Theory of Change & Theory of Action

for Strengthening of Healthcare Supply Chain through Artificial Intelligence

JSI

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MACRO-EYES HEALTH

Acronyms

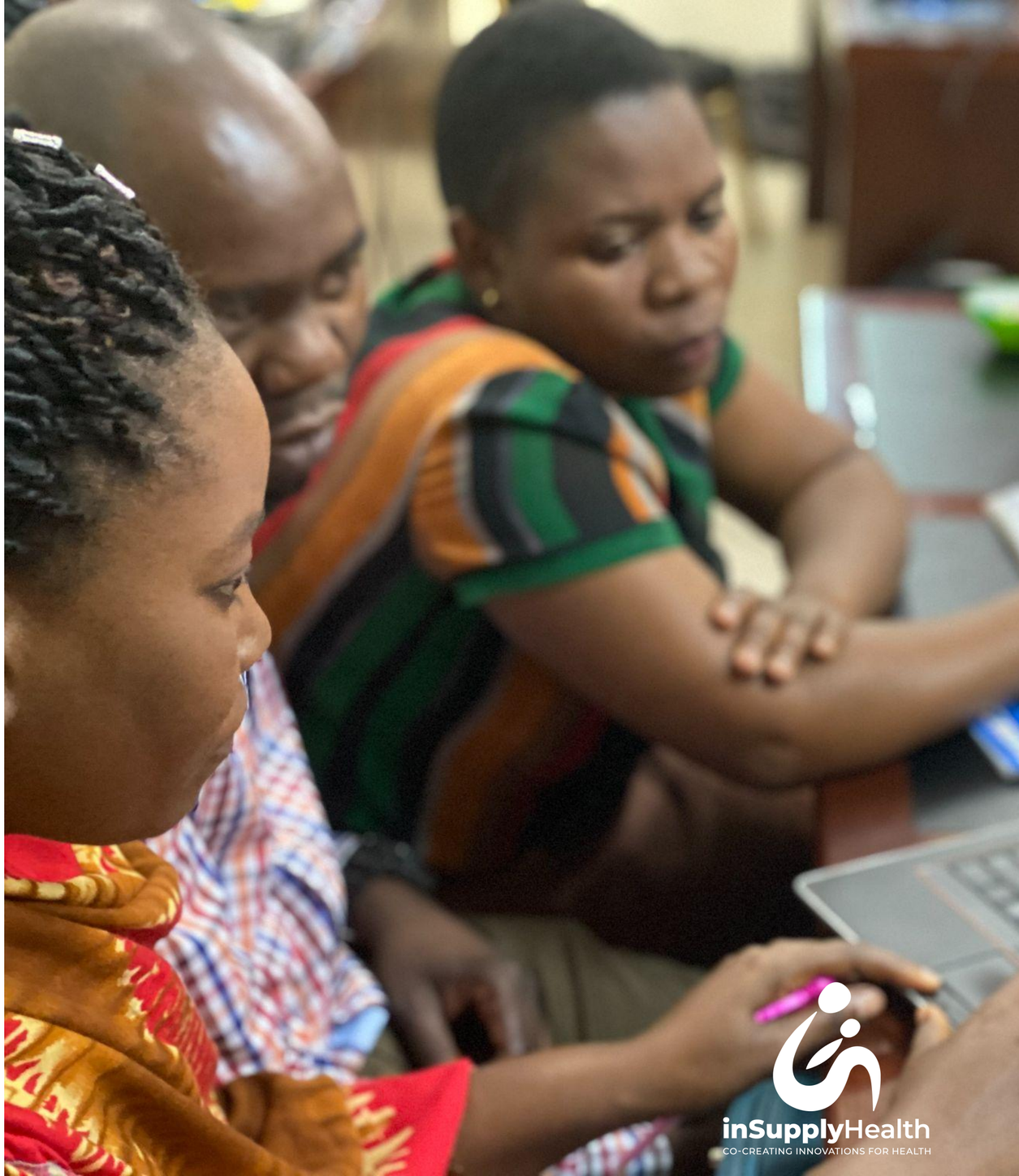
AI - Artificial Intelligence
ML- Machine Learning
TOC - Theory of Change
TOA - Theory of Action
RMNCH - Reproductive, Maternal, Newborn and Child Health
eLMIS - Electronic Logistic Management Information System
DHIS - Demographic Health Information Survey
GoT-HoMIS - Government of Tanzania Hospital Management Systems
IMPACT - Information Mobilize for Performance Analysis and Continuous Transformation

SOPs - Standard Operating Procedures
ROI - Return on Investment
TBS - Tanzania Bureau of Standards
TMDA - Tanzania Medicines and Devices Authority
BRELA - Business Registration and Licensing Agency
TRA - Tanzania Revenue Authority
PHLB - Private Health Laboratories Board
PORALG - President's Office, Regional Administration and Local Government
MOHCDGEC - Ministry of health, Community Development, Gender, Elderly and Children

AI for Supply Chains: TOC & TOA

With support from the Bill & Melinda Gates and ELMA Foundations and together with MOHCDGEC Tanzania, inSupply Health co-created a TOC & TOA with variety of partners:

- Theory of change (TOC) that includes the pre-conditions for effective use of AI to solve supply chain problems
- Theory of action (TOA) that includes practical ways to integrate, scale and sustain the technology in health supply chain systems



TOC & TOA

Theory of Change

What is it?
Describes **outcomes and pre-conditions through which change comes** about for individuals, groups or communities.

Questions it answers:
- **What** is the change?
- **Why** is the change occurring?

Characteristics:
- Dynamic
- Evolving
- Theoretical

Theory of Action

What is it?
Articulates the **mechanisms through which the activities are being delivered**, e.g. through which type of actors and following what kind of processes.

Questions it answers:
- **How** does the change occur?
- **Who** are the actors involved?

Characteristics:
- Captures potential unknowns
- May have multiple layers
- Linked to the Theory of Change

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Why Do We Need a TOC & TOA?

Enabling environment to support a AI/ML solutions

Empowered, skilled and motivated stakeholders to use AI/ML powered solutions

To have a responsive and integrated supply chain with prediction, automation and data visibility to ensure 100% health commodity availability

END GOAL

ACCESS
Health commodities are available to all who need them

EQUITY
Supply chains are optimised and responsive to needs of all population segments

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Preconditions & Stages of Operationalizing AI/ML for Health & Supply Chains

Change pathways for AI/ML solutions

Precondition	Definition
DATA PRIVACY, ETHICS & OWNERSHIP	**Confidence and trust** in the data flows, technology and the people who are solution providers
KNOWLEDGE & SKILLS	All the **competencies** needed to enable AI/ML for health supply chain
PARTNERSHIPS	The **agreements** that need to be in place to facilitate AI/ML use
RESOURCES	**Human and financial** resources that provide the means needed to follow through on AI/ML use.
TECHNOLOGY	The **tools and processes** that facilitate AI/ML use within health supply chain systems
POLICY & GUIDELINES	International and national **policies and guidelines** that codify AI/ML use as a necessary strategy for achieving results.

Stage of interventions

Stages	Definition
INSTILL	The actions or interventions that support **establishing the foundation** of a particular enabling environment in a specific jurisdiction and sub-group of people.
SCALE	The actions or interventions **to expand solutions** to new levels of the health system, new users or new geographies.
SUSTAIN	The actions or interventions that focus on macro, **system-level changes** that help permanently embed solutions across multiple levels of the health system, multiple geographies and multiple teams.

Adapted from Theory of Change/Theory of Action for Supply Chain Data Use developed by inSupply Health, JSI, VillageReach, and CHAI 2020.

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Stakeholder/User Groups

Who is involved or affected by the Change?

Patients

Healthcare Workers

Ministry Staff

Implementing Partners

Academic Institutions

AI Solution Providers

Public & Private Suppliers

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	Need	Preconditions	Instill	Scale and Sustain
Patient 	➔ I need information on where to get quality and affordable medicine and healthcare services near me ➔ I need to know when my clinic appointment is ➔ I need instructions for using my medications (time, dosage etc.) ➔ I need information on health interventions e.g. vaccinations, RMNCH services ➔ I need information on healthy living and preventive measures	DATA PRIVACY, ETHICS & OWNERSHIP KNOWLEDGE & SKILLS PARTNERSHIPS BUSINESS MODELS & RESOURCES TECHNOLOGY POLICY & GUIDELINES	➔ Community engagement on benefits of AI ➔ Policies to safeguard patient data trust, privacy and ownership ➔ Electronic Medical records (EMRs) with universal patient and services identifiers ➔ Development of AI powered chatbots for providing information to patients ➔ Push mobile messages for healthcare dispensed/ medicine use information, tailored to individual patients using AI	➔ Policies guiding AI powered Targeted Digitized information as part of patients & community outreach/communication programs ➔ Policies supporting e-Prescription information to be shared during dispensing/service delivery ➔ Integration platform of medicines and services available at public and private facilities ➔ AI-powered wait time predictions

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	Need	Preconditions	Instill	Scale and Sustain
Healthcare Worker 	➔ I need to be able to anticipate surges in demand based on outbreaks, seasonal disease ➔ I need to understand stock status to prevent wastage ➔ I need my orders to be fulfilled on time and in full ➔ I need to proactively know the availability of funds to plan my commodity ordering better ➔ I need information about incoming patient immediately to serve my patients better ➔ I need to make accurate diagnosis and provide the right services ➔ I need to be able to trust the data I am generating	DATA PRIVACY, ETHICS & OWNERSHIP KNOWLEDGE & SKILLS PARTNERSHIPS BUSINESS MODELS & RESOURCES TECHNOLOGY POLICY & GUIDELINES	➔ Interoperability of systems for managing demand, supplies and funds ➔ Development of AI-powered forecasting algorithms ➔ Development of AI-powered clinical decision support algorithms ➔ Capacity building in proactive and preventive data use ➔ Revised SOPs in proactive stock analysis and data use ➔ AI-assisted alerts/reports on medicine expiration/traceability	➔ Predictive analytics integrated in eLMIS ➔ Institutionalize Continuous Quality Improvement approaches for SC Problem Solving (IMPACT Teams) ➔ SMS/app based alerts features in health systems ➔ Systems with ability to determine expected clients and their medicines, health equipment, and services needed ➔ ML Skills incorporated in preservice training and continuous education plans

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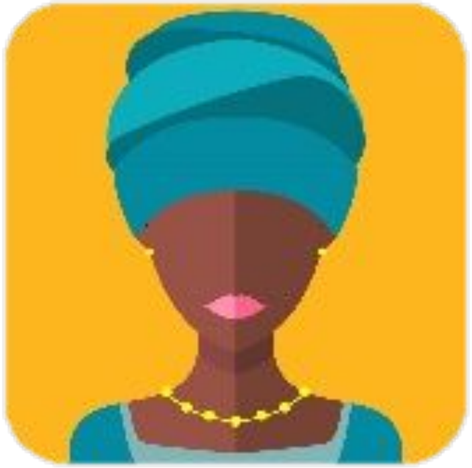
	Need	Preconditions	Instill	Scale and Sustain
Public Supplier (Medical Stores) 	➔ I need to know demand from my customers well in advance to provide better customer care ➔ I need to be able to forecast and optimize stock levels across warehouses to minimize stock out and expiry ➔ I need efficient distribution systems to be able to deliver according to schedule ➔ I need to receive payments on time ➔ I need to receive accurate orders on time ➔ I need performance data from prime vendors and other 3rd party service providers to manage contracts ➔ I need to segment products based on consumptions and costs	DATA PRIVACY, ETHICS & OWNERSHIP KNOWLEDGE & SKILLS PARTNERSHIPS BUSINESS MODELS & RESOURCES TECHNOLOGY POLICY & GUIDELINES	➔ Interoperability of systems for managing demand, supplies and funds ➔ Visibility of data between public, supplier, service delivery points and prime vendors ➔ Capacity building in proactive and preventive data use through continuous quality improvement ➔ Advocacy for on time funds disbursement using data predicting demand or stock outs ➔ AI-assisted operation alerts/ reports on medicine expiration/ traceability	➔ Predictive analytics (AI/ML) integrated in Warehouse management systems ➔ ML technology integrated in Distribution Management Systems ➔ ML Skills incorporated in preservice training and continuous education plans ➔ Framework contracts in place e.g. Prime vendors to facilitate order fulfilments ➔ Memorandum of understanding on funds disbursement and payment between suppliers, Health Facilities and MoH

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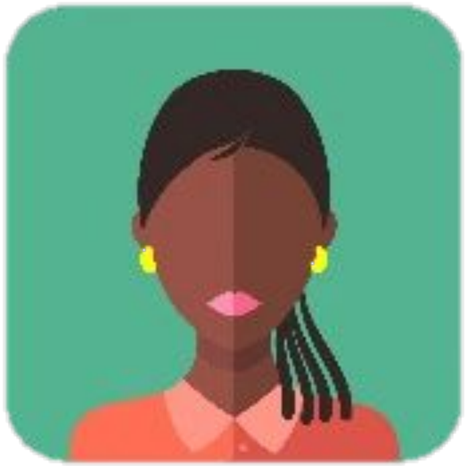
	Need	Preconditions	Instill	Scale and Sustain
Private Suppliers 	➔ I need to know stock position of my clients to plan well in advance ➔ I need to know real time stock levels across public and private suppliers for better planning ➔ I need to be able to offer competitive prices ➔ I need to have high order fulfilling rate to meet service level agreements to win tenders ➔ I need to know financial status of my customers and to receive payments on time ➔ I need to know the locations of my customers so as I can deliver on time ➔ I need to use data to maximize performance and profitability	DATA PRIVACY, ETHICS & OWNERSHIP KNOWLEDGE & SKILLS PARTNERSHIPS BUSINESS MODELS & RESOURCES TECHNOLOGY POLICY & GUIDELINES	➔ Prioritizing integration of systems for visibility of data across service delivery points, private and public suppliers. ➔ Integration of other systems such as TBS, TMDA, Brela, TRA, PHLB to show legitimacy of the supplier ➔ Updated geo-location of all service delivery points ➔ Data analytics to support performance based of tendering/contracting ➔ Training on predictive and proactive data use culture, and continuous quality improvement	➔ MoU for Data transparency between public suppliers, private suppliers and service delivery points ➔ Framework contracts in place e.g. Prime vendors to facilitate order fulfilments ➔ Predictive analytics(AI/ML) in inventory management systems ➔ National and Global quality management standards to include AI/ML components

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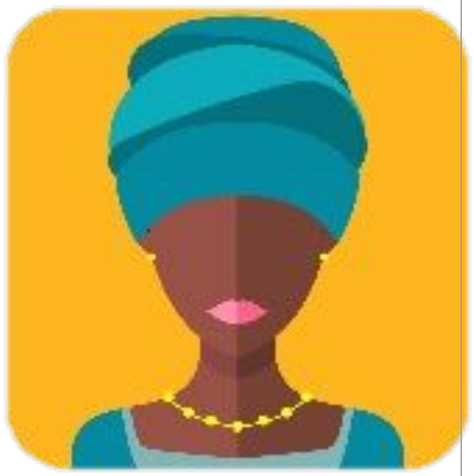
	Need	Preconditions	Instill	Scale and Sustain
Ministry of Health 	➔ I need performance data to manage public suppliers and outsourced vendors based on contracts ➔ I need to triangulate information from different systems to overcome data quality issues. ➔ I need to analyse data to uncover root cause of factors causing challenges or bringing success ➔ I need to know the total cost of ownership for proposed AI solutions ➔ I need to predict and prevent loss due to wastage ➔ I need to track free and subsidized health commodities ➔ I need to predict annual needs ➔ I need to eliminate the need of calling lower levels for reports ➔ I need AI awareness to all people at all levels ➔ I need to have data and predictions at my fingertips to advocate effectively	DATA PRIVACY, ETHICS & OWNERSHIP KNOWLEDGE & SKILLS PARTNERSHIPS BUSINESS MODELS & RESOURCES TECHNOLOGY POLICY & GUIDELINES	➔ Formative evaluation for need and acceptability of AI ➔ Adopt global guidance on use of AI in health sector ➔ Leadership sensitization on benefit of AI ➔ AI insights integrated in in routine data use meeting ➔ AI solution co-created and tested in small scale in current systems ➔ Development of a total cost of ownership for proposed AI solutions ➔ AI skills outsourced while building local capacity ➔ Link data source ➔ Verify reliability of data from the models	➔ Data science skills as part of preservice training and in service continuous education) ➔ AI powered Decision-support analytics integrated in systems ➔ Developed solutions can be adapt to changes or expansion. ➔ Monitoring Evaluation and Learning ➔ Costs included in budgets including ICT Infrastructure ➔ AI staffing optimization ➔ AI to work in different environment and scenarios ➔ National Policy with clear path of AI data security and privacy ➔ I need the technology to work at all levels

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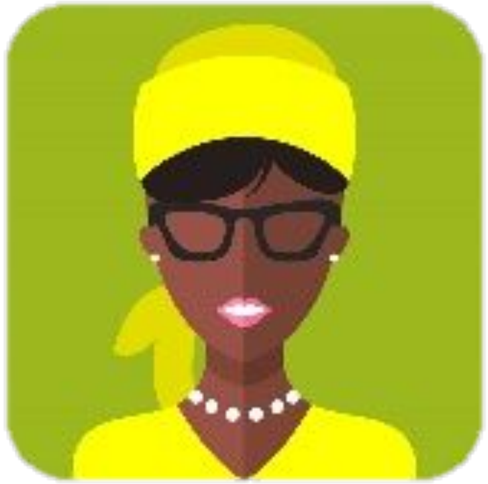
	Need	Preconditions	Instill	Scale and Sustain
Academic Institutions 	➔ I need to understand where there are gaps in knowledge or practice so we can participate in research to fill those gaps ➔ I need to access to relevant and good quality data for teaching and research ➔ I need access to quality data to develop case studies for teaching, research & consultancy ➔ I need skills development for academic staff and students ➔ Strengthening AI curriculum ➔ I need exposure to challenge driven AI special projects for students	DATA PRIVACY, ETHICS & OWNERSHIP KNOWLEDGE & SKILLS PARTNERSHIPS BUSINESS MODELS & RESOURCES TECHNOLOGY POLICY & GUIDELINES	➔ Advocacy and awareness promoting by involving Commision of Science & Technology ➔ Partnership with data owners to provide problem areas and data for graduates to do research ➔ Curriculum development for professionals and academic programs on how to use AI ➔ Internships and Practicums through partnerships with Implementing Partners to ensure AI is applied cost-effectively in practice ➔ Infrastructure to support AI learning	➔ Research agenda that is built with data owners and ministries ➔ Partnership with solution providers to provide ongoing technical assistance to MoH ➔ Research agenda that is built with data owners & ministries ➔ Partnership with solution provide ongoing technical assistance to MoH ➔ Establishing AI student clubs/forums ➔ Institutionazine the AI agenda in academic plans and budget

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	Need	Preconditions	Instill	Scale and Sustain
AI Solution Developer/ Engineer 	➔ I need to know the problem areas to focus on ➔ I need automation of systems and processes ➔ I need to prioritize aspects that bring best ROI ➔ I need access to AI tools and skills to use them ➔ I need access to resources e.g. computers, deployment, storage, data ➔ I need access to supportive community ➔ I need approvals developing and testing and improve from user feedback ➔ I need to know what systems and technologies currently being used and what data policy exist	DATA PRIVACY, ETHICS & OWNERSHIP KNOWLEDGE & SKILLS PARTNERSHIPS BUSINESS MODELS & RESOURCES TECHNOLOGY POLICY & GUIDELINES	➔ Partnership with domain/subject matter experts for consultation ➔ Mapping of data collection systems for particular program/ problem area ➔ Data approval for using data for co-creating working solution ➔ Grow a community that focused on real application of AI ➔ Establish strong partnership between experts and developers ➔ Transparency around available data sources ➔ Workshops, hackathons etc. for skills and capacity building development	➔ Successful change management ➔ Successful project exit strategy ➔ Engaging local institutions/ capacitate them ➔ Partnership with researchers ➔ Reduction in cost of resources (computers, servers etc.) ➔ Support from regulatory bodies and policy makers ➔ Access to funds ➔ Sensitization in the community about technology ➔ Sensitization for regulatory and policy partners ➔ AI implementation guidelines-centre design framework

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	Need	Preconditions	Instill	Scale and Sustain
Implementing Partner 	➔ I need to access to supply chain systems ➔ I need to be able to analyse data to give them information ➔ I need ready to use information for decision making ➔ I need to be able to understand how best to provide assistance and capacity support for interpreting data and making practical decisions with predictions ➔ I need to support adaptation of processes/SOPs to reflect changes in data use and decision making with AI/ML	DATA PRIVACY, ETHICS & OWNERSHIP KNOWLEDGE & SKILLS PARTNERSHIPS BUSINESS MODELS & RESOURCES TECHNOLOGY POLICY & GUIDELINES	➔ Build algorithm with current system ➔ Should have access to system ➔ Extend system(s) visibility to enable intervention and support from Implementing Partners	➔ Solution to adopt changes or expansion ➔ Capacity building beyond MoH (Academia, Local government and private institutions etc.)

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- I need easy accessibility and real-time data insights to provide to different levels e.g. Ministry, subnational etc.
- I need track status of medical equipments, medicine and non-medicine supplies
- I need to predict loss due to imminent wastage or expiry
- I need to predict annual needs
- I need to integrate data from LMIS, DHIS2, Got HOMIS and others
- I need to eliminate the need for me to call lower levels for reports
- I need to know cost implementation of AI
- I need flag to report data quality issues
- I need to analyze data and provide report
- I need system to function at operational level e.g. MoH, Regional & District Medical Officers, Health Facilities Incharges
- I need to ensure scalability to other beyond SC

DATA PRIVACY, ETHICS & OWNERSHIP

KNOWLEDGE & SKILLS

PARTNERSHIPS

BUSINESS MODELS & RESOURCES

TECHNOLOGY

POLICY & GUIDELINES

- Link existing systems
- Policy to guide path to keep clear path of AI and data security
- Conduct formative evaluation for need and acceptability of this technology experts and developers
- Awareness and readiness to adopt AI
- Share experience from other countries/regions benefits from AI

- Information Communication Technology (ICT) infrastructures and devices at all levels
- Reliable internet connectivity
- Tech skills and experts
- AI to work in different environment or scenario

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