Capacity Building on Supply Chain Connectivity with Cloud-based Manufacturing Solutions

Final Report

APEC Policy Partnership on Science, Technology and Innovation

February 2024

Asia-Pacific
Economic Cooperation

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Summary of the Survey Results

Purpose of this survey

In the post-pandemic era, smart manufacturing places a greater emphasis on supply chain reconstruction and the digital transformation of production lines, as well as the pursuit of manufacturing system solutions with higher energy efficiency. To address this, the survey questionnaire has been developed (in Chinese and English) to understand individual enterprises within the regional economic body. The goal is to identify the technological needs in advanced manufacturing, digitization, and intelligent solutions, fostering regional research innovation and practical applications. The survey focuses on aspects such as policy formulation and promotion, establishing technological capabilities, and breakthroughs in digital transformation and innovation, aiming to facilitate the connection and multilateral cooperation between businesses and research units within the region.

Survey Objectives: The survey targets member units of APEC economies, aiming to understand the challenges faced by industries during the pandemic. This includes assessing the prevalence of information and communication technology usage in existing production lines and understanding the problems and difficulties encountered in supply chain restructuring, reconstruction, and production line digital transformation. The ultimate goal is to collectively explore appropriate responses and solutions.

The content of the questionnaire can be accessed via
https://forms.gle/biLBdmJXh3zzMn7s6

Results from the questionnaire

Sectors

In the survey responses (Figure 1), a total of 14 individuals participated. The highest number of respondents came from public institutions, with a total of 5 individuals. Following that were participants from private enterprises, and NGOs, with academic-related institutions having the fewest respondents, totaling 2 individuals.

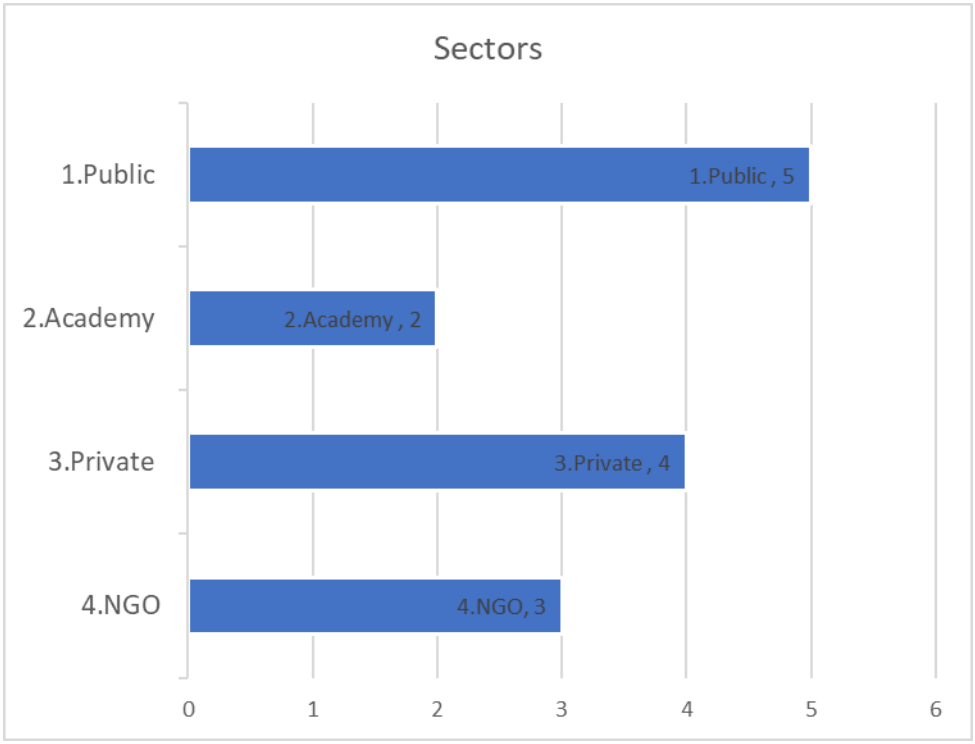


Figure 1 Survey Response by Sectors

Economies

In the survey responses (Figure 2), a total of 14 individuals participated. Among them, the highest number of respondents were Malaysians, totaling 6 individuals. Following that, there were 4 respondents from Chinese Taipei, 2 from Thailand, while Viet Nam and Singapore had the fewest respondents, each with 1 individual.

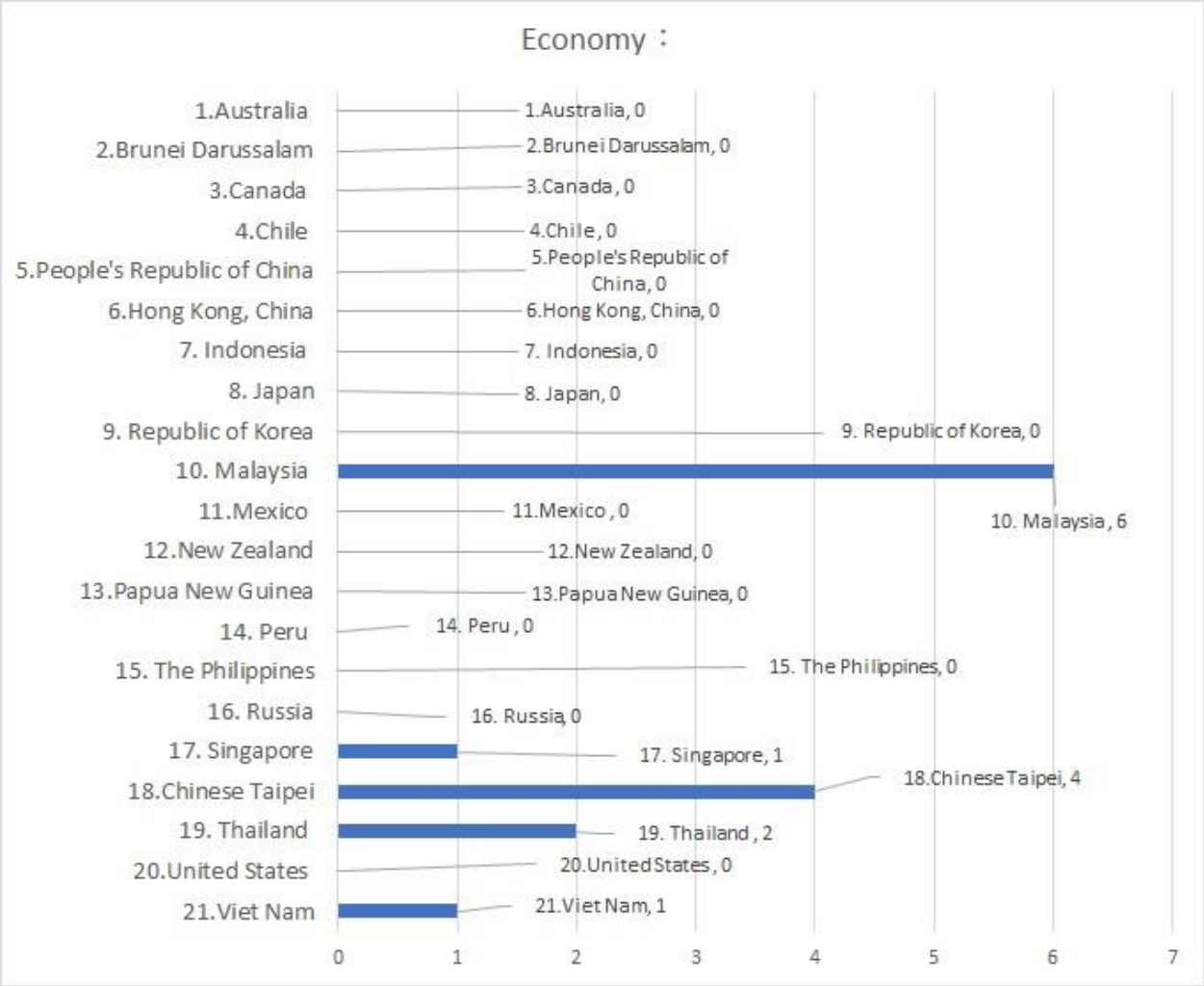


Figure 2 Survey Response by Economy

Industries

In the survey responses (Figure 3), a total of 14 individuals participated. Among them, one respondent indicated involvement in two industries, while the remaining 13 respondents all selected "Other" as their industry.

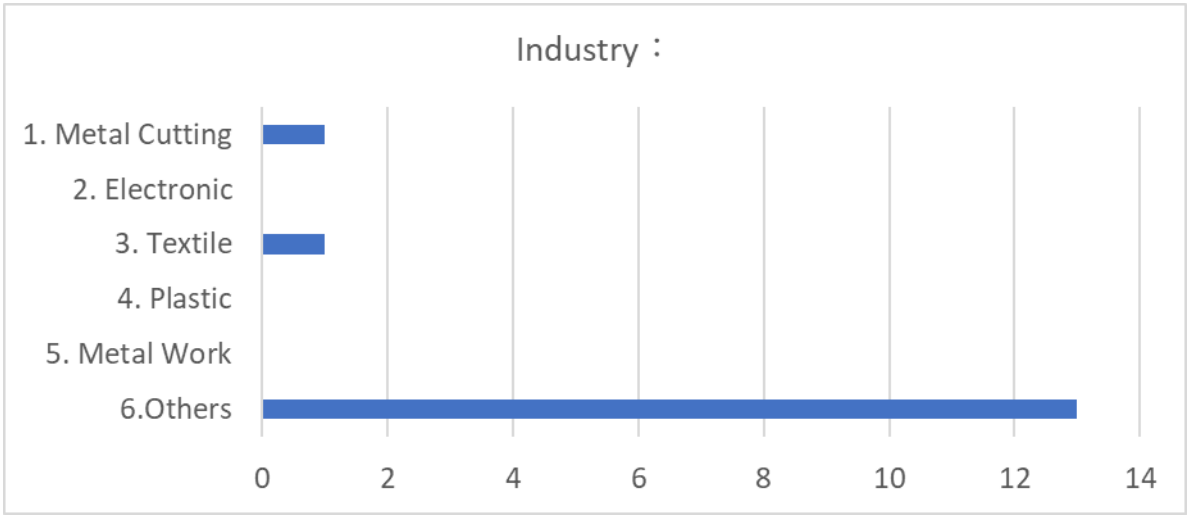


Figure 3 Survey Response by Industry

Need for Digital Transformation in Shopfloor

In the survey responses (Figure 4), a total of 14 individuals participated. The majority, comprising 11 individuals, responded with "Yes," while 3 individuals responded with "No."

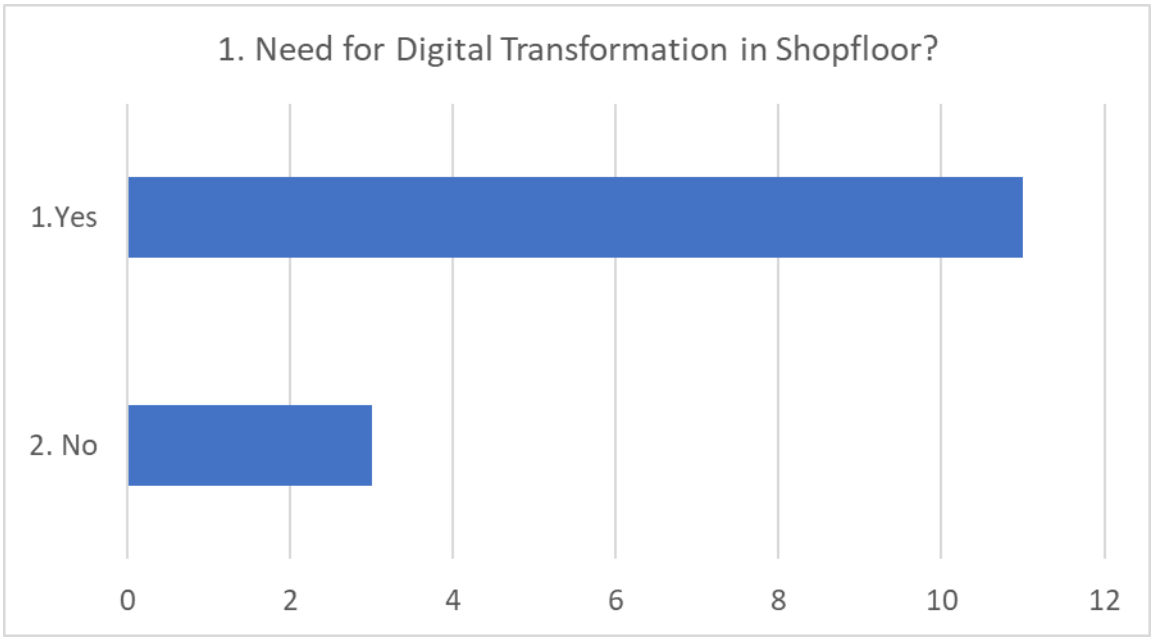


Figure 4 Survey Response on Need for Digital Transformation in Shopfloor

Current Status of Digitization

This question allowed for multiple choices (Figure 5), and a total of 13 individuals responded. Among them, the highest proportions were for "Interconnectedness" and "Visualization," each selected by 8 individuals. Following closely were "Transparency" and "Adaptability," chosen by 4 individuals each. The least selected option was "Default Settings," chosen by 3 individuals.

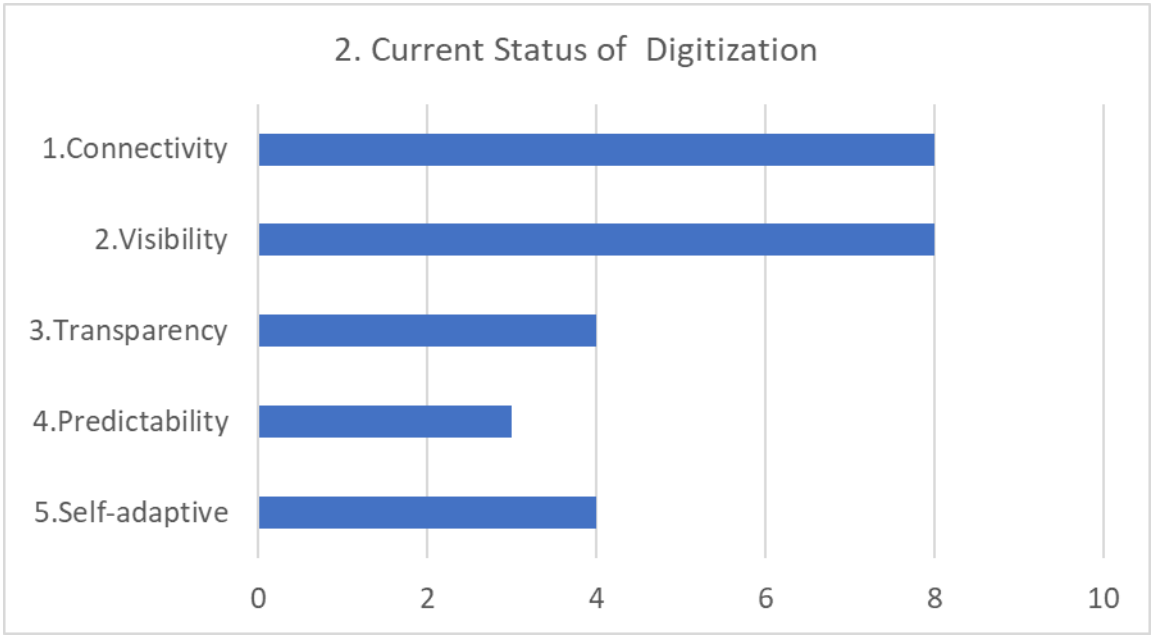


Figure 5 Survey Response on Current Status of Digitization

Purpose of Digital Transformation

This question allowed for multiple choices (Figure 6), and a total of 14 individuals responded. The objectives selected were as follows：

- "Realizing Smart Manufacturing"：9 individuals, the highest number.
- "Energy Conservation and Carbon Reduction"：9 individuals, tied for the highest number.
- "Reducing Overall Operational Costs"：9 individuals, tied for the highest number.
- "Enhancing Productivity and Quality"：9 individuals, tied for the highest number.
- "Improving Corporate Structure"：6 individuals.
- Other：2 individuals, the least selected option.

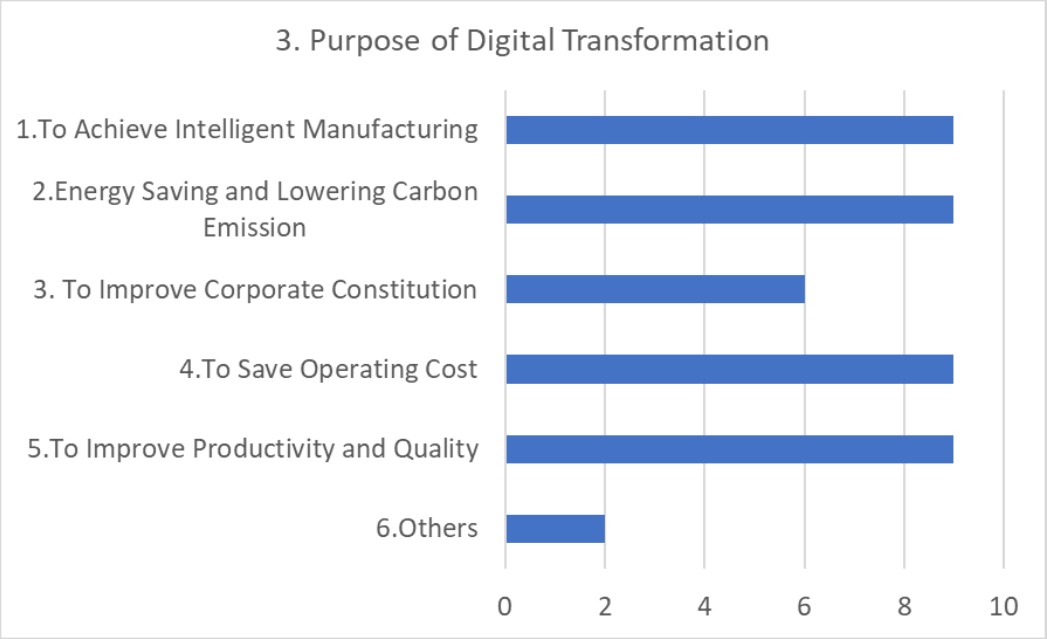


Figure 6 Survey Result on the Purpose of Digital Transformation

Difficulties in Digital Transformation

This question allowed for multiple choices (Figure 7), and a total of 14 individuals responded. When encountering difficulties, the most common challenge identified was "Digital Talent," selected by 10 individuals. Following that were "Funding," "Manufacturing Technology," and "Cloud Applications," with the least selected option being "Other," chosen by 2 individuals.

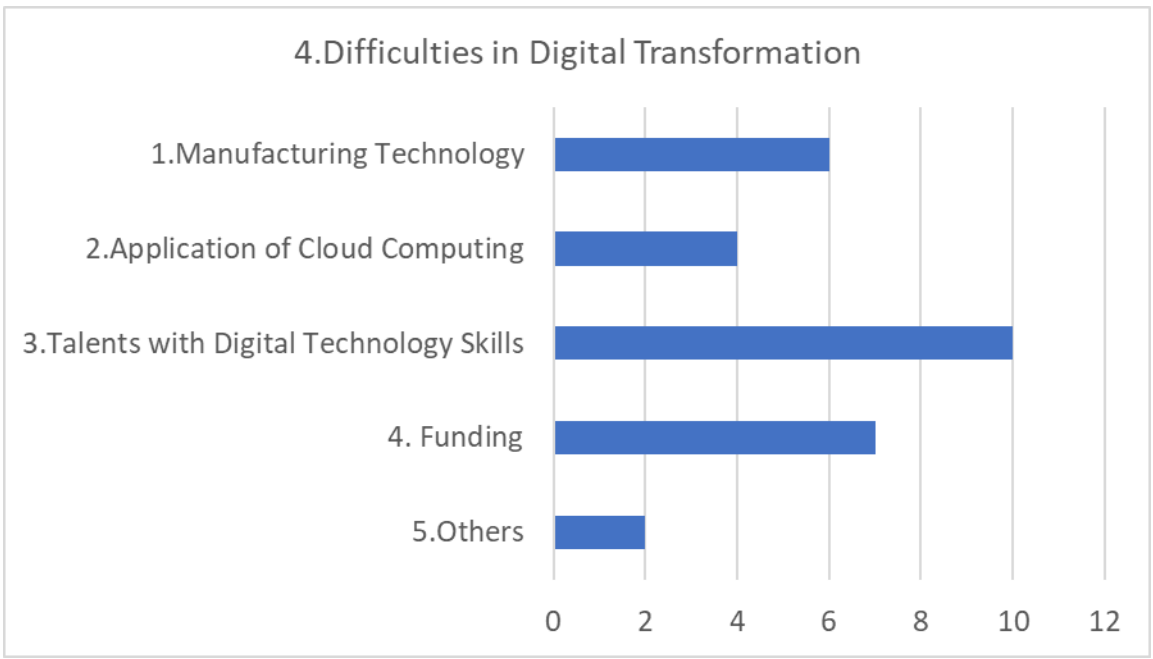


Figure 7 Survey Result on Difficulties in Digital Transformation

Needed Enhancement on Digital Transformation Technology

This question allowed for multiple choices (Figure 8), and a total of 13 individuals responded. The technology considered most crucial to strengthen was "Internet of Things (IoT)," selected by 11 individuals. Following that, "Artificial Intelligence" was chosen by 9 individuals, and "Robotic Process Automation" by 8 individuals. Two technologies were perceived as least in need of reinforcement, with both "5G/6G" and "Automated Guided Vehicles (AGV)" selected by 5 individuals each.

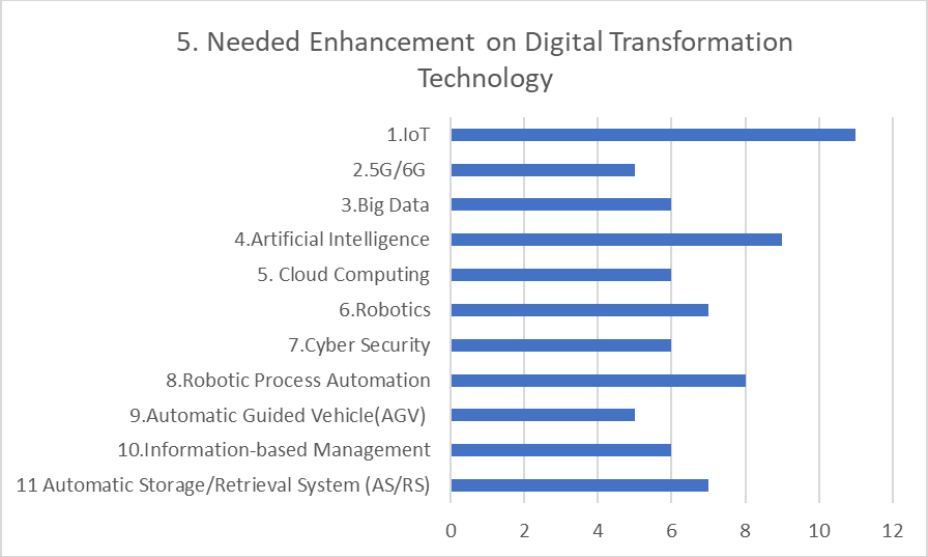


Figure 8 Survey Result on Need Enhancement on Digital Transformation Technology

Needed Digital Transformation Service

This question allowed for multiple choices (Figure 9), and a total of 14 individuals responded. The item with the highest demand was "Smart Equipment - Equipment Condition Data Collection, Equipment IoT Automation," selected by 11 individuals. Following closely was "Smart Production - Production Data Analysis, Production Management," chosen by 10 individuals. The least selected option was "Other," chosen by 1 individual, and following that was "Enterprise Transformation Diagnosis," selected by 6 individuals.

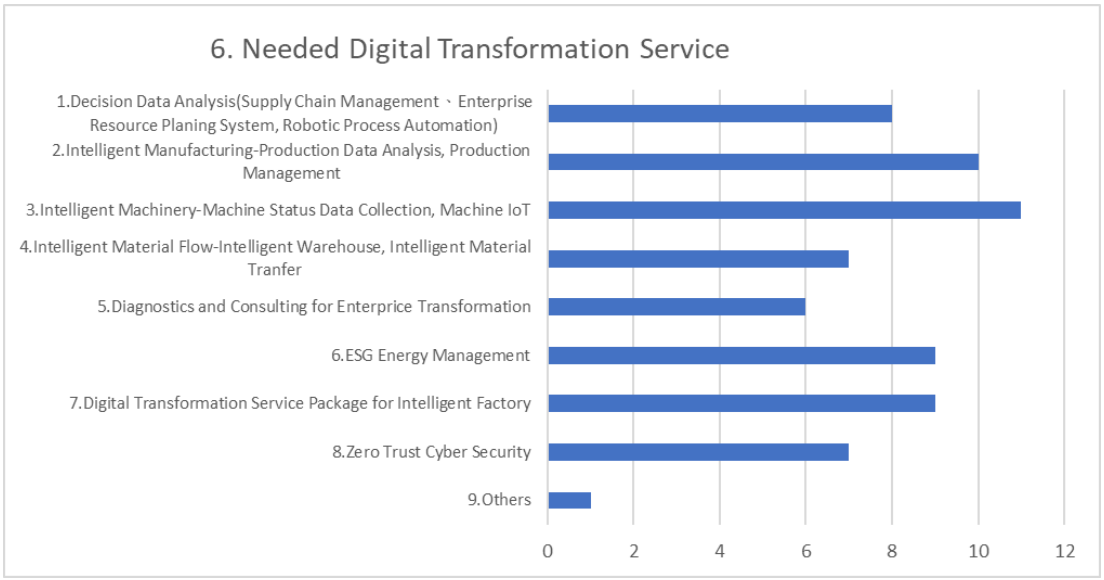


Figure 9 Survey Result on Needed Digital Transformation Service

What is the Prioritized Strength for a Cloud Computing Service

This question allowed for multiple choices (Figure 10), and a total of 14 individuals responded. The majority, 7 individuals, considered "Cross-Platform and Cross-Cloud Integration" to be the most important. The least selected option was "Other," chosen by 2 individuals.

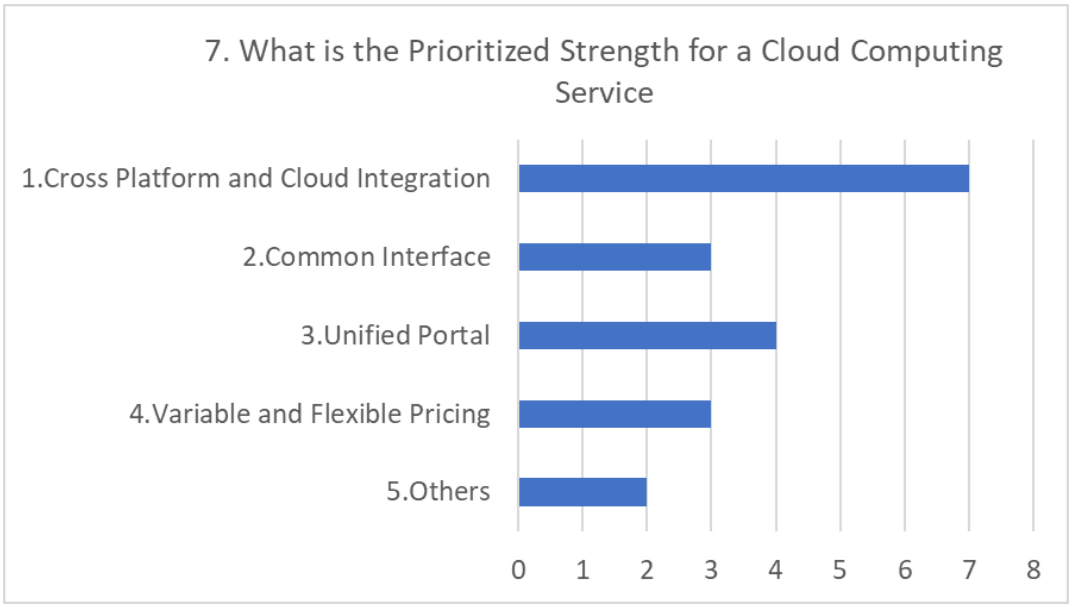


Figure 10 Survey Result on Prioritized Strength for Cloud Computing Service

How to Conduct Digital Transformation

This question allowed for multiple choices (Figure 11), and a total of 14 individuals responded. The majority, 9 individuals, considered "Collaboration with External System Integration Units" to be the most important. Following closely was "Internal Team Establishment," chosen by 8 individuals.

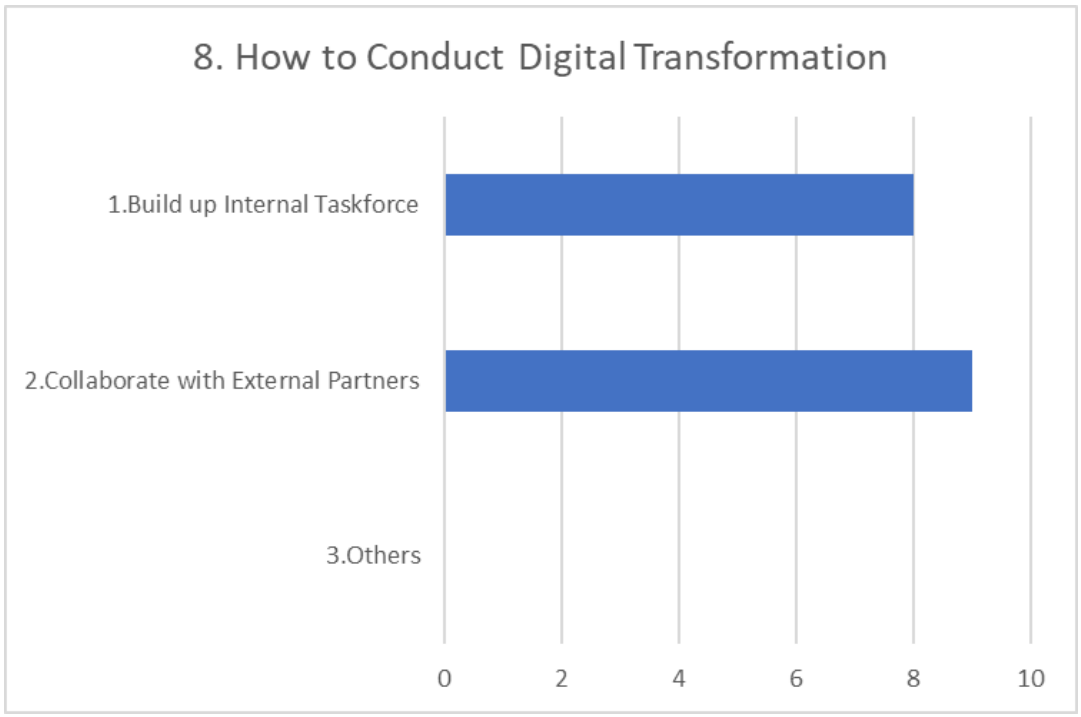


Figure 11 Survey Result on How to Conduct Digital Transformation

What is the Percentage of Female Workers in Your Current Intelligent Factory?

In the survey responses (Figure 12), a total of 14 individuals participated. The majority, comprising 6 individuals, indicated that the proportion of female colleagues is in the range of "20-40%." Following that, 5 individuals selected "0-20%," and the least selected option was "60% or more," chosen by 1 person.

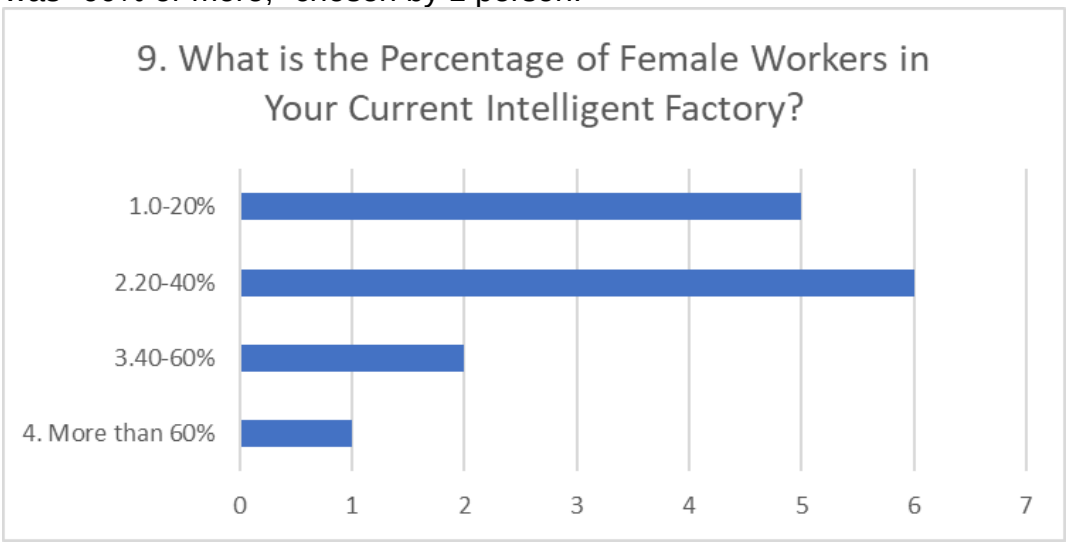


Figure 12 Survey Result on Percentage of Female Workers

How to Improve Female Influence in Intelligent Manufacturing Industry

This question allowed for multiple choices (Figure 13), and a total of 14 individuals responded. The majority, 7 individuals, considered "Advocating a friendly work environment and balancing 'Work-Family' life" to be the most important. Following closely were "Leadership involvement and corporate support" and "Establishing a concrete, transparent, and measurable recruitment and talent retention mechanism," each selected by 5 individuals. The least selected option was "Other," chosen by 1 person.

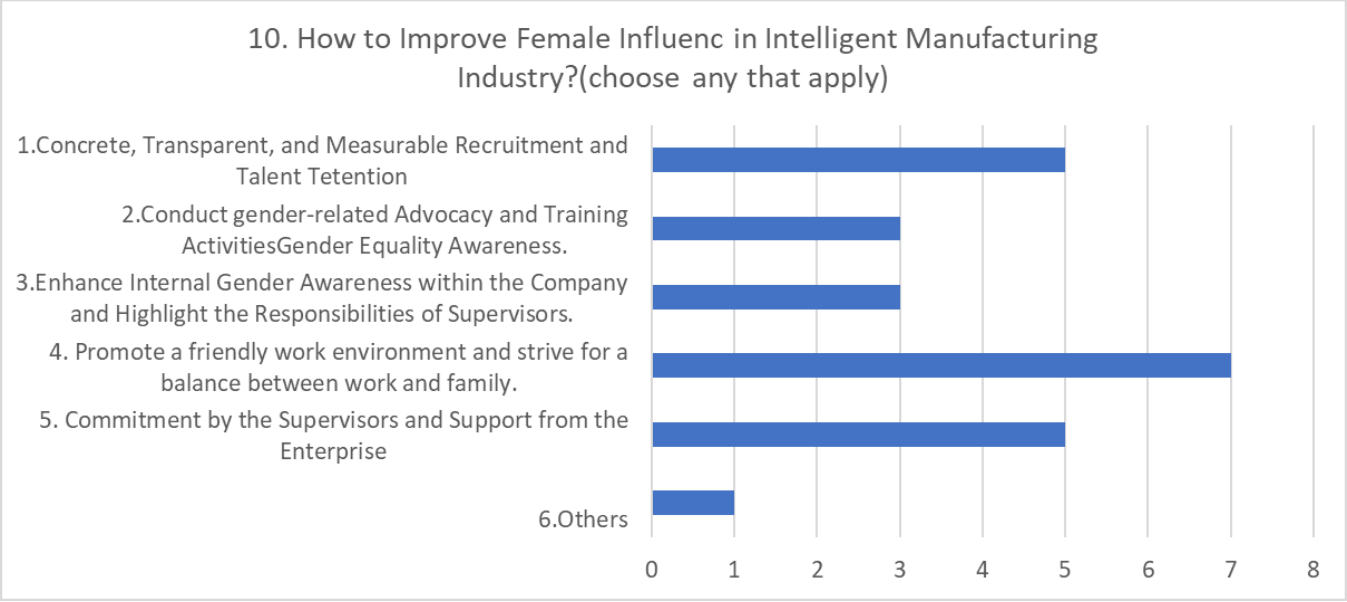


Figure 13 Survey Result on How to Improve Female Influence in Intelligent Manufacturing Industry

Summary of the Forum and Workshop

Event Overview

The APEC Conference on Cloud-based Intelligent Manufacturing Policy is a two-day event scheduled for September 2023 at the GRAND HYATT KUALA LUMPUR-Grand Salon in Kuala Lumpur, Malaysia. The conference aims to address policy planning, promotion, and strategic guidelines for cloud-based intelligent manufacturing, fostering collaboration between government officials, think tanks, and industrial representatives.

Figure 14 The APEC Conference on Cloud-based Intelligent Manufacturing Policy at the GRAND HYATT KUALA LUMPUR-Grand Salon in Kuala Lumpur, Malaysia

Day 1 (11 September 2023)：Forum on Policy Making and Site Visits

- Government officials and think tanks to share policy expectations and promotion strategies for intelligent manufacturing.
- Self-funded site visits to shopfloors or logistics hubs incorporating IoT and cloud-based intelligent manufacturing technology to provide participants with insights on technology integration, offering production managers a conceptual understanding to enhance overall efficiency.

Day 2 (12 September 2023)：Workshop on Case Studies and Panel Discussion

- Establishment of technology verification sites for intelligent manufacturing, covering policy background, strategy, implementation, and economic impacts.
- Creation of machinery clouds, addressing policy background, strategy, implementation, and benefits.
- Case studies illustrating digital transformation at various manufacturing stages (labor-intensive, semi-automatic, automatic, flexible, and intelligent manufacturing).
- Industrial representatives sharing experiences on adopting intelligent manufacturing technology, outlining roadmaps for future development, and presenting case studies.

Participants

For the Forum on Policy Making：

1. Government officials at operational levels for economic, industrial development, digital, or information affairs will be invited.
2. General management representatives from machinery and manufacturing industries, including automotive, shoe-making, textile, and logistics, will be invited.

For the Workshop on Case Studies Sharing：

1. Experts from ITRI presented overall IoT and intelligent manufacturing, including policy background, strategy, implementation, and economic impacts on building demo sites and machinery clouds.
2. Industrial representatives presented case studies.

Summary of the forum presentations：

Dr. Yau-Jr Liu, Vice President of Taipei University of Marine Technology

- The strategy for promoting the smart machinery industry ecosystem is divided into three directions：breadth, depth, and height. Practical industry application cases were presented to illustrate these directions. (Figure 15)
- Breadth involves promoting the Internet of Things (IoT) across major industries and having corporate research units donate IoT core hardware and software to universities, fostering more talents in the smart machinery field.
- Depth includes utilizing data obtained from IoT for analysis, diagnosis, monitoring, or applying AI technology to assist users in decision-making.
- Height involves extending smart manufacturing technology from a single process, equipment, or production line to the upstream and downstream of the supply chain, enhancing the competitiveness of the entire industry chain or industrial cluster.

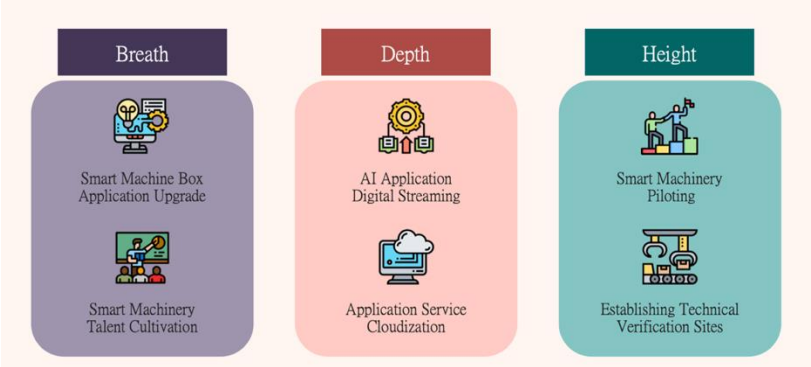


Figure 15 The strategy for promoting the smart machinery industry ecosystem is divided into three directions：breadth, depth, and height

Mr. Ding Hong Sing, President of SME Association of Malaysia

- Malaysia's GDP contributions mainly come from Micro, Small, and Medium Enterprises (MSMEs) (Figure 16).
- Introducing digital transformation and smart manufacturing technologies is relatively challenging, requiring fast, simple, and implementable technological solutions or government subsidies or research projects specifically targeting digital transformation for MSMEs. Malaysia's GDP contributions mainly come from Micro, Small, and Medium Enterprises (MSMEs)

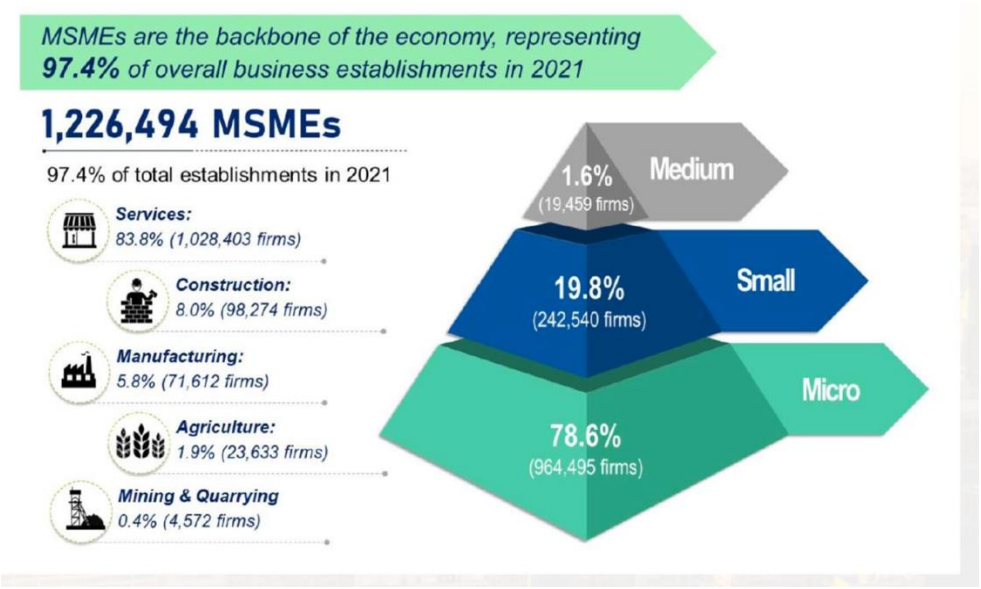


Figure 16 Malaysia's GDP contributions mainly come from Micro, Small, and Medium Enterprises (MSMEs)

Dr.-Ing. Do Manh Cuong, Deputy Secretary General of Viet Nam Automation Association

- Viet Nam's industrial structure is primarily composed of small and medium enterprises (Figure 17).
- The Vietnamese government categorizes the level of automation into seven types, with each level having different focal points in the digital transformation process.
- Influenced by the pandemic and geopolitical factors, many large factories have shifted their production bases to Viet Nam, providing favorable conditions for promoting digital transformation.
- The Vietnamese government encourages foreign investment in high-tech manufacturing as a strategy to drive industrial digital transformation.

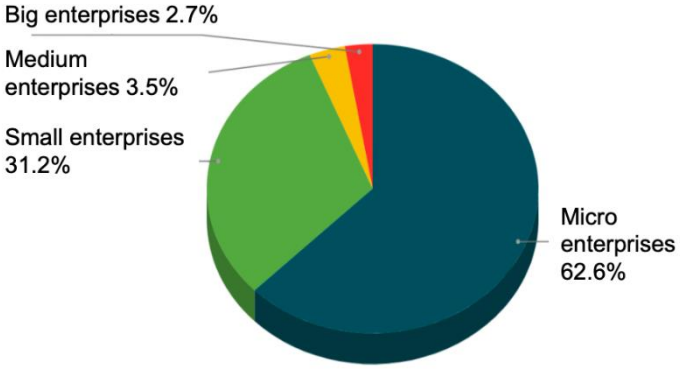


Figure 17 Viet Nam's industrial structure is primarily composed of small and medium enterprises

Summary of the workshop presentations

Dr. Neng-Kai Chang, Senior Technical Specialist of The Ministry of Economic Affairs' Department of Industrial Technology：

- Industry 4.0, AI, 5G/6G and carbon neutral is driving the need for cloud-based manufacturing solutions (Figure 18).
- Policy formation through government-led R&D in response to industry demands provided by associations and corporate entities is highly effective.
- The Intelligent Cloud for Machinery has been successfully adopted by machine builders, machine users, and system integrators.
- Chinese Taipei can contribute to digital transformation by sharing experience, technology, and use cases to assist policymakers and R&D groups in capacity building for digital transformation.

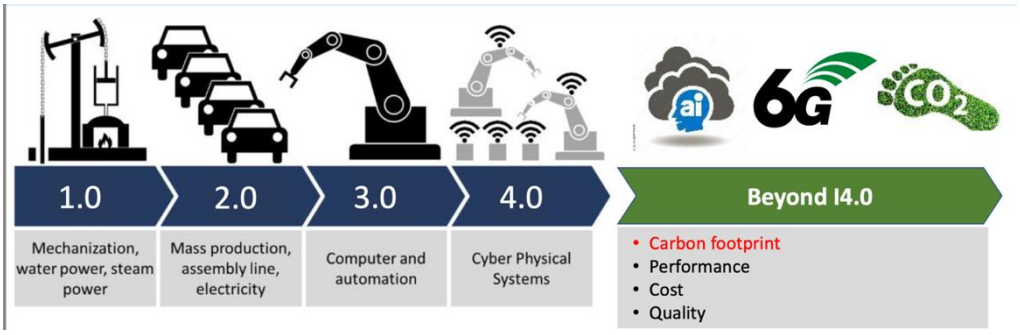


Figure 18 Industry 4.0, AI, 5G/6G and carbon neutral is driving the need for cloud-based manufacturing solutions

Dr. Tzuo-Liang Luo, President of Expetech Co., Ltd.:

- Combining corporate technology and venture capital, establishing a cross-domain service startup company with government support to provide a one-stop service for global manufacturing, logistics, and warehouse automation (Figure 19).

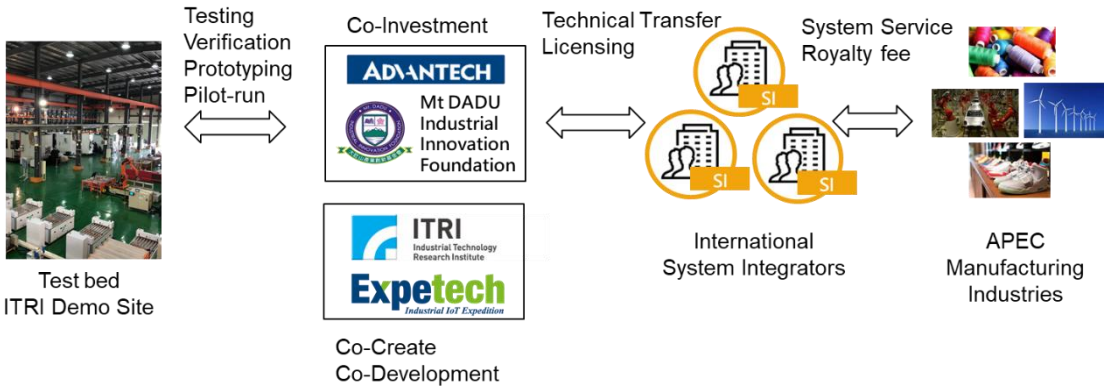


Figure 19 Combining corporate technology and venture capital, establishing a cross-domain service startup company

Mr. Jakub Tomasek, Engineering Director of Kabam Robotics：

- In the face of aging populations and labor shortages, the security industry also faces manpower challenges. Cloud-based security robots can collaborate with security personnel to accomplish tasks with fewer human resources (Figure 20).

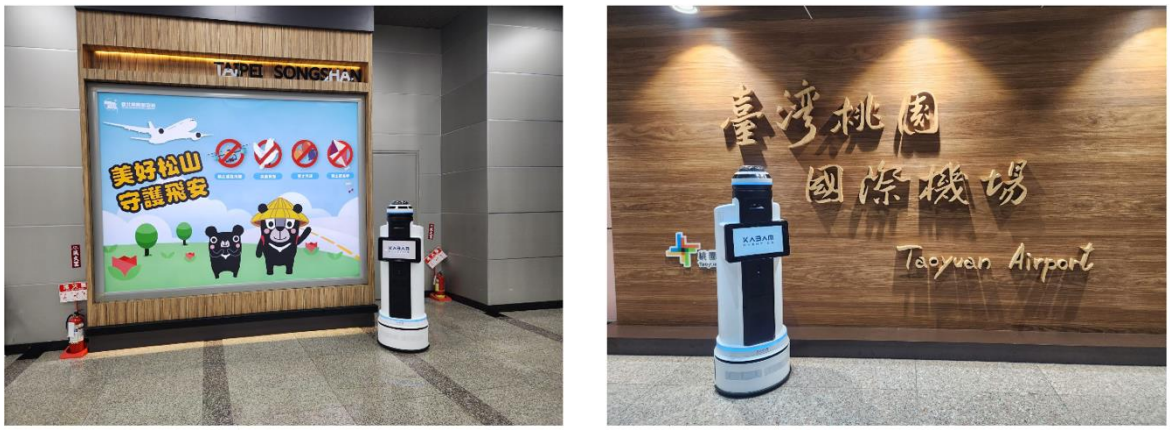


Figure 20 Use cases of the KABAM Robotics

Ms. Deh Hui Chuan, Principal Program Manager, Industry Solution Engineering Group, Asia, Microsoft：

- Connecting production line equipment, IoT, and other foundational technologies for digital transformation is a growing trend in the manufacturing industry (Figure 21). Further harnessing the power of the Internet of Things and digital twins is the next goal for industry players, despite the higher technological threshold.

- Tools such as the metaverse and AI on the Microsoft platform can enable users to quickly adopt and experience the benefits of the latest achievements in AI technology.

Figure 21 Connecting production line equipment, IoT, and other foundational technologies for digital transformation is a growing trend in the manufacturing industry

Prof. Nguyen Pham Thuc Anh, Associate Professor of Hanoi University of Science and Technology：

- Food scarcity is a global issue, and agriculture faces a shortage of manpower.
- Applying industrial control, image recognition, and other technologies in agricultural automation for tasks such as harvesting, planting, and spraying can significantly improve efficiency (Figure 22).

Precision agriculture is integration of cutting-edge technological achievements:
- Big Data,
- Machine Learning,
- Robotics,
- Artificial Intelligence,
- Cloud Computing,
- Internet of Things

….
to enhance productivity on existing farmland.

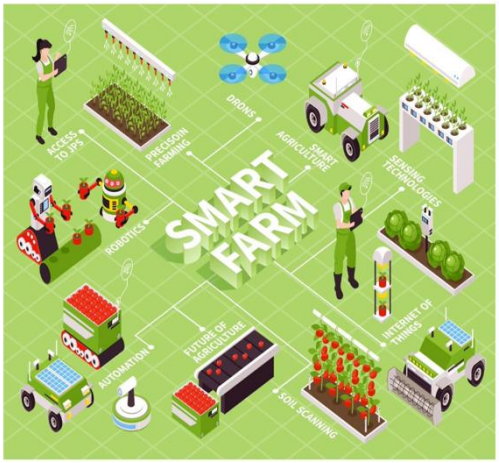


Figure 22 Applying industrial control, image recognition, and other technologies in agricultural automation

AGENDA

APEC Conference on Cloud-based Intelligent Manufacturing Policy

Location：GRAND HYATT KUALA LUMPUR-Grand Salon
12 Jalan Pinang, Kuala Lumpur, 50450, Malaysia

Table 1 Agenda for Day 1: Forum on Policy Making of Cloud-based Intelligent Manufacturing

Monday, 11 September 2023 **Forum on Policy Making of Cloud-based Intelligent Manufacturing**		
Time	**Topic**	**Speaker**
08:30 – 09:30 (60mins)	**Registration and Test Run**	
09:30 – 09:45 (15mins)	**Opening Session** •Opening Remarks	
09:45 – 09:50 (5mins)	•Group Photo	
Session I : Policy Making and Advocacy on Intelligent Manufacturing		
09:50 – 10:10 (20mins)	**Keynote Speech** • Dual Transformation in Chinese Taipei	• Yau Jr Liu, Vice President of Taipei University of Marine Technology
10:10 – 10:30 (20mins)	**Keynote Speech** • Industry 4.0：Are Malaysian SMEs Ready?	• Ding Hong Sing, President of SME Association of Malaysia
10:30 – 10:50 (20mins)	**Keynote Speech** • Policy Making and Advocacy on Intelligent Manufacturing in Viet Nam	• Do Manh Cuong, Deputy Secretary General of Viet Nam Automation Association
10:50 – 11:20 (30mins)	**Tea Break**	
11:20 – 12:00 (40mins)	**Panel Discussion** • Recap on key information and learnings, panel discussion on gaps between policy making and implementation	• Moderator：Yau Jr Liu, Vice President of Taipei University of Marine Technology
12:00 – 13:00 (60mins)	**Lunch Break**	

Monday, 11 September 2023 **Site Visits Tour**	
Time	**Topic**
13:00 – 13:45 (45mins)	**Travel Time**
13:45 – 14:45 (60mins)	• Moulded Plastic Parts Site: MYM Technology(M) Sdn. Bhd (Lot 19, Jalan TSB 8, Taman Industri Sg. Buloh, 47000 Selangor Darul Ehsan, Malaysia)
14:45 – 16:00 (75mins)	**Travel Time**
16:00 – 17:00 (60mins)	• Intelligent Manufacturing Site: Tron Bradbury Energy (Malaysia) Sdn. Bhd. (Precinct 2, Jln FZ6-P2, P228 & P229 Port Klang Free Zone KS/12, 42920 Pulau Indah, Selangor, Malaysia)
17:00 – 18:10 (70mins)	**Travel Time (Back to Grand Hyatt Kuala Lumpur)**

Table 2 Agenda for Day 2: Workshop on Case Studies Sharing of Cloud-based Intelligent Manufacturing

Tuesday, 12 September 2023 **Workshop on Case Studies Sharing of Cloud-based Intelligent Manufacturing**		
Time	**Topic**	**Speaker**
08:30 – 09:30 (60mins)	**Registration and Test Run**	
09:30 – 09:40 (10mins)	**Opening Remarks** • Brief introduction to speakers and topics	• Moderator：Yau Jr Liu, Vice President of Taipei University of Marine Technology
Session I : Future Development of Intelligent Manufacturing		
09:40 – 10:05 (25mins)	**Keynote Speech** • Achievements from Implementation of the Policy on Intelligent Machinery Cloud	• Neng Kai Chang, Senior Technical Specialist of The Ministry of Economic Affairs' Department of Industrial Technology
10:05 – 10: 30 (25mins)	**Keynote Speech** • The Promotion and Future of Smart Manufacturing in Chinese Taipei	• Hakiem Hsu, Chairman of 3DFamily
10:30 – 11:00 (30mins)	**Tea Break**	
Session II : Solutions for Digital Transformation		
11:00 – 11:25 (25mins)	**Keynote Speech** • Intelligent Manufacturing Solutions- Co-Created with ITRI	• Tzuo Liang Luo, President of Expetech Co., Ltd.
11:25 – 11:50 (25mins)	**Keynote Speech** • Revolutionizing Front-Line Work: Embracing Cloud-Based Robotics for Digitization	• Jakub Tomasek, Engineering Director of Kabam Robotics
11:50 – 13:20 (90mins)	**Lunch Break**	
Session III : Industrial Use Cases for Intelligent Manufacturing		
13:20 – 13:45 (25mins)	**Keynote Speech** • Disruptive Innovation in Logistics Industry	• Keren Liu, Head of Ally Logistic Property (ALP) Malaysia (Managing Director)
13:45 – 14:10 (25mins)	**Keynote Speech** • Industrial Digital Transformation with Microsoft Industrial Metaverse & AI	• Deh Hui Chuan, Principal Program Manager, Industry Solution Engineering Group, Asia, Microsoft
14:10 – 14:30 (20mins)	**Tea Break**	

Tuesday, 12 September 2023 **Workshop on Case Studies Sharing of Cloud-based Intelligent Manufacturing**		
Time	**Topic**	**Speaker**
Session IV : Remote Collaborative Engineering for Intelligent Manufacturing		
14:30 – 14:55 (25mins)	**Keynote Speech** • AI-powered Digital Twins: Transforming Manufacturing	• Richard Yen, Senior Vice President of Altair Engineering
14:55 – 15:20 (25mins)	**Keynote Speech** • AI & Robotics- Effective Solutions for Developing Smart Agriculture in Viet Nam	• Nguyen Pham Thuc Anh, Associate Professor of Hanoi University of Science and Technology
15:20 – 15:40 (20mins)	**Tea Break**	
15:40 – 16:30 (50mins)	**Panel Discussion** • Recap on key information and learnings, panel discussion on common issues adopting intelligent manufacturing	• Moderator：Yau Jr Liu, Vice President of Taipei University of Marine Technology

Key Discussions

Summary of the panel discussion of the forum

Title: Enhancing Collaboration Between Universities and Industry: Strategies from the Discussion

In the contemporary fast-paced technological landscape, the importance of collaboration between universities and the industrial sector has reached unprecedented levels. In a recent discussion, participants exchanged their perspectives and tactics aimed at enhancing this collaboration, specifically concentrating on Malaysia and Viet Nam. This collection of valuable insights is organized into an article here.

Figure 23 Panel Discussion of the Forum

1. Leveraging Alumni Connections

One of the primary ways to enhance collaboration is by maintaining close contact with alumni. These individuals, who have successfully transitioned into entrepreneurs, offer invaluable financial support and opportunities to current students. This connection facilitates practical experience and industry networking, preparing students for real-world challenges.

2. Embracing Digital Training Platforms

In the digital age, universities are shifting away from traditional training platforms towards digital ones. This transformation ensures that students and alumni remain updated with the latest industry trends and knowledge. It's crucial to keep pace with the ever-evolving technology landscape.

3. Establishing Employment Centers
Employment centers provide a platform for universities, enterprises, and authorities to collaborate. This open environment allows students and researchers to work on projects, share knowledge, and contribute to the industry. Collaboration in these centers helps bridge the gap between academic learning and practical application.

4. Bridging the Gap Between Theory and Industry
The second speaker, representing Malaysia, highlighted the necessity of universities working closely with businesses. While universities excel in theory and technology, they often lack marketing and industry integration skills. Collaboration with businesses, especially small and medium-sized enterprises (SMEs), helps bridge this gap and ensures that academic knowledge is applied effectively in the industry.

5. Integrating Universities in Science Parks
The third speaker discussed the integration of universities within science parks. This approach allows professors to collaborate closely with technology companies, fostering research and development activities. Professors can exchange knowledge and expertise with industry professionals, leading to innovative solutions and technology transfer.

6. Contributions from Alumni and Leading Companies
Alumni and leading companies play a significant role in providing software and hardware to universities. This support ensures that universities stay current with the latest technologies, benefiting both students and the industry.

7. Government Support for Professor Startups
Government support is crucial for professors looking to start businesses or startups within the university. This support encourages professors to engage in entrepreneurial activities, leading to innovative solutions that address industry needs.

8. Creation of Industrial Colleges
Creating industrial colleges with government funding and support allows universities to attract more students and funding. This approach helps cultivate talents aligned with industry needs, ensuring that graduates are better prepared for the job market.

9. Open Collaboration Spaces
Open collaboration spaces are essential for universities and associations to collaborate with companies. These spaces facilitate networking, knowledge exchange, and collaboration on various projects, fostering a dynamic environment for innovation.

In conclusion, the discussion underscored the significance of collaboration between universities and the industrial sector. Leveraging alumni connections, embracing digital training, and bridging the gap between theory and industry are all critical steps. Integrating universities into science parks, receiving support from alumni and government, and creating industrial colleges are also

vital strategies. Open collaboration spaces provide a dynamic environment for innovation. By implementing these strategies, universities and industry can work hand in hand to foster technological growth and innovation, ultimately benefiting students and businesses alike.

Summary of the panel discussion of the workshop

Moderator：

Dr. Yau-Jr Liu, Vice President of Taipei University of Marine Technology

- With a wealth of experience in academia and leadership, Yau Jr Liu will guide our esteemed panelists through insightful discussions on the challenges and opportunities presented by cloud-based services and generative AI in the APEC region.

Panelists：

Dr. Hakiem Hsu, Chairman of 3DFamily

- As a seasoned industry leader, Dr. Hakiem Hsu brings his wealth of expertise to the panel. Through his role as Chairman of 3DFamily, he will shed light on the transformative impact of cloud-based services in the context of inclusive and sustainable growth, sharing key insights gained from his experiences.

Mr. Jakub Tomasek, Engineering Director of Kabam Robotics

- As an Engineering Director at Kabam Robotics, Mr. Jakub Tomasek will offer valuable perspectives on the integration of generative AI in robotics. His insights will explore the potential for generative AI to revolutionize manufacturing processes, contributing to both economic growth and sustainability.

Ms. Deh Hui Chuan, Principal Program Manager, Industry Solution Engineering Group, Asia, Microsoft

- With a focus on Microsoft's role in the digital transformation landscape, Ms. Deh Hui Chuan, as Principal Program Manager, will elaborate on the synergy between cloud-based services and Microsoft's technologies. He will highlight how Microsoft's initiatives contribute to fostering inclusive growth in APEC economies.

Prof. Nguyen Pham Thuc Anh, Associate Professor of Hanoi University of Science and Technology

- Bringing an academic perspective to the panel, Prof. Nguyen Pham Thuc Anh will share insights from Hanoi University of Science and Technology. His contributions will delve into the educational aspects of cloud-based services and generative AI, elucidating the role of academia in preparing the workforce for the digital era.

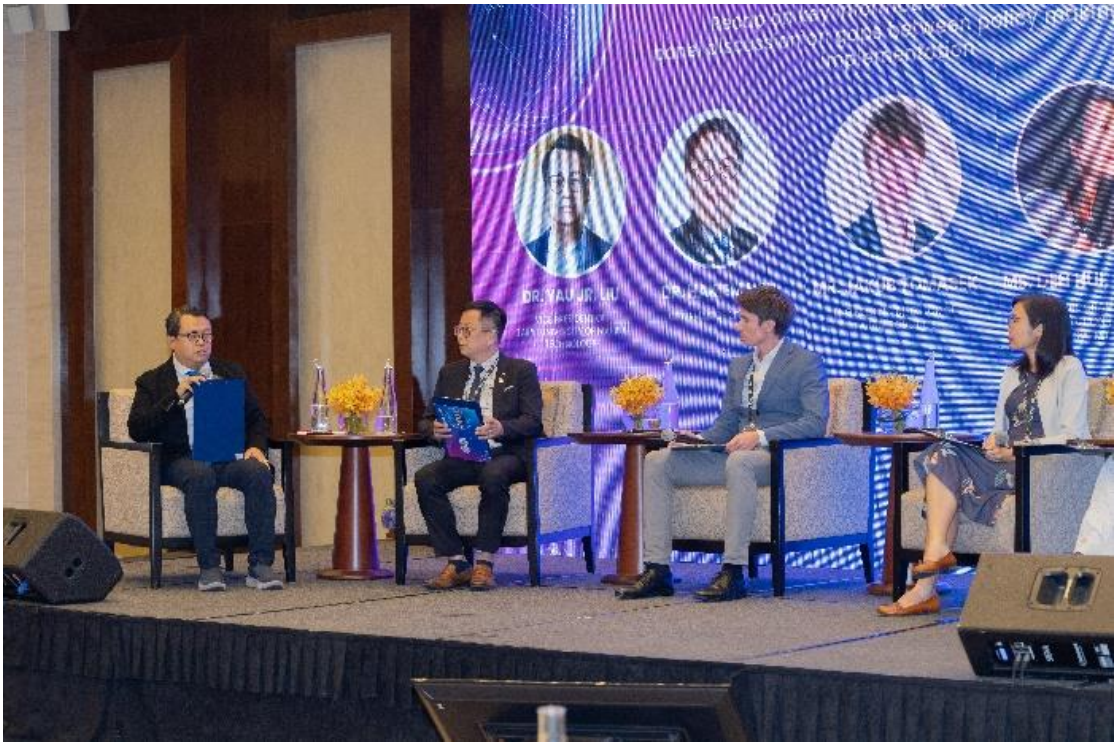


Figure 24 Panel Discussion of the Workshop

Title: Advancing Cloud-Based Services and Generative AI: APEC's Path to Inclusive and Sustainable Growth

Introduction：

The Asia-Pacific Economic Cooperation (APEC) forum serves as a collaborative platform for member economies to drive policies and initiatives promoting inclusive and sustainable growth. The recent two-day discussions focused on the pivotal role of cloud-based services and generative AI in realizing APEC's objectives, emphasizing themes like awareness, best practices sharing, and technology adoption acceleration.

Key Points：

1. Cloud-Based Services: An Inclusive Approach

- Affordability and Accessibility：Cloud-based services break entry barriers, enabling both developed and developing economies to benefit, especially crucial for resource-limited regions and SMEs.
- Generative AI：Lowers the technical bar, democratizing AI and making it accessible to a broader audience without deep expertise, fostering inclusivity.
- Education and Skills Development：APEC economies can collaborate on workshops and training programs to ensure citizens possess the necessary skills for cloud-based services and generative AI.

2. Public and Private Sector Partnerships
- Collaboration：Joint efforts between the public and private sectors are essential for fostering innovation, research, and development in cloud-based services and generative AI.
- Fail Fast, Learn Faster：Encouraging experimentation with a time-bound approach accelerates progress and allows for rapid adjustments and improvements.

3. Lessons from the Private Sector
- Minimal Viable Experiments (MVEs)：Instead of lengthy Minimal Viable Products (MVPs), short-term MVEs allow for rapid learning and adjustments.
- Internship Programs: Engaging with interns brings fresh perspectives and innovative ideas, contributing significantly to APEC's goals.
- Business Case Early： Developing a clear business case early ensures technology aligns with specific needs, providing a return on investment and sustainability. Even with government subsidies, a sound business case is crucial.

Conclusion

- APEC is poised to harness the power of cloud-based services and generative AI to promote inclusive and sustainable growth. By focusing on affordability, accessibility, education, public-private partnerships, and an agile mindset, APEC member economies can lead the way in adopting these technologies. The lessons from the private sector underscore the importance of experimentation, intern collaborations, and clear business cases. APEC has a unique opportunity to shape the future of cloud-based services and generative AI, making them accessible to all and driving inclusive, sustainable growth.
- Concluding the discussion, the participants are urged to carry forward the valuable takeaways and collaborate in crafting a roadmap for the future. Encouraging a collective commitment to harnessing technology for the benefit of all, APEC can persist as a driving force for positive change in the Asia-Pacific region.

Best practices for digital transformation

Global trend of digital transformation

The manufacturing industry is focusing on Industry 4.0 (as illustrated in Figure 25), characterized by smart, interconnected systems. The ongoing transformation is evident as there is a shift from the traditional, centralized factory model to a more dynamic and decentralized structure.

Simultaneously, it is apparent that artificial intelligence (AI) is playing a transformative role in the manufacturing landscape. The maturation of cloud computing is also noteworthy. Consequently, there is a substantial shift towards cloud-based solutions in smart manufacturing, signifying a significant development in the industry.

The underlying communication infrastructure for industrial IoT also plays an important role on intelligent manufacturing. It's like giving a turbo boost to how devices connect and share data. This will drive the need for cloud-based analytics, making our digital twins, devices, and us, the users, deeply connected.

The push for net-zero carbon emissions is opening new opportunities for smart manufacturing as companies will have to optimize overall manufacturing process in terms of performance and energy efficiency.

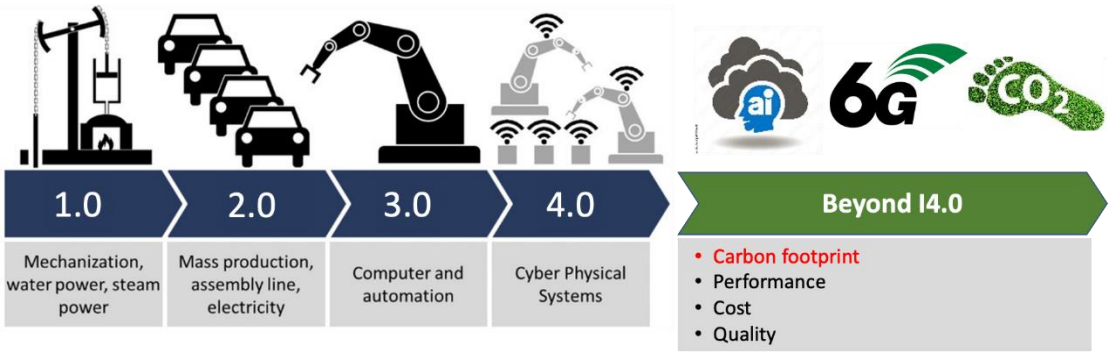


Figure 25 The Global Trend of Industry 4.0 and Beyond

Another trend that have been noticed recently is the market growth in intelligent manufacturing.

According to TrendForce research (Figure 26), companies are moving actively on energy conservation and carbon reduction. In the short term, the introduction of automation as an intelligent foundation will attract increasing attention from the industry and emerging market demands such as remote operations, virtual reality, and simulation operations will become more practical in the medium term.

This stage of development is expected to solve the dilemma posed by the slow progress of Industry 4.0, accelerate the development of related technologies, and drive the global smart manufacturing market to reach USD620 billion by 2026.

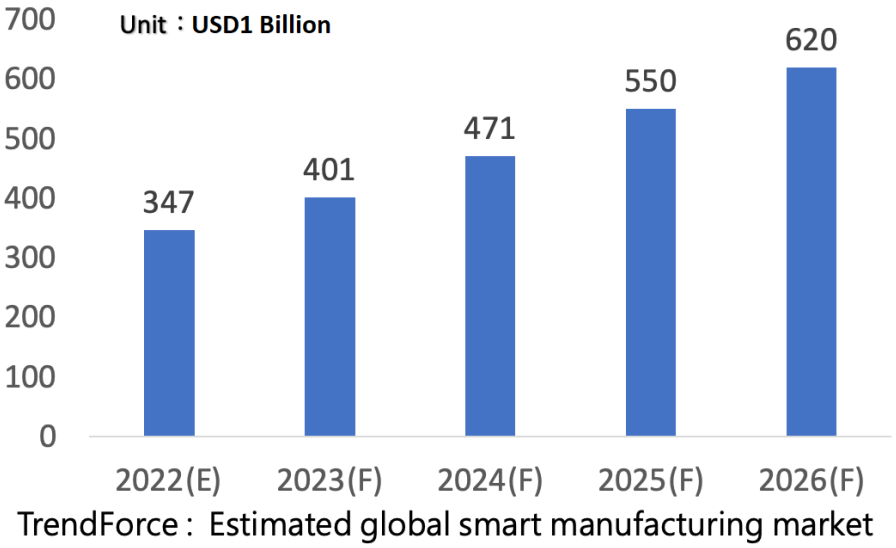


Figure 26 Estimated Global Smart Manufacturing Market

Challenges within APEC region

With the global trends and opportunities mentioned, machinery industry is also facing challenges. One of the most important challenges is labor shortage.

Labor force participation rate in APEC region has been decreasing since 1990 (Figure 27). One of the key contributors to this challenge is the aging population, with a growing number of individuals aged 60 and above.

To address this, embracing automation and intelligent manufacturing has become imperative. By leveraging advanced technologies, such as robotics and AI, industries can not only compensate for the diminishing labor force but also significantly enhance the per capita output value.

This shift towards automation not only ensures the sustainability of industries but also paves the way for increased productivity and innovation, helping to tackle the labor shortage issue effectively in the APEC region.

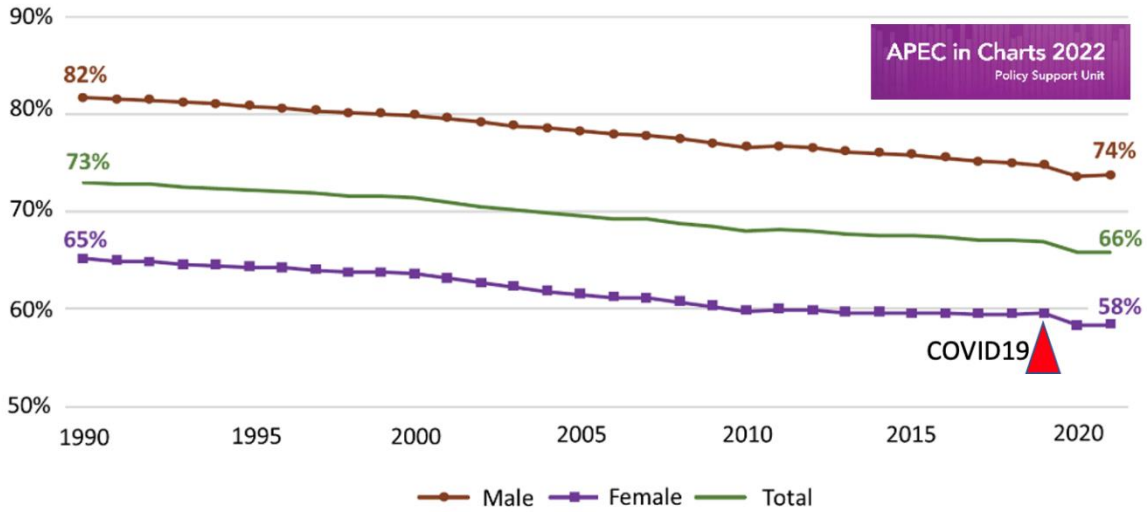


Figure 27 Labor force participation rate in APEC region

Challenges also came from the real production scenario and existing equipment.

Industries such as consumer electronics and everyday items present an array of product styles with short lifecycles. This trend has compelled the manufacturing sector to cater to small batches and diverse production requirements (Figure 28). However, small and medium-sized enterprises without digital production management capabilities will likely struggle to keep up with these demands.

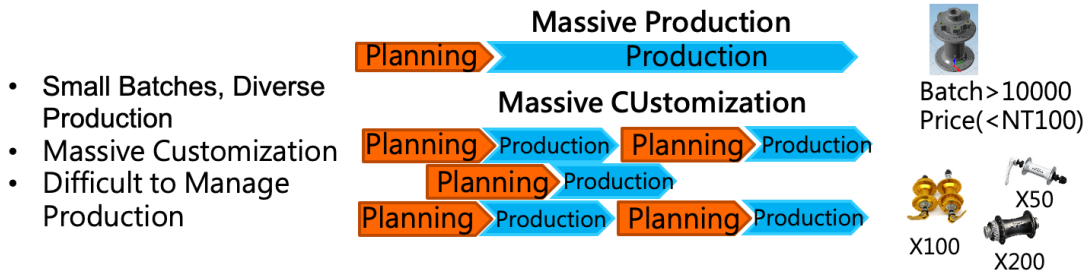


Figure 28 Production Scenario Changed from Massive Production to Massive Customization

Bringing legacy equipment into the digital age poses its own challenges.

Outdated production lines suffer from the limitations of technology, hindered by equipment lacking communication interfaces (Figure 29).

Figure 29 Legacy Machines That Lack of Communication Interface

Furthermore, it is noteworthy that these machines are frequently situated in challenging operational environments, where installing sensor systems is often difficult or impractical (Figure 30). As the industry progresses towards a digital future, the imperative to discover innovative solutions for the modernization of such equipment becomes crucial for ensuring sustainable growth in manufacturing.

Figure 30 Harsh Environment Makes it Difficult to Install Sensors or Communication Device

Steps for Digital Transformation

Shopfloor Data Collection

IoT and cloud computing play important role in intelligent manufacturing.

Drawing parallels with consumer digital content platforms, the industrial IoT platform for machinery mirrors user-friendly accessibility (Figure 31). Smart set-top box devices are seamlessly adaptable to diverse industry equipment communication interfaces.

These devices streamline data collection, channeling it to our cloud computing platform. This inclusive platform offers holistic solutions encompassing operational, product, and production management, serving both equipment and manufacturing sectors effectively.

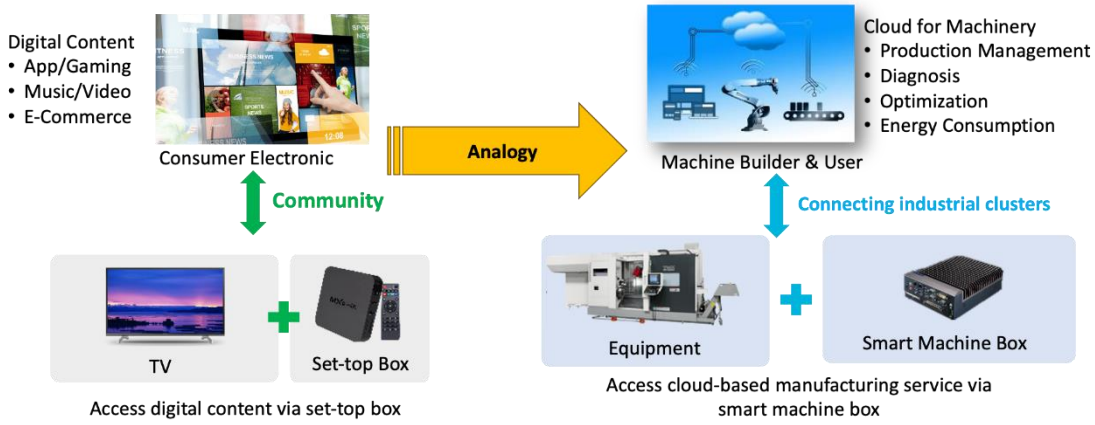


Figure 31Analogy between Smart Machine Box and TV Set-top Box

However, there are problems to be solved for most machine builders and users before they can embrace the power of intelligent machine, as shown in Figure 32.

For the cloud computing, there are three problems

- Lack of software marketplace for machinery industry so that Apps/SaaS can sell to international market
- Lack of cloud computing platform to orchestrate applications and software modules from machine builder, component make, software developers and system integrators

For the development of cloud-based application for intelligent manufacturing

- No standard mechanism for SaaS/App development, deploy, and upgrade
- No standard information model to communicate between machine and software
- No dedicated development tool or reusable software components which encapsulate domain knowledge of machinery and manufacturing process for App/SaaS developers

For the IoT device

- No device management mechanism
- Compatibility for various communication standard

To solve the problems, a standardized cloud computing platform which consist of standardized IoT device, cloud computing, and marketing platform is needed (Figure 33). The platform could be constructed with the following objectives

Computing& Marketplace

- Mechanism for SaaS/App subscription and deploy
- Business transaction

Standardized IoT device

- Edge-to-cloud data streaming
- Resource Management
- Cyber Security
- Information Model

Use Cases

Use cases in metal cutting, laser, composite manufacturing, wood working, textile, injection molding, PCB, and metal working to demonstrate deploy, operation, edge-to-cloud data streaming of SaaS/Apps

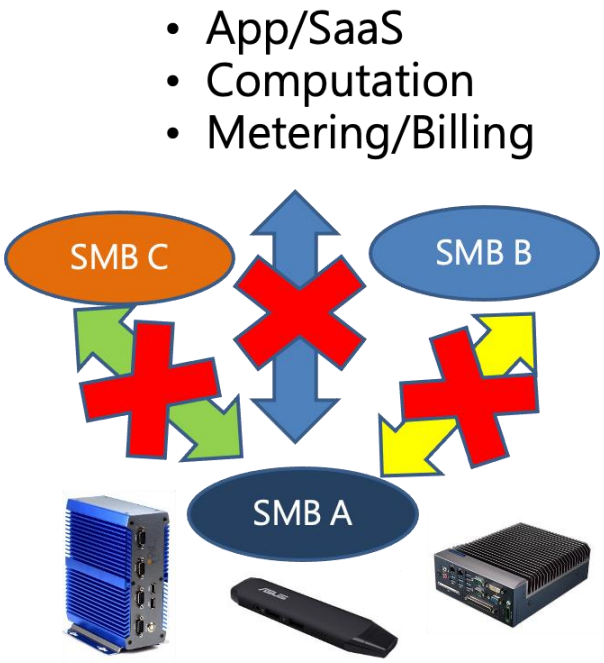


Figure 32 Problems to be Solved on Machine IoT, Software Development and Deployment

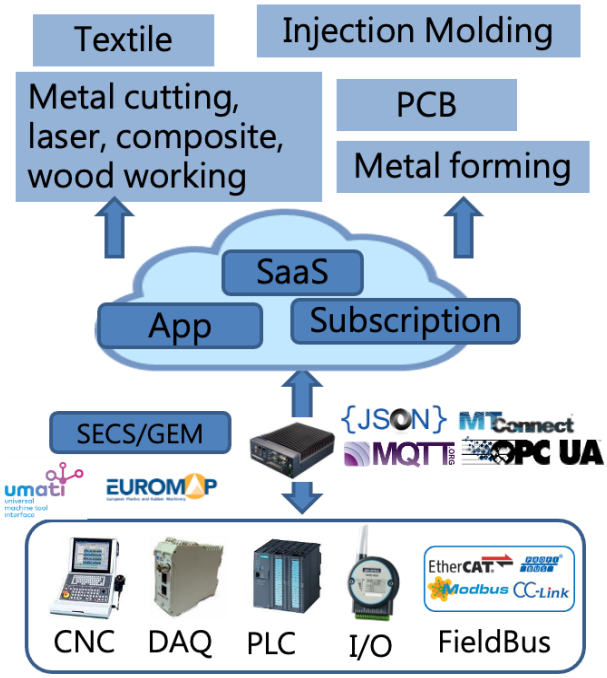


Figure 33 Standardized Cloud Computing Platform that Consist of Standardized IoT Device, Cloud Computing, and Marketing

Leveraging standardized IoT modules, the intelligent cloud for machinery offers digital services for various industries such as metal cutting, metal working, injection molding, wood working, textile and others (Figure 34). By gathering shopfloor data through these modules, visualization, analysis, and diagnosis are enabled, culminating in commercialization via a software marketplace. This approach paves the way for a range of software modules or apps to be bundled into comprehensive solutions for intelligent manufacturing, streamlining rapid deployment and facilitating the journey of digital transformation.

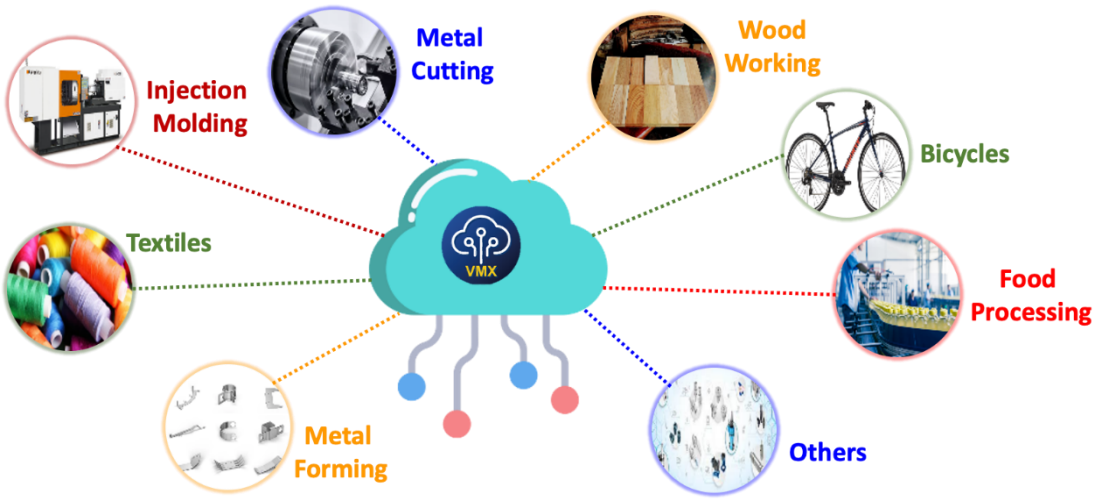


Figure 34 Intelligent Cloud for Machinery Offers Digital Services for Various Industries

Linkage within Factory

With the above mentioned IoT, process monitoring and optimization, manage and business operation, traditional factory as well as newly established intelligent factory can benefit from the technology behind these software systems on both production and management (Figure 35).

For example, in the supply chain management sector, 50% scheduling time reduction and downtime for material have been reported. In the production sector, 30% cycle time reduction and 50% production cost reduction have been reported. With the process monitoring and statistics process control, 20% yield rate improvement have been reported.

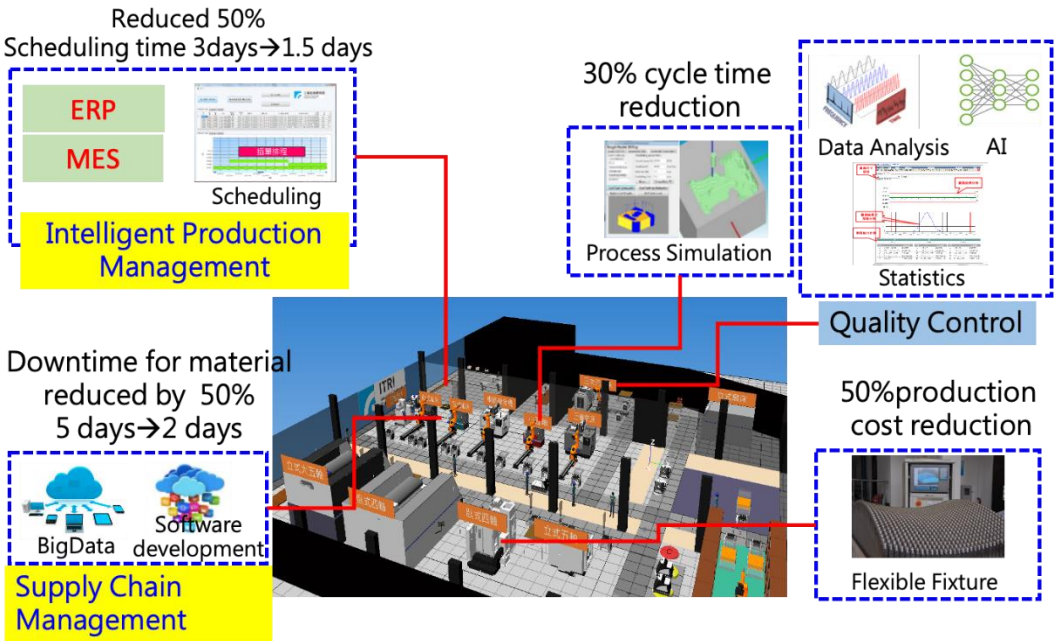


Figure 35 Benefit of Adopting Intelligent Manufacturing from Various Aspects

Linkage Across Supply Chains

Intelligent manufacturing is achieved by not just the machines in the shopfloor, but also the software system behind the hardware, which can be categorized as (1) IOT system (2) Process monitoring and optimization (3) management and business operation including MES, APS, cloud services.

As shown in Figure 36, IoT is the backbone of the site, which supports most CNC, PLC in the market. All machines in the shopfloor are connected with the IoT backbone. Process data are collected and stored in data base for further analysis for diagnostics and optimization.

Process monitoring and optimization software are developed based on process physics and data-driven AI models, which continuously monitor and optimize the process on each machine.

Management and business operation system in the take care of the production schedule and interaction with suppliers and customers to ensure minimum delivery time and cost.

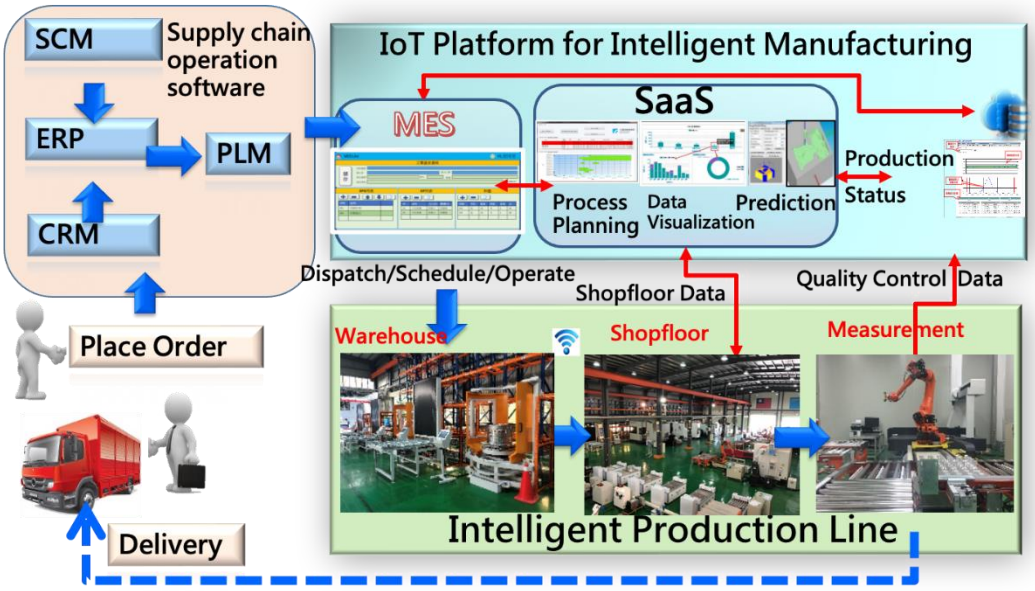


Figure 36 IoT Backbone that Link Across Supply Chain

Use Cases

In this chapter, three use cases of digital transformation are described. The first use case is about implementation of the technology in real production site while the second uses case is about synergetic start-up company. The third use case is a joint development in between research institute, industrial associations and government official for the intelligent cloud for machinery.

The first use case is to implement IoT, digital management, and data analysis in a textile shopfloor in Viet Nam (Figure 37). In the textile industry, manufacturers often face challenges in combining equipment data for analysis and suffer from inefficiencies due to lack of shopfloor data collection. Smart machine box has been deployed to gather data and utilizing cloud analysis to enhance production management. With the shopfloor data, production schedule has been optimized with a remarkable 20% increase in dyeing machine utilization rates.

This solution not only addresses pain points but also drives substantial operational improvements for manufacturers.

Figure 37 Textile Production Site at Viet Nam. No shopfloor data, low efficiency, lack of digital management and low productivity before digital transformation

Figure 38 Textile Production Site at Viet Nam. Shopfloor IoT data, cloud analysis and optimization of dyeing process, increased productivity after digital transformation.

The second use case is to co-create a start-up company with the support of technology developed by research institute and packaged into total solution for various industrial sectors (Figure 39). The start-up team fostered the creation of a joint start-up company through a dynamic collaboration that merges research accomplishments and an overseas system integrator firm.

This collaboration harnesses the power of patent licensing and technology transfer, serving as a catalyst for innovation.

The overarching objective is to facilitate the digital transformation of manufacturing companies. By leveraging the capabilities of their cloud for machinery, a holistic packaged solution is offered. This solution simplifies the journey towards digital excellence, providing a range of services tailored to the unique needs of manufacturing enterprises.

Through the amalgamation of cutting-edge technology and strategic partnerships, the initiative aims to drive change and empower businesses to thrive in the era of digital transformation.

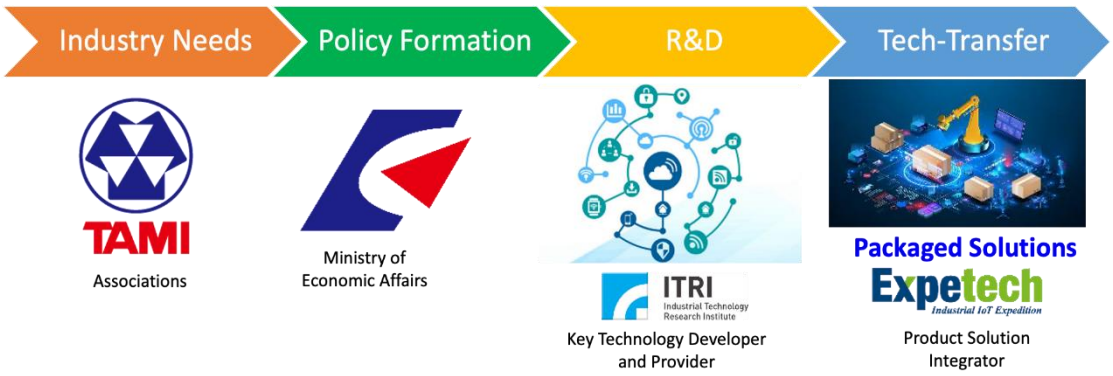


Figure 39 Start-up Company with the Support of Technology Developed by Research Institute and Packaged into Total Solution

The third use case is to develop an intelligent cloud for machinery industry in Chinese Taipei (Figure 40). The cloud platform features a diverse collection of specialized and versatile apps, totaling over 200 in number. These apps are designed to expedite the digital transformation process for manufacturers abroad, propelling them towards the realm of smart manufacturing. These apps provide a seamless integration pathway into comprehensive solutions, thereby hastening the journey towards digital excellence.

Since 2018, the development team forged partnerships with 63 system integrators, spanning 17 distinct industries. This collaborative effort has successfully engaged 399 manufacturers, leading to the successful networking of an impressive 10,466 pieces of equipment. This accomplishment firmly underscores our dedication to fostering innovation and promoting connectivity.

For overseas multinational corporations and system integrators, the platform extends the capability to develop customized apps tailored to their needs.

These dedicated apps can then be made available on the portal web page, facilitating prompt client service and promoting software exchange within their network.

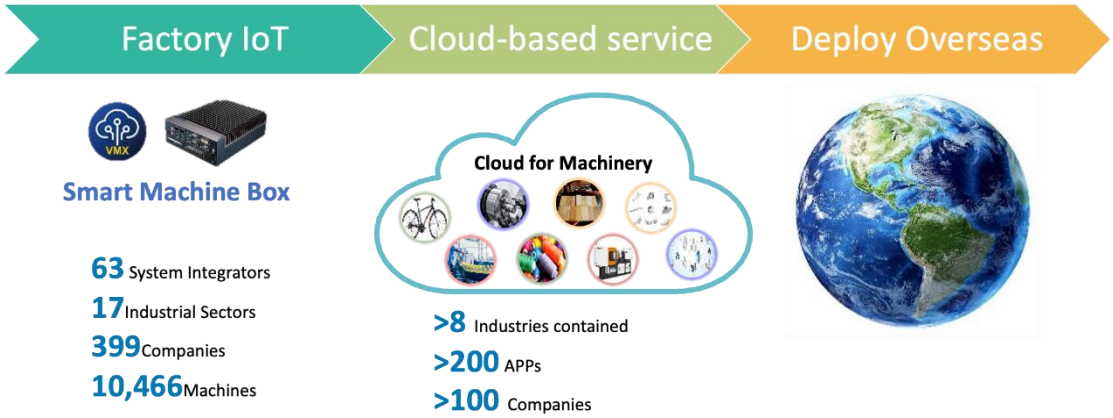


Figure 40 Development and Promotion Stages of the Intelligent Cloud for Machinery

Lessons Learned and Policy Recommendations

The Asia-Pacific Economic Cooperation (APEC) forum has become a crucial platform for member economies to collaborate on policies and initiatives promoting inclusive and sustainable growth. Speakers were invited to share topics related to smart manufacturing policy formation, smart manufacturing applications, robotics applications, digital twins, metaverse, and artificial intelligence. Discussions centered around the role of cloud-based services and generative AI in achieving APEC's objectives. This article aims to organize key insights from the forum and workshop into coherent lessons learned and policy recommendations.

Lessons learned from the Panel Discussion of the Forum: Leveraging Collaboration Between Universities and Industry

1. Alumni Connections for Industry Support
Maintaining strong connections with alumni emerged as a pivotal strategy for universities. Successful entrepreneurs, often alumni, provide financial support and opportunities for current students. This collaboration facilitates practical experiences, industry networking, and prepares students for real-world challenges.

2. Embracing Digital Training Platforms
As the digital landscape evolves, universities are transitioning to digital training platforms. This shift ensures that students and alumni remain updated with the latest industry trends and knowledge, aligning education with the ever-evolving technology landscape.

3. Establishing Employment Centers
Employment centers serve as platforms for collaboration between universities, enterprises, and authorities. These centers facilitate collaborative projects, knowledge sharing, and industry contributions, bridging the gap between academic learning and practical application.

4. Bridging Theory and Industry
The collaboration between universities and businesses, especially small and medium-sized enterprises (SMEs), is crucial for bridging the gap between theoretical knowledge and practical industry application. This collaboration ensures that academic expertise is effectively applied in the industry.

5. Integrating Universities in Science Parks
The integration of universities within science parks promotes close collaboration between professors and technology companies. This collaboration fosters research and development activities, leading to innovative solutions and technology transfer.

6. Contributions from Alumni and Leading Companies
Alumni and leading companies play a significant role in providing software and hardware support to universities. This collaboration ensures that universities stay current with the latest technologies, benefiting both students and the industry.

7. Government Support for Professor Startups
Government support for professors looking to start businesses within the university encourages entrepreneurial activities. This support leads to innovative solutions that address industry needs.

8. Creation of Industrial Colleges
Establishing industrial colleges with government funding allows universities to attract more students and funding. This approach helps cultivate talents aligned with industry needs, better preparing graduates for the job market.

9. Open Collaboration Spaces
Open collaboration spaces are essential for universities and associations to collaborate with companies. These spaces facilitate networking, knowledge exchange, and collaboration on various projects, fostering a dynamic environment for innovation.

In conclusion, the collaboration between universities and the industrial sector is crucial for technological growth and innovation. Leveraging alumni connections, embracing digital training, and bridging the gap between theory and industry are critical steps. Integrating universities into science parks, receiving support from alumni and government, and creating industrial colleges are also vital strategies. Open collaboration spaces provide a dynamic environment for innovation.

Lessons Learned from the Workshop: Implementing Intelligent Cloud for Machinery Policies

1. Dr. Neng-Kai Chang – Senior Specialist of The Ministry of Economic Affairs' Department of Industrial Technology

- Government-Led R&D: Effective policy formation involves government-led research and development in response to industry demands. The Intelligent Cloud for Machinery, is an extension to an existing policy called 5+2 Industry Innovation Plan (Figure 41) in Chinese Taipei.
- Successful Adoption: The Intelligent Cloud for Machinery has been successfully adopted by machine builders, users, and system integrators in Chinese Taipei (Figure 42).
- Capacity Building: Chinese Taipei can share its experience, technology, and use cases to assist policymakers and research and development groups in other economies with capacity building on digital transformation (Figure 43).

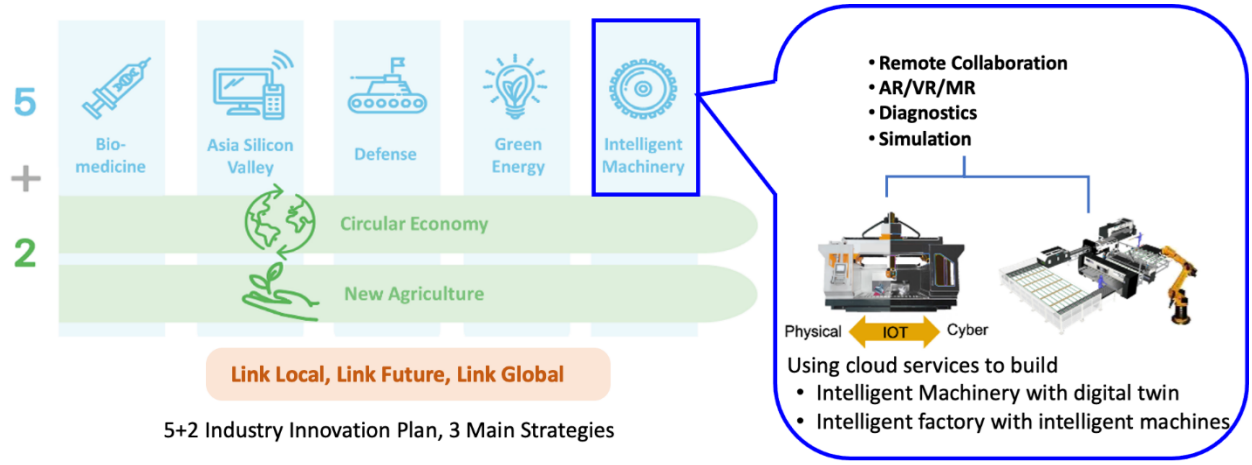


Figure 41 The 5+2 Industry Innovation Plan conducted in Chinese Taipei

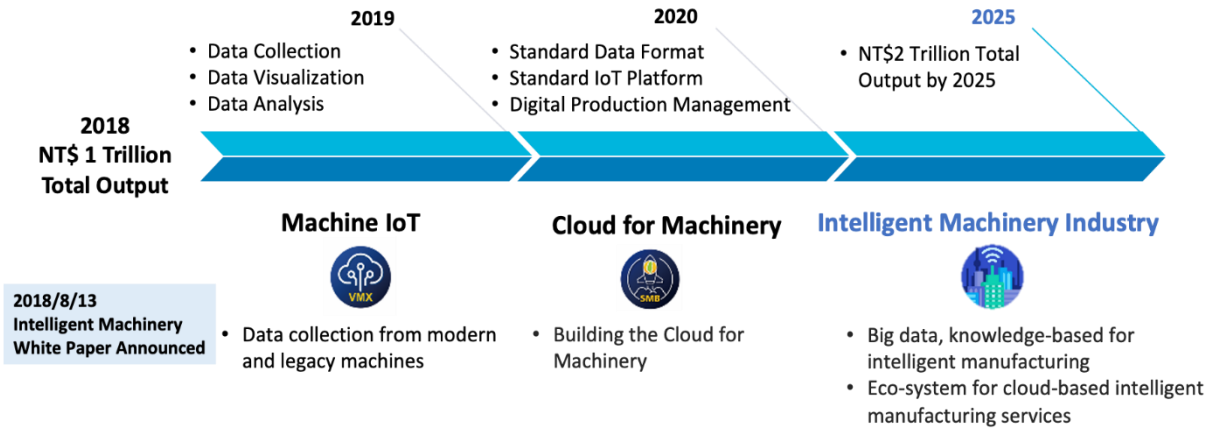


Figure 42 Formation, Implementation and Promotion of the Cloud for Machinery Policy

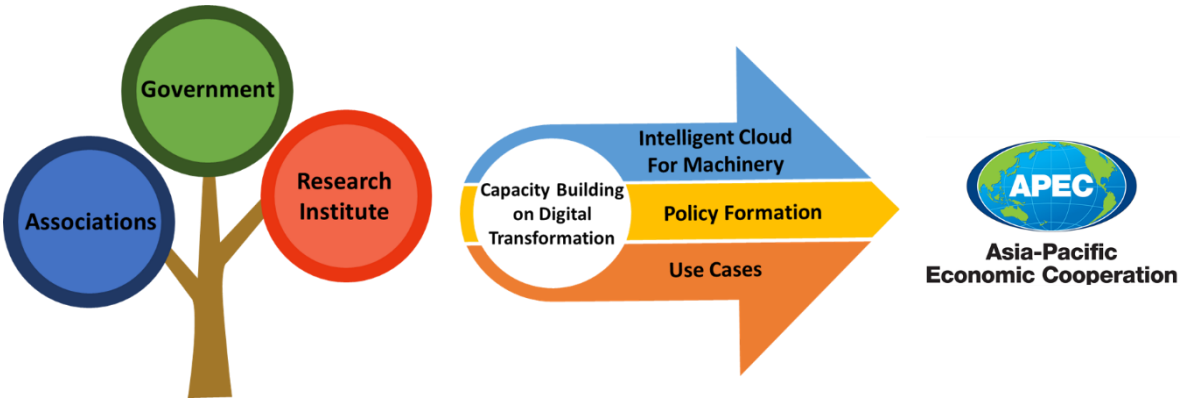


Figure 43 Policy Formation by Government-led R&D in Response to Industry Demands Provided by Associations and Corporate Entities

2. Dr. Hakiem Hsu – Chairman of 3DFamily

- Cluster Effect: The machinery industry in Chinese Taipei benefits from a cluster effect, with major clusters in semiconductors and electronics, machine building, and metal cutting and forming (Figure 44).
- Another big issue in the presentation is the digital and green transformation, or Duo Transformation (Figure 45).

- Digital transformation is to Use IoT to change the value provided to customers, and also change the way of providing value, and become an organization that focuses on customer value and experience and is constantly updated and transformed.
- Green transformation is to use IoT technology to create sustainable industries, transportation and reduce pollution.

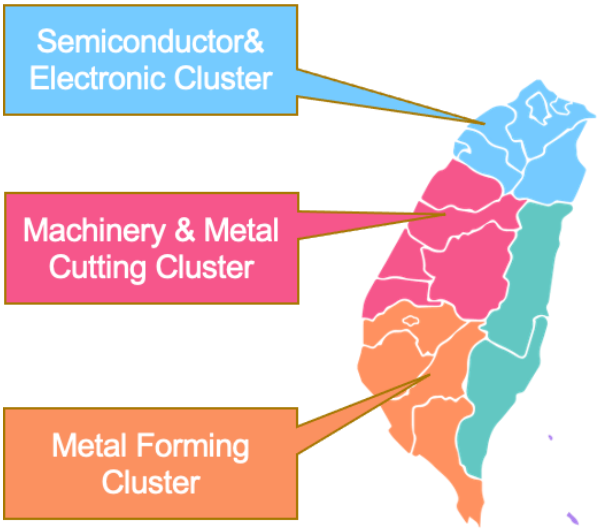


Figure 44 Machinery Clusters in Chinese Taipei

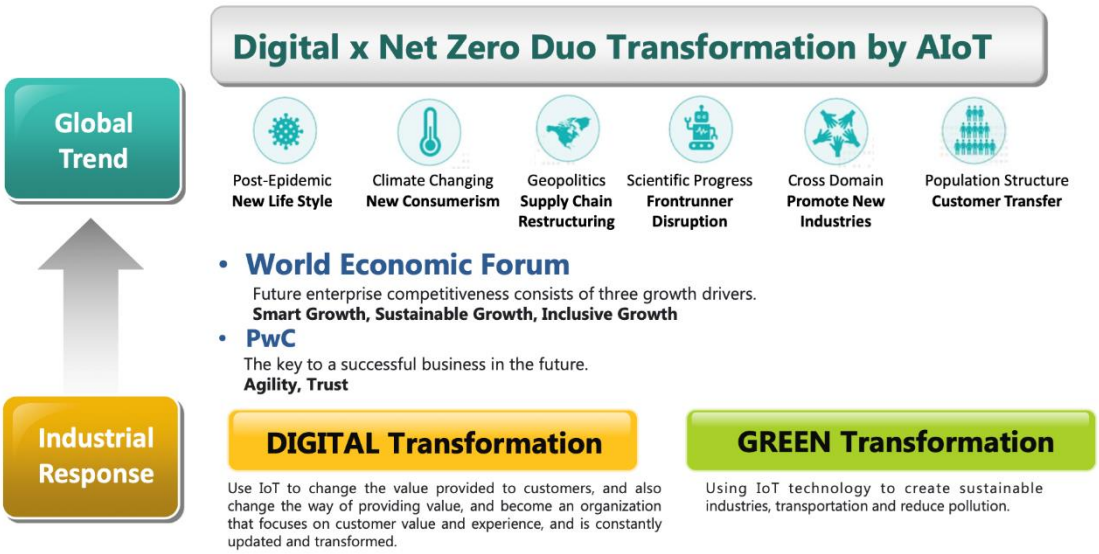


Figure 45 The Digital and Green Transformation

3. Dr. Tzuo-Liang Luo – President of Expetech Co., Ltd.

- Cross-Domain Service Startup: Start-up Company by collaborating with corporates and venture capital, with government support. The cross-domain service start-up (Expetech) specializing in providing one-stop services for global manufacturing automation (Figure 46).
- The startup company will continue to growth by licensing core technology to system integrators to build smart factories for manufacturing industries. System integrators can benefit from this licensing model by collection system service and royalty fee.

- The business mode can be further promoted to encourage the creation of cross-domain startups by providing support and resources, fostering innovation and services in manufacturing automation.

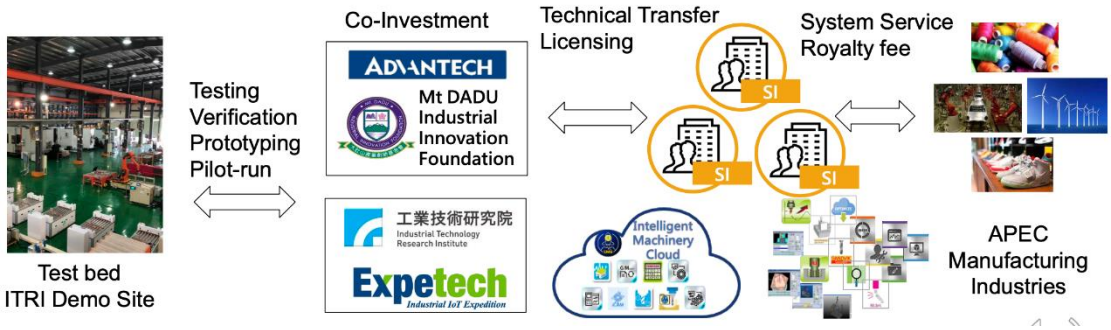


Figure 46 Start-up Company by Collaborating with Corporates and Venture Capital, with government Support

4. Mr. Jakub Tomasek – Engineering Director of Kabam Robotics

- Labour Crunch: Developed economies face a labor crunch, especially for manual work, driven by an aging population and changing career aspirations.
- Empowering Service Workforce: Robotics can empower the service workforce, especially in industries facing a shortage of manpower (Figure 47).
- Support for Cloud-Based Robotics: Encourage the development and adoption of cloud-based robotics to address labor shortages in various industries.

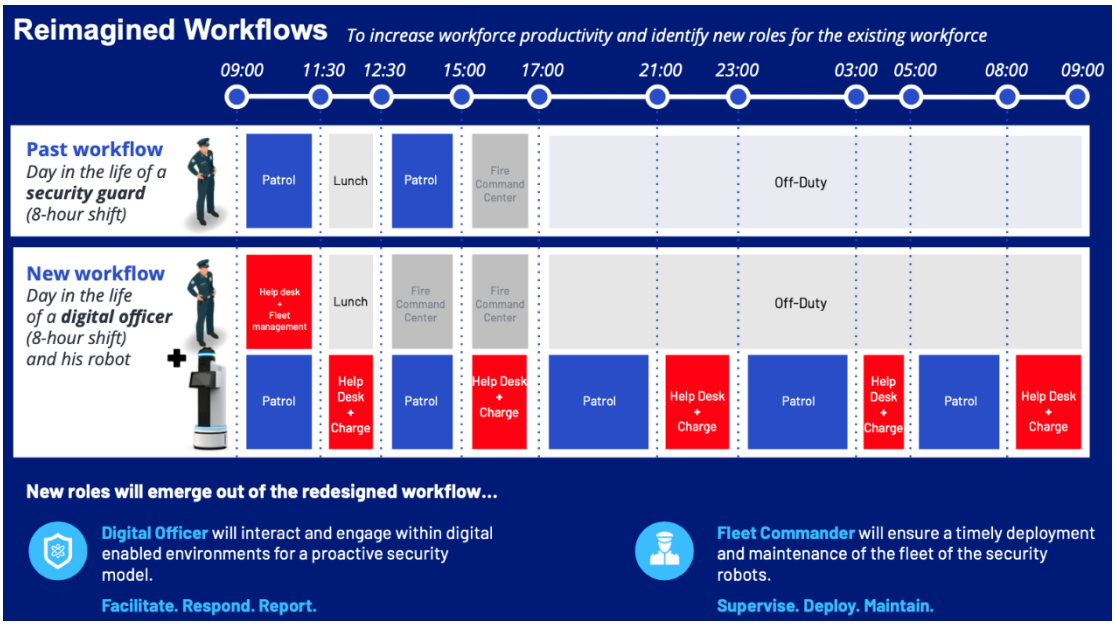


Figure 47 Workflow Changed for a Security Guard by using Cloud-based Robotic Service

5. Mr. Richard Yen – Senior Vice President of Altair Engineering

- Smart Manufacturing: Orchestrating physical and digital processes within factories and supply chains is essential for smart manufacturing.
- Future Trends: Digital twin and AI are future trends that optimize supply and demand requirements (Figure 48).
- Cloud-Based Digital Twins: Altair provides cloud-based digital twin modules (Figure 49) that can serve as building blocks for enterprise solutions. Encourage the adoption of these modules for enhanced manufacturing capabilities.

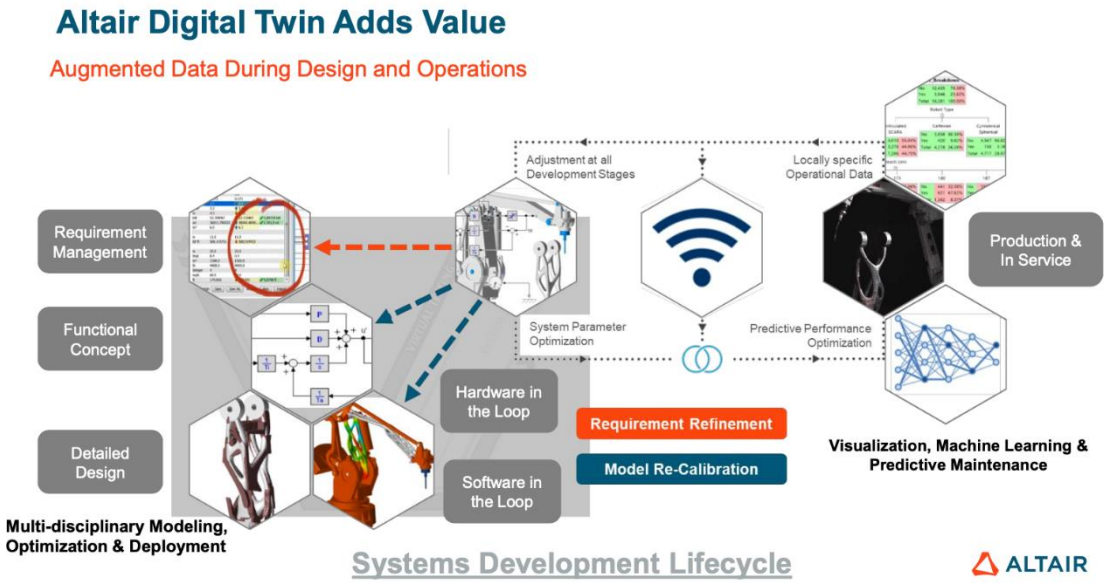


Figure 48 Altair Provides Digital Twin Platform for Various Engineering Domains

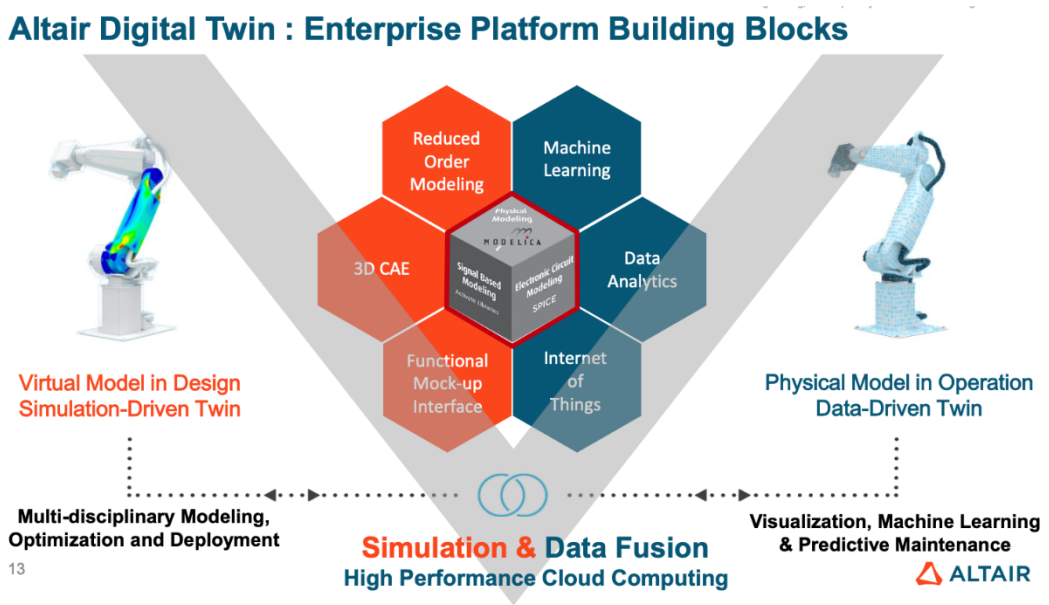


Figure 49 Using Altair Digital Twin modules as Building Blocks of Enterprise Solutions

6. Ms. Deh Hui Chuan – Principal Program Manager, Industry Solution Engineering Group, Asia, Microsoft

- Microsoft's platform, including the metaverse and AI tools, accelerates the adoption of AI technologies (Figure 50).
- Microsoft's Tools for Rapid Adoption: Promote the use of Microsoft's platform tools, such as the metaverse and AI, to facilitate the rapid adoption and experience of the latest AI technologies (Figure 51).
- Digital Transformation in Manufacturing: Digital transformation is a significant trend in manufacturing and leveraging IoT and digital twins is various scenarios (Figure 52).

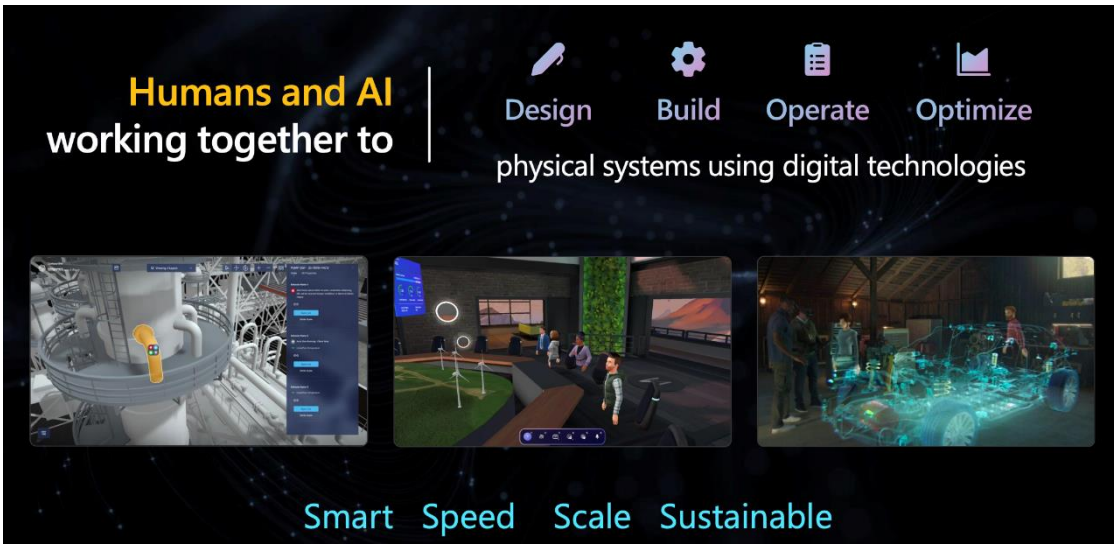


Figure 50 Microsoft Provides Platform to Construct Metaverse where Humans and AI can Work Together

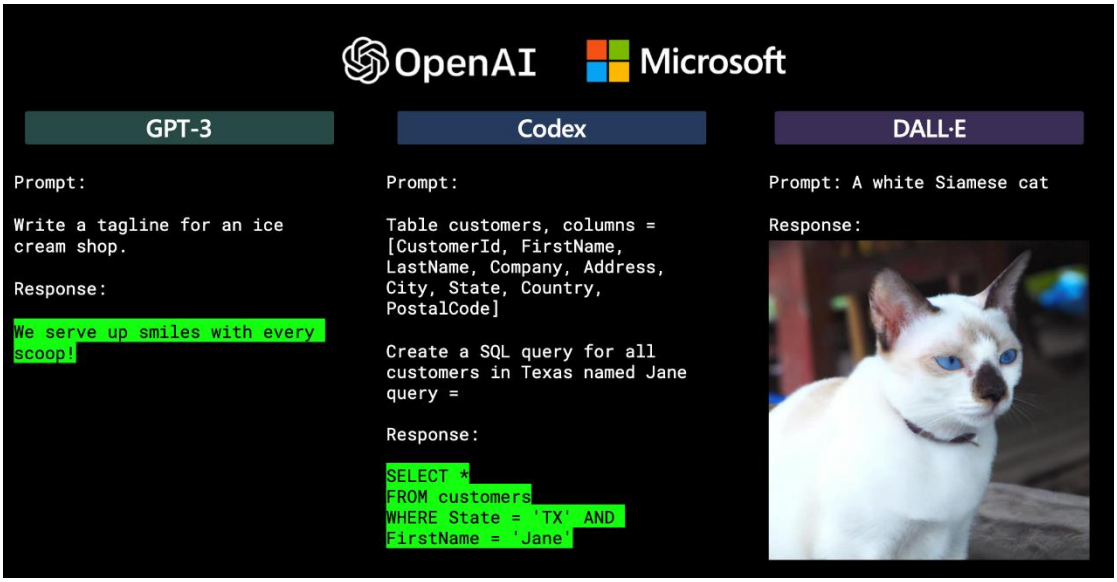


Figure 51 The Latest AI Tools

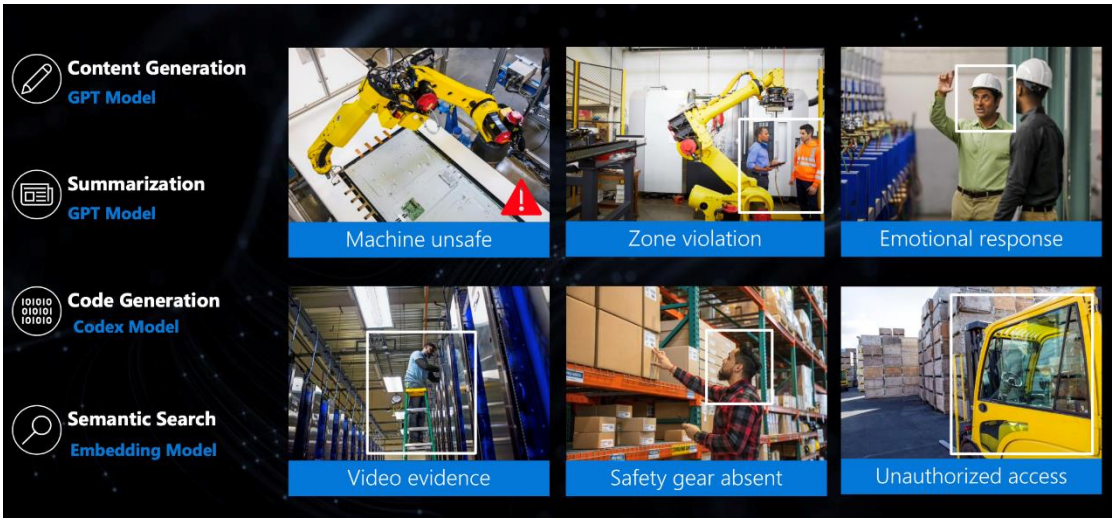


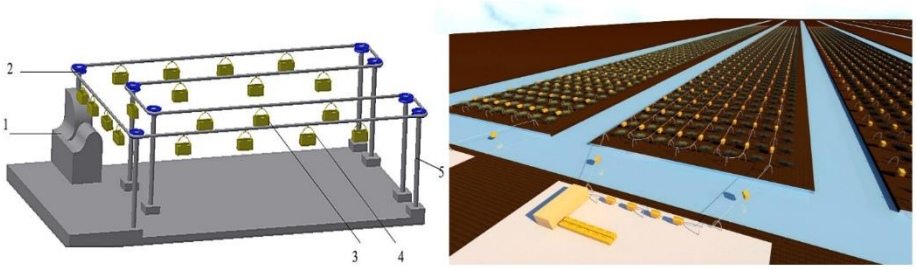
Figure 52 Scenarios of AI in Manufacturing

7. Prof. Nguyen Pham Thuc Anh – Associate Professor of Hanoi University of Science and Technology

- Global Food Shortage: Addressing the global issue of food shortage requires innovations in agriculture.
- Application of Technology in Agriculture: Applying industrial control, image recognition, and other technologies to agriculture automation can significantly improve efficiency, with three development examples (1) Harvesting Pineapples , shown in Figure 53, Figure 54 (2) Transporting Dragon Fruits, shown in Figure 55, Figure 56(3)Automatic Sawing Line shown in Figure 57
- Support for Agricultural Technology: Encourage the application of advanced technologies in agriculture through supportive policies and initiatives.

Figure 53 Example 1: Design and Control a Robotic System for Harvesting Pineapples

Figure 54 The Pineapples Harvesting Robot working in the Field



1- Control Panel;
2-Puli;
3-Cable;
4-Basket ;
5- Support Pillar

The system is moveable, easy to install in a field and move to other field. It can used for 50 hectare field.

Figure 55 Example 2: Design and Control of Automated Transfer Lines for Transporting Dragon Fruits

Figure 56 Transfer Lines for Transporting Dragon Fruits Working in the Field

1- Raw wood log
2- Automated feeding conveyor
3- 3D Laser Scanner
4- Fixing clamp and rotate system
5- Vertical bandsaw station
6- Edging station
7- Wood boars
8 – Pick & place machine
9- Chip and waster removal system
10- Control Cabinet

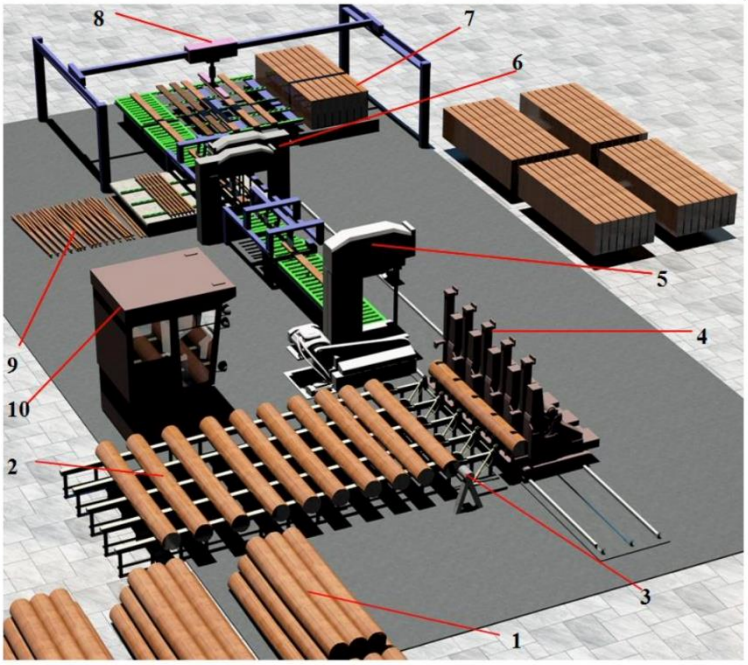


Figure 57 Example 3: Design of Automatic Sawing Line

Panel Discussion: Advancing Cloud-Based Services and Generative AI

Moderator：Dr. Yau-Jr Liu, Vice President of Taipei University of Marine Technology

Panelists：

1. Dr. Hakiem Hsu, Chairman of 3DFamily
2. Mr. Jakub Tomasek, Engineering Director of Kabam Robotics
3. Ms. Deh Hui Chuan, Principal Program Manager, Industry Solution Engineering Group, Asia, Microsoft
4. Prof. Nguyen Pham Thuc Anh, Associate, Professor of Hanoi University of Science and Technology

In the panel discussion, representatives from various sectors provided valuable insights into advancing cloud-based services and generative AI for inclusive and sustainable growth within the APEC region.

Key Discussion Points：

1. Inclusivity through Cloud Services: Cloud-based services were recognized as an inclusive approach to technology adoption, providing affordability and accessibility to both developed and developing economies.
2. Generative AI for Democratization: Generative AI emerged as a tool to lower the technical barriers, democratizing AI development and making it accessible to a broader audience.

3. Education and Skills Development: The importance of raising awareness and providing training in cloud-based services and generative AI was emphasized as a crucial step for inclusive growth.

4. Public-Private Partnerships: Collaboration between the public and private sectors was highlighted as key to success, with governments fostering innovation, and the private sector providing technology and expertise.

5. Agile Mindset：The panel emphasized the significance of an agile mindset, encouraging experimentation and rapid learning from failures.

Lessons Learned and Policy Recommendations：

1. Affordability and Accessibility: Promote the adoption of cloud-based services to ensure affordability and accessibility, especially for small and medium-sized enterprises (SMEs) in the APEC region.

2. Generative AI for Democratization: Encourage the use of generative AI tools to democratize AI development, making it accessible to a broader audience.

3. Education and Skills Development: Collaborate on workshops, training programs, and educational initiatives to ensure citizens in APEC economies have the necessary skills for cloud-based services and generative AI.

4. Public-Private Partnerships: Foster collaboration between the public and private sectors to create a thriving ecosystem for cloud-based services and generative AI.

5. Agile Mindset: Promote an agile mindset, encouraging experimentation with a time-bound approach to accelerate progress in adopting cloud-based services and generative AI.

6. Lessons from the Private Sector: Learn from successful projects in the private sector, including the use of Minimal Viable Experiments (MVEs), engagement with interns, and the development of clear business cases.

Conclusion

Conclusion for the survey result

The survey results provide valuable insights into the challenges, preferences, and priorities within the surveyed group, offering a foundation for strategic decision-making in the context of digital transformation and workplace dynamics.

The survey plays an important role in planning of the agenda of the forum and workshop. For example：

1. “Digital Talent” was the most commonly identified challenge in the survey, therefore the organizing team invited Dr. Yau-Jr Liu, Vice President of Taipei University of Marine Technology as the moderator and speaker. He also provided suggestions on talent cultivation, alumni connection in the panel discussions.
2. The technology considered most crucial to reinforce was "Internet of Things (IoT)”, which also fits well with Dr. Neng-Kai Chang’s presentation “Implementation Achievements of the Intelligent Cloud for Machinery Policies”, in which the standardized IoT hardware and software architecture are the crucial components for the successfulness of the Intelligent Cloud for Machinery developed in Chinese Taipei.
3. Speakers from Microsoft (Ms. Deh Hui Chuan – Principal Program Manager, Industry Solution Engineering Group, Asia) and KABAM Robotics (Mr. Jakub Tomasek – Engineering Director) were invited in response to the highlight on artificial intelligence, data analysis and robotic process automation in the survey.
4. Among the technologies listed, "Cross-Platform and Cross-Cloud Integration" was deemed the most. This could be resolved by the latest and commonly used virtualization and containerization technique and design of application programing interface (API) to decouple interconnections between software modules. This methodology has been widely used in the development team of the Intelligent Cloud for Machinery in Chinese Taipei.
5. Finally, for the diversity and inclusion, the majority of respondents noted that the proportion of female colleagues falls within the range of "20-40%. A significant number of respondents emphasized the importance of "Advocating a friendly work environment and balancing 'Work-Family' life." Additionally, a substantial number highlighted the significance of "Leadership involvement and corporate support" and "Establishing a concrete, transparent, and measurable recruitment and talent retention mechanism."

Conclusion from the forum and workshop

Participants learn how to adapt cloud-based manufacturing solutions and speed up development. For example：

1. Dr. Yau-Jr Liu mentioned in his presentation and panel discussion about interaction between policy makers and industrial associations to come up with a feasible system architecture and business model, linkage between industries and research groups to quickly transform domain expertise to industrial application

2. Presentations from associate representatives (Malaysia, Chinese Taipei; and Viet Nam) showed a big picture that SMEs and MSMEs play important roles in the economy and need support from local governments on talent cultivation, R&D of ready-to-use solutions for design, implementation of an IoT platform to fit relevant industries within economies or region while compatible with existing industrial standards.

3. Interactions, discussions between enterprise, associate representatives during the event and follow-up meetings after the event have triggered opportunities on developing, marketing, and deploying cloud-base manufacturing solutions for global manufacturing industries.

4. Technical presentations from Microsoft and Altair demonstrated tools and solutions for cloud-based software development tools available to speed up development of IoT software, interaction between cloud computing modules as well as metering and billing of usage at end user’s site or production machines.

5. Presentations from industrial representatives (Expetech, KABAM Robotics) on start-up and successful business model may encourage governments to increase resources on policy formation and promotion to enhance best practices and stakeholder networks.