

ENVIRONMENTAL SERVICES

Digital Roadmap

The Environmental Services Digital Roadmap is for small and medium enterprises (SMEs) to assess their digital readiness and identify opportunities for going digital.

An Initiative by:



Sector Lead:



Supported by:



A decorative background on the left side of the page consisting of various shades of green in a low-poly, geometric pattern.

01

**Our Environmental
Services Industry**

02

**Trends Impacting
Environmental Services**

03

Digital Roadmap

04

**Digital Skills
Needed**

05

**Get Started
Today**

01 - OUR ENVIRONMENTAL SERVICES (ES) INDUSTRY

The ES industry provides essential cleaning and waste management services to keep Singapore clean and healthy.



The ES industry is important as it comprises more than 78,000 in the industry's workforce and over 1,700 companies, of which 90% are SMEs.

Sub sectors - Waste Management and Cleaning

Cleaning

Offices & Commercial Buildings
Food & Beverage Establishments
Conservancy

Waste Management

Waste Collection
Sorting & Recycling
Treatment & Disposal

Intended Users of this Guide*



Waste Management
Company

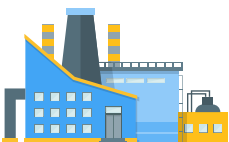


Cleaning Company

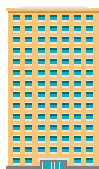


Building Owner/
Service Buyer

Deployment Sites



Industrial



Residential



Commercial



Public Areas*

*Streets/Expressways/Roads

Source: ES ITM

*Intended users of this digital roadmap is for SMEs in the ES industry; larger enterprises in the ES industry can also use the digital roadmap to guide their digitalisation decisions.

02 - TRENDS IMPACTING ENVIRONMENTAL SERVICES



Increasing demand and expectations

Singapore's demand for environmental services continues to rise, driven by economic sophistication, urbanisation, and population growth. Public expectations on maintaining good standards of public hygiene remain high amidst Singapore's international reputation as a Clean and Green city.



Educated workforce with higher aspirations

As the local workforce becomes increasingly higher educated, the Environmental Services Industry will see heightened competition for manpower resources. Due to the nature of work and lower wages, it will be more challenging for the industry to attract new entrants.



Source: ES ITM

The ES Industry Transformation Map (ITM)

The ES ITM launched on 11 December 2017 aims to ensure a vibrant, sustainable and professional industry that will provide services and solutions to help achieve the Zero Waste vision and a clean and liveable Singapore.

As demand for environmental services continue to rise, increasing manpower is not sustainable given Singapore's manpower lean processes. Transforming the industry is thus necessary to improve productivity, promote growth and create better jobs.

Adoption of digital technology plays an important part in helping SMEs to be more productive and efficient, as they are able to optimise resources more effectively.



Click [here](#) or scan this QR code for more details on the Environmental Services ITM

The Industry Digital Plan (IDP)

The IDP serves to meet the productivity and innovation objectives of the ITM.



*Includes training under SkillsFuture Series and Skills Framework.

03 - DIGITAL ROADMAP (SOLUTIONS)

This Digital Roadmap serves as a guide for you to follow on your go digital journey.

Stage
01

Getting Digital Economy Ready

Digital Operations, Optimised Resources



Fleet Management



Workforce Management



Asset & Resource Health Monitoring



Service Quality Audit



Workforce Health Monitoring



Bin Fill Monitoring



Tonnage Monitoring



Smart Toilet System

Stage
02

Growing in the Digital Economy

Integrated Sensing, Dynamic Response



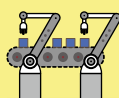
Dynamic Routing



Robotics Usage Monitoring and Maintenance Management



Supervisory Control and Data Acquisition Platform



Automated Recyclables Picking and Machine Learning

Stage
03

Leaping Ahead

Autonomous Operations, Intelligent Business



Autonomous Environmental Service Vehicles



Collaborative Robotics



Augmented Reality/Virtual Reality (AR/VR) Training



Swarm Robotics



Autonomous Collection Robots

Business Capability



Resource Management (including Customer Relation Management, Enterprise Planning, Human Resources / Staff Appraisal, Payroll, Contract and Quotation, Digital Invoicing, Inventory Management).



Stage 01

Getting Digital Economy Ready

Digital Operations, Optimised Resources

Digitalise workforce, fleet and assets to enhance productivity

Fleet Management



Solution Description:

Enable real-time visibility of cleaning and waste management fleet.

Benefits:

- Enhance visibility through real-time access to fleet's location and utilisation
- Enhance fleet utilisation through effective planning
- Reduce vehicle downtime through preventive maintenance

Workforce Management



Solution Description:

Track and schedule workforce for deployment at multiple sites.

Benefits:

- Improve productivity of workforce
- Enhance recruitment capabilities
- Increase retention and motivation of workforce

Asset & Resource Health Monitoring



Solution Description:

Track location and monitor health of equipment and resources/assets at multiple worksites to determine its operational usability.

Benefits:

- Reduce time to locate and use assets
- Increase asset utilisation
- Reduce asset downtime through preventive maintenance

Digitalise workforce, fleet and assets to enhance productivity

Service Quality Audits



Solution Description:

Perform quality audits of cleaning and waste collection performance in compliance to service standards and follow up actions.

Benefits:

- Reduce manual efforts to track service provided
- Prevent disputes with quantitative data trails

Workforce Health Monitoring



Solution Description:

Monitor workforce for health status and exposure to physical, chemical agents that impact workplace safety and health.

Benefits:

- Protect employees from potential health issues
- Improve workforce productivity
- Reduce workplace safety and health risks

Bin Fill Monitoring



Solution Description:

Measure bin fill-level in real-time to trigger waste removal actions.

Benefits:

- Increase productivity of waste removal team
- On demand collection for ease of tracking of service delivery
- Enhance customer satisfaction
- Real-time visibility of bin fill-levels across site

Stage 01

Getting Digital Economy Ready

Digital Operations, Optimised Resources

Digitalise workforce, fleet and assets to enhance productivity

Tonnage Monitoring



Solution Description:

Track and monitor waste tonnage, haulage and related fees.

Benefits:

- Optimise waste tonnage and haulage
- Reduce costs from unnecessary trucking
- Improve transparency of waste reporting

Smart Toilet System



Solution Description:

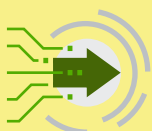
Track user feedback, odour level, consumables replenishment needs with data collation and reporting functions.

Benefits:

- Assist cleaning crew in the management of the toilets
- Improve visibility of consumables replenishments needs
- Improve service delivery
- Prevent client-provider disputes with quantitative data

Integrated real-time environmental sensing to enable dynamic response capabilities

Dynamic Routing



Solution Description:

Provide guidance to vehicles and automated movable equipment on best possible routes.

Benefits:

- Improve utilisation of vehicles and equipment
- Reduce transit time
- Reduce costs

Supervisory Control and Data Acquisition (SCADA)



Solution Description:

Integrate multiple singular function software into a cloud-based common monitoring platform for ease of monitoring and analytics for both service provider and client.

Benefits:

- Ease supervisory monitoring and control across multiple applications in multiple locations through a single platform
- Eliminate hassle and confusion from monitoring multiple user interfaces



Integrated real-time environmental sensing to enable dynamic response capabilities

Robotics Usage Monitoring and Maintenance Management



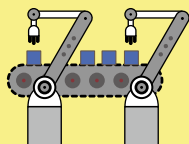
Solution Description:

Singular function autonomous robotics operations. Tracking, data collation of usage rate. Self-help troubleshooting user guides. Corrective and preventive maintenance triggers.

Benefits:

- Autonomous functions divert user to higher value added tasks
- Preventive maintenance reduce robots' downtime
- Self-help troubleshoot reduces robots' downtime and builds up user repair capabilities

Automated Recyclables Picking and Machine Learning



Solution Description:

Use machine learning for automated recyclables picking.

Benefits:

- Reduce manpower needs
- Increase productivity and picking accuracy
- Reduce costs



Exploit autonomous robotics and advanced tech to maximise business value and impact

Autonomous Environmental Service Vehicles



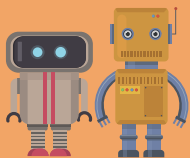
Solution Description:

Leverage self-driving capabilities of autonomous vehicles for street cleaning and refuse collection in public places.

Benefits:

- Reduce reliance on manpower
- Improve productivity
- Enhance ES worker job

Collaborative Robotics



Solution Description:

Harness robots that interact with humans in a shared space.

Benefits:

- Augment capabilities of ES workers
- Job redesign to help older workers with menial heavy lifting tasks
- Achieve higher productivity

Augmented Reality/Virtual Reality Training



Solution Description:

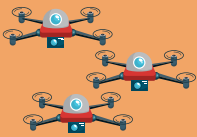
Unlock AR/VR training for ES industry.

Benefits:

- Simulate real-world situations realistically in a controlled environment
- Enable safety and hazard training in a safe & controlled environment
- Training at the convenience of the workers

Exploit autonomous robotics and advanced tech to maximise business value and impact

Swarm Robotics



Solution Description:

Mutually communicating robotics to perform a single task in a defined environment.

Benefits:

- Wider area robotics service delivery with minimal human intervention
- Eliminates collision possibility/damage to property with robotics communication

Autonomous Collection Robotics



Solution Description:

Deploy autonomous robots to collect, transport and empty refuse bins onto garbage truck.

Benefits:

- Create higher value jobs for worker
- Increase automation of refuse removal



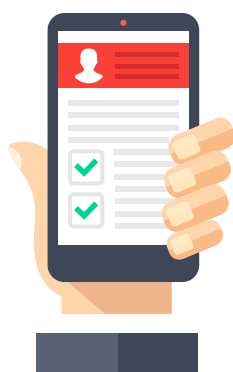
04 - DIGITAL SKILLS NEEDED

Types of Users

All Users

Require broad-based digital literacy and awareness

ES operations staff who are light digital users



Advanced Users

Require higher proficiency level digital skills

ES supervisory and management staff who are advanced digital users



Environmental Services Job Roles (examples)

Cleaning

- General Cleaner
- Multi-Skilled Cleaner/Team Leader
- Cleaning Operations Supervisors/Executive/Manager
- Operations Director/General Manager

Waste Management

- Waste Collection Attendant/Recycling Sorter/Waste Treatment Worker
- Mechanical Operator/Weighbridge Operator/Truck Driver
- Waste Collection/Recovery/Treatment/Disposal Executive and Manager
- Environment, Health and Safety Specialist/Manager

04 - DIGITAL ROADMAP (TRAINING)

Leveraging Technology:

Improve business operational efficiency through the adoption of technology



Getting Digital Economy Ready

Growing in the Digital Economy

Leaping Ahead

Tech Basic Courses

Require broad based digital literacy and awareness

ES Tech Basic 1.1:

Introduction to Digital Technologies in Environmental Services

- Digitisation, Internet of Things & Smart Systems
- Robotics & Automation
- Cleaning Management Software

Digitalising Environmental Services 1

- Workforce Scheduling & Management
- Quality Audit & Report
- Asset Tracking



ES Tech Basic 2.1:

IoT for Environmental Services

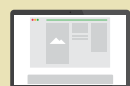
- Dynamic Routing
- Smart Trash Bin
- NB-IoT Environmental Sensing



ES Tech Basic 3.1:

Cleaning & Waste Management Robotics

- Collaborative Robots (Cobots)
- Autonomous Collection Robot
- AR/VR Training



Vendor solution specific training



Tech Advanced Courses

Require higher proficiency digital skills

ES Tech Advanced 1.2:

Digitalising Environmental Services 2

- Workforce & Equipment Health Monitoring
- Smart Toilet System
- Bin Fill & Tonnage Monitoring



ES Tech Advanced 2.2:

Digital Solutions for Environmental Services

- Robot Fleet Management
- Anomalies Detection & Need-based Cleaning
- Automated recyclables picking



ES Tech Advanced 3.2:

Environmental Services with Machine Intelligence

- AI-powered Workforce Optimisation
- Predictive Maintenance Analytics
- Autonomous Environmental Services Vehicles



Training programmes aligned to Skills Framework and emerging areas under SkillsFuture Series.

Legend



Blended Learning



Online Learning/
Micro-Learning

Improve business operational efficiency through the adoption of technology

ES Tech Basic 1.1A



Introduction to Digital Technologies in Environmental Services

- Digitalisation, Internet of Things and Smart Systems
- Robotics and automation
- Cleaning Management Software

Course Synopsis:

Participants will acquire fundamental understanding and gain insight into the trends in digital solutions in the Environmental Services Industry. He/she will be immersed in a hands-on learning environment to understand how technology will impact the workplace and gain knowledge in robotics systems to perform cleaning tasks.



1 day course (7 hours), referencing to WSQ 1 day courses.

The course is designed for new entrants and existing practitioners.

ES Tech Basic 1.1B



Digitalising Environmental Services 1

- Workforce Scheduling & Management
- Quality Audit & Report
- Asset Tracking
- Fleet Tracking & Management

Course Synopsis:

Participants will acquire digital skills to improve operations & processes, better manage work, and add business value. The course offers a hands-on learning environment involving mobile apps and cloud-based software tools. Participants will learn how to use digital solutions in planning work schedules, generating paperless audit reports, tracking assets for optimised utilisation, and monitoring fleet vehicles in real time.

At the end of the course, participants will gain a better understanding on the range of industry & open-source digital tools available.



1 day course.

The course is designed for new entrants and existing PMETs.

05 - GET STARTED TODAY

You will be supported at every stage of your digital journey. You have the option to self-assess or contact business advisors at SME Centres for assistance.



Self Assess



You can assess your digital readiness by using a self-assessment checklist

Click [here](#) or scan this QR code for more details



Resources Available*

List of Digital Solutions

Visit Tech Depot to access digital solutions, including Pre-approved Digital Solutions

Projects to Uplift Whole Sectors

Partner large companies and industry leaders to enjoy new growth

Business Advisory & Digital Consultancy

Access to advisory services

- SME Centres
- SME Digital Tech Hub

Skills Framework

The Skills Framework provides key information on:

- Sector and employment opportunities
- Career pathways
- Occupations and job roles
- Existing and emerging skills
- Training programmes for skills upgrading & mastery

*Refer to the next page on how to access these resources



Contact SME Centre



You can seek assistance from Business Advisors at SME Centres

Click [here](#) or scan this QR code for more details



For advanced digital advisory, you may be referred to Principal Consultants at SME Digital Tech Hub

SME Centres

www.smeportal.sg

- Association of Small and Medium Enterprise (ASME) - SME Centre @ ASME
- Singapore Chinese Chamber of Commerce & Industry (SCCCI) - SME Centre @ SCCCI
- Singapore Indian Chamber of Commerce & Industry (SICCI) - SME Centre @ SICCI
- Singapore Malay Chamber of Commerce & Industry (SMCCI) - SME Centre @ SMCCI
- Singapore Manufacturing Federation (SMF) - SME Centre @ SMF

Satellite SME Centres are located at Community Development Councils (CDCs)

SME Digital Tech Hub

- SME Digital Tech Hub operated by the Association of Small and Medium Enterprise (ASME)

FOR MORE INFORMATION

For SMEs

Digital Solutions

Tech Depot

<https://www.smeportal.sg/content/tech-depot/en/home.html>

Projects to Uplift Whole Sectors

SMEs Go Digital

<https://www.imda.gov.sg/SMEsGoDigital>

Business Advisory & Digital Consultancy

SME Centres

<https://www.smeportal.sg/content/smeportal/en/resources/sme-centres.html>

SME Infoline: +65 6898 1800

SME Digital Tech Hub

www.digitaltechhub.sg

Digital Project Management Services

<http://www.smfederation.org.sg/capability-capacity-development/project-management-services>

For Individuals

Capability Upgrading

Digital Roadmap (Training)

<https://www.np.edu.sg/lifelonglearning/Pages/des.aspx>

<https://www.ite.edu.sg/wps/portal/pt.sfseries>

Fundamentals for Future Economy

<http://www.skillsfuture.sg/digitalworkplace>

Course Directory

<http://www.skillsfuture.sg/credit>

Skills Framework

<http://www.skillsfuture.sg/skills-framework>

Career Facilitation

WSG's Careers Connect

<http://www.wsg.gov.sg/career-services.html>

e2i Centres

<http://e2i.com.sg/app/>



This Digital Roadmap is part of the
SMEs Go Digital programme

For programme information and feedback:
<https://www.imda.gov.sg/SMEsGoDigital>



For more news and information, visit www.imda.gov.sg
or follow IMDA on Facebook IMDAsg and Twitter @IMDAsg.

The Infocomm Media Development Authority (IMDA) will develop a vibrant, world-class infocomm media sector that drives the economy, connects people, bonds communities and powers Singapore's Smart Nation vision. IMDA does this by developing talent, strengthening business capabilities, and enhancing Singapore's ICT and media infrastructure. IMDA also regulates the telecommunications and media sectors to safeguard consumer interests while fostering a pro-business environment. IMDA also enhances Singapore's data protection regime through the Personal Data Protection Commission.