# CONSTRUCTION AND FACILITIES MANAGEMENT

## INDUSTRY DIGITAL PLAN

A guide for enterprises to assess their digital readiness and opportunities to go digital, and acquire solutions to be able to plug into Integrated Digital Delivery (IDD).

An initiative by:

SG:D EMPOWERING POSSIBILITIES

IIM INFOCOMM MEDIA DEVELOPMENT AUTHORITY

Sector lead:

Building and Construction Authority

Supported by:

SKILLSfuture SG

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# 01 OUR CONSTRUCTION AND FACILITIES MANAGEMENT SECTOR

The Construction and Facilities Management Sector is an important pillar of Singapore's economy, building safe, sustainable and progressive environments for living, work and play; and contributing to a better quality of life for Singaporeans.

**Architecture**

**Construction Management**

**Digital Delivery Management (upcoming)**

**Engineering**

**Facility Management**

**16,000** Firms

**3%** GDP contribution

**Quantity Surveying**

**Project Management**

**Production Management (upcoming)**
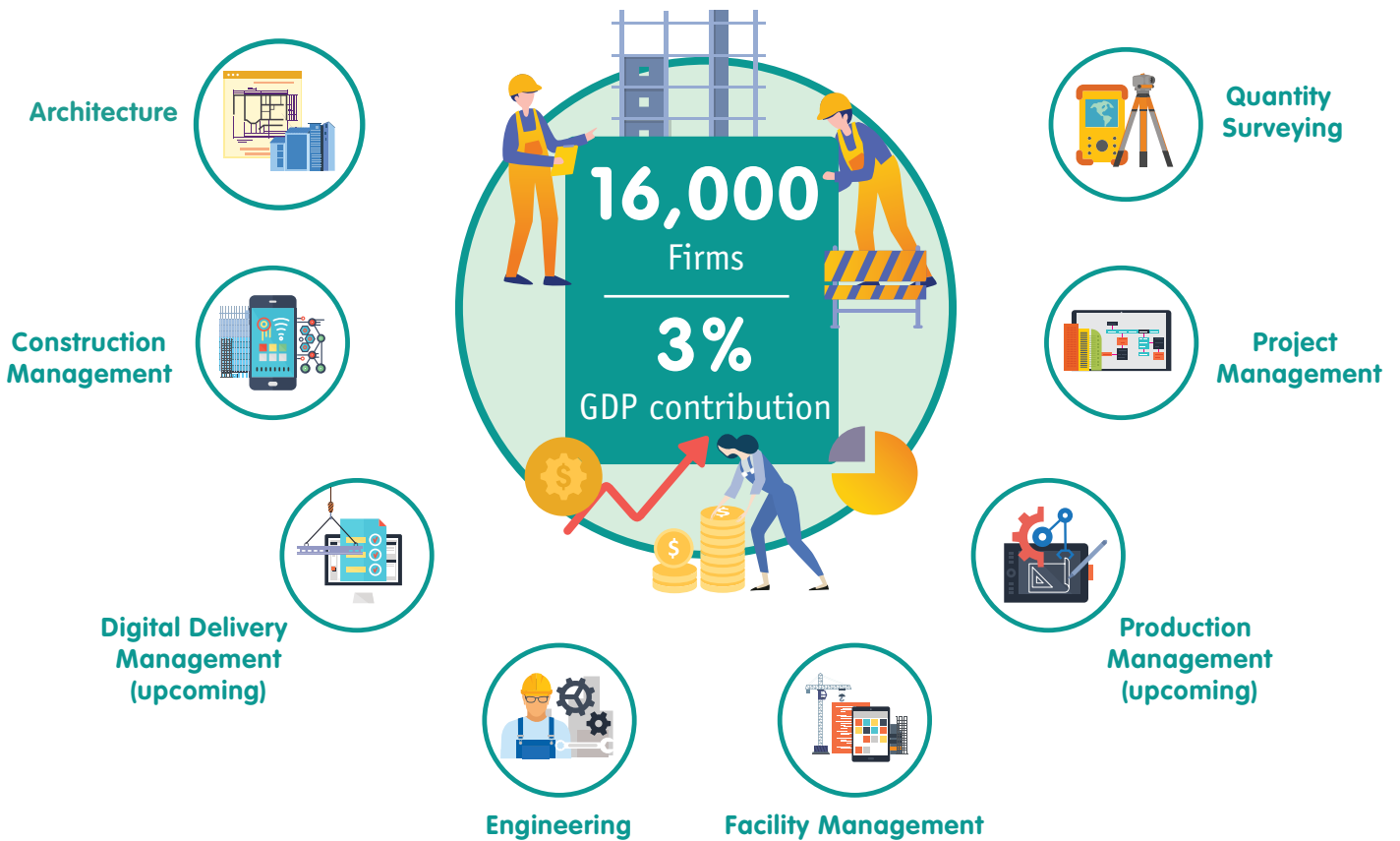
## THE BUILDING AND CONSTRUCTION LIFE-CYCLE

Streamlining work processes and connecting stakeholders through digital data, innovation and technology across the whole project life cycle from design, fabrication, construction to facilities management to deliver a better outcome for end users.
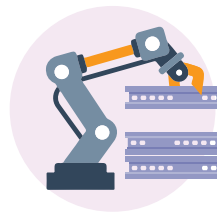
**Digital Design**
Engaging stakeholders to achieve optimised and coordinated design that meets client's, regulatory and downstream requirements.

**Digital Fabrication**
Translating design to standardised components for automating off-site production.

**Digital Asset Delivery & Management**
Real time monitoring for operations and maintenance to enhance asset values.

**Digital Construction**
Just-in-time delivery, installation and monitoring of on-site activities to maximise productivity and minimise rework.

Source: Building and Construction Authority (BCA), Singapore Department of Statistics 2018

### Increasing gap in digital skills and capabilities

prevailing among the various stakeholders in the labor intensive construction ecosystem, causing delays & abortive works.

### Low degree of collaboration and alignment of construction information

among the various stakeholders through the different stages of project implementation.

### Lack of shared platforms and standards

to fully integrate various parties involved in building projects, resulting in most work done on site.

## INDUSTRY TRANSFORMATION MAP

The Construction Industry Transformation Map (ITM) launched in 2017 envisions creating an advanced and integrated sector with widespread adoption of leading technologies, led by progressive and collaborative firms well-poised to capture business opportunities, and supported by a skilled and competent workforce offering good jobs for Singaporeans.

To achieve this vision, the key strategies are to:
(i)   increase adoption of Design for Manufacturing and Assembly (DfMA) and Integrated Digital Delivery (IDD);
(ii)  build progressive and collaborative firms; and
(iii) support workforce needs and aspirations.

Click here or scan this QR code for more details on the Construction ITM

Source: Construction Industry Transformation Map (ITM)

Aligned to the Industry Transformation Map (ITM), the Industry Digital Plan (IDP) is part of the SMEs Go Digital Programme that helps to make going digital simple for SMEs.

## SG:D | SMEs GO DIGITAL

# 3 STEPS TO GO DIGITAL

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

### Support available

- Consultancy Services (SME Digital Tech Hub)
- Government Grants (e.g. Productivity Solutions Grant - PSG)
- Project Management Services
- Pre-Approved Solutions
- Start Digital Pack

**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?**
Contact the nearest SME Centre for support.

## SMEs Go Digital comprises the following:

### Industry Digital Plan (IDP)
Guide on digital solutions and training required for each stage of your business growth.

### Pre-Approved Solutions
Proven SME-friendly digital solutions pre-approved by IMDA to meet your business needs. Government grants such as Productivity Solutions Grant (PSG) are available for the adoption of these solutions.

### Start Digital
Initiative to help you start digital early with foundational digital solutions for new SMEs.
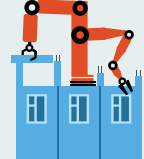
### Consultancy Services (SME Digital Tech Hub)
Expert advice you can tap on to transform your business with digital technologies.

### Project Management Services
Project managers with expertise to support you in implementing the digital solutions.

# 04 DIGITAL ROADMAP

This digital roadmap serves as a guide for you to follow on your digital journey.

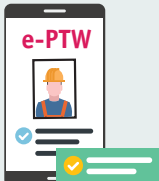| STAGE 01 | STAGE 02 | STAGE 03 |
|---|---|---|
| **GETTING DIGITAL ECONOMY READY** Uplifted Digital Capabilities, Optimised Operations | **GROWING IN THE DIGITAL ECONOMY** Integrated Ecosystem, Streamlined Processes | **LEAPING AHEAD** Intelligent Business, Autonomous Operations |
| 3D Modeling, Immersive Visualisation and Analysis | Integrated and Smart worksite Monitoring and Inspection | Data and AI-driven Decision Support System |
| Digital Wearables for Workers' Health and Safety | Coordinated Regulatory Approvals and Rule-based Model Checker | Blockchain for Progress Verification |
| Quantity Surveying and Valuation | Computational Design | Robotics for Autonomous Construction and Facilities Management |
| BIM to Field (Hardware/Software) | Built Environment Digital Platform | Intelligent National Productivity and Quality Specification (iNPQS) |
| Site/Yard Management | BIM for Asset Delivery/ Facilities Management | |
| e-Permit-to-work (e-PTW) | | |
| FM Workflow Automation (e.g. Smart Access, Energy Management and Smart Metering, Mobile Inspection, Digital Signage) | | |
| Coordination Tools and Collaboration Platform | | |

## BUSINESS CAPABILITIES

Accounting Management, Human Resource Management, Customer Relationship Management, Sales Management, Inventory Management, Fleet Management, Cybersecurity

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

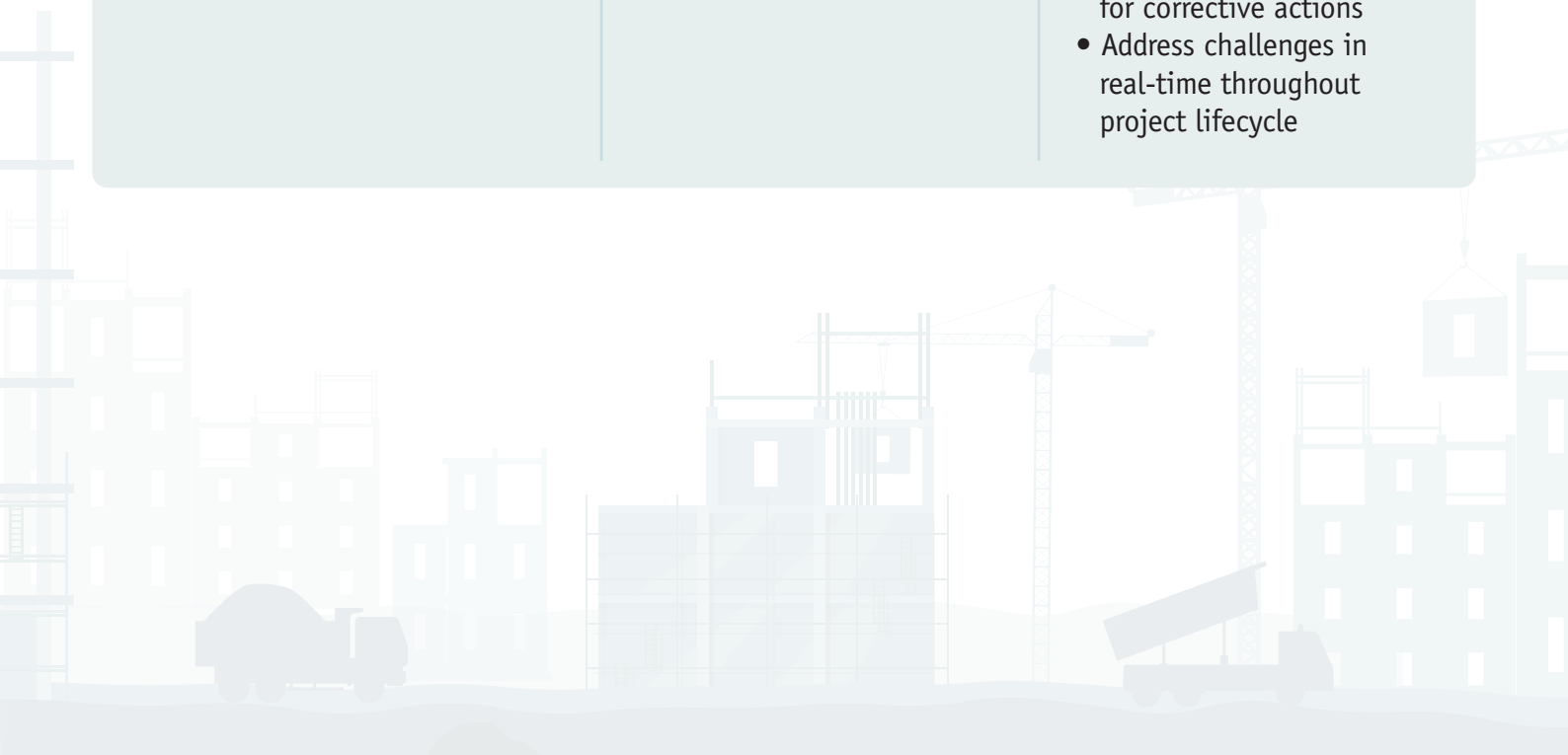Build core digital competencies and acquire digital solutions.

| SOLUTION CATEGORY | DESCRIPTION | BENEFITS |
|---|---|---|
| 3D Modeling, Immersive Visualisation and Analysis | Create 2D/3D models from initial concept to final documentation for construction.<br><br>Render cinematic-quality models for architectural visualization.<br><br>Design sustainable and efficient buildings with advanced simulation engines and insights on building performance. | • Enable effective presentation of projects to clients by communicating project benefits through 3D photo-realistic visualisation<br>• Save documentation time and efforts involved in design stage<br>• Speed up design process and contribute to minimising waste from early stage<br>• Provide actionable insights through early diagnosis at design stage |
| Digital Wearables for Workers' Health and Safety | Track critical health and safety information such as human fatigue and stress, heat stress, ergonomics risks and alert affected party accordingly to avoid safety incidents. | • Address safety issues in the workplace and health condition of the workers that may impact safety<br>• Track data and remind workers and supervisors through audio and visual alerts |
| Quantity Surveying and Valuation | Automate take-off based on BIM for accurate quantity and cost estimation. | • Provide fast, effective and efficient quantity take-off and cost estimation<br>• Produce reliable quantities and competitive cost estimates<br>• Improve cost database management to reduce information loss |

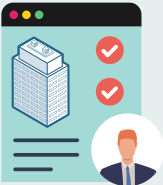Build core digital competencies and acquire digital solutions.

| SOLUTION CATEGORY | DESCRIPTION | BENEFITS |
|---|---|---|
| BIM to Field (Hardware/Software) | Perform reality captures to accurately record site information for better area visualization, and to auto-assemble point cloud for integration with Building Information Modelling (BIM) model. | • Provide better area visualization, informed decisions are made before work starts on site. |
| Site/Yard Management | Plan and manage site activities using BIM model and digital layouts.<br><br>Manage material and equipment on construction sites and monitor the production quality and progress. | • Reduce paperwork on-site and during project operations<br>• Boost productivity and streamline site processes |
| e-Permit-to-work (e-PTW) | Submit, track and monitor Permit to Work applications (PTW) for high risk activities digitally via a centralized system | • Enhance productivity through reduced paperwork and waiting time<br>• Increase accountability by tracking approval of PTW in real-time<br>• Increase ease of access and visibility of permits through automatic generation of dashboards and reporting<br>• Detect potential incompatible works better |

Build core digital competencies and acquire digital solutions.

| SOLUTION CATEGORY | DESCRIPTION | BENEFITS |
|---|---|---|
| **FM Workflow Automation** (e.g. Smart Access, Energy Management and Smart Metering, Mobile Inspection, Digital Signage) | Automate the creation, tracking, logging and/or closing of incidents upon triggers by sensors/humans; to provide for reporting, document management, tracking of energy consumption, and resource management; and to provide display of real-time content. | • Reduce turnaround time with streamlined workflow process<br>• Automate incident reporting and track with single point operator |
| **Coordination Tools and Collaboration Platform** | Enable different construction disciplines (Architects, Engineers, Contractors etc.) to collaborate on the same BIM project, across the design, construction and operation phases. | • Reduce reworks and improve productivity<br>• Reduce conflicts and changes during construction<br>• Reduce risks of using outdated information<br>• Track issues and allows project members to communicate accountability for corrective actions<br>• Address challenges in real-time throughout project lifecycle |

Integrate and streamline key processes along the value chain.

| SOLUTION CATEGORY | DESCRIPTION | BENEFITS |
|---|---|---|
| Integrated and Smart worksite Monitoring & Inspection | Provide real-time digital monitoring and insights to project health in a connected digital environment for various site solutions and technologies.<br><br>Monitor onsite activities such as through sensors and video analytics to provide alerts to potential safety and health risks including those posed by vehicles/machines, fatigue, noise, dust, heat, working at height. | • Centralise site data, progress, and inspections<br>• Analyze data and create dashboards to drive decision making<br>• Provide real-time identification of worksite hazards<br>• Improve safety and health of workers |
| Coordinated Regulatory Approvals and Rule-based Model Checker | Verify model quality and code compliance via an automated model checker prior to coordinated submission for regulatory approval. | • Improve design and BIM quality through automated checking<br>• Streamline regulatory submission and approval process |
| Computational Design | Explore creative and alternative design scenarios, and automate the adaptation of building configuration changes through parametric design, relationship modelling, and computing logic. | • Explore more design choices leading to desired solutions for productivity gains<br>• Automate repetitive tasks to speed up design process |

# GETTING DIGITAL ECONOMY READY

**Integrated Ecosystem, Streamlined Processes**

Integrate and streamline key processes along the value chain.

| SOLUTION CATEGORY | DESCRIPTION | BENEFITS |
|---|---|---|
| Built Environment Digital Platform | Facilitate data sharing in different format among project partners over the project life-cycle to coordinate their work activities, monitor issue resolutions and smoothen project delivery. It also allows projects to access to an ecosystem of suppliers to source for the right materials. | • Access to timely information<br>• Resolve errors in a timely manner<br>• Reduce reworks and delays<br>• Source from wider range of materials<br>• Improve overall project performance. |
| BIM for Asset Delivery / Facilities Management | Manage defect resolution during handover and maintenance, and support building operation and maintenance operations. | • Systematise manual inspection of assets and facilities through automation, resulting in more reliable inspection reports<br>• Provide capabilities for preventive maintenance |

Enable forward-thinking LLEs and their key SMEs partners to venture overseas.

| SOLUTION CATEGORY | DESCRIPTION | BENEFITS |
|---|---|---|
| Data and AI-driven Decision Support System | Increase project predictability and performance through cumulative data collection, machine learning, and artificial intelligence | • Mitigate risks in construction predictably<br>• Improve cost, schedule, and resource planning and forecasts |
| Blockchain for Progress Verification | Record construction progress efficiently and in a verifiable and permanent way. | • Increase security as approved transactions are encrypted and stored across a network of computers<br>• Reduce cost as there is no need for middlemen |
| Robotics for Autonomous Construction and Facilities Management | Undertake strenuous and repetitive work such as brick stacking, painting and cleaning.<br><br>Greet visitors and help them with navigation information. | • Reduce repetitive and laborious tasks done by human and free them up to spend time on higher value tasks<br>• Reduce number of workplace accidents |
| Intelligent National Productivity and Quality Specification (iNPQS) | Allow user to compose specifications that can be linked to the BIM model. | • Improve productivity through integration of BIM with common specifications for architectural and engineering works<br>• Ensure traceability of requirements<br>• Able to link with latest products, and local and international standards |

Digital skills are required for all construction and facilities management job roles to varying levels of proficiency. All job roles may require upskilling to support your digitalisation journey.

| ALL PROJECT TEAM MEMBERS | TEAM MEMBERS WHO ARE ADVANCED USERS |
|---|---|
| **TECH BASIC COURSES** | **TECH ADVANCED COURSES** |
| Broad-Based Integrated Digital Delivery (IDD) Understanding and Awareness <br><br> Solution-Specific Training | Higher Proficiency Digital Skills to perform tasks in Integrated Digital Delivery (IDD) projects at various stages |

### JOB ROLES (EXAMPLES)

**ARCHITECT, ENGINEER, QUANTITY SURVEYOR, CONSTRUCTION MANAGER, PROJECT MANAGER, FACILITIES MANAGER**

**UPCOMING: PRODUCTION MANAGEMENT, SPECIALIST (DIGITAL DELIVERY)**

| | STAGE 01<br>GETTING DIGITAL ECONOMY READY | STAGE 02<br>GROWING IN THE DIGITAL ECONOMY | STAGE 03<br>LEAPING AHEAD |
|---|---|---|---|
| **TECH BASIC COURSES** | • SkillsFuture for a Digital Workplace<br>• Introduction to Construction Industry Transformation Map (ITM) and Integrated Digital Delivery (IDD)<br>• Understanding Building Information Modelling (BIM) Data and Modelling | • Overview – Integrated Digital Delivery (IDD) Concepts and Project Framework<br>• Understanding Project Collaboration<br>• Understanding Construction Site Management | • Understanding Digital Design for Manufacturing and Assembly (DfMA)<br>• Understanding Virtual Construction<br>• Basics to Smart Facilities Management (FM) |
| | **VENDOR-SPECIFIC SOLUTIONS TRAINING** | | |
| **TECH ADVANCED COURSES** | • Basic Building Information Modelling<br>• Intermediate Building Information Modelling (Coordination & Documentation)<br>• Advanced Building Information Modelling (Computational) | • Integrated Digital Delivery (IDD) Project Planning and Execution | • Integrated Digital Delivery (IDD) Application and Development<br>• Data Analytics and Machine Learning<br>• Internet of Things |

# 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?

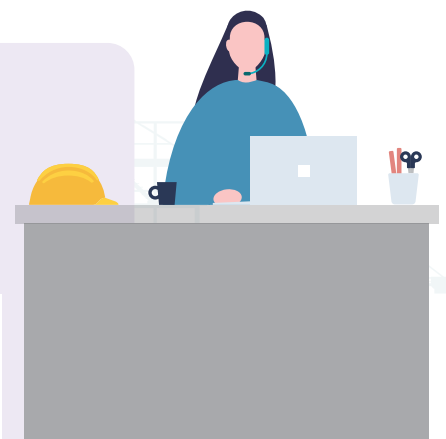Find out if you are digital ready by using the IDP resources here or scan the QR code.
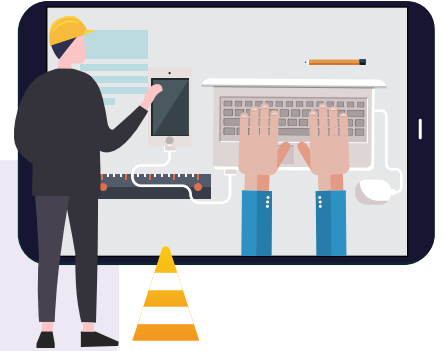
## 2 How do you get started?

Visit the Tech Depot website to contact solutions providers. If funding support is required, apply for Productivity Solutions Grant (PSG) to purchase and implement digital solutions. You can also apply for training subsidies under Productivity Solutions Grant - SkillsFuture Training Subsidy (PSG-SFTS)

## 3 Where can you get help?

- Make an appointment with a Business Advisor at your nearest SME Centre for your digital advice, or be referred to the Principal Consultants at SME Digital Tech Hub for more advanced digital needs.

- Contact Singapore Manufacturing Federation (SMF) for digital project managers who can help you implement your digital solutions.

## FOR SMEs

### DIGITAL SOLUTIONS

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

**Tech Depot**
https://www.smeportal.sg/content/tech-depot/
en/tech-solutions.html

### BE SAFE ONLINE HANDBOOK

https://www.csa.gov.sg/~/media/csa/documents
/publications/be_safe_online/be_safe_online
_handbook.pdf

### BUSINESS ADVISORY & DIGITAL CONSULTANCY

**SME Centres managed by Trade Associations**
• Association of Small and Medium Enterprises (ASME)
• Singapore Chinese Chamber of Commerce & Industry (SCCCI)
• Singapore Indian Chamber of Commerce & Industry (SICCI)
• Singapore Malay Chamber of Commerce & Industry (SMCCI)
• Singapore Manufacturing Federation (SMF)

https://www.enterprisesg.gov.sg/contact-info/overview
Enterprise Infoline: +65 6898 1800

**SME Digital Tech Hub**
http://www.digitaltechhub.sg

**Digital Project Management Services**
http://www.smfederation.org.sg/capability-capacity-
development/project-management-services

## FOR INDIVIDUALS

### CAPABILITY UPGRADING

**BCA Academy**
https://bcaa.edu.sg/

**Singapore Polytechnic**
https://www.sp.edu.sg/pace/

**Course Directory**
http://www.skillsfuture.sg/credit

**Fundamentals for Future Economy**
http://www.skillsfuture.sg/digitalworkplace

**SkillsFuture Series**
https://www.skillsfuture.sg/series

### CAREER FACILITATION

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

**e2i Centres**
http://e2i.com.sg/app/

## FOR ICM VENDORS

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

This Industry Digital Plan is part of the SMEs Go Digital Programme.

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