITY SOLUTIONS (PAKISTAN)

Quality Solutions was visited and interviewed to assess best practices applied in product and process development while providing innovative solutions in the field of design and engineering.

Engineers are adept at understanding the dynamic requirements of clients who in turn are offered cost-effective, value-added services to make their business more profitable. The company offers innovative services in product development, 3D documentation, and reverse engineering [69].

Through interviews about the best practices in the targeted company, the researcher found some key points about the innovation process and the desire of local production for innovation management as well as the lack of skills and expertise in the field.

The innovative processes and solutions have played a vital role in localization, particularly in the textile, automotive, and manufacturing sectors in Pakistan. Local production units had a strong demand for localization. However they were not equipped with the required skills and expertise. With the advent of these globally recognized innovative solutions, several organizations took advantage of the processes resulting in enhanced skill levels, improved productivity and quality, and an increase in self-reliance.

REJANO'S BAKERY (PHILIPPINES)

The Philippines' NE carried out in-depth research on innovation management capacity at Rejano's Bakery. A full picture of the company was depicted against 24 criteria of the assessment of innovation management capacity. The case study also shares examples of best practices in innovation processes applied in the bakery company.

Additionally, the six aspects of innovation management capacity assessment were discussed, and the findings and identified recommendations/opportunities for improvements (OFIs) were offered to the company by the researcher.

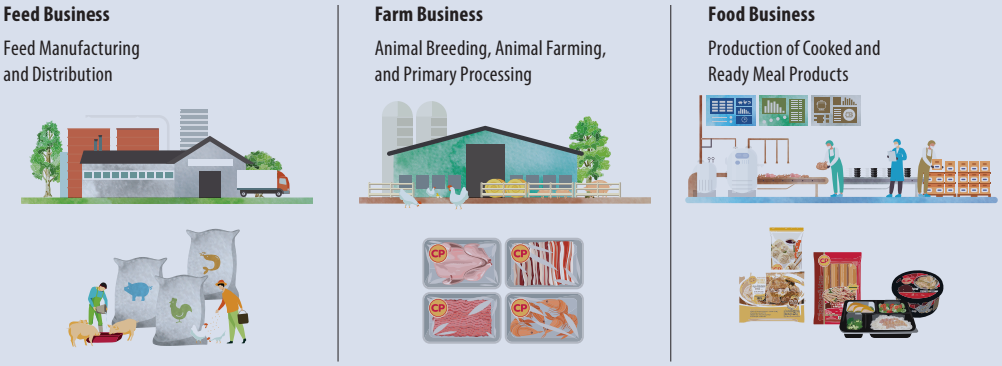
This is an elaborate study conducted by the NE. Please see Annex 3 for the full case study of Rejano's Bakery.

CHAROEN POKPHAND FOODS PUBLIC COMPANY LIMITED (THAILAND)

Charoen Pokphand Foods Public Company Limited (CP Foods) first registered under the name 'Charoen Pokphand Feedmill Company Limited' in 1978 as a producer and distributor of animal feed. In 1999, it was renamed "Charoen Pokphand Foods Public Company Limited" and became an agri-business company. Today, it is a leading agro-industrial and food conglomerate in three main business categories - feed, farm, and food (Figure 4.1). It operates in 17 countries and exports to more than 40 countries.

FIGURE 4.1

CP FOODS' THREE BUSINESS CATEGORIES



Source: CP Foods

ISO 56002:2019

CP Foods became the first Thai company to receive ISO 56002:2019 certification on 30 October 2020. The certification is awarded to CP Foods' Feed Mill which is located at Bangna KM21 in Samutprakarn Province, in the outskirts of Bangkok.

During the certificate award ceremony, Siripong Aroonratana, Chief Operating Officer of CP Foods, said that "ISO 56002:2019 standard is a way to help CP Foods to adapt to a fast-changing environment and create an innovative corporate culture as well as meeting consumer's demand, creating added value for the business while helping to develop a sustainable society. Ultimately, this will lead the organization to achieve the vision of the Kitchen of the World" [70].

Sakchai Buamoon, Senior Vice President of CP Foods, explained that at first, CP Foods did not have a standardized innovation management system, but the company tried to encourage employees of all levels to participate in improving and creating new products and innovations. Later, the company realized that it needed to manage its innovation more systematically, or it might lose some knowledge and innovation in the event staff are reshuffled or face another unexpected event. When ISO 56002:2019 was announced, the management was in the opinion that the company was ready and applied for certification. They were proud of becoming the first Thai company to receive the internationally recognized ISO 56002:2019 certification which shows that the company has followed the right direction.

FIGURE 4.2

ISO 56002:2019 CERTIFICATE AWARD CEREMONY ON 30 OCTOBER 2020

Source: CP Foods

National Innovation Awards 2021

Other than receiving ISO 56002:2019 certification in 2020, CP Foods also received the National Innovation Awards 2021 in the Innovative Organizations category from the Ministry of Higher Education, Science, Research, and Innovation for its achievement in improving operational efficiency and business competitiveness with innovations.

Pairoj Apiruknusit, Executive Vice President for aquaculture business, said that "CP Foods, as a leading food producer with "Kitchen of the World" vision, strives to build food security. To do so, the company has spawned countless inventions to create an efficient and sustainable business from farm to fork as well as to accomplish the United Nations Sustainable Development Goals (SDGs)"

The company has developed the 2030 Sustainability in Action strategy, which sets a goal to increase the proportion of healthy food innovations from 35% to 50% by 2030 and has established the CPF Food Research and Development Center on its 1.6 hectares area in Phra Nakhon Si Ayutthaya Province.

Examples of CP Foods' Innovation

- **Benja Chicken** - The world's first brown rice-fed chicken, raised without antibiotics and no added hormones. Winner of Top Innovative Product from THAIFEX - World of Food Asia 2019
- **Cheeva Pork** - The world's first Omega 3 pork-fed with superfoods. Winner of THAIFEX Taste Innovation Show from THAIFEX-Anuga Asia 2020
- **Meat Zero** - 100% plant-based meat. It was developed in collaboration with Chulalongkorn University and Mae Fah Luang University, Thailand as well as leading companies from Japan, USA, and Singapore
- **Test Kit for Listeria Monocytogenes Bacteria** - Developed in collaboration with Srinakharinwirot University

TAI SIN ELECTRIC (SINGAPORE)

This case study highlights a cable production company and a partnership between a governmental agency and a German MNC which has taken the initiative to become the drivers of change.

Tai Sin Electric was founded in 1980 and is the largest cable manufacturer in Singapore with a workforce of about 160 and four factories in operation. The company made its first move toward digitization after it was identified that human error led to frequent mistakes in the daily production reports. This led to time being lost as each report had to first be analyzed. The nature of their manual also made it increasingly difficult to backtrack older data. Through engagement with industrial consultants, the company digitized its operating procedure through the introduction of automated processes into the production cycle. One such addition was the automatic cable-winding machine and subsequent factory expansion. The monitoring and control of this machine are now performed remotely through the addition of cameras and sensors. Another additional improvement is measuring cable geometry through automatic testing and record-keeping which improve the accuracy and historical significance of the data collected [71].

SIRI was created by the Singapore Economic Development Board (EDB) in partnership with a network of leading technology companies, consultancy firms, and industry and academic experts. SIRI comprises a suite of frameworks and tools to help manufacturers - regardless of size and industry - start, scale, and sustain their manufacturing transformation journeys. It covers the three core elements of IR 4.0: Process, Technology, and Organization.

TÜV SÜD, a German MNC uses SIRI in this instance, to support their clients with a clear understanding of Industry 4.0 concepts and evaluation of the client's current state. Consultation advice is also provided in implementation strategies to increase the digital capacities at identified pain points along the supply chain. In 2018, SIRI was implemented for Tai Sing Electric [72]. The index consists of a total of 16 dimensions, ranging from topics, such as overall digital integration, process automation/connectivity/intelligence on the shop floor, the facility and the administration, human resources, and strategy. These 16 dimensions are scored with up to 5 points, thereby indicating the level of Industry 4.0 readiness in that focus area. The final scoring is compared to the general state of the industry, giving the client a holistic perspective of their overall standing within the industry and relative to companies of similar economic output. SIRI applies to all industries, regardless of the size of the company assessed. Through a key partnership with the World Economic Forum, these industrial comparisons are done on a global scale [73].

While these two examples show the transition from holistic assessment and identification to implementation of the innovation, many companies have yet to take the step toward innovation management.

DAI NAM UNIVERSITY'S INNOVATION (VIETNAM)

Dai Nam University (DNU) was established in 2007, in accordance to Decision 1535/QD-TTg by the prime minister. Since its establishment, the university has pursued the ambition to be one of the leading universities in terms of "Quality, Reputation, Innovation, and Good Service". DNU is set out to produce high-quality human resources in business, engineering, technology, and social sciences to serve the country's modernized process in international integration.

As a private university, its board of directors comprises former public university leaders and corporation presidents with experience in academic and business fields. The head of the board of directors is Dr. Le Dac Son who was a professor at Hanoi University of Science and Technology and former president of one of the largest commercial banks in Vietnam.

Dai Nam University is located on a 10.6 ha piece of land at Phu Lam in Hadong district, approximately 15 km west of the city center. The University has two campuses - one at 56 Vu Trong Phung Street and the other in Phu Lam, Hadong district. The campuses have ample comfortable space and fresh air, providing ambient conditions for students to study, discuss, and organize outdoor activities. All classrooms are equipped with projectors, blackboards, tables and chairs, air conditioners, fans, etc. The library is diverse and attractive with over 5,000 books available on social, economic, and technical fields. These books are allocated systematically to meet the students' demands for information. The computer labs have over 250 modern computers with internet connections all day long. Wireless internet is free across the university which helps students to search for information while studying. The canteen does not only serve food but it is also a place for students to gather, discuss and do group work, etc.

The university has a good lineup of lecturers, tutors, and staff. They are masters with rich knowledge and experience in economics and finance. Many of them are in charge of high-level management positions in major banks and financial institutions in Vietnam. Their experience of studying, researching, and working in advanced international environments will ensure their efficient support in tutoring students as well as performing administrative affairs of the program in innovating DNU. In addition to the professors in the university, leading experts and educationists in Vietnam's banking and finance sectors are also invited to participate in the workshops. Their comprehensive knowledge and understanding in Vietnamese banking and finance ensure the effective adaptation of the innovation program based on the distinctive characteristics of Vietnam. The quality of lecturers is acknowledged as one key determinant of the teaching and training operations in DNU. The university pays much attention to the recruitment and cultivation of lecturers to ensure that each lecturer has adequate competencies to take care of students' development. In 2022, DNU has 536 lecturers (four Professors, 52 Associate Professors, 142 Assistant professors, 307 masters, and 31 practical lecturers).

By 2030, DNU is expected to be in the top 20 universities in Vietnam in terms of reputation, talent, and human resources, contributing to the country's stable development.

The university is to produce human resources in the following four areas:

- Health Care Sciences, such as medical, pharmaceutical, nursing programs
- Sciences and Technology, such as computer sciences, IT, automotive engineering programs
- Business and Management, such as finance and banking, accounting and auditing, business administration programs
- Social Sciences, such as languages (English study, Chinese study, and Korean study), tourism, communication programs

The university's training maxim is "training adheres to practice". DNU focuses on teaching innovation to equip its students with diverse skills. After graduation, the students can perform well in different organizations across the country and integrate internationally.

The NEs worked with DNU to train and apply the ISO 56002 toolkit during this research. On that basis, NEs have made suggestions and proposals to help DNU build an innovative environment for lecturers and students.

CHAPTER 5

RECOMMENDATIONS

CAMBODIA

The study recommends a national innovation system for Cambodia to harness the potential of innovation management among entities, including the government, academia, and private sectors. However, the directive guidance from this assessment could be more significant if there is a bigger sampling size in the study.

Participation from government institutions and best practices from various institutions are needed to demonstrate innovation management, which is essential to inspire the enterprises throughout the nation.

A more comprehensive study on the intellectual property rights, enforcement ecosystem, and promoting open innovation is also suggested.

INDIA

The study recommends to develop a continuous improvement mechanism for enterprises where the company board members will evaluate and suggest measures for further improvement in the organizations' innovative initiatives. A special focus has to be on the SMEs to realize their full innovative potential. To develop resiliency among SMEs, there is a need to focus on building a high emotional quotient. Integration and collaboration should be the key to develop the productivity potential of SMEs. Creating awareness on intellectual property rights and productivity tools is another area that requires attention. Importance must be placed on continuous evaluation of the environment so that enterprises can take timely actions to survive and progress. Database of enterprises should also be developed and updated for accurate contact information for all stakeholders. Regular training programs can be organized for enterprises to educate them about changes and new trends that they can adopt. The output of training programs should be evaluated to monitor the progress and include changes as per the requirement. A model should also be developed to encourage cross-country collaboration for manufacturing and/or marketing.

INDONESIA

The world has entered the era of IR4.0 that witnesses a big leap in the industry, where technology information and communication are fully utilized. In order to compete, Indonesia must be able to adopt the advancements of IR4.0 and prepare the right strategies for all sectors. In line with this, the Ministry of Industry launched "Making Indonesia 4.0" as a roadmap and integrated strategy for Indonesia to enter the digital era. The impact of innovation can only be seen in two outcomes - positive which will lift the overall company performance, or negative, resulting in financial losses. One example of a failed innovation is IBM in 1992, where they suffered the largest annual financial loss in the American history after investing heavily in innovation activities in the previous years [74]. Therefore, companies need a

way to ensure that their investment in innovation can lead to positive results. An innovation audit is an analytical framework that allows a comparison of the company's current innovation capability with the level of past or desired performance [75]. When a company knows its current level of innovation, better strategic decisions can be made, such as developing new or improved products and services.

There are companies that do not make innovation one of their core strategies as they find it difficult to invest large amounts of funds in innovation activities. They are likely to have other priorities in the use of their funds, such as for expansion, promotion, and others. The recommendations here feature the latest trends in innovation management and how companies can adopt them in stages to win the competition in today's market place as the innovation development process can be a long and complicated process. The stages of an organization in carrying out innovations are as follows:

- **Introduction on needs**

  The first step in innovating is to identify the needs and problems that occur in the community. Needs are goods or services demanded by the community. When fulfilled, it can provide satisfaction. In observing the needs of the community, it should be carried out by involving various groups to obtain diverse views.

  Basic research is carried out to explain a scientific phenomenon while applied research is carried out to provide solutions to practical problems in the community. According to Martinez (2012), collaboration is needed at different stages of innovation to get innovative ideas with the goal of accelerating innovation activities. From basic and applied researches, it will produce an idea or ideas that can meet needs or solve problems that exist today.

- **Development**

  In the development process, new ideas or solutions from the previous stage are determined and passed on. At this stage, the formulation of innovation is offered as a solution to community problems. For innovation to have a big impact on society, it should be supported by knowledge transfer or technology transfer activities.

  Knowledge transfer can be in the form of methods, strategy, or even the substance of the innovation itself. The following are the three categories that differentiate knowledge transfer activities:

  - Information category that includes ideas and knowledge

  - The managerial category that includes organizational systems applicable in the company

  - The technical category that includes the company's technology, expertise, and business processes

- **Commercialization**

  This stage is carried out after the innovation has been developed and is ready to be distributed, and marketed to its users. At this stage, the first innovation makes contact/interact with users through socialization activities or innovation product marketing.

- **Diffusion and adoption**

  This last stage determines the success of the innovation. If the community accepts the innovation, it will then be adopted and diffused into a bigger and wider community. There are four elements in the diffusion of innovation that need to be noted:

- The innovation itself, namely a new idea or product that is ready to be adopted by consumers
- Communication channels, namely media or communication facilities to introduce innovation
- Time, i.e., the period during which the innovation will diffuse into the larger society
- Social system, which is the place where the innovation diffusion process occurs. In this system, a set of units will relate to each other in solving a problem or meeting community needs

With good management practices, the company can get better performance. Management practices on technology and operations are usually applied in R&D activities, but it is not clear whether the two are complementary, substitution, or independent of each other. However, from several previous studies, it is stated that when companies focus on human resources, the company's growth is greatly enhanced by R&D activities. This is the opposite to small and medium companies, where most of them invest in non-R&D activities. When companies pursue complex innovation strategies, they are likely to benefit from investing in R&D. But some large companies prefer to prioritize investing in updated physical capital stock as the benefits are reaped much earlier than investment in R&D. It remains unclear whether investing in R&D can immediately bring better results compared to investing in patent activities related to R&D. Romano [76] found that the performance of innovation is positively correlated with the complexity of the innovation strategy.

One of the other findings of this paper is that human resource management has no direct effect on the innovation strategy adopted by the company but has the potential to have detrimental effects on performance-based incentive payments. In addition, this research identifies that in a company, its growth is associated with product innovation and process innovation. When a firm's goal is to maximize efficiency, the firm may adopt a pay-for-performance policy. This can encourage effort among workers, which in turn leads to higher productivity and company growth. Only mutually reinforcing systems of practice can affect companies that innovate and those that do not. To maintain growth, a company needs to ensure consistency over time between the adopted human resource management practices and the impact of its technological trajectories.

PAKISTAN

The recommendation here is presented as a SWOT analysis – Strengths, Weaknesses, Opportunities, and Weaknesses.

The analysis reflects partial Strengths in the three system elements of ISO 56002:2019.

In general, the management demonstrates its commitment to innovation with the following:

- Encourage the adoption and integration of IMS requirements into existing processes
- Support individual employees to innovate and facilitate learning from success and failure
- Promote the process of understanding, identifying, and meeting stakeholder needs

Organizations that manage innovation initiatives review the objectives, expected results and performance, and have built a team of capable and experienced professionals. The survey also highlighted that organizations identify opportunities through innovative ideas and learned from the previous experience in implementing innovation initiatives. They utilize methods, such as basic research,

benchmarking, and use developed solutions as input to implement solutions.

The analysis also reflects on the Opportunities in the six system elements of ISO 56002:2019, which are also recommendations for other enterprises. They are highlighted in the following:

- Organizations realize the effects and impact of economic, technological, cultural, political, and geopolitical changes in the region and demonstrate the ability to resist change to some extent

- Responsibilities and roles are assigned, communicated, and understood within the organization. The performance on innovation is reported to the management. Organizations have innovation goals, however they are required to be defined at relevant levels

- Organizations encourage people and stakeholders involved in innovation work to be aware of the objectives. Organizations communicate internally through team meetings and externally through websites, reports, and periodic project reviews

- Organizations have an approach to managing intellectual property. However, they need to identify their intellectual property assets that have to be protected. Organizations monitor intellectual property-related matters but they need to ensure data access through agreements, procedures, and security policies

- Organizations have processes through which they can interact for product development through collaboration

The analysis reflects partial Weaknesses in five system elements of ISO 56002:2019.

- Organizations need to consider their resources for innovation on issues, such as vision, ambition, innovation performance, budgeting process, control process to assess the potential and maturity of processes, and commitment to innovation

- Organizations need to establish, implement, and maintain an innovation strategy to affirm the role and importance of innovation activities to evaluate context, vision, support processes, and resource allocation

- Organizations need to manage, evaluate, and prioritize innovation portfolios to ensure alignment of innovation portfolios with innovation strategies and goals

- Organizations need to identify and promptly provide the resources needed to establish, implement, maintain, and continuously improve the IMS

The analysis observed the partial Threats in four system elements of ISO 56002:2019.

- Organizations need to implement approaches, methods, rules, and agreements on cooperation with external partners to build trust and openness among parties in innovation cooperation

- Organizations need to establish, implement, and maintain an innovation policy to ensure the implementation of innovative activities. Innovation policy needs to be communicated

- Organizations need to consider establishing structures appropriate to their size to ensure that the adoption of innovations will not affect existing services, ensure resources for the implementation of

innovative activities, and processes need to be adjusted to accommodate uncertainty

- Organizations need to build a supportive culture that will foster innovative activities, facilitating creative thinking and behavior. Organizations need to promote and demonstrate commitment to innovation activities, support and recognize individuals with innovative ideas, behaviors, and initiatives

PHILIPPINES

Strong Leadership and Clear Innovation Policy

Based on ISO 56002:2019's definition, an IMS is a set of interrelated and interacting elements, aiming for the realization of value. It provides a common framework to develop and deploy innovation capabilities, evaluate performance, and achieve intended outcomes. The relationship of these individual elements and how they form an integrative structure that drives innovation results is captured in the innovation policy of an organization. This policy outlines innovation management principles to establish specific strategies and goals for innovation.

As illustrated in the results, the criteria for determining the presence or expression of the organization's innovation policy obtained a Level 2 rating for the majority of the respondents, hence it is only managed at a basic level. This is consistent with the results of criteria ten and nine on the Innovation Goals and Action Plan and Innovation Process Models, respectively, which also resulted in only a Level 2 overall rating.

For this case, there would be a need for the senior management of the organization to get acquainted with the basic concepts and value of having a management system that would create an innovation policy. It would be good to have a conducive policy environment where relevant and immediate influencers/stakeholders can interact and support innovation endeavors. For the case of MSMEs, DOST is providing appropriate support services and programs for innovation, such as technology acquisition and upgrading, techno-trainings and forums, productivity consultancies, laboratory services, including R&D and techno-transfer, and commercialization support services. Continued advocacy on innovation is also made available to the MSMEs. Further, as mentioned at the beginning of this paper, there are already policies in place, like the Innovative Startup Act which aims to strengthen, promote, and develop an innovative and entrepreneurial ecosystem and culture in the Philippines. This was complemented by the Philippine Innovation Act to guide the country's innovation goals, making the policy environment in the country conducive to more STI efforts.

Internally, the senior management of the MSME respondent organizations also needs to have a strong resolve in advancing and effectively communicating their innovation policy to all the members of the organization which could be done through management meetings, consultations, capability building, and performance assessment activities. The innovation policy of an organization should likewise be aligned to the quality management principle of continual improvement, to ensure a sustained commitment to organizational development and customer focus/satisfaction.

Optimizing Innovation Tools and Methods

This means creating environments where businesses can leverage innovation to deliver meaningful change that drives positive business outcomes. With MSMEs at the heart of the economy, they need to be empowered with the right tools to tackle the next steps toward being a sustainable business.

As mentioned in the survey questionnaire, "enterprises need to identify and provide the tools and methods needed to develop, maintain, and improve the IMS. Enterprises select and integrate appropriate tools and methods to support different innovative activities; ensure access and use of tools and methods available in the enterprise; share and collaborate in the use of tools and methods to implement innovative activities in the enterprise. Tools and methods can come in many different types, forms, and formats."

Dakila Lavilla of Pricewaterhouse Coopers International (PwC) in her online article entitled "Innovation and digital transformation: How are Philippine MSMEs performing?" in August 2020 said innovation for any organization does not necessarily imply the invention of new or enhanced products, but encompasses any novel approach to business organization, marketing strategy or product distribution that allows the enterprise to differentiate itself relative to its market competitors [77].

There may be various approaches or methods to innovate for an organization. In 2015, the Philippine Institute for Development Studies (PIDS) conducted a Survey of Innovation Activities (SIA), in partnership with DOST. Based on the findings of the study, a firm is deemed to be innovation active if it is:

- A product innovator that introduced new or significantly improved goods or services
- A process innovator that introduced (a) new or significantly improved methods of manufacturing or producing goods or services; (b) new or significantly improved logistics, delivery, or distribution methods for their inputs, goods, and services; (c) new or significantly improved supporting activities for their processes, such as maintenance systems or operations for purchasing, accounting, or computing
- Engaged in innovation projects that are either ongoing or not abandoned
- Engaged in expenditure on innovation activities for internal or outsourced R&D, training, acquisition of external knowledge, machinery, equipment, or software linked to innovation activities, market introduction of innovations, and other preparations to implement innovations
- On-going applications for intellectual property especially inventions and utility models [78]

The respondent organizations should consider exploring and examining the abovementioned approaches/methods and tools as part of their innovation portfolios.

In a statement, Sen. Win Gatchalian (author of Senate Bill No. 1793 or the Full Digital Transformation Act of 2020), said MSMEs need to constantly innovate on their products and services if they want to survive the global disruptions caused by IR4.0 [14]. He pointed out that one of the constraints that many MSMEs face is access to finance hence limiting MSMEs' productivity and capability to innovate. This is aligned with Strategic Goal 4: Improved Access to Technology and Innovation of the Philippines MSME Development Plan 2017–2022. That is to have improved innovation and technological competitiveness of MSMEs to transform and create new business models and enterprises with a strengthened innovation ecosystem to make innovative technologies sustainable, cost-effective, and accessible to all MSMEs.

Strengthen the Planning Process and Building Goals

Following the ISO 56002 standard, planning is an integral part of the IMS. This standard requires taking the general concepts of planning into operation by defining the needs associated with service or product provision, creating supportive processes, and determining customer acceptance criteria and the needed assets to ensure compliance with quality standards.

These were not manifested by the respondents, particularly by the MSMEs surveyed. Though with existing organizational goals, they were more confined to the vision for the enterprise but not under the context of innovation. While the conduct of organizational meetings and consultations to discuss management and operational concerns were fairly distinct for the respondents, there was less concrete information to support the conduct of institutionalized planning activities in general for the survey participants. There were no defined innovation objectives, the unclear process for assessing the internal and external environment, and the non-existent analysis of risks and opportunities.

From the statement of the innovation policy and the general or strategic goal of the organization, it could be recommended for these selected respondent organizations to consider developing in parallel an innovation goal and defining its objectives. From here, the management could employ a straightforward Plan-Do-Check-Act (PDCA) cycle approach that drives continual improvement of the IMS to ensure that the innovation initiatives and processes are adequately supported, resourced, and managed, and that opportunities and risks are identified and addressed by the organization.

According to Patalinghug's "PIDS Study on the Philippines Innovation System: Structure and Characteristics" in 2003, the internal organization or structure of firms are the critical components of the structure of the national innovation system. The organization of the flow of information and the learning process influences the innovative capability of a firm. In particular, the linkage between the sales, production, and R&D departments of the firm is an important aspect of the innovation process [79].

The majority of the firms interviewed are micro and small in terms of size of operation that the extent of having several distinct units or departments is not that evident. According to DTI, micro enterprises have an approximate asset size up to PHP3 million (USD59,600) while small enterprises' asset size is at PHP3 million–PHP15 million (USD59,600–USD298,000). The existing organizational structures are mainly straightforward with not much room to accommodate or establish structures appropriate to their size to ensure the adoption of innovations or innovation activities. However, it should be noted that one of the SUC respondents have recently established an office dedicated to the management of innovation -related activities and initiatives of the university with corresponding manpower and complementary resources.

Expand the Scope of the IMS Survey

SETUP (Small Enterprise Technology Upgrading Program) is the banner program of DOST regional offices. It essentially presents and espouses to MSMEs the value of STI which is aligned with the IMS objective of improving the overall productivity of the organization. With SETUP's approximately 5,100 clients nationwide, it is strongly recommended to expand the scope of this study as this is an opportunity to foster and enhance consciousness and advance interest in the value of IMS in organizations.

SINGAPORE

Innovation and implementing IMS across companies requires time. The survey results indicate that companies perceive themselves as knowledgeable about innovation and its management but perform poorly when it comes to executing the groundwork which includes the planning and actual execution of innovation processes. However, the results show that these companies have begun embarking on innovation management and this could be attributed to government initiatives and policies, or even pressure from their industry peers. The true effects of the government initiatives, such as the NRF's RIE2025 plan require time to be visible and companies in Singapore are still at the infancy stage.

On the contrary, more data points are needed to obtain accurate results. The current sample size of 20 is not sufficient to justify the rationale behind certain scores. At least 10 results per industry group are required to make an informed analysis.

Should a further study be performed, it is recommended that there be a target industry sector to focus on. The industry groups used were too generic and within each of them, there were multiple sectors. Having respondents from different sectors in a particular industry group causes a large disparity in the results and will ultimately provide an inaccurate reflection of the industry's innovation management practices. Additionally, respondents should be able to indicate if they belong to an SME or MNC. The size of a company is a huge factor in implementing innovative practices.

There needs to be a guideline or benchmark for respondents to compare themselves to before selecting a level. At present, the respondents are basing most of their selection on their knowledge, which causes ambiguity in the results. Alternatively, a moderator could also be present when submitting responses to ensure that all respondents have the same baseline and understanding.

If implemented, these changes would allow the researcher to obtain more accurate results which would help him/her find out the current state of innovation management within or across industries.

THAILAND

The current status of STI in Thailand, along with the survey data, suggests that although Thai organizations have become much more innovative in the past few years, most of them, especially smaller ones, are still in the process of improving and developing their innovation management capacities. Therefore, the recommendations are:

- The main priority of government policy would be to focus on increasing R&D and innovation activities in the private sector. New programs focusing on improving innovation management capacity could be implemented

- As ISO 56002:2019 is still relatively new and many organizations might still have not learned about it, it would be beneficial to raise awareness on the standard via industrial networks or industrial associations

- In the next three to five years, the government could consider developing incentives for organizations to obtain ISO 56002:2019 certification. This may include tax incentives, special public procurement programs, or other financial and nonfinancial incentives

- Open innovation and collaboration between companies, such as joint researches or joint ventures should be supported. This would encourage companies to think about how they manage innovation within the organization and with other organizations

VIETNAM

The survey results show that leading enterprises in Vietnam incorporate the ISO 56002 innovation elements. These enterprises expressed similar ways of using different formulas and terms to promote innovation in their enterprises. This can be one of the big benefits of ISO 56002 for it to be widely adopted among enterprises [1].

However, some factors are considered more important than others in the survey, such as Culture that supports creation and implementation, Commitment of top management, and Intellectual Property Management. This combination of qualitative and quantitative data provides valuable insights to ISO 56002 developers to cater for end users [1].

The study also shows that all 24 survey questions related to ISO 56002 include factors considered important by the respondents. Since these 24 questions were developed as an innovation management competency assessment tool by Magnus Karlsson at Inngage Consulting, the results of the study demonstrate its applicability in the context of developing countries, including Vietnam [1].

This study helped to analyze innovation management practice of Vietnamese businesses in relation to the international standard of ISO 56002. Studies like these increase the general knowledge of current innovation management practices, allowing other enterprises to learn from the 110 participating enterprises. Sharing current best practices will have a positive impact on the overall effectiveness of innovation management. In turn, this will spur researchers and enterprises to develop improved methods and advance the scientific field of innovation management [1].

Using ISO 56002 as a foundation in the survey provided a broad perspective of business innovation management methods. When the ISO 56002 standard was released in 2019, it could be argued that the scope and definition were updated with the latest scientific research in the field of innovation management [1].

In future, it is proposed to establish a common foundation on innovation management for enterprises in assessing innovation management capacity, building a roadmap for innovation management, and the process of applying and improving IMS to produce more accurate and consistent results [1].

Further, these research results will be an important input for policy makers to amend policies and regulations to support enterprises in Vietnam in improving productivity and efficiency, competitiveness in the new context, and innovative ranking progression. This will also aid in promoting Vietnam's Innovation Index [1].

APPENDIX

SURVEY FORM

SURVEY ON ASSESS INNOVATION MANAGEMENT CAPACITY USING ISO 56002:2019

The ISO 56002:2019 standard provides guidance on establishing, implementing, maintaining, and continuously improving an Innovation Management System (IMS) for adoption in all organizations. The potential benefits of implementing IMS, according to ISO 56002:2019, include (i) growth, increased revenue, profit, and competitiveness; (ii) reduce costs and wastes, and increase productivity and efficient use of resources; (iii) increase the satisfaction of consumers, customers, citizens, and social benefits; (iv) making investment, sustainable innovation; (v) enhance decentralization and empowerment in organizations; (vi) increase the ability to attract sponsors, partners, and collaborators; (vii) enhance the reputation and value of the organizations; and (viii) strengthen the capacity to comply with regulations and requirements.

To get insights on the adoption of IMS in accordance to ISO 56002:2019, a survey on assessment of innovation management capacity was designed with 24 criteria that are categorized into six aspects. They are as following:

CONTEXTS	1. Understanding external trends and drivers 2. Understanding of internal capabilities and assets 3. Culture that supports creation and implementation 4. External and internal innovation cooperation
LEADER	5. Commitment of top management 6. Focus on value realization 7. Vision and strategy for innovation 8. Innovation policy 9. Roles and responsibilities of the organization
PLANNING	10. Innovation goals and action plan 11. Organizational structure for innovation activities 12. Innovation portfolio
SUPPORT	13. Resources to support innovation activities 14. Abilities 15. Communication and perception 16. Innovation tools and methods 17. Intellectual property management
ACTIVITIES	18. Innovation initiatives and projects 19. Innovation process model 20. Processes for identifying opportunities 21. Processes for creating and validating concepts 22. Solution development and implementation process
ASSESSMENT AND IMPROVEMENTS	23. Advanced performance indicators 24. Performance evaluation and improvement

The 24 innovation management issues, according to ISO 56002:2019 standard, are based on five-level evaluation:

- Level 1: None, informal (Capability is not established or established informally, is not defined or managed)
- Level 2: Managed at a basic level (Capability is established at a basic, but incomplete, managed level)
- Level 3: Defined and managed (Ability is defined and established, managed in a proactive manner)
- Level 4: Systematically managed (Ability is defined, established, and linked, systematically managed)

- Level 5: Optimization (Continuously improved and optimized capabilities, managed based on active monitoring)

Organizations participating in the survey can download and read (for free) the book on Innovation Management Standards (in Vietnamese) by the author.

SURVEY INFORMATION SECTION

Full name of person filling in information:

Position, title:

Department:

Number of employees in the organization:

Type of organization:
☐ State-owned enterprises
☐ Non-state-owned enterprises
☐ FDI
☐ Others

Industry:
☐ Power electronics
☐ Construction
☐ Education and training
☐ Healthcare and medical services
☐ Textile and footwear
☐ Information technology
☐ Automobiles and automobile parts
☐ Food and beverage
☐ Others (please specify):

Criteria 1. Understanding external trends and drivers

Organizations analyze the external context, considering different issues (such as economic, market, social, cultural, scientific, technological, legal, political, geopolitical, environmental); geographical context (international, national, regional, local); time context (such as past results, present situation, and future scenarios).

With the external context, the organization assesses its ability to resist change, the potential impact of external trends, and potential opportunities and challenges that may arise.

Question: To what extent does the organization have a process for identifying insights about external trends and drivers?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 2. Understanding of internal capabilities and assets

Organizations analyze the internal context, consider the resources of the organization on related issues (such as vision, ambition, strategic direction, core competence); management context (structure, organization, management systems, overall performance, innovation performance); operational context (budgeting process, control process, collaborative process); resource context (people, knowledge, skills, technology, intellectual property, brands, infrastructure).

With the internal context, organzations assess the potential and maturity of current value models; adaptability of corporate strategies, processes, and commitment to innovation.

Question: To what extent does the organization have a process for identifying insights about internal capabilities and assets?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 3. Culture that supports creation and implementation

Organizations establish, maintain, and improve an IMS in line with innovation goals through processes, necessary supporting activities, innovation management principles, and new creations.

The goal of innovation is the basis for defining innovation strategies, thereby forming a culture of support and cooperation in the organization.

A supportive culture in organizations will foster innovative activities, allowing for the coexistence of creative thinking and behavior within the organization. Organizations build a new working environment: open, stimulate "curiosity", and direct activities to customers; encouraging ideas to suggest; encourage creative activities, experimentation, change the current; promoting connection and cooperation at home and abroad; respect the diversity of different innovation perspectives; shared values, beliefs and creative behaviour; balance analyses based on fact and “assumption” conditions; encourages risk-taking, and learning from failure.

For organizations with a culture that supports innovation, senior management promotes and demonstrates commitment to innovation activities; support and recognize individuals with innovative ideas, behaviors, and initiatives; encouragement for innovative achievements based on the internal resources of organizations; develop capacities to support innovative activities; cultural assessment through related indicators.

Question: To what extent has the organization built a culture that supports innovation and implementation?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 4. External and internal innovation cooperation

Organizations develop innovative collaborative management methods with stakeholders (internal and external). Innovation collaboration facilitates sharing and access to knowledge, intellectual property, and other resources. In order to promote innovation cooperation, organizations need to specifically consider a number of contents related to: strategies, objectives, capabilities, resources, and existing capacities to implement innovation; approaches, methods, rules, and agreements on cooperation with external partners; intellectual property requirements; develop an appropriate cooperation strategy; building trust, respect, and openness among parties in innovation cooperation.

Collaborative innovation assists in identifying stakeholder needs; sharing ideas, knowledge, capabilities, and know-how in innovation activities; exploiting infrastructure, investment portfolio, market; jointly use resources to carry out innovative activities.

Innovation collaboration is carried out at the level of groups, departments, and units with the same or different functions in the organization. Innovation cooperation involves organizations and individuals, such as customers, partners, suppliers, associations, and other related parties.

Question: To what extent does the organization have an internal and external innovation collaboration process?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 5. Commitment of top management

Senior management demonstrates its commitment to IMS through the following specific activities:

- Responsible for the effectiveness and efficiency of the IMS
- Establish vision, strategy, policy, and innovation goals in accordance with the context and strategic direction of the organization
- Promote a culture that supports innovation
- Ensure the adoption and integration of IMS requirements into existing organizations processes and operations
- Secure the necessary resources for the IMS
- Create awareness and communicate the importance of effective innovation management and apply IMS guidelines to organizations
- Encourage and recognize individuals to innovate, and facilitate learning from successes and failures
- Promote the IMS continuous improvement plan

In addition, senior management should demonstrate a commitment to realizing the value of innovation by: identifying opportunities based on current needs; balance between opportunities and risks; consider the possibility of failure; allow experimentation involving customers and stakeholders to test hypotheses.

Senior management should establish, implement and maintain an innovation vision by assessing the impact of innovation activities on the future of the organizations; select and develop strategies, policies, and objectives for innovation; inspire people toward an innovative vision; enhance the reputation of the organizations, and attract relevant stakeholders.

Question: To what extent is the commitment of the organization's top management demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 6. Focus on Value Realization

Realizing value is the goal and reason for engaging organizations in innovation.

Realizing Value: The purpose of innovation management is to create value, through the process of understanding, identifying, and meeting stakeholder needs. Realizing the values (financial and nonfinancial) are vital to the sustainability of the organizations.

Question: To what extent does the organization implement the principle of focus on value realization?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 7. Vision and strategy for innovation

Senior management establishes, implements, and maintains an innovation strategy to affirm the role and importance of innovation activities in the organization. The innovation strategy evaluates several requirements as follows:

- Organization's context
- Vision and innovation policy
- Roles, responsibilities, and authorities
- Innovation goals and plans for implementation
- Organization of the establishment
- Support processes, resource allocation

The innovation strategy focuses on realizing value under "uncertainty" conditions. This requires a balance of decision-making based on assumptions and facts for innovation. An innovation strategy helps organizations and stakeholders understand the decisions made to achieve their innovation goals and attract and inspire organizations to strongly deploy these activities.

Question: To what extent is the organization's innovation vision and strategy expressed?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 8. Innovation policy

Senior management establishes, implements, and maintains an innovation policy in order to commit to implementing innovative activities in the organization. The innovation policy should be suitable for the purpose and context of the organization, implementing the strategic orientation of the organization, and at the same time, in line with the innovation vision in the organization.

Innovation policy examines innovation management principles in order to establish specific strategies and goals for innovation. Innovation policy meets requirements and the commitment to continuous improvement of IMS in the organization. Innovation policy is presented in the form of information and documents to be communicated and widely applied in organizations.

Question: To what extent is the organization's innovation policy expressed?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 9. Roles and responsibilities of the organization

Organizational roles, responsibilities, and authorities: Top management should ensure that the responsibilities and authorities for relevant roles are assigned, communicated, and understood within the organization.

Top management should specifically assign responsibilities and authorities for: ensuring that the IMS meets the guidelines of the document; reporting to top management on the performance of the IMS and on opportunities for improvement in a timely manner; ensure the integrity of the IMS is maintained.

Responsibilities and authorities may be assigned to: existing roles, e.g., all leaders in the organization, or roles related to specific functions, units, or services; dedicated roles that focus on general innovation management or specific innovation activities and initiatives.

Question: To what extent are the roles and responsibilities of the organization shown?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 10. Innovation goals and action plan

When planning for an IMS, an organizations considers issues related to needs, expectations, and requirements, and identifies opportunities and risks that need to be addressed for the IMS.

Planning should ensure that the IMS accepts risks in order to achieve continuous improvement while reducing unwanted "effects".

Planning helps organizations take timely actions to address opportunities and risks by considering the "uncertainty" associated with those opportunities and risks.

Planning helps an organization integrate and implement actions in the IMS process, and evaluate the effectiveness of these actions. Besides the opportunities and risks affecting the management system, a number of opportunities can lead to strong innovation initiatives in the organizations.

Organizations build innovation goals at relevant levels. Innovation goals need to be consistent with innovation policy and toward innovation vision; ensure consistency across levels of the organizations.

Innovation goals need to be tracked, communicated, and updated under the right conditions. This objective should take into account applicable, measurable, or verifiable requirements. Organizations should have a process to document information about innovation goals.

In order for the plan to be feasible and meet its innovation goals, organizations need to identify: a number of key contents (opportunities, types of innovation); the participating objects (internal and external); specific requirements (organization's organization, resources, processes); responsible organizations and individuals; completion schedule (plans, milestones); criteria for evaluating innovation initiatives; innovation performance index; methods of protecting and exploiting innovation results; maintain, store, and communicate information about innovation activities in the organization.

Question: To what extent are the roles and responsibilities of the organization shown?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 11. Organizational structure for innovation activities

To implement the plan, the organization considers and adjusts its organization accordingly to achieve the desired results of IMS. The organization considers establishing structures appropriate to its size to ensure that the adoption of innovations will not affect existing services; resources to ensure the implementation of innovative activities; processes need to be adjusted to accommodate "uncertainty" levels compared to existing processes.

Question: To what extent is the organizational structure for innovation activities of the organization shown?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 12. Innovation portfolio

Organizations manage, evaluate, and prioritize innovation portfolios to ensure: alignment of innovation portfolios with innovation strategies and goals; consistency between initiatives within and outside the innovation portfolio; optimize the use of resources, technologies, platforms and processes; balance risk and return; improve and align organization's innovation portfolios, strategies, and goals.

When managing an innovation portfolio, organizations combine relevant innovation initiatives to optimize, extend existing services, or shape new solutions for customers and stakeholders. In special cases, organizations may consider expanding to new markets.

Question: To what extent is the organization's innovation portfolio represented?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 13. Resources to support innovation activities

The organization needs to identify and promptly provide the resources needed to establish, implement, maintain, and continuously improve the IMS. Organizations consider a proactive, transparent, flexible, and adaptive approach to providing resources. In particular, organizations need to ensure long-term accumulation of innovative activities. Resources for innovation activities are segregated from other activities as follows:

- Organizations need to identify, provide, and manage the people working to effectively implement the organization's IMS. Organizations have policies to attract, recruit, and treat employees; have an appropriate incentive mechanism (financial and nonfinancial incentives); protect innovative ideas with a higher level of risk. There are sanctions that protect ownership of ideas, manage patents, and exploit innovations within the organizations
- Organizations establish an appropriate mechanism to manage IMS implementation time. The organization allocates time equally to innovation activities (e.g., as a percentage of joint working time); allocate specific time for each different innovation and innovation process
- Organizations establish an approach to effective knowledge management. In particular, organizations need to have a mechanism to acquire knowledge and experience (from inside and outside the organizations), analyze performance data from lessons learned from successes and failures. Organizations also need to maintain appropriate mechanisms to analyze information and

manage current and future knowledge. External sources of knowledge can be users, customers, partners, suppliers, competitors, consultants, databases, expert networks, conferences, etc.

- Organizations identify and provide financial resources for effective implementation of IMS. Specifically, organizations consider financial opportunities and risks related to innovative activities. Organizations establish sponsorship guidelines; allocate financial resources for innovation activities (e.g., as a percentage of the annual budget or designate funds for innovation initiatives); investment principles (e.g., investment in start-ups, venture capital)

Organizations need to identify, make provision, and maintain the "real and virtual" infrastructure needed to effectively deploy their IMS. Organizations proactively assess and consider other important infrastructure, such as new technologies, tools, and methods on the context of the fourth industrial revolution. Infrastructure to support innovation activities may include: buildings, facilities, and associated facilities (e.g., creative environments, R&D labs, production spaces, simulation labs); research and simulation equipment, physics tools, hardware, software, advanced methods, technologies, and models; information and communications technology; knowledge network, market network.

Question: To what extent are resources supporting the organization's innovation activities demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 14. Abilities

The organizations establish an approach to capacity development and management. Specifically, the organizations determine the necessary capacity of the people directly involved, affecting the effectiveness of the IMS. In addition, the organizations determine its existing capabilities; identify the gaps required to implement IMS.

Organizations need to have a plan to regularly evaluate, improve, and innovate the necessary creative capacity and evaluate the effectiveness of the implemented innovation activities. In addition, organizations consider the need for outsourced capacity (e.g., cooperating with or entrusting consultants, external partners, innovation support services).

Competencies may include the ability to the following:

- Management of innovation activities. Examples, on leadership, managing change, allocating resources, engaging and empowering people, enabling teams, participation, collaboration, fostering a culture that supports innovation activities; create, manage "uncertainty" and risk, conduct research, manage intellectual property, etc.
- Identify insights and opportunities. Examples, market and technology analysis, analysis of bottlenecks and gaps, data-driven testing and hypothesis testing, design thinking, scenario planning, big data analysis
- Generate ideas, develop concepts, implement solutions to realize value. Examples, creativity, discovery skills (questioning, observing, testing, connecting), market analysis, value modeling

Question: To what extent is the organization's innovation capacity shown?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 15. Communication and perception

Organizations need to ensure that all people involved in innovation work are aware of the innovation vision, strategies, policies, and objectives; the meaning and importance of innovation for organizations; stakeholder contributions to the effectiveness of the IMS (including innovation performance benefits); the effects of not meeting IMS guidelines; willingness to support innovative activities.

Organizations need to determine internal and external communication related to IMS, including communication content, communication objectives, communication time, communication method, communication object.

Communication can be used to create awareness, increase people's participation, build brand value of organizations in innovation activities.

Communication is done internally (team meetings, bulletin boards, intranets, newsletters, staff conferences) or externally (websites, annual reports, white papers, financial briefings, advertising, press releases, trade shows, users, customers, partners, suppliers).

Question: To what extent is communication and awareness of innovation in the organization demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 16. Innovation tools and methods

Organizations need to identify and provide the tools and methods needed to develop, maintain, and improve the IMS. Organizations select and integrate appropriate tools and methods to support different innovative activities; ensuring access and use of tools and methods available in the organizations; share and collaborate in the use of tools and methods to implement innovative activities in the organizations.

Tools and methods can come in many different types, forms, and formats.

Question: To what extent are the organization's innovative tools and methods demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 17. Intellectual property management

Intellectual property rights can be used to achieve goals, such as branding, differentiating and positioning services, customers, R&D, revenue generation, etc.

Organizations need to establish an approach to managing intellectual property appropriately and supporting innovation strategy. At the same time, organizations need to identify their intellectual property assets that need to be protected (e.g., patents, copyrights, trademarks, organization secrets).

Organizations need to set up a mechanism to regularly monitor and analyze intellectual property related to the organizations, as an input for innovation activities. At the same time, organizations must also regularly review the value derived from intellectual property, evaluate the need for intellectual property management in the organizations (including establishing appropriate processes, clarifying relevant ownership rights) to external partners in collaborative innovation initiatives).

Organizations also need to have a mechanism to ensure data access or limit intellectual property rights to internal and external parties in some necessary cases, through agreements, procedures, and security policies; confidentiality; handle infringements of intellectual property rights, other domestic and international legal requirements.

Question: To what extent is the organization's intellectual property management demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 18. Innovation initiatives and projects

An innovation initiative is a set of coordinated activities (formal or informal), be it an innovation project, an innovation program, or any other approach. An initiative that can be proposed by any person in the organization is characterized by a starting point and an ending point. Organizations can establish one or more processes to manage these initiatives.

The organizations manage each innovation initiative, establishing and reviewing the scope of the initiative (including objectives, related factors, expected results, and performance); identify indicators and how to apply them to evaluate and improve the initiative; establish management mechanisms; ensure resources for implementation; protecting and building a team who are capable and experienced; establish the necessary internal and external cooperation; establish and implement appropriate innovation processes; take advantage of opportunities, lessons of failure for organizations; ensure the protection of intellectual property and other important assets.

Organizations need to determine ways of using a single method or a combination of different methods to implement each innovation initiative in the organization.

Question: To what extent are the organization's innovative initiatives and projects represented?

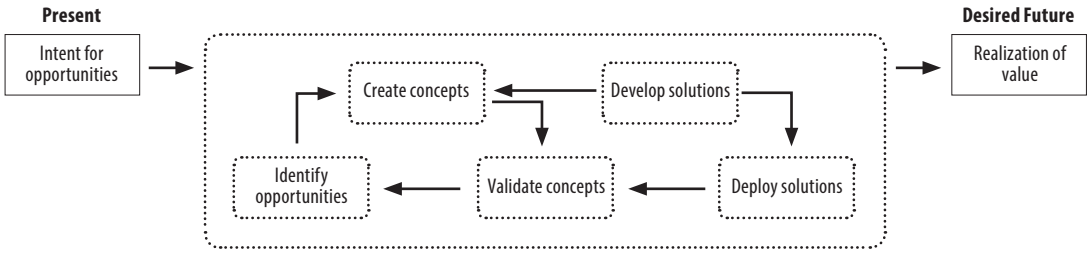
Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 19. Innovation process model

Organizations build innovation processes to match innovation initiatives. The innovation process can be flexible and adaptive, depending on the type of innovation and the organizations context.

The innovation process can interact with other processes in the organizations, such as research, product development, marketing, sales, collaboration, intellectual property.



Illustrated overview of the innovation processes.

Question: To what extent is the innovation process model of the organization demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 20. Processes for identifying opportunities

To identify opportunities, organizations consider the following inputs: understanding of the organizations and their context; innovative ideas; and the scope of the innovation initiative; previous experience in implementing innovation initiatives.

To identify opportunities, organizations identify related needs, trends, and challenges (such as competitors, technology, intellectual property, and markets), and identify opportunities (impact to be achieved), gain, value, prioritization of opportunities.

Tools and methods that can be used to identify organizations' opportunities for innovation include basic research, prospect analysis, benchmarking, interviews, risk analysis, system model.

Question: To what extent are the processes for identifying opportunities in the organization demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 21. Processes for creating and validating concepts

- **Building the point of view**

  To build perspective, organizations look at opportunities and identify inputs.

  - Organizations generate new ideas, potential solutions, or combine existing ideas from internal and external sources
  - On that basis, the organizations conduct investigation, recording, and evaluation of ideas and potential solutions related to new levels, risks, feasibility, sustainability, and intellectual property rights. Organizations select ideas and potential solutions based on established criteria to develop new perspectives and value models (e.g., new organization models, operations, or marketing)

- **Validate opinion**

  - The constructed view is the input for validating the view, considering one or more approaches to fact-checking (e.g., research, experiment, experiment, etc.).
  - On that basis, organizations make important hypotheses and assumptions to learn and form new knowledge through interaction with users, customers, partners, and stakeholders; allocation of resources for implementation; forming a new legal framework; reduce time to market. Organizations can evaluate the feasibility of the concept built, adjust, and improve the concept based on lessons learned, feedback during the identification process, and real point of view.

Question: To what extent are the processes for creating and validating organizational concepts demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 22. Solution development and implementation process

Organizations use developed solutions as input to implement solutions.

Organizations provide solutions to users, customers, partners, and stakeholders; promote and support solution implementation (such as sales, marketing, communication, creating awareness, and engagement with users, customers, partners, and stakeholders); track information and feedback from users, customers, partners, and stakeholders; impact monitoring; capture new knowledge from implementation to improve solutions.

Question: To what extent is the organization's process of developing and implementing solutions demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 23. Advanced Performance Indicators

Organizations track and measure innovation performance indicators. Innovation performance indicators are reflected in the following requirements:

- Indicators related to inputs (number of ideas, number of innovative initiatives, potential to create value of ideas, knowledge, new understanding, resources, capacity)
- Performance-related metrics (test performance, number and percentage of employees, managers or users involved, effectiveness of collaboration, effectiveness of tools, new methods, time to profit, time to market, brand value)
- Output-related indicators (quantity, percentage of ideas realized, return on innovation investment, revenue and profit growth, market share, user adoption rate, user satisfaction, spreading speed of innovation activities, social benefits, cost savings, corporate image value)

Innovation performance indicators applied at the system level are evaluated and improved under the right conditions. Organizations evaluate the elements of IMS, the interaction of these factors as well as the results of IMS implementation in the organizations. Organizations use tracking, measuring, analyzing, and evaluating metrics with other organizations when monitoring and evaluating performance.

Question: To what extent are the organization's enhanced performance indicators demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

Criteria 24. Performance evaluation and improvement

Organizations analyze and evaluate innovation performance as well as the effectiveness and efficiency of IMS. The analysis and evaluation are based on the realization and redistribution of value, related to innovation strategy and objectives, and the results of innovation activities; elements of the IMS and their interactions.

The application of monitoring, measurement, analysis and evaluation tools and methods will depend on the context of the organizations as well as the vision of the organizations in improving innovation performance.

The results of the analysis are used to assess the understanding of the organizations context; leadership commitment level; effectiveness of performing activities; the effectiveness of the innovation strategy; effectiveness and efficiency of the innovation support process; share knowledge of successes and failures; IMS improvement factors.

Based on the results of the performance assessment, the organizations identify and select opportunities for improvement and implement corrective measures to the IMS in order to strengthen, address weaknesses and gaps, and reduce “deviation” or the “nonconformity” of the IMS system. Adjustment measures to the organizations' IMS must be implemented in a timely, complete, and effective manner.

When "deviation" or “nonconformity” occurs, the organizations must apply measures to control and correct. On the other hand, organizations need to evaluate and take action to eliminate the causes of "deviation" or "nonconformity".

On that basis, the organizations review the effectiveness of corrective actions, identify opportunities and risks in the process of planning, and implement IMS changes in some necessary cases.

Organizations need to continuously improve the relevance, adequacy, effectiveness, and efficiency of the IMS.

Question: To what extent is the organization's performance evaluation and improvement demonstrated?

Circle one of the following five options:

Level 1 None, informal	Level 2 Managed at a basic level	Level 3 Defined and managed	Level 4 Systematically managed	Level 5 Optimization

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ABBREVIATIONS

AIoT	Artificial Intelligence of Things
AIPI	Indonesian Academy of Sciences
APO	Asian Productivity Organization
AVI	Asian Vision Institute
CDRI	Cambodia Development Resource Institute
DICT	Department of Information and Communications Technology
DOST	Department of Science and Technology
DTI	Department of Trade and Industry
EST	Emerging Stronger Taskforce
F&B	Food and beverage
FDI	Foreign direct investment
FEC	Future Economy Council
GDP	Growth domestic product
GD/STI	General Department of Science, Technology & Innovation
GERD	Gross Domestic Expenditure on R&D
HEIs	Higher education institutions
ICT	Information and communication technology
IMA	Innovation management assessment
IMS	Innovation Management Systems
IP	Intellectual property
IPO Pakistan	Intellectual Property Organization of Pakistan
IPR	Intellectual property rights
IR 4.0	Fourth industrial revolution
IRR	Implementing rules and regulations
ISO	International Organization for Standardization
IT	Information technology
ITMs	Industry Transformation Maps
LGU	Local government unit
MAFF	Ministry of Agriculture, Forestry and Fisheries
MEF	Ministry of Economy and Finance
MISTI	Ministry of Industry, Science, Technology & Innovation
MNC	Multinational company
MoEYS	Ministry of Education, Youth and Sports
MoLVT	Ministry of Labour and Vocational Training
MPTC	Ministry of Posts and Telecommunications
MSS	Management system standards
MSMEs	Micro, small, and medium-sized enterprises
NCSTI	National Council of Science, Technology & Innovation
NE/s	National expert/s
NGAs	National government agencies
NIC	National Innovation Council
NIS	National innovation system

NRF	National Research Foundation
PDCA	Plan-Do-Check-Act
PEC	Pakistan Engineering Council
PITC	Pakistan Innovation and Testing Center
PLC	Product life cycle
QA	Quality assurance
QM	Quality management
RIE	Research, Innovation, and Enterprise
RIEC	Research, Innovation and Enterprise Council
ROC	Republic of China
ROK	Republic of Korea
S&T	Science and Technology
SETUP	Small Enterprise Technology Upgrading Program
SIRI	Smart Industry Readiness Index
SMEs	Small and medium enterprises
SRI	Science, research, and innovation
STEM	Science, technology, engineering, and mathematics
STI	Science, technology, and innovation
STIP	Science, Technology, and Innovation Policy
SUCs	State universities and colleges
SWOT	Strengths, weaknesses, opportunities, and threats
TAPI	Technology Application and Promotion Institute
TECHNICOM	Technology Innovation for Commercialization
VFP	Venture Financing Program
WIPO	World Intellectual Property Organization

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INNOVATION READINESS ASSESSMENT

IN SELECTED APO MEMBER ECONOMIES