

## Technology Needs and Opportunities in Services & Digital Economy

- 1. Artificial/Augmented Intelligence & Big Data Analytics**
  - a. Deep Learning
  - b. Ambient Intelligence, Context-Aware Computing
  - c. Computer Vision (Cloud and Edge)
  - d. Autonomous Vehicles
  - e. Natural Language Processing, Semantic Technologies
  - f. Speech/Audio Analysis and Recognition Systems
  - g. Predictive and Prescriptive Analytics
  
- 2. Distributed Ledgers**
  - a. Blockchain
  - b. Fast and Scalable Distributed Ledger Protocols
  
- 3. Immersive Digital Media**
  - a. Augmented Reality
  - b. Virtual Reality
  - c. Interactive Digital Media
  
- 4. Cybersecurity**
  - a. Deception Technology
  - b. Homomorphic Encryption
  - c. Threat Intelligence and Incident Response
  - d. Data Protection and Privacy
  - e. Mobile Security
  - f. Software and Systems Security
  - g. Cyber-Physical/IoT Security
  
- 5. Industry-Specific ICT**
  - a. Health IT
  - b. Financial Technology (FinTech)
  - c. Legal Technology
  - d. Educational Technology
  - e. Smart Factory/Industry 4.0
  
- 6. Emerging ICT**
  - a. Quantum Computing
  
- 7. Power source for wearables (small size)**
  - a. Advanced high-density solid state Li-ion batteries for wearables
  - b. Hybrid super capacitors
  - c. Micro Fuel cell
  - d. Printable batteries
  
- 8. Wireless & Communications Technologies**
  - a. Long range, wide-area wireless network
  - b. Low-power, wireless mesh network and applications

## **9. Sensors**

- a. Smell detector and odour identification
- b. Health Sensors (e.g. EEG, ECG, Blood pressure, Blood Glucose, Stress level, Fatigue, attentiveness)
- c. Biometric Identification Sensors
- d. Inspection and Surveillance Sensors
- e. Low-cost thermal imaging sensor
- f. Unified Sensor management system (firmware updates, battery management, etc.)
- g. Environmental Sensors (e.g. Ambient temperature, relative humidity, PM2.5, PM10, CO2, etc.)
- h. Stretchable sensors
- i. Food freshness sensors

## **10. Robotics & Automation**

- a. Service/inspection Robots
- b. Anti-Drone system
- c. Robot Navigation and motion control
- d. E-commerce order picking
- e. Robotics modules for Robot Operating System (ROS) or equivalent
- f. Automated packaging machines
- g. Robotic solutions for Marine & Offshore industry – For underwater inspection, welding, cleaning, etc.

## **11. Electronics**

- a. Energy harvesting systems for wearables (e.g. TEG, Radio Frequencies, Kinetics, Ultrasound)
- b. Wireless power transfer system
- c. Haptics feedback technologies (e.g. ultrasonic, force feedback)
- d. Flexible Hybrid Electronics (FHE)
- e. Assistive Electronics (e.g. vision prosthetics)
- f. System-on-chip (SoC) for Edge-based Artificial Intelligence
- g. Advanced Power Electronics (e.g. GaN & SiC)

## 1. Performance Materials

- a. Transparent ceramics
- b. High strength, high temperature resistant natural fibres
- c. High performance elastomers
- d. Low cost thermal management materials
- e. Light weight, impact resistant materials

## 2. Functional Coatings

- a. Low cost and easy to apply heat reflecting coating for glass
- b. Multi-functional coating
- c. Environmentally-friendly anti-fouling coating
- d. Low cost anti-corrosion coatings (non-sacrificial) for marine, oil and gas applications
- e. Non-stick coating for oil and gas applications
- f. Long lasting, low cost anti-fingerprint coating
- g. Low temperature processed bulk ceramic and coating
- h. Long lasting and easy to apply anti-fog coating
- i. Hybrid flexible and hard coating
- j. Functional textile coatings
- k. Surface cleaning and pre-treatment technologies

## 3. Functional Plastics

- a. Biocompatible plastics
- b. Biodegradable plastics
- c. Functional polymers
- d. Non-isocyanate polyurethane

## 4. Specialty Chemicals

- a. Natural flavours
- b. Natural colourants
- c. Natural additives as substitutes in food
- d. Agrochemicals: crop care, crop yield improvement formulations
- e. Functional additives for bulk polymers
- f. Animal feed additives

## 5. Nanotech

- a. Graphene technologies
- b. Lightweight, high strength nanomaterials & nanocomposites
- c. Metamaterials technologies for antenna, sensors and optics

## 6. Machine Vision

- a. 3D machine vision platforms that can be customised for different manufacturing environment
- b. Vision systems for picking and sorting of items for e-commerce

**7. Additive Manufacturing**

- a. Multi-material printing solution
- b. Free form additive printing for large industrial components
- c. Hybrid Additive and Subtractive manufacturing for large components
- d. Biocompatible polymers for additive manufacturing
- e. Additive rapid prototyping technologies for Printed Circuit Boards (PCBs)

**8. Industrial Automation**

- a. Condition monitoring algorithms for retrofitting onto existing machines
- b. IoT sensor suite for Industry 4.0 solution that can be retrofitted onto existing factory

# Technology Needs and Opportunities in Health & Personal Care

## 1. Diagnostic

- a. POC Diagnostics
- b. Molecular & Genetic Diagnostics
- c. Digital PCR and reagents
- d. Non-Invasive Wellness Monitoring Technologies
- e. Biomarkers for Skin, Nutrition and Diseases
- f. Rapid on-site detection for pathogens (biosensor or others)
- g. Porcine detection kit (consumer level)
- h. Rapid detection for food allergies
- i. Test kits for used cooking oils (vision systems)

## 2. Med Tech

- a. Rehab Technologies
- b. Handicap Assistive Technologies
- c. Elderly Care Technologies
- d. Disease Management Technologies
- e. Stem Cell Technologies
- f. 3D Bioprinting

## 3. Health, Telemedicine & Big Data Analytics

- a. Enabling Patient Empowerment
- b. Enabling Personalised Genomics

## 4. Beauty

- a. Skin Whitening Technologies
- b. Cosmeceutical Ingredients
- c. Transdermal Delivery Systems
- d. Patch Technologies
- e. Skincare Devices for Home
- f. Hair Growth/Dye Formulation
- g. Surfactants and Liquid Crystals

## 5. Wellness (Non-therapeutic)

- a. Women health, Feminine Hygiene, Hormone Replacement
- b. Anti-Stress Formulations
- c. Pain Sensors & Management Technologies
- d. Dermatological Formulation
- e. Olfactory & Fragrance Technologies

- 1. Green Building – Renewable Energy System**
  - a. Building integrated photovoltaics
  - b. Micro wind turbines for urban environment
  
- 2. Green Building – Energy Efficiency**
  - a. Building materials/coatings to reduce thermal load
  - b. Efficient air conditioning and mechanical ventilation technology
  - c. Thermal energy storage for cooling application
  - d. Energy efficient air purification & disinfection system
  - e. Personalised cooling for building occupants
  - f. Building materials/coatings/technologies to reduce noise pollution
  - g. Building materials/coatings to reduce environmental pollutant
  
- 3. Green Building – Sensors and Control**
  - a. Low cost and self-powered sensors and sensor network
  - b. Virtual sensors and intelligence for preventive maintenance of critical equipment
  - c. Energy monitoring and disaggregation algorithm
  - d. Building structural inspection and monitoring
  - e. In-door plant and human health monitoring and management
  
- 4. Green Building – Water Conservation & Recycling**
  - a. Cooling tower water treatment
  - b. Grey water treatment
  - c. Non – revenue water monitoring and detection for building and distribution network
  - d. Green surface cleaning or sanitisation technologies
  
- 5. Thermal Power Generation**
  - a. Carbon capture and storage
  - b. Low-level waste heat recovery
  - c. Ash utilisation / repurposing
  
- 6. Renewable Energy**
  - a. PV cleaning
  - b. PV power boosting
  - c. PV optimisation and control technologies
  - d. Low cost energy storage system
  - e. Micro power generator
  
- 7. Water Resource Management – Industrial Wastewater Treatment**
  - a. High strength COD industrial wastewater treatment
  - b. Industrial wastewater sludge management
  - c. Wastewater resource recovery technologies
  - d. Oily water wastewater treatment or separation
  - e. Solvent separation or recovery technologies
  - f. Nanobubble or Microbubble generator
  
- 8. Water Resource Management – Environmental Monitoring**
  - a. Low energy and long range air, water, plant and soil monitoring sensors
  - b. Rapid, high sensitivity and high selectivity portable water borne pathogen monitoring
  - c. Monitoring of surfaces or air for environmental control

**9. Water Resource Management – Advanced Oxidation Processes**

- a. Low energy and low heat advanced oxidation system
- b. Solar photocatalytic process
- c. Integrated advanced oxidation processes
- d. Low cost and off-grid water treatment systems

**10. Air Quality Management**

- a. Odor control technology
- b. Odor sensor technology
- c. Industrial exhaust air treatment
- d. Low energy indoor air quality improvement solution
- e. Industrial gas monitoring and detection

**11. Solid Waste Management**

- a. Waste sorting technologies
- b. Waste to resource
- c. Waste to energy
- d. Low cost and off-grid waste treatment systems
- e. Plastic recycling, upcycling and reuse
- f. E-waste or battery recycling
- g. Food waste valorisation to extract bioactives or high value products
- h. PV module or panel recycling

**12. Agri/ Aqua Technologies**

- a. Agriculture robots for planting, harvesting and sorting of vegetables or fruits (for small farms)
- b. Optical, video and environmental sensors for monitoring plant or animal health
- c. Micro/Nanobubble solutions for agri/aquaculture applications
- d. Non-contact marine life inventory counting system for aquaculture applications
- e. Circular agri/aquaculture systems for urban farms
- f. Predictive or data analytics based technologies for farm management
- g. Blockchain for agriculture or aquaculture
- h. Low energy environmental control technologies
- i. Micro or macro algae related production, harvesting or extraction technologies
- j. Bioengineering of microbiome or enzymes
- k. Food and feed safety
- l. Mycotoxins diagnostic solution

### 1. Food Processing and Technologies

- a. Food preservation systems such as using microwaves, light technologies (UV, Pulsed, LED), non-thermal methods
- b. Automated cooking machines for industrial use
- c. Automated food preparation for home use
- d. Automated packing machines
- e. Filling and packing of Ready-To-Eat meals
- f. Robotic assistive systems for kitchens
- g. Drying, freezing and thawing technologies
- h. Pesticide removal technology
- i. Automated cutting technologies for ingredients
- j. Asian noodle processing methods
- k. Rapid Cooling technologies
- l. Extraction technologies
- m. Encapsulation technologies
- n. IOT solutions for monitoring manufacturing process

### 2. Food and Nutrition

- a. Functional food, nutraceutical and novel ingredients
- b. Health and Wellness ingredients/ formulation
- c. Food structure engineering
- d. Clean label and Free-from food ingredients and formulations
- e. Meat alternatives, and alternative proteins
- f. Alternative low-calories natural sweeteners
- g. Shelf-life extending ingredients/ formulation
- h. Weight management
- i. High bioavailability health supplements
- j. Energy booster & sport nutrition
- k. Pre & Probiotics technologies
- l. Medical food formulation
- m. Ready-To-Eat meal formulation
- n. Food biotransformation technologies
- o. Low GI meals
- p. Rapid testing kit for personal nutrition
- q. Elderly nutrition

### 3. Food Waste/ By-product Valorisation

- a. Repurposing of: Soy Bean Dreg/ Okara
- b. Spent Grains
- c. Fruit pulp and husks
- d. Meat, seafood trimmings
- e. Egg Shells
- f. Whey
- g. Expired Bread/Dough
- h. Bran
- i. Cooked food waste



#### **4. Food Packaging**

- a. Biodegradable packaging technologies
- b. Shelf-life extending packaging technologies
- c. Self-heating packaging technologies

#### **5. Food Quality and Analysis**

- a. Detection of shelf-life, freshness and quality of food products
- b. Rapid food safety analysis technologies
- c. Food traceability technologies

### 1. Intelligent Transportation Systems

- a. Autonomous navigation systems
- b. V2X or CV2X communications and applications (e.g. telematics)
- c. Emerging Navigation sensors (e.g. Solid-state LIDAR, ultrasonic sensors)
- d. Multi-modal transportation system
- e. Account-based ticketing system
- f. Smart parking system (video based)
- g. Mobility-as-a-service systems and sub-components

### 2. Logistics and Delivery Systems

- a. Food delivery systems for front of house use (e.g. waiting tables in a restaurant)
- b. Food delivery systems for tenants within a building complex (multi storey buildings)
- c. Track and tracing systems
- d. Logistics system to reduce inventory
- e. Blockchain-based logistics platforms
- f. Emerging warehouse robotics

### 3. Indoor Positioning Systems

- a. Low-cost, easy to install indoor positioning systems
- b. Light-based, Ultrasonic, others
- c. Centimetre-range precision systems (e.g. UWB, etc.)