PROCESS CONSTRUCTION AND MAINTENANCE (PCM) | INDUSTRY DIGITAL PLAN

A Guide for Small and Medium Enterprises (SMEs) to Assess Their Digital Readiness and Opportunities to Go Digital

In collaboration with:

Enterprise Singapore

ASPRI Connect · Engage · Grow

In support of:

SG:DIGITAL

Supported by:

SKILLS*future* SG

SCIC SINGAPORE CHEMICAL INDUSTRY COUNCIL

CONTENTS

01 PROCESS CONSTRUCTION AND MAINTENANCE INDUSTRY OVERVIEW

The Process Construction & Maintenance (PCM) industry comprises over 500 companies. Approximately 98% of these are SMEs, and account for more than 30,000 employees. The PCM companies deliver reliable and efficient process construction, maintenance and turnaround services to a range of process plants, which include refineries, petrochemicals, pharmaceutical, water and semiconductor plants. These process plants use specialised equipment and machinery in their production processes. Hence, niche skills and expertise are required in the day-to-day construction and maintenance of the production units.
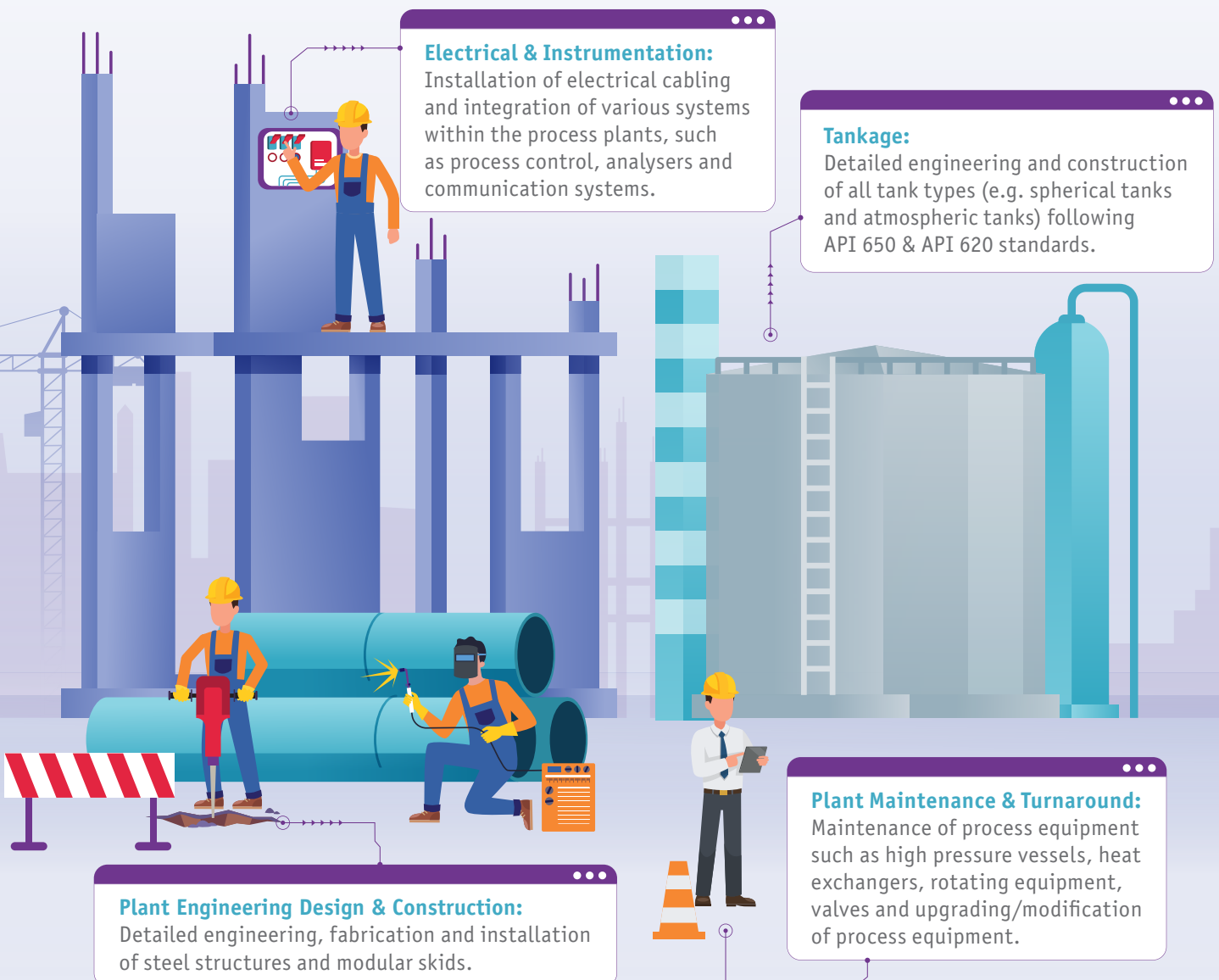
>500 Companies

>30,000 Employees

Key Capabilities of PCM Companies

PCM companies specialise in various engineering services in compliance with the industry's stringent safety standards. Their key capabilities include Electrical & Instrumentation; Tankage; Plant Engineering Design & Construction; and Plant Maintenance & Turnaround.

Electrical & Instrumentation:
Installation of electrical cabling and integration of various systems within the process plants, such as process control, analysers and communication systems.

Tankage:
Detailed engineering and construction of all tank types (e.g. spherical tanks and atmospheric tanks) following API 650 & API 620 standards.

Plant Engineering Design & Construction:
Detailed engineering, fabrication and installation of steel structures and modular skids.

Plant Maintenance & Turnaround:
Maintenance of process equipment such as high pressure vessels, heat exchangers, rotating equipment, valves and upgrading/modification of process equipment.

02 TRENDS IMPACTING THE PROCESS CONSTRUCTION AND MAINTENANCE INDUSTRY

Plant owners move towards smart manufacturing

Technological proliferation (Artificial Intelligence (AI), Robotics, Internet of Things (IoT)) will disrupt traditional business models and accelerate fundamental changes in the sector. Companies will need to develop new capabilities to stay competitive and relevant to their clients.

Increased access to digitalisation

As computing technologies become increasingly accessible and affordable, there are more opportunities to pursue productivity-driven growth and create new business models.

Increased competition for local talent

With the need to reduce manpower reliance for low-skilled jobs, companies need to redesign jobs to provide stronger growth pathways to attract and retain a larger proportion of local talents.

PCM MANAGEMENT COMMITTEE

The PCM Management Committee (PCMMC) was formed in 2015 to improve productivity in the PCM sector and help companies navigate industry trends. The committee consists of stakeholders from major Energy & Chemicals plant owners, PCM companies and relevant government agencies.

The Committee drives initiatives to help transform the industry through skills, technology and data, which are vital in enabling the industry to continue delivering high quality services.

Aligned with the objectives of the PCMMC, the Industry Digital Plan (IDP) will guide PCM companies on suitable digital solutions to meet business needs.

Click here or scan this QR code for more details on PCM Management Committee

03 SMEs GO DIGITAL

The Industry Digital Plan (IDP) is part of the SMEs Go Digital Programme that helps to make going digital simple for SMEs.

IIM INFOCOMM MEDIA DEVELOPMENT AUTHORITY | SMEs GO DIGITAL

3 STEPS TO GO DIGITAL

For more information
Scan the QR code or visit
www.imda.gov.sg/SMEsGoDigital

Support available

- Chief Technology Officer-as-a-Service (CTO-as-a-Service)
- Industry Digital Plans
- Pre-Approved Solutions
- Start Digital
- Grow Digital
- Advanced Digital Solutions
- Government Grants e.g. Productivity Solutions Grant (PSG)

1 Is your business digital-ready?
Find out using the Industry Digital Plan (IDP) for your sector.

2 How do you get started?
Take up pre-approved solutions with grant support.

3 Where can you get help?
Access the CTO-as-a-Service for support.

SMEs Go Digital comprises the following:

CTO-as-a-Service
Assess your digital readiness, explore digital solutions and request for digital advisory and project management services.

INDUSTRY DIGITAL PLANS (IDP)
Step by step guide on digital solutions and training required at each stage of your business growth.

PRE-APPROVED SOLUTIONS
Proven off-the-shelf digital solutions pre-approved by IMDA to meet your business needs. Government grants, e.g. Productivity solutions Grant (PSG), are available for the adoption of these solutions.

START DIGITAL
Foundational digital solutions for new SMEs to get a head start in going digital.

GROW DIGITAL
Leverage Business-to-Business (B2B) and Business-to-Consumer (B2C) e-commerce platforms to go international, without a physical presence overseas.

ADVANCED DIGITAL SOLUTIONS
Advanced and integrated digital solutions to help you strengthen business continuity and build longer term resilience.

04 DIGITAL ROADMAP

As you embark on your digital journey, this Digital Roadmap serves to guide your company through the process.

Stage 01
Getting Ready for the Digital Economy

Streamlined Operations, Enhanced Capabilities

- Digital Wearables* for Workers' Health and Safety
- e-Permit-to-work* (e-PTW)
- e-Procurement
- Field Management
- Inventory (Materials and Equipment) Management
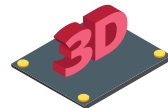- Project Management
- Training Platforms
- Workforce Management

Stage 02
Growing in the Digital Economy

Integrated Systems, Innovative Planning

- 3D Printing for Maintenance
- 3D Visualisation for Project Crafting
- Asset Data and Information Integration
- Equipment Health Monitoring
- Integrated Inspection System
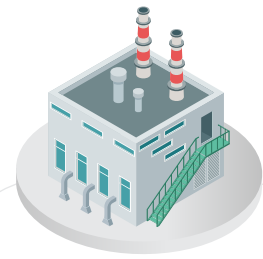
Stage 03
Leaping Ahead

Intelligent Business, Automated Operations
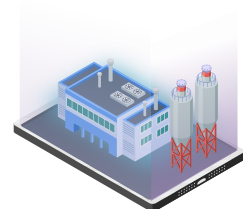
- Predictive Asset Monitoring and Maintenance
- Project Simulations
- Semi-Automated Robotics

Business Capabilities

Accounting Management, Customer Relationship Management, Cybersecurity, Human Resource Management

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* May require close consultation and collaboration with site owners throughout the digital adoption process, e.g. in the refinery operations environment.

Note: This roadmap will be updated over time as digitalisation of the industry progresses and new technologies are introduced to the industry.

GETTING READY FOR THE DIGITAL ECONOMY
Streamlined Operations, Enhanced Capabilities

Streamline and integrate your business operations to enhance productivity.

DIGITAL SOLUTION	DESCRIPTION	BENEFITS
Digital Wearables for Workers' Health and Safety	Track critical health and safety conditions (e.g. human fatigue, heat stress and ergonomic risks) with notification alerts to prevent safety incidents. Access employees' medical history via peer-to-peer (P2P) network for safety purposes. Enable identification of onsite personnel and improve work coordination and communication. Workplace data is captured in real-time and reports about site workers are generated automatically.	• Reduce safety risks through notification alerts to employees and supervisors upon immediate detection. • Disseminate auto-generated, error-free digital reports for convenient sharing and analysis of information. • Improve coordination and communication among site workers using real-time data and reporting.
e-Permit-to-work (e-PTW)	Submit, track and monitor e-PTW applications for high risk activities digitally via a centralised system connecting plant owners and operators. The solution can be integrated with Project Management solutions.	• Enhance productivity by reducing paperwork and waiting time. • Increase accountability and traceability of the e-PTW applications with early detection of potential incompatible permits. • Enable visibility and analysis through dashboards and reports.
e-Procurement	Facilitate and automate sale and purchase of supplies, work and services through a B2B platform. Consolidate components of supply management (e.g. materials, equipment and supplies) on a centralised platform with integration to sales and contract management (e.g. purchase orders, e-invoicing and e-payment).	• Increase productivity by reducing manual searches and processing of orders, enabling employees to focus on higher value work (e.g. strategic sourcing). • Improve budgeting process and monitor operational expenditure. • Reduce processing time and errors in the procurement process.

GETTING READY FOR THE DIGITAL ECONOMY
Streamlined Operations, Enhanced Capabilities

Streamline and integrate your business operations to enhance productivity.
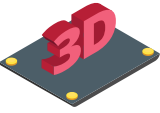
DIGITAL SOLUTION	DESCRIPTION	BENEFITS
Field Management	Digitalise field operations and processes by integrating modules, such as quality management, maintenance tracking, workforce planning, worker safety and health, and activity management into a single platform. The solution can be integrated with other solutions, such as Project Management solutions.	• Improve the overall visibility and management of field operations and its related activities, including worker safety and health, on a consolidated platform. • Allow stakeholders such as plant owners to be involved in the quality management process.
Inventory (Materials & Equipment) Management	Monitor usage and movement of materials and equipment across the supply chain. Manage the supply and demand to achieve Just-in-Time (JIT) production. This solution can be integrated with other solutions, such as Project Management solutions.	• Optimise material inventory levels and the usage of equipment with tracking and monitoring tools. • Reduce costs by minimising wastage, ad-hoc rental or capital expenses. • Reduce risks of onsite accidents and ensure compliance with workplace safety standards via early notifications of potential equipment faults. • Manage inventory with buffer stock to mitigate supply chain disruptions.
Project Management	Facilitate end-to-end project management and coordination with stakeholders, track budgets with real-time dashboard and reporting, thereby enabling timely decision-making. The solution is interoperable with other solutions such as e-Procurement, Materials and Equipment Management solutions.	• Improve productivity with real-time visibility of projects and workflows. • Increase efficiency with streamlined project scheduling, tracking and improved communication with clients. • Improve cost management with budgeting tools. • Ensure consistency and quality across projects through standardised processes.

GETTING READY FOR THE DIGITAL ECONOMY
Streamlined Operations, Enhanced Capabilities

Streamline and integrate your business operations to enhance productivity.

DIGITAL SOLUTION	DESCRIPTION	BENEFITS
Training Platforms	Customise employees' learning experiences by allowing them to access training courses at their convenience. Allow employers to track employees' training and certification progress. The solution is interoperable with other solutions such as Workforce Management solutions.	• Enhance learning experience and enable employers to track employees' learning progress. • Easy access to training content. • Promote self-learning and skills upgrading.
Workforce Management	Consolidate workforce management functions including recruitment, employee onboarding, staff rescheduling, recording of attendance and shifts, leave management, performance appraisal and payroll, in compliance with CPF and IR8A. The solution is interoperable with other solutions such as Project Management solutions.	• Reduce operation costs by automating the administrative process. • Increase productivity by reducing manual paperwork that is error-prone and improving workforce planning and scheduling. • Generate insights to enhance employees' performance with better engagement, training and coaching programmes.

GROWING IN THE DIGITAL ECONOMY
Integrated Assets, Innovative Planning

Connect digitally and innovatively to enhance business capabilities and sustain growth.

DIGITAL SOLUTION	DESCRIPTION	BENEFITS
3D Printing for Maintenance	Work in tandem with 3D laser scanning, Integrated Inspection System and Equipment Health Monitoring. It enables the identification and replacement of worn out parts/fittings with 3D printed parts. *Note: May involve metal fusion 3D printing*	• Enhance maintenance of facilities and equipment by using additive technology to produce replacement parts. • By having the replacement parts readily available, this enables faster turnaround and reduces equipment downtime.
3D Visualisation for Project Crafting	Enable 3D visualisation of projects through the usage of surface modelling software. The software visualises 3D models based on image references of the location provided. 3D visualisations aid planning and early detection of potential faults and errors. The software displays scheduled maintenance sessions in an easy-to-understand, fully interactive platform.	• Intuitive identification of potential faults to enable early-stage corrections, which saves time and cost. • Reduce human errors and increase productivity of site workers by having accurate measurements and dimensions on hand.
Asset Data and Information Integration	Identify and extract asset tag data automatically from drawings and documents, integrating all available information on an easy-to-navigate user interface. Complement other solutions and workflows to provide accurate asset and engineering information.	• Improve productivity with access to consolidated facility information through a unified data platform. • Save time with faster retrieval of asset information. • Improve quality of facility information, reduce risks and enhance safety standards and compliance.

GROWING IN THE DIGITAL ECONOMY
Integrated Assets, Innovative Planning

Connect digitally and innovatively to enhance business capabilities and sustain growth.

DIGITAL SOLUTION	DESCRIPTION	BENEFITS
Equipment Health Monitoring	Monitor and collect data on equipment status. This enables businesses to optimise the use of their equipment, and track scheduled asset maintenance. In addition, the tool can be used as a hardware product to aid the visualisation on the operating parameters of the machine with built-in functions for overload protection (i.e. a circuit breaker).	• Lower maintenance costs. • Extend equipment lifespan.
Integrated Inspection System	An all-in-one dashboard that integrates onsite monitoring tools, such as sensors and cameras, to provide data and images for inspectors to conduct remote inspections. Plant owners can adopt this solution to monitor onsite plant activities, or for maintenance purposes.	• Increase efficiency and reduce cost by reducing the need for physical onsite manpower and commutes. • Enable concurrent work on multiple maintenance plans regardless of plant locations. • Faster turnaround for inspections. • Improve employees' health and safety with early identification of worksite hazards.

STAGE 03

LEAPING AHEAD
Intelligent Business, Automated Operations

Automate and implement advanced technologies to support smart manufacturing.

DIGITAL SOLUTION	DESCRIPTION	BENEFITS
Predictive Asset Monitoring and Maintenance	Track and forecast overall performance of equipment. Using predictive analytics and monitoring systems, businesses can minimise operation lapses, machine defects and failures, and reduce energy costs. The solution can be integrated with IoT (Internet of Things) and AI (Artificial Intelligence) solutions to enhance its predictive capabilities to optimise equipment health and performance.	• Reduce time spent on equipment maintenance. • Reduce asset downtime and maintenance costs. • Enable strategic and pre-emptive maintenance and reduce the need to stock additional spare parts.
Project Simulations	This solution integrates project information with 3D visualisations, enabling users to view simulations of the project, onsite activities and hypothetical scenarios to pre-empt potential problems. The solution simulates loading and unloading operations, and equipment handling and movement during the construction process.	• Minimise project risks and accelerate completion time. • Enhance planning for a safer worksite. • Improve employees' problem-solving skills
Semi-Automated Robotics	Augment and support manual efforts on typically strenuous and repetitive tasks (e.g. blasting and painting, cleaning, disinfecting and lifting).	• Increase efficiency by reducing repetitive and laborious tasks, enabling employees to focus on higher value tasks. • Reduce risk of workplace accidents (e.g. fall from height) and occupational illnesses (e.g. work-related musculoskeletal disorders).

05 DIGITAL SKILLS NEEDED

Digital skills are required for all PCM job roles, albeit to varying levels of proficiency. It is crucial to upskill your employees to harness the potential of digital technologies, and in turn remain competitive and relevant.

ALL USERS
Require broad-based digital literacy and awareness

"Tech Basics" Skills

Broad-based innovation mindset and digital literacy/awareness

SkillsFuture Singapore (SSG) funded broad-based courses – e.g. SkillsFuture for Digital Workplace

Solution-specific user level digital skills

Vendor solution-specific training

ADVANCED USERS
Require higher proficiency digital skills

"Tech Advanced" Skills

Higher proficiency level digital skills

Training mapped to the Skills Framework for Energy & Chemicals and Information and Communication Technology (ICT)

Site Worker
The Site Worker executes worksite activities as scheduled by the Resource Coordinator and reports to the Site Supervisor.

Safety Supervisor
The Safety Supervisor ensures Site Workers comply to the worksite's Health, Safety and Environmental standards.

Resource Coordinator
The Resource Coordinator schedules work activities according to the contracts established with the Plant Owners and ensures that resources (manpower, materials and time) are allocated efficiently.

Discipline Engineer
Each Discipline Engineer specialises in a single engineering background (Chemical, Mechanical, Civil & Structural, Electrical & Instrument engineering), and develops technical drawings and documents for implementation by Site Supervisors and Site Workers.

Site Supervisor
The Site Supervisor oversees the work activities performed by the Site Workers and ensures their tasks are completed according to the workplan and schedule.

Project Manager
The Project Manager ensures employees' worksite safety, and delivers high-quality projects within the timeline and budget to the Plant Owner.

05 DIGITAL SKILLS NEEDED: DIGITAL ROADMAP ON TRAINING

This training roadmap serves as a guide to prepare companies' workforce to adopt digital solutions at each of the three stages of growth.

	STAGE 01 Getting Ready for the Digital Economy	STAGE 02 Growing in the Digital Economy	STAGE 03 Leaping Ahead
"TECH BASICS" All employees in the industry	• Project Management Professional Training • SkillsFuture for Digital Workplace (SFDW) • Mindset Transformation for the Workplace • Basic Digital Confidence	• Fundamental Data Analysis using Excel 2016 • Introduction to Data Analytics and Applications • Data Analysis using Python • Data Analytics Using R • Robotic Process Automation • Intermediate Robotic Process Automation • Robotic Process Automation Implementer • Strategies for Effective Data and Information Management • Fundamentals of Data Architecture, Governance and Strategy • SolidWorks – 3D Modelling and Drawing • AutoCAD 2018 Basics (2D & 3D) • Business Needs Analysis – a Data-Driven Approach • Introduction to Data Engineering	• Autonomous Mobile Robots (AMR) Implementation and Applications • Application of Robotics • Autonomous Robots and Computer Vision • Technology and Applications of Digital Transformation and Robotics • AI E-Enabled Robotics for Beginners • Introduction to Predictive Analytics for Maintenance
	Vendor Solution-Specific Training		
"TECH ADVANCED" Employees that use or are exploring advanced tech in their work / organisation	• Introduction to Predictive Analytics for Maintenance	• Appreciation of IoT and Data Management • Collaborative Robot Cell Integrated with Vision for Shop Floor Applications • Industrial Robotised Polishing • Data Engineering for Effective Data Analytics	• Introduction to AI and Machine Learning • Analytics and Computational Modelling
	Training programmes are aligned to Skills Framework and emerging areas under SkillsFuture Series		

Course directory: https://www.sp.edu.sg/pace/courses/course-type/short-modular

06 GET STARTED TODAY

You will be supported at every stage of your digital journey, through three simple steps:
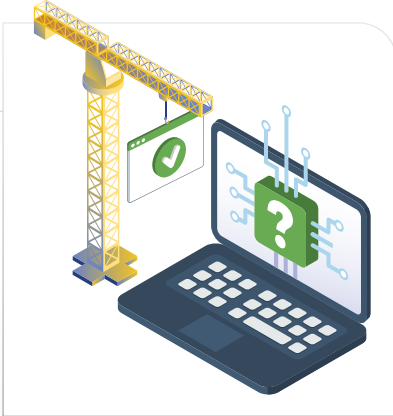
1 Is your business digital-ready?
Find out using the Industry Digital Plan (IDP) for your sector.

- Find out if you are digital-ready by using the IDP resources here or scan the QR code.

Process Construction and Maintenance IDP

2 How do you get started?
Take up pre-approved solutions with grant support.

- Tap on CTO-as-a-Service to complete your Digital Readiness Self-Check in the web app and select from the recommended digital solutions that best meet your business needs.

- Visit GoBusiness Gov Assist to search for digital solutions and solution providers. If funding support is required, apply for the Productivity Solutions Grant (PSG) on the Business Grants Portal, before purchasing and implementing the digital solutions.

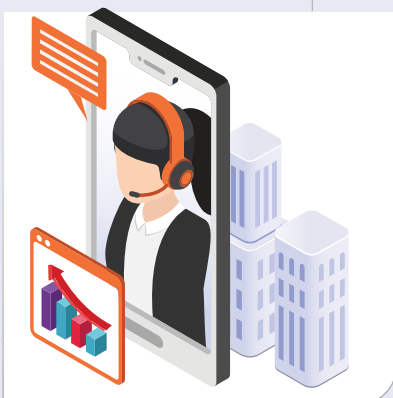- You can also apply for training subsidies under the SkillsFuture Enterprise Credit (SFEC).

CTO-as-a-Service

GoBusiness Gov Assist

SFEC

3 Where can you get help?
Contact your nearest SME Centre for support.

- Tap on CTO-as-a-Service for digital consultancy and project management services.

- Visit SME Centre if you require business advisory.

SME Centre

07 ADDITIONAL INFORMATION

FOR SMALL AND MEDIUM ENTERPRISES (SMES)

Digital Consultancy and Solutions

CTO-as-a-Service
go.gov.sg/CTOaaS

SMEs Go Digital
https://imda.gov.sg/SMEsGoDigital

GoBusiness Gov Assist
https://govassist.gobusiness.gov.sg/productivity-solutions-grant/

Be Safe Online
https://www.csa.gov.sg/~/media/csa/documents /publications/be_safe_online/be_safe_online_ handbook.pdf

Business Advisory

SME Centres managed by Trade Associations:
• SME Centre@ASME
• SME Centre@SCCCI
• SME Centre@SICCI
• SME Centre@SMCCI
• SME Centre@SMF

www.enterprisesg.gov.sg/smecentre

Enterprise Infoline: +65 6898 1800

FOR INDIVIDUALS

Capability Upgrading and Career Facilitation

SkillsFuture Credit
https://www.skillsfuture.gov.sg/credit

SkillsFuture for Digital Workplace
https://www.skillsfuture.gov.sg/digitalworkplace

Skills Framework
https://www.skillsfuture.gov.sg/skills-framework

TechSkills Accelerator (TeSA)
https://www.go.gov.sg/TeSA

WSG's Careers Connect
https://www.wsg.gov.sg/career-services.html

WSG's Professional Conversion Programme
https://www.wsg.gov.sg/programmes-and-initiatives/professional-conversion-programmes-individuals.html

WSG's Industry 4.0 Human Capital Initiative (IHCI)
https://www.wsg.gov.sg/programmes-and-initiatives/industry-4-0-human-capital-initiative-ihci.html

e2i Meet a Career Coach
https://e2i.com.sg/app

FOR ICM VENDORS

Vendors Self-Assessment Checklist
https://imda.gov.sg/icmvendors

This Industry Digital Plan is part of the SMEs Go Digital programme.
For programme information and feedback: https://imda.gov.sg/SMEsGoDigital

#SGDIGITAL

Singapore Digital (SG:D) is a nation-wide movement to unify Singapore's digitalisation efforts. Whether it is help for different industries to start their digitalisation journeys, or creating new ecosystems, opportunities and capabilities for the future, SG:D is set to take us ahead as a leading digital global node. The :D smiley face icon in the logo signifies the optimism of Singaporeans advancing together with digital innovation. As we progress into the digital economy, it is all about the people – the heart of all we do.

imda.gov.sg/sgdigital
enterprisesg.gov.sg

facebook.com/IMDAsg
facebook.com/enterprisesg

twitter.com/IMDAsg

youtube.com/IMDAsg
youtube.com/enterprisesingapore

instagram.com/imdasg

linkedin.com/company/IMDAsg
linkedin.com/company/enterprisesg

t.me/SMEsGoDigital

Enterprise Singapore

INFOCOMM MEDIA DEVELOPMENT AUTHORITY