“TOWARDS AN INTEGRATION OF UBI AND ITS CLUSTERS’ CAPABILITIES WITH IOA (INTERNET OF AGENTS): A FIRST STEP AND A ROADMAP”

Research Paper

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“Abstract”

The emergence of Agentic AI and AI Agents has proliferated the use of automation in enterprise processes. UBI as a community and ecosystem must also tap into this opportunity and trends of AI agents as a Service usage and context protocols via the integration of needed AI Agents and accompanying technologies like IoA into their business workflows. The advent of Internet of Agents(IoA) will also spur the interconnection of different agents (virtual and embodied robots) across enterprise and institutions using newly established communication protocols like A2A, ANP, ACP and AGNTCY. This study presents an introductory first step on how UBIs and their clusters can securely integrate their processes with Agents Communication Protocols like A2A, function calling and resource access like MCP and IoA (Internet of Agents) while also extending the application and integration across several industries and clusters such as MedTech, Biotech, Nanotech, Fintech, Network of UBIs, Luxury, Space Based Business Incubation Centers and Insurance. The proposed introductory steps and roadmap will ensure future interconnected private networks of UBI Agents across different UBI domains and multi-operability of Agents with secure knowledge flows and knowledge bases.

Keywords: AI Agents, Agentic AI, University Business Incubators Capabilities, Internet of Agents(IoA).

1 Introduction

This study introduces the concept and application of AI agents in UBI studies, while also educating readers and audience on the need for integration across the UBI value chain. The study intends to unravel the usage of AI agents and accompanying technologies for UBI capabilities and processes orchestration. This include capabilities at incubation inception, during incubation, adaptation, resilience network and linkages and also different UBI forms and clusters: MedTech, Biotech, ESABIC, Nanotech, Luxury, Insurance and Fintech) (Taiwo and Provodnikova, 2025). Although Agentic AI and AI Agents trends in enterprise integration has gained ground in recent times, however, the advent of Internet of Agents(IoA) has the potential of expanding the frontiers of multi-agents’ integration, co-ordination and task execution in UBI process. Generally, AI Agents have a level of reasoning based on their vector embedded models to autonomously aid robots and human in analyzing data and making decisions while explaining their thought patterns and approaches during analysis and tasks execution. AI Agents could be autonomously coordinated to execute several UBI processes and capabilities based functions integrated into the organizational operations (Taiwo, 2024). For example, UBI innovation based processes like developing highly innovative ideas from Universities, Project selection, IP patenting and licensing, triggers and adaptation to market dynamism could be orchestrated using AI agents. In addition to this, AI agents could also be assigned Cluster based capabilities orchestration and operational integration via performance metrics and key results e.g. developing robust and sustainable clusters, successful project ideas and commercialization, adaptation to various challenges and uncertainties could be integrated

within the value chain of Lifescience based clusters MedTech, Biotech, Nanotech based clusters. AI Agents abilities could also be extended to research and analyses based tasks e.g. Using Google' ADK (Agents Design Kit) and templates for risk, financial analyses and academic research or employing multi-tasking agents to run complex tasks with robots across healthcare, manufacturing and automobile (Wang *et al.*, 2025). For example, Tesla has Reinforcement Learning based sensors integrated into its autonomous vehicles which aids self-learning, collaboration and context addressing of reduced failed path and traffic routing. Other applications include medical device communications with robots during diagnostics and surgery (Patrizio, 2025). The innovation and integration of agents, robots and human could be multi-tasked and co-ordinated among agents to form a web of connected agents via IoA. Such innovation and integration could be employed by UBIs across their value chains.

Based on this, the remaining section are divided into: discussions on Agents, their communications protocols, Internet of Agents brief discussion, AI Agents and UBI processes and Capabilities workflow automation.For easier grasp of the concept, theme and readable flow, the figures are also structured as follows: Figure 1 illustrates this article as a representation of an extension of an earlier research(which includes UBI Dyanmic capabilities and IT integration, Intelligent automation with Agentic AI, Business Workflow Process, portals for UBI assessments and game simulation. Figures 2 to 8 depict the various UBI dynamic capabilities(DCAPS), resilience, adaptation and dynamic social networks and their clusters, figures 9 to 15 explains how the DCAPs could be integrated into UBIs and their Clusters' processes and workflows for agentic automation and also GenAI sample and setup with RAG. Figures 16 to 19 illustrate the implementation and grounding of these UBIs processes and workflows with RAG using Neo4j, H_2O.ai and the author's published articles which is important for ethical and responsible AI and thus preventing hallucination, Google's ADK AI agent sample implementation, figures 20 to 28 higlight the UBI and their clusters AI agents architecture,creation of Agents, multi-agents, agents communication protocols(MCP, A2A), agents marketplace, multi-agents in regional,national and EU levels and the agentic integration with IoA and EU' Gigafactory, while figure 29 to 31 show the roadmap, platform for assessment and game simulation portal.

2 Agents Communications Protocols, Accompanying Technologies and IoA(Internet of Agents)

The advent of IoA (Internet of Agents) enables the interconnection of several network domains of virtual and embodied agents(robots) across different networks to coordinate and manage several tasks effectively using protocols like Google's A2A (Agent to Agent) or Cisco ACP (Agents Communication Protocol) and AGNTCY. While these technologies are still in the early stages, it has been projected that AI agents and Agentic AI would be the next major tech trend in 2025 and peak till 2028 with about 15% of enterprise expected to be utilizing AI agents for their operational tasks (Sapkota, Roumeliotis and Manoj, 2025). A deeper look into the accompanying technologies and protocols would aid our understanding of the practical applications to UBIs and their Clusters' processes.

RAG (Retrieval Augmented Generation): It aids the retrieval and analysis of information from a database or repository based on knowledge graphs. The documents in the repositories are divided into nodes, chunks with their relationships using vector embedded models. RAG applications to UBIs processes could be extended to Cluster's document and information management processes e.g. in startups selection processes, selecting innovation ideas from Universities, knowledge management via absorptive capabilities in UBIs, UBIs key results and performance indices and metrics assessments, MedTech Cluster Innovation, Research and Development Processes with metrics across their value chain e.g. Ability to Innovate(A2I), Ability to Develop(A2D), Time to Develop(T2D), Time to Innovate(T2I), Approval and Validation of MedTech devices, MedTech Regulations and Compliances across different countries and regions in EU and the United States e.g. DACH, UK, US FDA, CFR 21 Part 11,Time to Market(T2M) activities.

MCP (Model Context Protocol): It is based on a client-server with users' architecture, MCP could be used for function calling, tool and resources access, prompts with LLM frameworks (Langgraph, Lang

chain) and Models (Claude Anthropic, Gemini, OpenAI, Hugging Face, MCP Agents) (Khanh *et al.*, 2025). Such application in UBIs could be different function calling on repositories and database for tasks like Risk management, financial analysis, performance monitoring, socio-triggers, Regulations and Compliances. Multi-task Agents could also be used together with protocols like A2A (Agent to Agent) for communication. A2A defines inter-operability of agents in a coordinated manner using autonomous learning of agents' skills description and tasks via the agent card and name registers. The coordinated A2A communication protocol is based on a client server and user architecture for LLMs and MCP(s). A2A ensures communications and interoperability of Agents via learning one another skills, expertise and description (like a broadcast) in the Agent's Card. For Application to UBIs processes, several MCP servers can be used for tools, resources (knowledge and innovation indices repository), UBI Innovation Strategies, Performance metrics and resilience development with interconnected MCPs using A2A communication protocols.

Further extension could be made with different domains combined and developed for UBIs i.e. virtual (agents) and embodied (robots) inter connected via Agents gateway and A2A or AGNTCY protocols to form IoA (Internet of Agents) (Weize *et al.*, 2024) to execute complex multi-connected tasks across different networks and domains. These domains could enable the combined coordinated workings of AI agents and robots. Such applications could be in Network of UBI formation for example a Tetrad (four UBIs combined) with MCPs designated for different UBI processes, resources and tools with agents located at each UBI with A2A communication protocol and all connected via IoA. A four-layered architecture is also proposed which is made up of Users and Agents interfaces and access, Orchestration layer (capabilities, processes, tools, resources) with LLMs, Management and Control Layer (Agents interworking, registration, control, assessments) and Infrastructure layer. Guardrails and security guidelines would be defined for each layer to facilitate the integration to IoA for UBI processes. In addition to this, several types of UBI agents performing different function across their value chain also needs to be available for selection and integration to each UBI domain.

Based on this a 'UBIAIagentsmarketplace' is proposed which would include an hotspot for UBIs agents e.g. 'UBI Capabilities Agents' across different industries(Traditional UBIs, Fintech, Biotech, MedTech, Fintech, Nanotech, ESABIC), Network UBI interworking agents, Life science and their UBIs agents, Fintech, Risk and Crises analysis and their ecosystem agents, Sustainability Agents (Climatic, Business and Governance or Leadership), RAGs Knowledge Bases Agents for UBIs and their Clusters, Dynamic Capabilities agents for incubation inception, during incubation, adaptability and resilience and performance metrics Agents, RISs and EEs transformation overtime agents, Startups Survivability, MedTech Compliance and Regulations agents. This marketplace could also be integrated with process and operational tools: project, program, lean management, emails, social media, online meeting and also partnership and affiliation with other AI Agent marketplaces, Cloud Providers, Agents developers and integrators. While this marketplace might be a new innovation in UBI concept, a roadmap guide is essential for implementation and co-evolution. Figure 29 shows a suggested roadmap and integration with IoA for the UBI ecosystem.

3 Methodology

This study is an extended part of a larger doctoral research on University Business Incubation Capabilities that enhances entrepreneurial activities across diverse industrial sectors which include: MedTech, Biotech, Fintech Clusters, Space Based Business Incubation Centers (ESABICs) and Network of University Business Incubators. The research methodology is based on Mixed methodology but spans several strands of techniques and applications through the combination of qualitative and quantitative (ML, Deep Learning and AI) research and integration of business management (research) and IT based on IT Strategy definition, GenAI, Business Process Automation (with Agents), Cloud Integration and Data Analytics, Web Development (for capabilities assessment) and Game Simulation. An overview of the methodological strands is shown in Figure 1.

4 UBI Capabilities, Workflows and Processes: Agentic AI Applications

In this section we would discuss how the capabilities identitied could be integrated into UBI processes and workflow. It also provides an overview of architecture across different UBI forms and how AI Agents could aid business process automation.

4.1 UBI and their clusters' processes across their value chain

Enterprise agility and efficiency lies in their ability to orchestrate their assets and competencies(capabilities) continuously. While business automation using RPA(Robotic Process Automation) has aided enterprise automation over a decade, the advent of Intelligent automation using AI Agents fosters the collaborations of agents, human and robots. UBIs and their clusters can also take advantage of this new technology trend. In this vein, we would elucidate on the various UBI forms' capabilities and processes and later how these processes can be automated with AI agents or Agentic AI frameworks. Architectures to be used are also provided. Figure 2 gives an overview of the UBIs(traditional) capabilities identified (Taiwo and Provodnikova, 2025)with the processes. This commences with the setting up guide at pre-incubation stage (i.e. before inception) which aids the assessment of the Regional Innovation System(RIS) and Entrepreneurial Ecosystems(EE) on the need to understand the RIS type or modes, attractiveness, existing infrastructure and support, knowledge flows and spillover, presence of firms with rivalry(innovation), EE attributes and lifecycle with entrepreneurial climate, the host Universities' pedigree in research and academic, roles of the UBI in their region(transformative or developmental), the UBIs portfolio development based on the RIS,EE assessments, industry, market and customers' analyses. This is followed by the capabilities and its underlying processes involved at UBI' inception (based on entrepreneurial cognitive behavior such as risk taking, opportunity recognition, motivation and entrepreneurial mindset), during incubation (knowledge flows and innovation development), networks and linkages (collaborations, partnerships, alliances and relationships) adaptation and operational adjustments, startups survivability and UBI sustainability with the required metrics. These capabilities and their processes and frameworks are documented in the setting up guide document, adaptation and resilience templates, network collaborations and linkages(with dynamic social network framework) as shown in Figures 2 and 8 below.

Key measuring indices with OKRs and KPIs (Objective Key Results and Key Performance Indices must be set and assessed at each stage in the UBI life cycle. For example, RIS and EE attractive index can be measured during the initial assessment with OKRs based on the University roles (transformative or developmental) contribution to the region assessed overtime.

For the UBIs and their Clusters e.g. MedTech and Biotech their capabilities and processes are also analyzed and shown in the figures below. For typical MedTech Clusters their value chains pass through Innovation, R&D, Approval & Validation, Reimbursements, Time-to Market(T2M) and End-User Acceptance and Impact. Capabilities required for MedTech Clusters and their UBIs have been identified in earlier discusses and these include Capabilities for Robust and Sustainable MedTech Ecosystem, UBI Projects and Startups Success, TTOs and Actor Impact, Challenges and Adaptation (Regional, Cluster and Organizational). These capabilities must be ingrained within the UBI value chain and metrics and KPIs must be set at each stage of the value chain and related parameters such as ability to innovate(A2I), Time to Innovate (T2I), Ability to Develop (A2D), Time to Develop(T2D),Time to Validate(T2Vd), Time for Reimbursement(T2Rm), Time to Market(T2M) and End-User Acceptance are all measured based on the accompanying processes and metrics. How these processes are ingrained into the value chain and business process orchestration towards achieving dynamic capabilities is vital. While the capabilities required at each stage have been identified, the essential questions should be: how does innovation process aid the development of a robust and sustainable ecosystem or how can the orchestration of robust and sustainable ecosystem capabilities affect innovation in the value chain,who are the actors within these innovation ecosystem? What research and development processes performed contributes to the overall achievement of successful UBI and MedTech clusters' startups? How can licensing and patenting strategies and agreement impact on selected projects? How do network and firm

collaborations and linkages affect the adaptation and resilience development? How do the business and economic logic actors of MedTech Clusters and their UBIs impact on compliance,validation and regulations and how do they impact reimbursements, end-user acceptance and impact with Time to Market(T2M)?

Generally innovation is triggered via idea generation from Universities, Project collaborations with firms and industries and regional needs for developmental and transformative projects. Universities play a major role as the source of continual generation of highly innovative ideas as well as CROs (Clinical Research Organizations),University Teaching Hospitals and Bridging organizations. The idea evaluation and selection process must be ingrained with the innovation phase of the value chain including the strategies for ideas selection criteria and funding sources and generation for the project(s). Licensing and Patenting strategies and agreements must also be defined for selected projects and added to the knowledge and documentation repositories. Similar firms and industries involvement for collaboration and partnerships during innovation must be selected based on set of standards defined by the Cluster and theMedtech industry. The economic and business logic actors required during the product (drug) development must also be ascertained at this point to combat hindrance during development and results expectations of stakeholders. The inclusion of end users at the early stages of development is also an important factor as this would enhance a positive End User assessment at the end of the value chain.

A knowledge of the level of adaptation required due to government regulations, technology adoption for renewal, complexities in value chain during product development, challenges and bottlenecks due to funding, IP licensing and strategies,tolerance to failure, Project or product development results or expectations(failure or success), presence of experts that might be required at the stages of innovation and R & D. During R & D infrastructural costs(lab or clinical testing) and risk analysis are required. The processes and methodologies required during development with the standards and requirements must be complied with at this stage. In case of market entry (into other countries or regions), intriguing questions such as: what standards and compliances are required for approvals e.g. in MedTech devices, what are the tiers or levels of requirements and classification for the MedTech based devices or services i.e. what class, tiers or level does the product belong to in the industry standards. e.g. ISO/IEC 16345/438,62303 generally define standards for MedTech based devices,while each country also classify medtech devices based on Tiers A,B and C (UK) or levels and what part of CSV and GxPs are also required for the approval of their MedTech device?

The onus rests on MedTech entrepreneurs to understand the classification they belong to and which standards based on quality management and risks (i.e. ISO standards for validation and approval). The procedures for reimbursements where applicable for their product must also be ascertain,updated continually and added to the repository. MedTech Clusters and their UBIs also need to ascertain where process automation is important and essential across their value chain and what OKRs and KPIs would aid the measurement and control of these processes across the valuechain. The sets of processes are shown for MedTech Based Clusters and their UBIs in figures 9 and 10.

For Biotech Clusters and their UBIs, sets of capabilities(Successful Biotech Based UBIs, Entrepreneurial Activities Survivability, Early Stage and Matured Phase Capabilities, Perseverance Biotech value chain and Regional Biotech Capabilities) identified are shown in figures 11 and 12 below with the typical workflow processes. These are separated into different processes with repositories for RAG(Retrieval Augmented Generation) and Agents assigned for automation which would be automated by AI Agents.

For ESABICs their capabilities can be segmented on a multi-level based analysis across the value chain segment and this include: Perseverance and motivation on the individual level for the incubation process and an entrepreneurial mindset(for entrepreneurs), at the organizational level(UBI) capabilities is required for a Space based robust ecosystem with funding and collaboration, presence of experts and firms(in specific areas of the valuechain), leverage on host University pedigree in related academic research fields and leverage on other regional University collaborations in Space Based Business

segments, Open Innovation process, (Market) need and demand analyses for effective UBI incubation process and on the network level capabilities are required for regional and trans-regional activities.

The next sections illustrate typical architechtures and samples and implementation of agentic automation with the accompanying technologies described below.

4.2 Agentic automation in UBI processes: typical examples

Based on the accompanying technologies description in earlier sections (RAG,MCP and A2A), we would apply the UBI forms' capabilities and their processes using RAGs and combination of AI Agents. Figures 14,15 and 16 shows typical RAG applications for UBIs. For the UBI, the setup UBI guide document can be used as in the repository (a database for storing your private document) and information retrieved via RAG using LLM models like Anthropic, Open gpt4 and frameworks like Langchain, Langgraph. RAG as explained above works based on vector embedding. The documents in the database are divided into nodes, chinks and relationships as shown in Figure 14. Users can use prompts to ask questions. Information are retrieved based on the embedded chunks and relationships analyzed. However, for the case of using agents, an assigned agent as shown in Figure 15 would explain the level and plan of action(s) to solve the task based on the question from the prompt. In the case of figure 16, private articles by the author were used and RAG based models were selected for the GenAI model and the assigned agent executed the tasks precisely as expected. The beauty of some GenAI models and framework is the ability to evaluate Agents performance based on the task given. For this particular case, an evaluation was made based on fairness, bias, hallucination (a major challenge with LLM based models) and the percentage score was 98% showing the level of accuracy and ethical behavior during task execution. Another example is shown in figure 17 below with an agent assigned using LLM models. In this case RAG for private database or document access wasn't selected but the Agents was assigned to solve the tasks using public information (internet, wiki and other sources) however, the sources of information were cited in this case.

Another typical example of AI Agent implementing tasks is shown below(Figure 18) using Google's ADK (Agent Development Kit) and Gemini 2.5 as the GenAI model. This was part of the ADK files provided by Google Cloud Vertex AI for Agentic AI implementation. This was implemented using Google Cloud SDK Shell, Google's ADK, Google Cloud Vertex AI and windows command. This example was for agents that could perform academic research, cite references and also state other lines for future research. The second was an agent that could perform financial advice for stocks trading. This agent gives analysis on stocks and also performs risk management analysis other examples are list on Google Cloud Vertex AI ADK implementable samples. The UBI(traditional) agents can be setup to coordinate and automate the UBI capabilities based tasks as shown below. Agents are assigned for each part of the incubation stage and a coordinating agents assigns tasks based on the User' prompt. Agents are assigned for setting up UBI guide, at inception, during incubation, adaptability and resilience and also for UBI' sustainability and survivability as shown in figure 19. UBI Capabilities based metrics, OKRs, KPIs are coordinated by the 'coordinating agent' and the results could be observed on a UBI based portal or cloud for assessment real-time. The agents shown are available on the UBI Agents' Marketplace (see next section for details and Figure 27). The Biotech based processes, workflow and capabilities automation via agents can also be implemented with similar architecture as in Figures 19, 20 and 21. Specific agents are also assigned tasks for the Biotech based UBI and their clusters capabilities and processes: Early and Matured stages, regional biotech capabilities, Entrepreneurial activities survival, Regional Biotech based capabilities and Perseverance and Adaptability related UBIs, Clusters and collaboration processes embedded in the workflow automation. These agents are also available in the UBI Agents Marketplace.

MCP client-server architecture could also be used for the UBI Agents' processes and capabilities automation and coordination. MCP usage would aid function calling (e.g. ML training) and tools or resources (RIS, EE assessments document, sustainability reports, knowledge and innovation document usage). This would also allow inter-agent communication using A2A as shown in figure 19 below. For

the MedTech based Clusters and their UBIs, the approach for the agent task execution is a bit different due to the interwoven processes and the capabilities required at each stage of the value chain. Our analysis as explained earlier also looked into how these capabilities impact and affect each stage of the incubation MedTech value chain. The coordinating agent also takes care of the various metrics required at each phase of the value chain. These metrics include A2I, A2D, T2I, T2D, A2Vd, A2Rm, T2Vd, T2Rm, T2M and End User Impact. An agent has been dedicated to handle the compliance, validation and regulation tasks due to the rigorous tasks required during compliance, validation, government and industry regulations. Sets of repositories are also assigned for documentation of MedTech and lifescience based standards: ISO, IEC, FDA, CSV, GxP. Multi-Agentic Interworking relationships is also used for the Robust and Sustainable Capabilities processes automation due to the sets of activities required to ensure this. Figure 22 gives an illustration of the MedTech Agents' architecture. The agents for the MedTech Clusters are also available in the UBI and their Clusters' Agents Marketplace. Similar MedTech Based Cluster and their UBIs processes and capabilities could also be used with MCP client-server architecture as shown in figure 23. In this architecture, users can call on resources and tools based on prompts. These resources would include compliance standards and documents, sustainability, innovation and knowledge flows reports, Metrics, KPIs and OKRs indices. For the Network of UBIs MCP-A2A architecture using a client-server architecture would be suitable due to the combination of several UBIs and a centralized governing structure. The architecture for the Network of UBIs is shown below in figure 24. A centralized coordinating agent is used which coordinates other UBI based agents at each region. A central repository or server is also used that embedded the Network UBI's governance, alliances, collaborations, structures and support system. Each UBI can make function and resource calling using MCPs while inter-agent communications via A2A. Figure 26 also shows the FintechInsure Agents network with inter agent-robot communications with the UBIs based clusters and startups.

A regional or national cluster based agentic architecture is also proposed as shown in Figure 26 in this case all clusters with their agents are connected to the central coordination agentic AI framework (Yang *et al.*, 2025). This architecture is suitable on a regional or national levels for Cluster processes and capabilities coordination. A central server repository is also proposed for all documentation, agents' orchestration, authentication and registry, function calling and resources and tools triggers can also be made via prompt calling in a client server based architecture. The sets of reporting and KPIs monitoring, control and collaboration activities are also embedded in the central repository (server). MCP is used for function calling with A2A for inter-agent communication. The Agents Register shows the list of available agents, their skills and abilities. Authentication via tokens, encryption keys or OAuth is done for each agent as a means of security checks. Since user interface could be a HTTPS, JSON or with RPC, TLS encryption is advised for data exchanges. A Gateway agent is assigned at each cluster' entry to communicate with the central CoE(Cluster of Excellence) Cluster Coordinating Agent via A2A communication. Further Agentic architectural designs are also in progress for Nano, Luxury, Automobile and Insurance based Clusters and their UBIs.

5 UBI and their Clusters' AI Agents Marketplace

Due to the flurry of AI Agents and Agentic AI required in the course of this research, the need for AI agents' marketplace is indispensable. Having analysed the various agents required for different tasks and process orchestration, a UBIAgents'Marketplace (url:www:ubiagentsmarketplace.com) has been designed to cater for the diverse agents required for all UBI forms. The Agents are categorized in the marketplace based on the abilities,tasks,UBI forms and Agent Roles. There are general agents available for UBI process and capabilities orchestration such as innovation and knowledge flow agents, entrepreneurial activities asssessments, entrepreneurial cognitive behaviour agents(handles opportunity recognition, entrepreneurial mindset, risk taking and motivation in student entrepreneurs), Adaptability agents, Project Selection and Inter-Firm Collaboration. There are also agents for special tasks such as: UBI Sustainability and Survivability Agents and Resilience Agent. Agents are also available for MedTech Robust and Sustainable Capabilities Assessments, MedTech Compliance, Collaborations and Networking, Market Analysis, Biotech Based Cluster and Capabilities Agent(handles Entrepreneurial Survival in Biotech Clusters and their UBIs, Biotech Early and Matured Stages, Perseverance and

Resilience in Biotech Clusters and their UBIs). There is also a Central Coordination UBI Agents for Multi-Agents Task completion. In this case, three other AI Agents would complete a task execution with the Master Coordinating UBI Agent directing and assigning tasks to the other agents. Other Cluster based agents would be included and updated shortly. Figure 27 gives an overview of the UBI Agents Marketplace.

6 Proposed UBI Agentic Domain Architecture

This section introduces a UBI agentic domain architecture suitable for inter-clusters, EDIHs, national and EU Central AI Data Center, EU Cluster Collaboration Partnership(ECCP) and EU AI gigafactory ('Shaping Europe's Future: AI Factories', 2025)integration. From Figure 25, a National Cluster of Excellence(CoE) can inter-connect with the various regional clusters explained in later sections. A central repository with resources and tools for Sustainability(Business,Climate and Governance) of Clusters and UBIs, Start-ups Survability, UBI and their Clusters Adaptability and Resilience could be assessed and monitored while also controlling the metrics for capabilities(substantive and dynamic),collaboration indices and End-User Impact for cases of Lifescience Clusters. Each regional cluster would represent a domain which could consist of both virtual(AI agents) and embodied agents(robots). Inter AI agents and robots standard communications and interoperatability must be ensured at both regional and national levels. MCP and A2A protocols can be used for inter-cluster fuction calling and resource based assess.

A Central AI Agents Register at the CoE is also proposed as this would have the details of all agents' lists,description,capabilities,assignments,performance,evaluation reports. The Central controlling Agents at the CoE will also coordinate all agents' requests and assignment. A Gateway access at each cluster entry is also proposed for authentication,authorization and accounting. A 4-Layered interface for the Domains and CoE would be made of user interface with HTTPS, RPC and JSON access and also IAM(Identity Access Management) and Privileged Access Management with Role Based Aceess and Control specifications for Cloud based interfaces. The Applications and Orchestration Layers manages the tools, prompts, function calling and resources at the Central CoE and each client on regional clusters level during MCP exchanges. This layer also handles Agents based applications coding in case of intrusion and attacks during exchanges,communications protocol exchanges and abuse. The Management and Control Layer oversees Agents inter-communications, operations, life-cycle and exchanges. This layer with the application and orchestration layer also evaluated LLM models (Wu *et al.*, 2023) and Agents performance. This layer also handles the security of the CoE and Clusters communications on the interface,application,transport and network infrastructure levels. Dashboards for performance evaluations and metrics should be set based on each models and data (analysis) training. The Infrastructure layer oversees the client,server,Cluster and CoE AI based infrastructure and Cloud based integrations using the Cloud Shared Responsibility Matrix for cloud based integrations and also the AI Framework. Ethical consideration must be put in place for all LLM models and data usage and as also specified by cloud provider's related Explainable, Responsible and Ethical AI usage.

The EU General Purpose AI Model Acts of Transparency, Copyright and Safety and Security must be adhered to. The explainable reasoning and memorying of AI agents must be duly expantiated during tasks execution, the guide and usage of GDPR for data training and analysis must also be complied with. For instance during the course of developing the RAG and Agents Analysis, the authors personal articles and documents were used for RAG integration and vector embedding search. This also applied to the Agents' guide on the Agents Marketplace. For cases of Agents LLM model search, citation were used for internet searches and for sources of information. However for commercial usage the Agents Marketplace the database for RAG is basically made from the author's private documents and articles. For Safety and Security of agents, Performance evaluation of models and agents should be checked per task or as when required. The LLM models and platforms used in this study had evaluation performances for Agents based on hallucination,fairness and bias. Risk management measures should also be adhered to in the deployed. NIST AI based risk assessments and also the EU AI Act for level of risk must be done throughout the lifecycle of the Agents and during exchange and ommunication. Based

on the EU Act' level of Risk, Unacceptable, High, Limited and Minimal levels of Risks must be assessed based on Agents Activities and Machine Learning models.Transparency must be effected during deployment based on explainable AI models acts and integration to IoA and EU Central AI Giga factory.

6.1 Integrating the UBI and their clusters' domain(s) to IoA: defining interfaces and standards

As shown in Figure 28, a high level crossdomain architecture for interclusters and the UBIs' networks integration to IoA is proposed at the EU level. This would be made up of the already established EU AI Giga factories across major EU countries. Our assumption is these factories would be equipped with Agentic AI interfaces and Gateway connections to IoA. Each EU 27 member states central Cluster CoE as explained above would be connected to the Giga Factory and the Giga factory Gateway for non EU member states is also proposed based on the working memorandum with countries like Switzerland and the UK. EU's EDIHs (Digital Innovation Hubs), Network of UBIs and EU's BICs(Business Incubation Centers) are also added into the fray for interconnection with the EU IoA backbone server and repositories. IoA' Inter-network communication and operability e.g with V2X (V2I,V2V,V2G,V2S) vehicle to infrastructure, grid, server and vehicle, drones with AI agents must be effected for cases of AI agents communications with vehicles and related vehicular communications as well as Drones, Robots Acts and usage with AI Agents for the industrial use cases based on the EU General AI and Drone Acts. Communication protocol standards and interoperability for AI Agents like A2A,ACP,ANP and MCP with Mobile networks must also be integrated especially with 5G and 6G standards. Domain addressing of IoA agentic framework (Ehtesham *et al.*, 2025) must also be considered as well as Security at each level of Inter-clusters(EU level), Intercluster(National level), Inter UBIs and their Clusters.

7 Discussion and Conclusion

In conclusion the integration of UBI processes, workflows and capabilities orchestration with AI Agents and communication protocols that aids multi-agents interworking will aid a paradigm shift in UBI processes and capabilities orchestration. UBI processes integration into the IoA will also serve as a pathway to the web of UBI Interconnected agents (either on private or public networks) and multi-parties or domains coordinated multi-working. This paper serves as an introductory guide and an eye-opener to the possibilities of Agentic AI usage and integration with communication protocols and Networks within UBIs and their Clusters at Regional, National and EU levels. Further details of the AI Agentic Act guarding UBIs and their Clusters must also be enacted in creating standards and ensuing policies for the UBI community. Decisions must be made on accompanying technologies(RAG,MCP), protocols and usage of data, repositories and configurations.

While EU Digital Networks Communications Act with the Gigafactory has established testing and implementation of AI based solutions and devices across industries, the onus rests on the UBI communities to take advantage of this and establish a working group or forum that defines and appropriates the suitable required standards of UBI and their Clusters processes. Regional Government and Cluster Executives are also encouraged to aid the inception and definition of the expected standards for the UBI and their Clusters Marketplace. The author has initiated a "UBI AgenticMarketplace"(details will be given shortly) shown in figure 27 for UBI forms like ESABIC, MedTech, Biotech, Network of UBIs, Fintech and their Clusters' inter-connection at regional and national levels and also a UBI portal assessment for Dynamic Capabilities, Socio-Human Structuration and Social Neworks Collaborations (Figure 30) and UBI Game Simulation Portal(Figure 31), however a collective collaboration across industries is still required to ensure appropriateness and standardized accompanying AI Agents and Agentic AI across UBIs and their Clusters. Security at levels of interconnection and on the layers defined is also crucial. Spoofing, intrusion, malicious(SQL) injection are notable AI agents attacks and caution should be taken to establish standardized security assessments framework with experts and the UBI community.

Future research is also in the pipeline by the author for the integration of UBI(different business models (Borins and Gnielda, 2017), forms (Taiwo, 2024), typologies, value co-creation processes and agents on AI based chips. With the evolution of electronic circuits from FPGA(Field Programmable Gate Arrays) to SoC(System on Chip) and lately AI based chips from NVIDIA and Photonics that could reduce energy consumption by almost 90% and with a high data analytical capabilities,organizations like UBIs and their clusters could maximize productivity,business process management and data analysis capacities with these embedded AI chips. The future of organization productivity lies in Agentic AI productivity optimization and high processing capabilities chips ('Substack Business Analytics Newsletter Review', 2025)

It is a known fact that the AI Agent trend is a huge shift in the industry and this study serves as a clarion call to the UBI and its Clusters' community to jointly initiate a deeper research forum and expansion that fosters Business management and IT interjection.

7.1 Figure

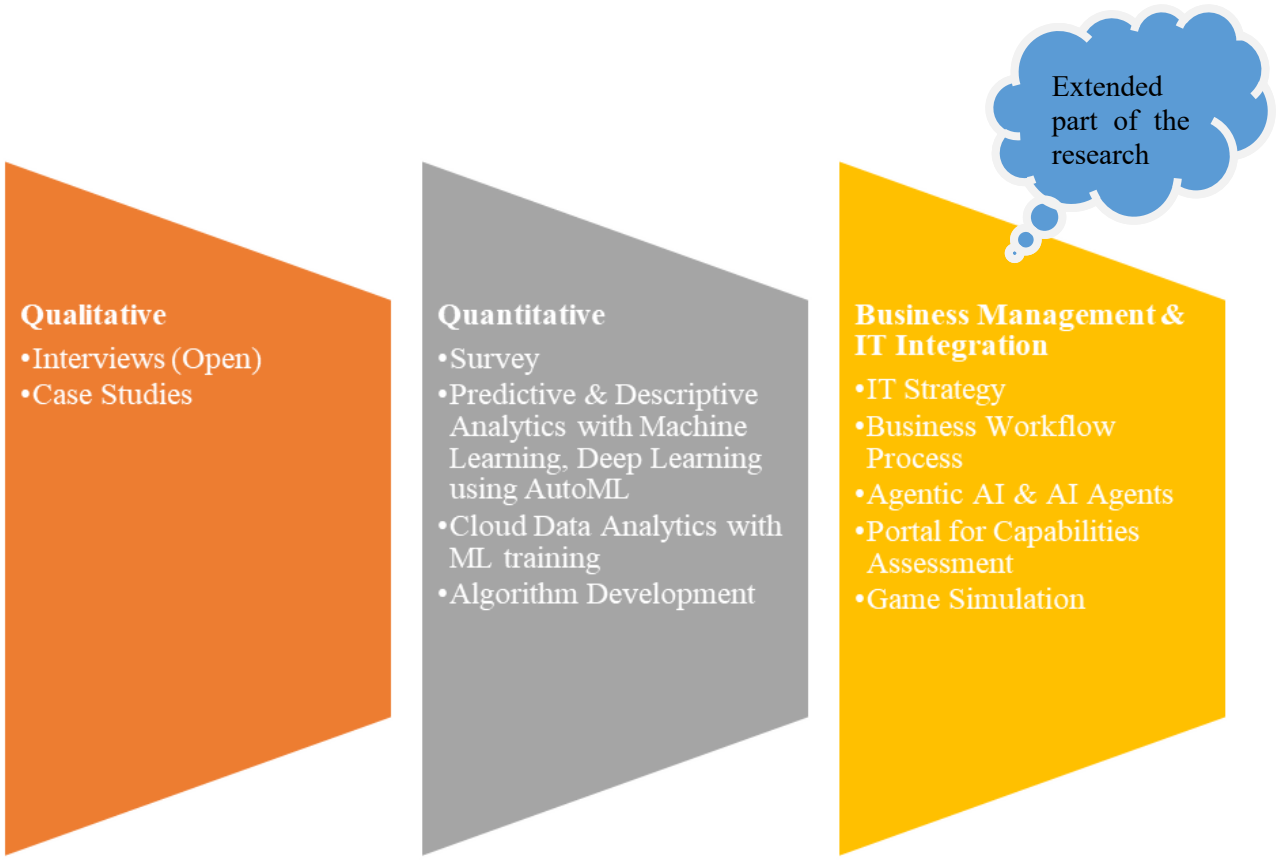

Figure 1. Research methodology strands based on a summary of the research tehcniques used by the author.

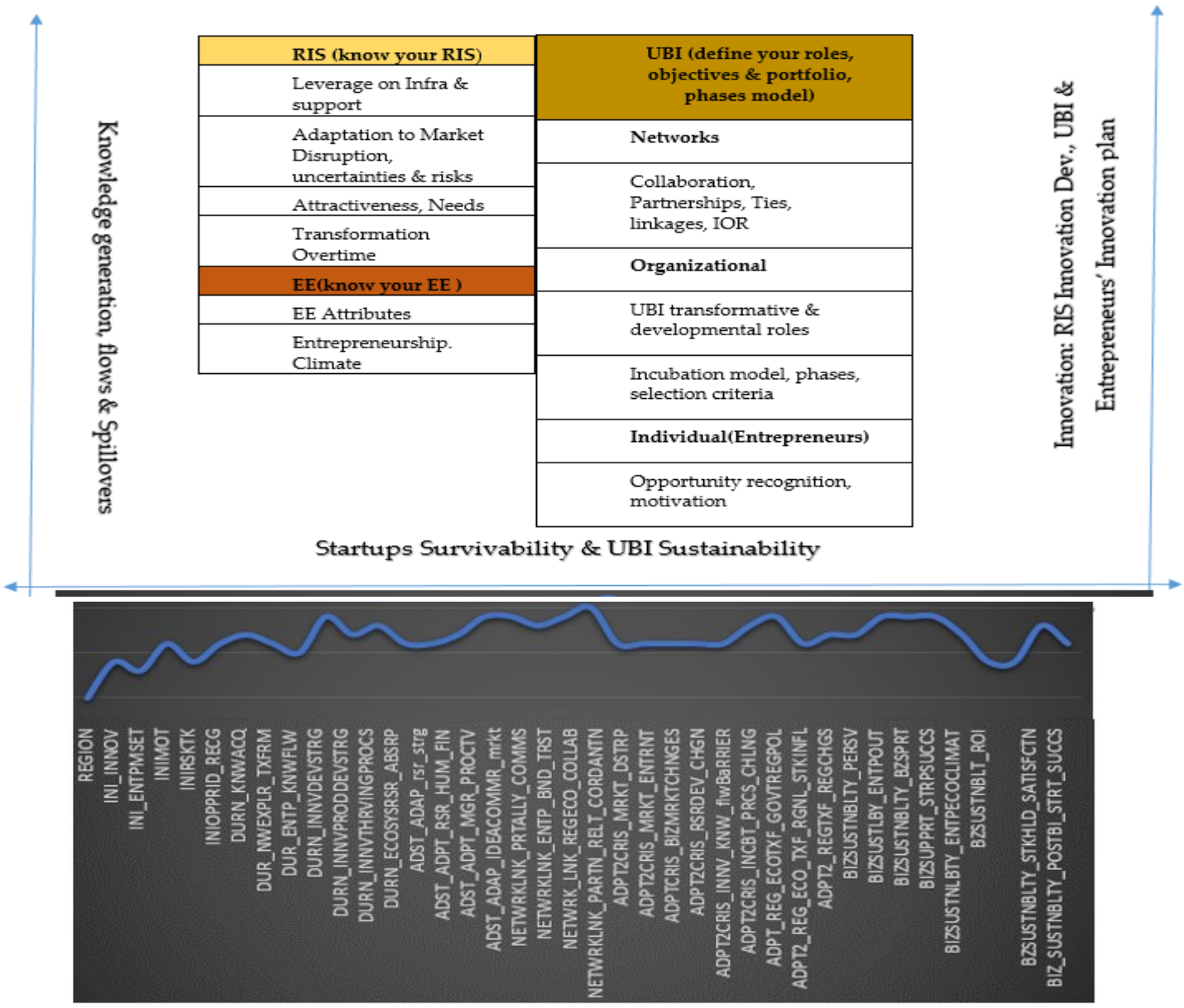

Figure 2.UBI Process guide with capabilities required across the value chain (Source: Taiwo and Provodnikova,2025,p.13)

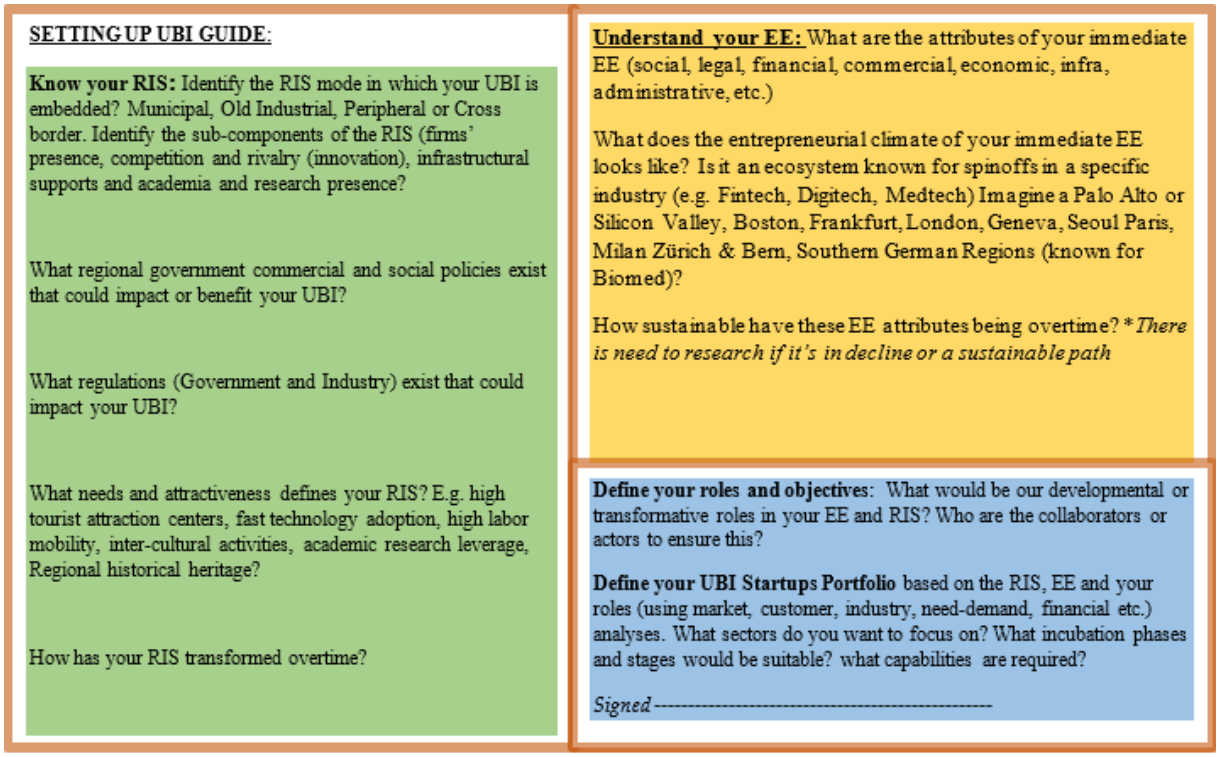

Figure 3. UBI 'Setting Up Guide' Document.(Source: Author's design)

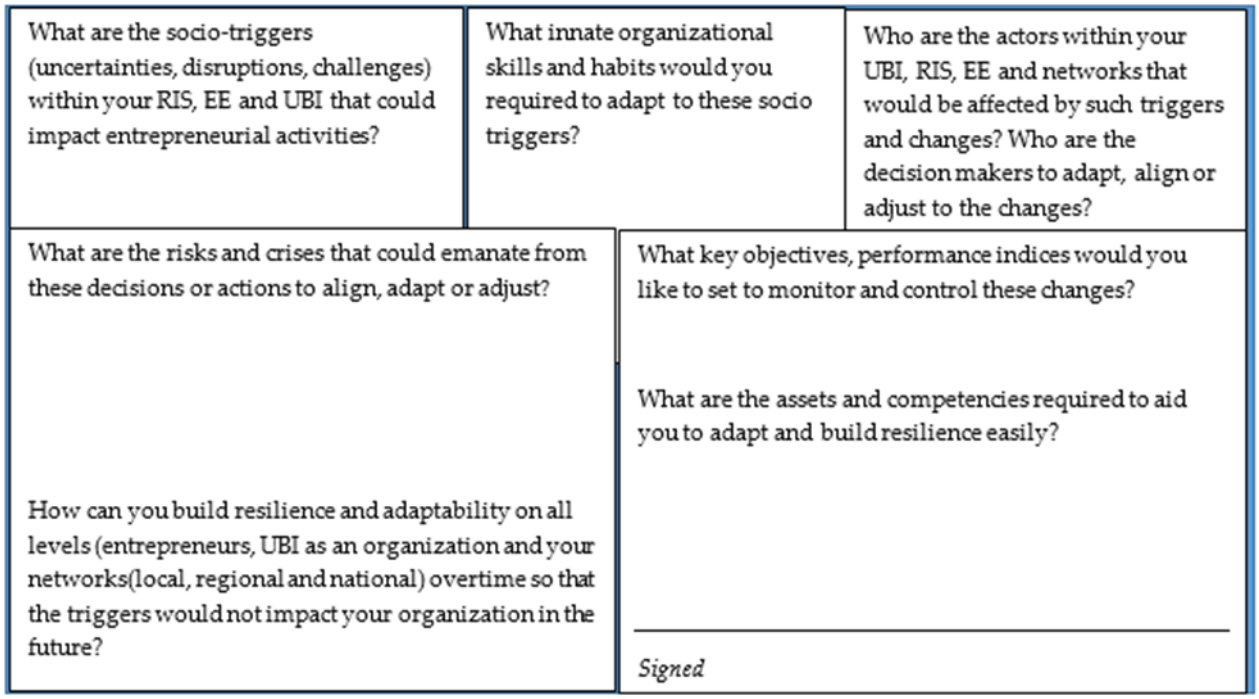

Figure 4. UBI Adaptive capabilities and Socio Human Triggers template.(Source: Author's design)

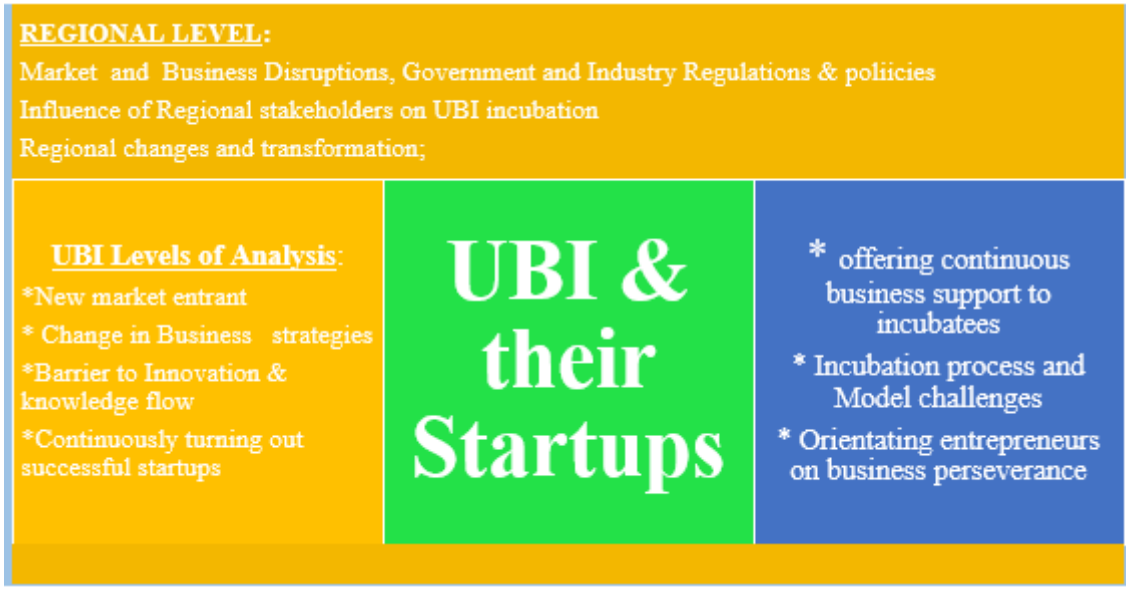

Figure 5. UBI Adaptation and Resilience on a multi-level (regionally, the UBI and its entrepreneurs).

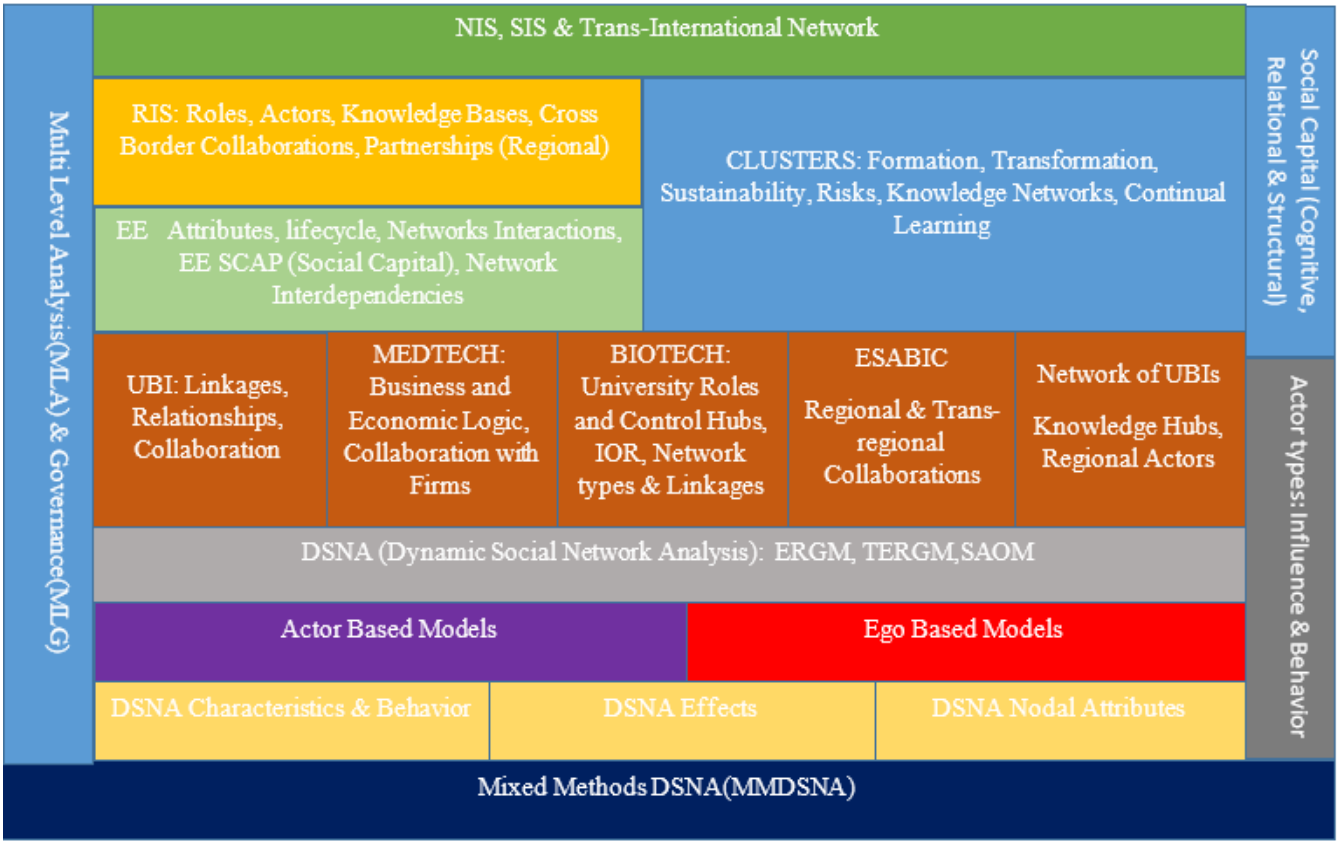

Figure 6. Dynamic Social Networks Framework.(Source: Taiwo,2025,p.31).

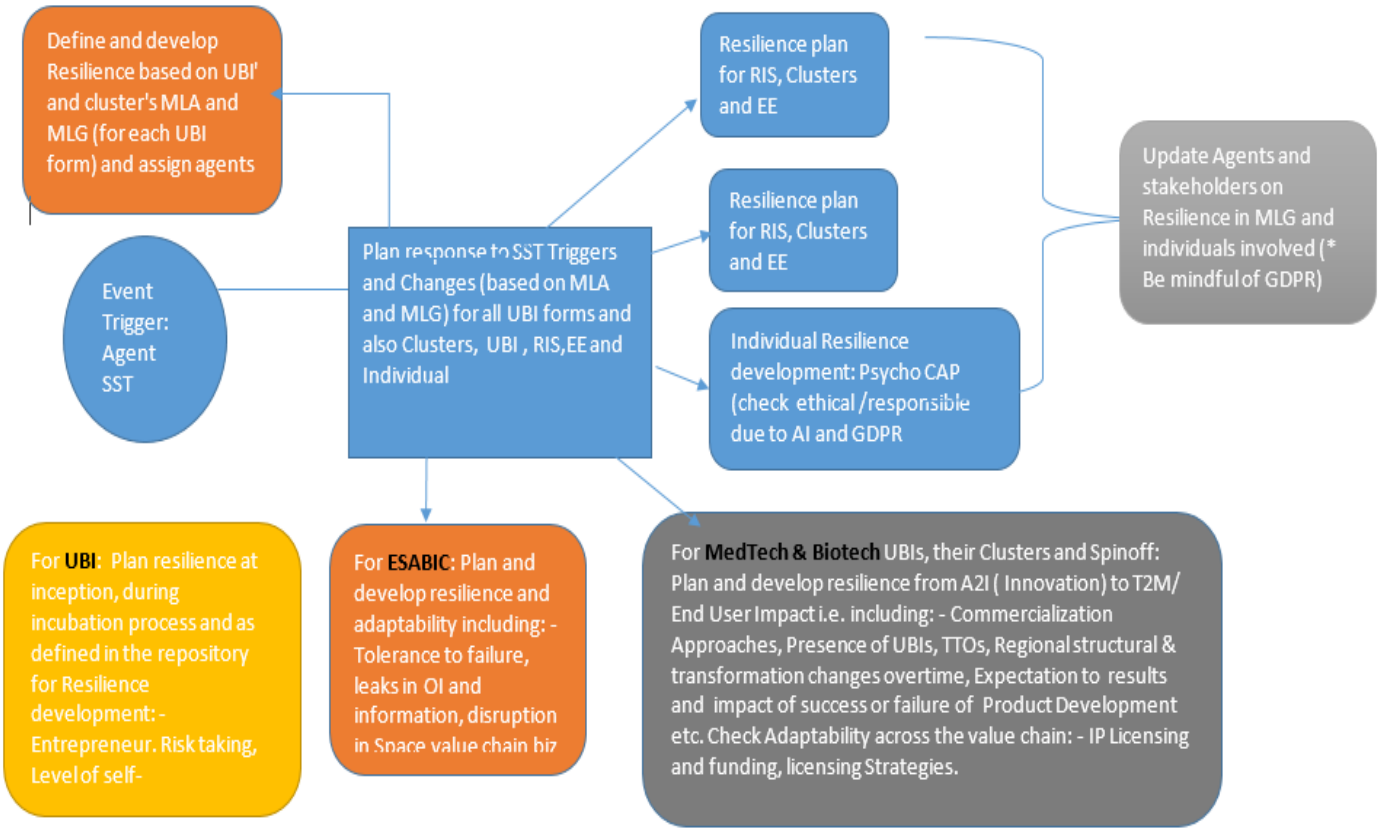

Figure 7. Typical Resilience and Socio-human structural analysis workflow for all UBI forms(Source : Author's design).

Figure 8. Adaptation, Resilience, Risks and Crises Management development framework for all UBI forms.Source: Taiwo,2025,p.24).

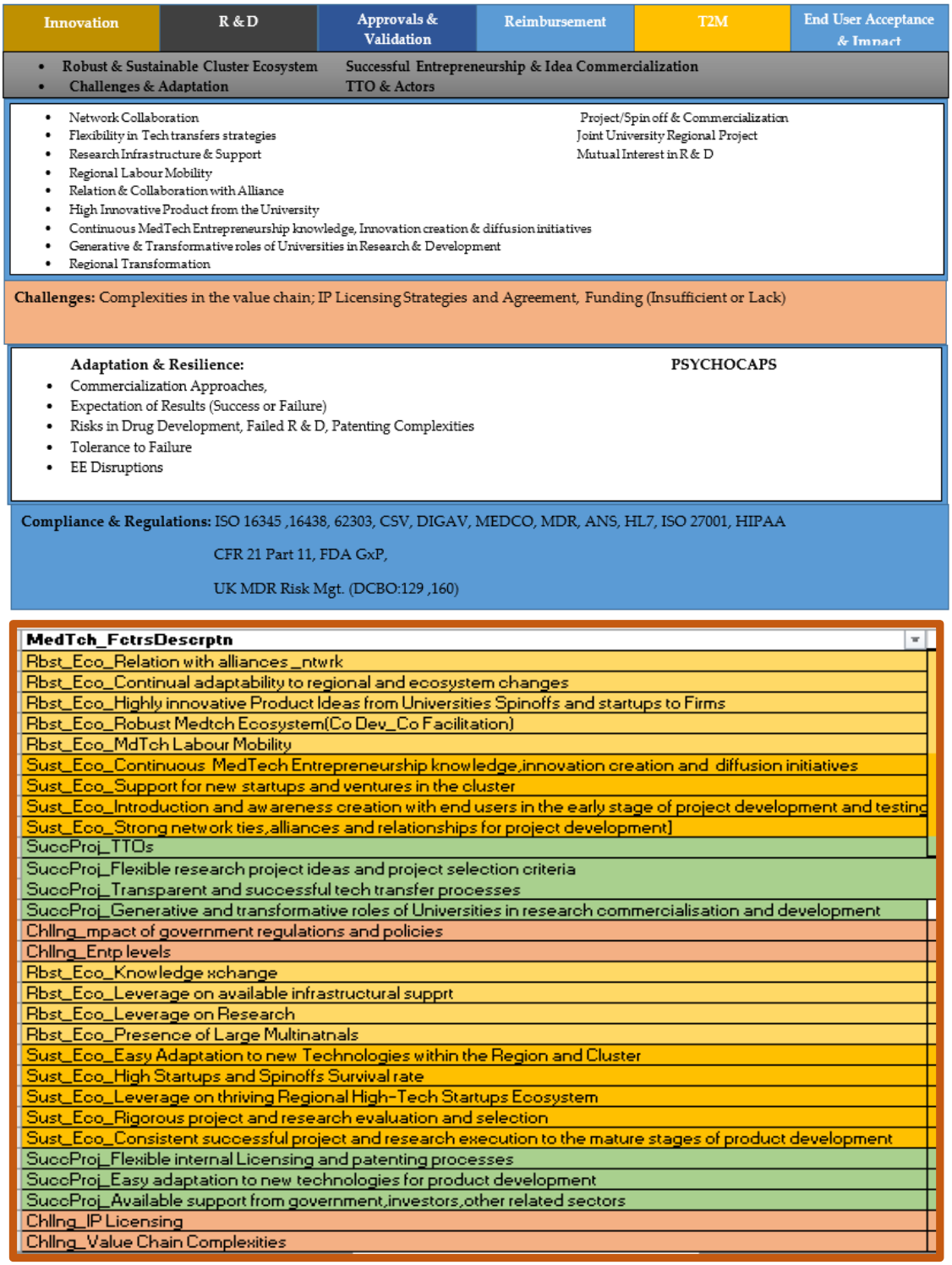

Figure 9. MedTech Based Clusters' and their UBI's processes and Capabilities (Source: Taiwo and Provodnikova,2025,p.5).

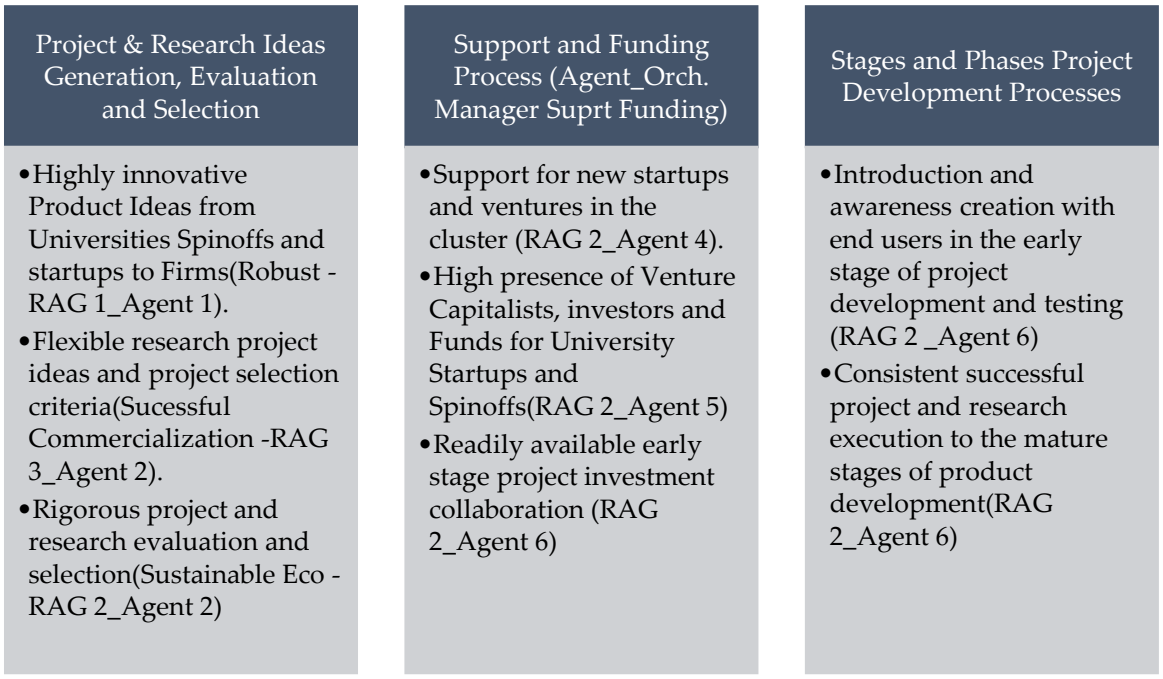

Figure 10. MedTech Based Capabilities and Processes with specified Agents and RAGs. (Source: Taiwo and Provodnikova,2025,p.22)

Figure 11. Biotech Based Dynamic Capabilities with RAGs assignment. (Source: Taiwo and Provodnikova,2025,p.23)

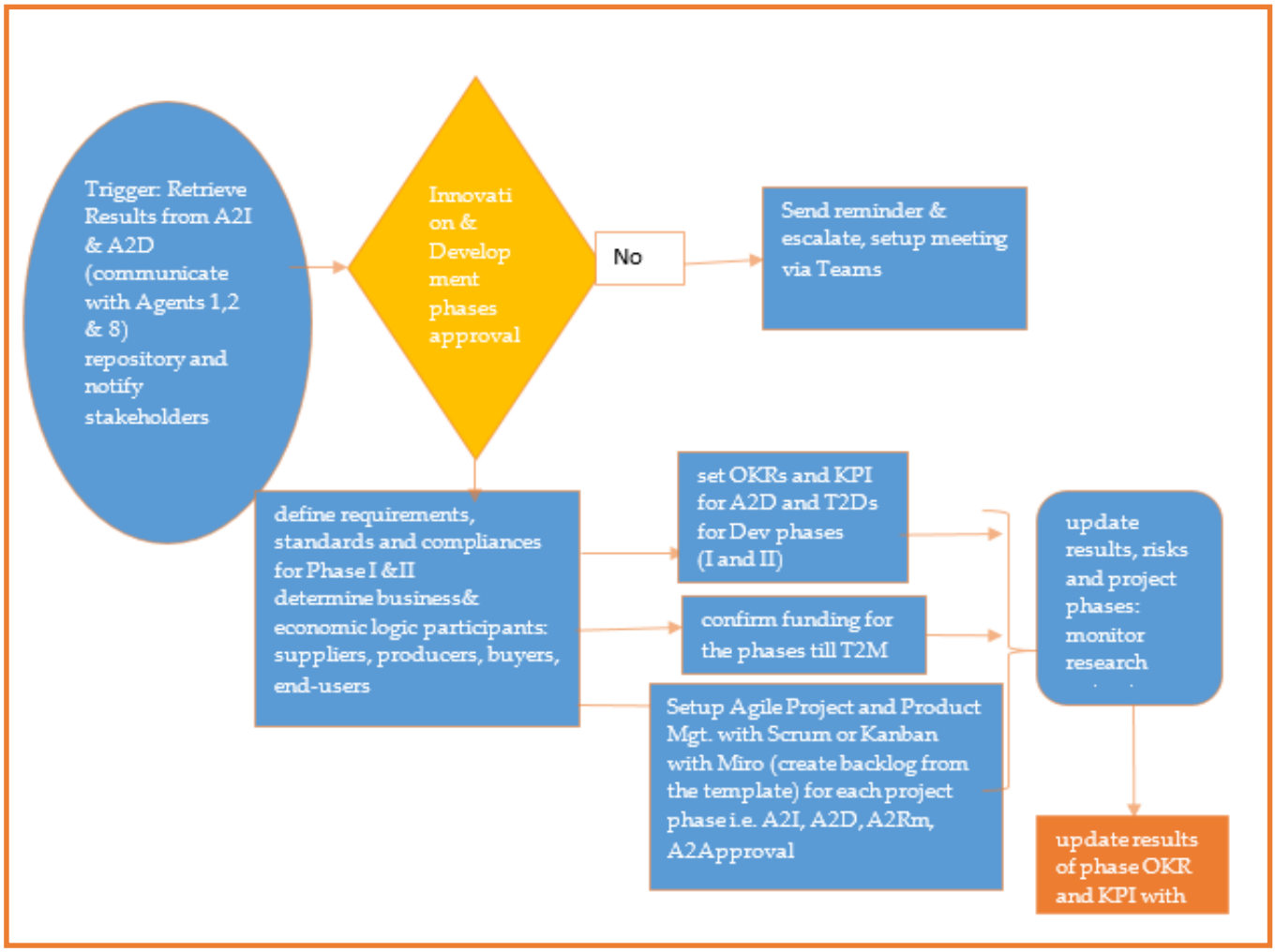

Figure 12. Workflow process for Early and Matured Phases of Biotech Based Clusters and their UBIs.(Source: Author's design).

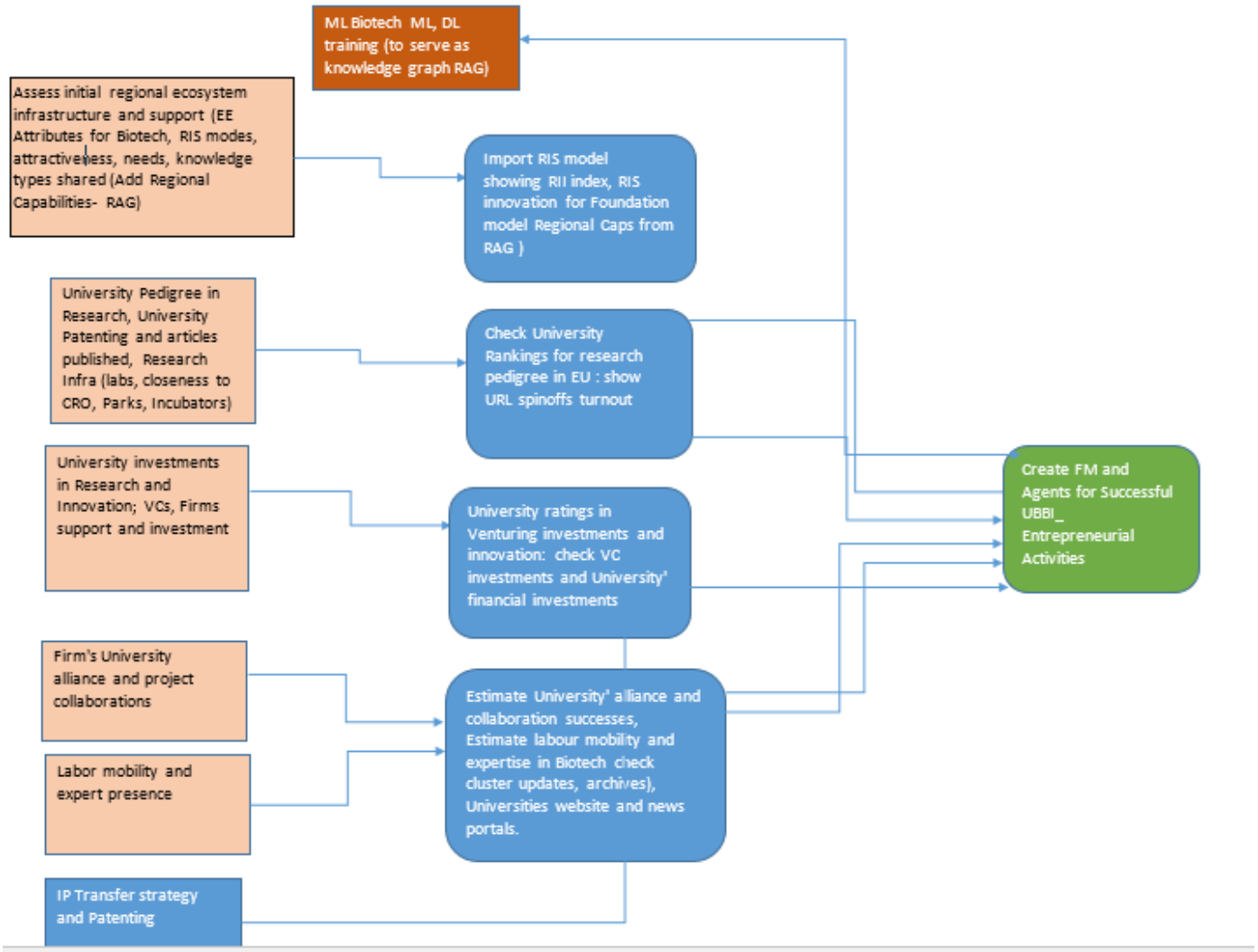

Figure 13. Workflow Process for Biotech Based UBI and Successful TTO and Entrepreneurial Survivability. (Source: Taiwo and Provodnikova,2025,p.5)

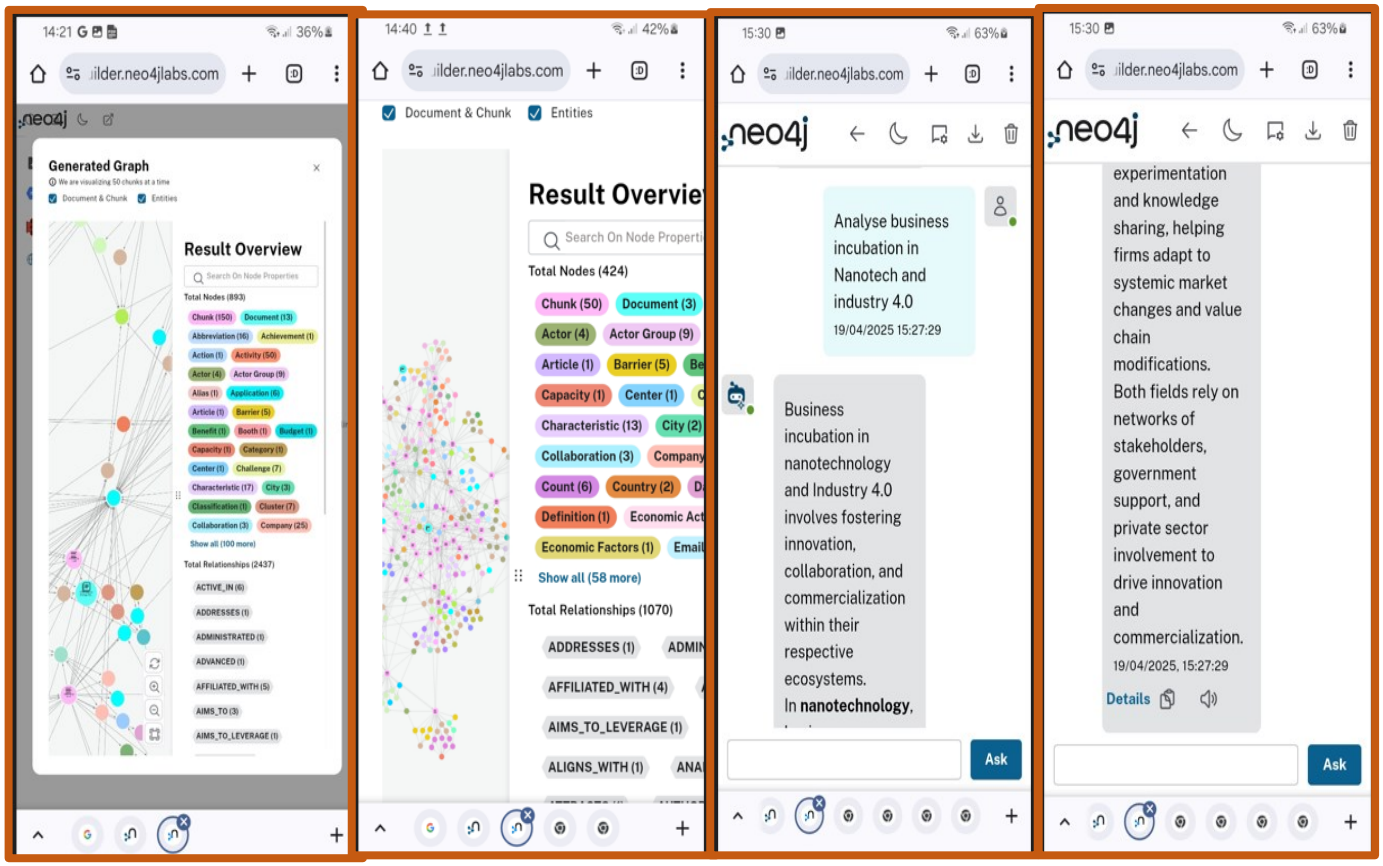

Figure 14. Knowledge Graph Implementation(RAG) with Neo4j Aura DB.

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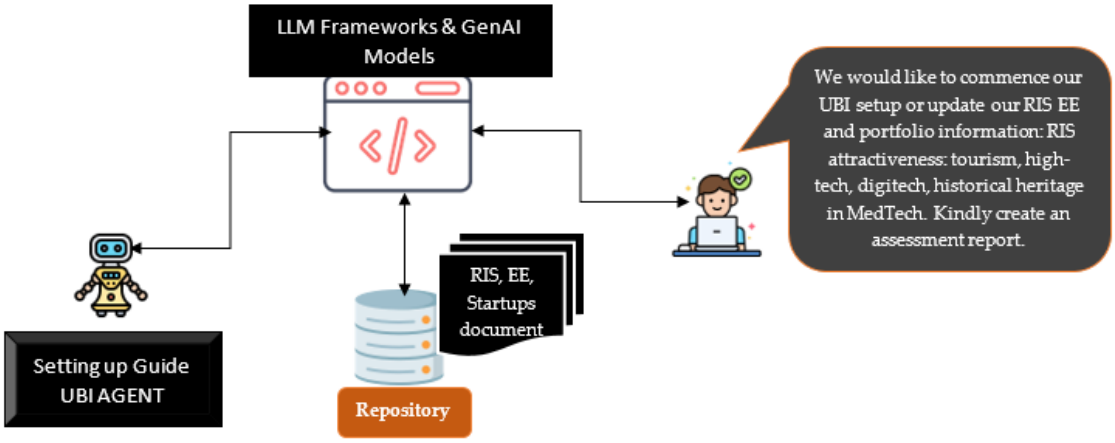

Figure 15 . UBI(Traditional) Application of RAG at Pre-Inception.((Source: Taiwo and Provodnikova,2025,p.25)

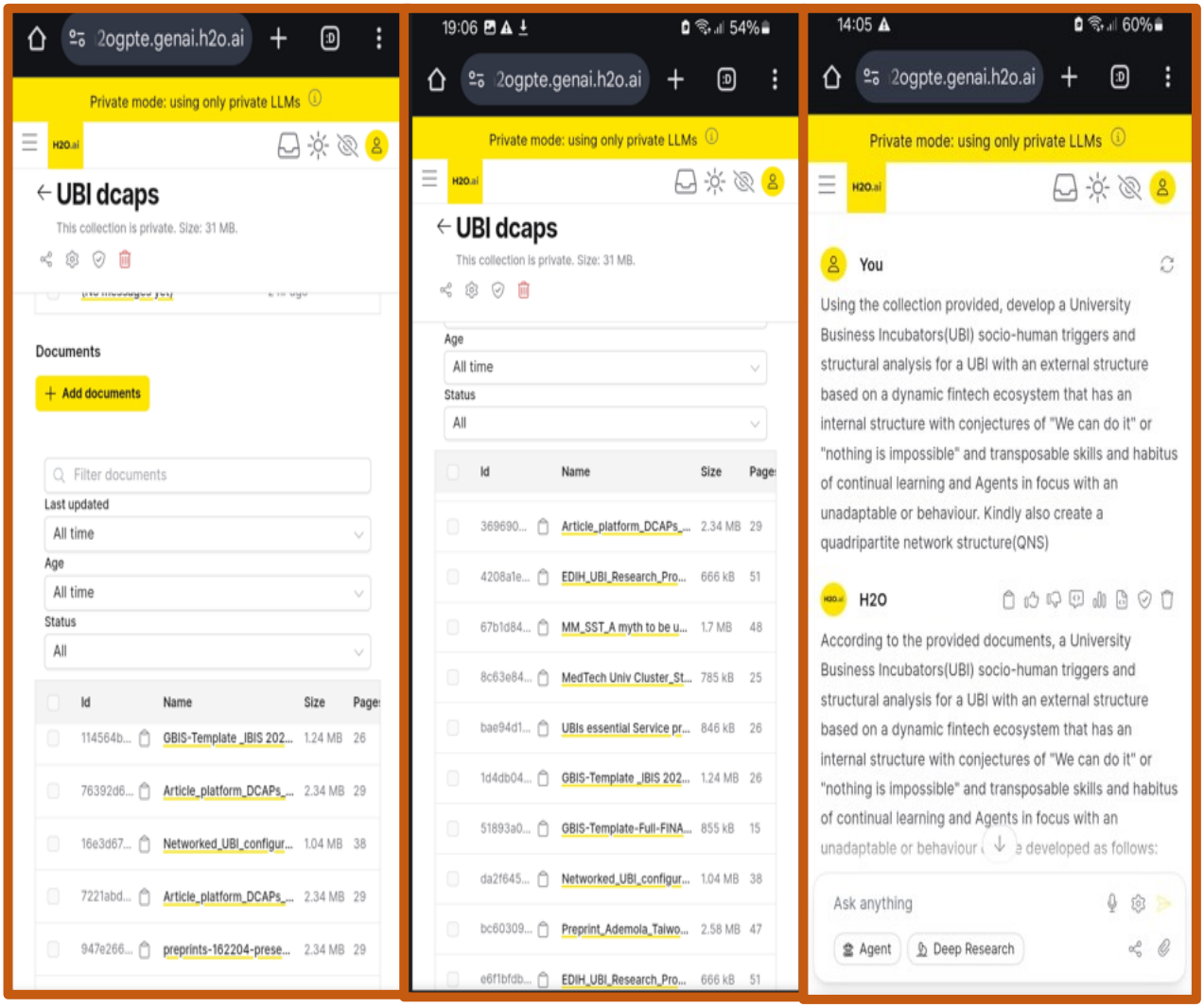

Figure 16. Knowledge retrieval Implementation with RAG only (based on the author's private articles and documents). (Source: Taiwo and Provodnikova,2025,p.29)

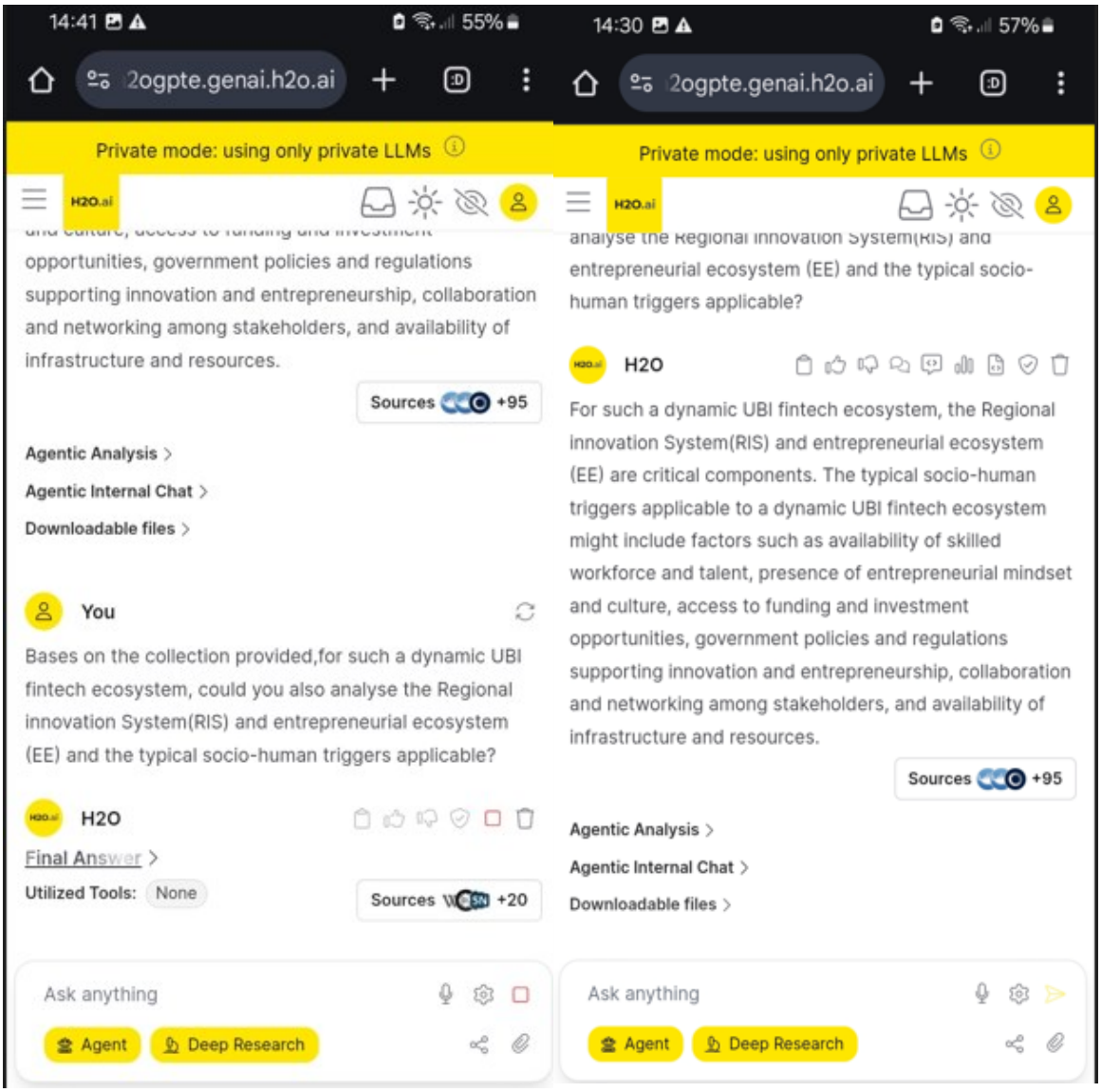

Figure 17. Knowledge Retrieval and Analysis with using AI Agents with H2O AI for analysis tasks with LLM models using public information (note the sources of information reference. (Source: Taiwo and Provodnikova,2025,p.32)

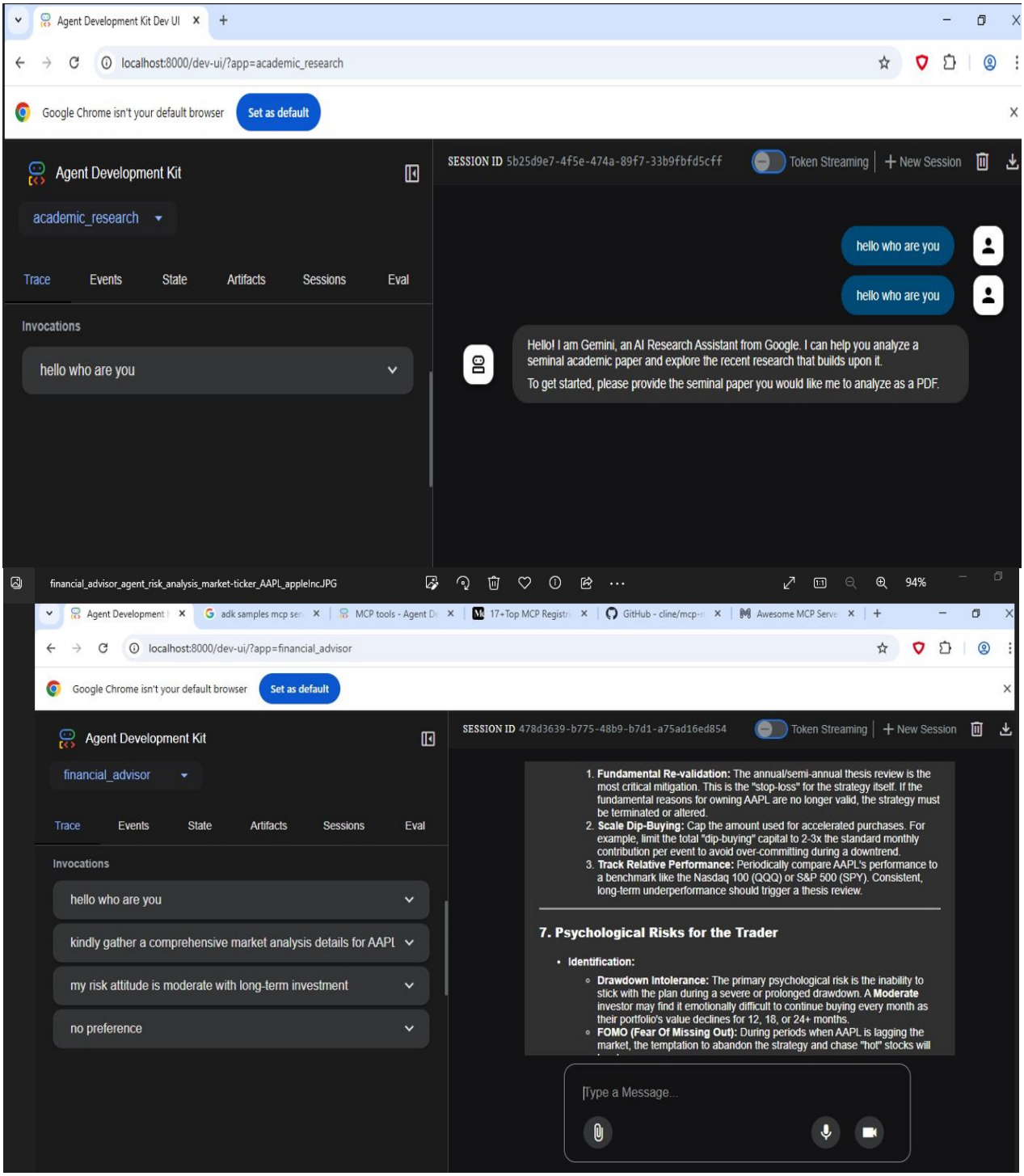

Figure 18. Agent performing academic research and Multi-task agents performing financial and risk analyses.(Source: Author's implementation of Google ADK Agent's examples)

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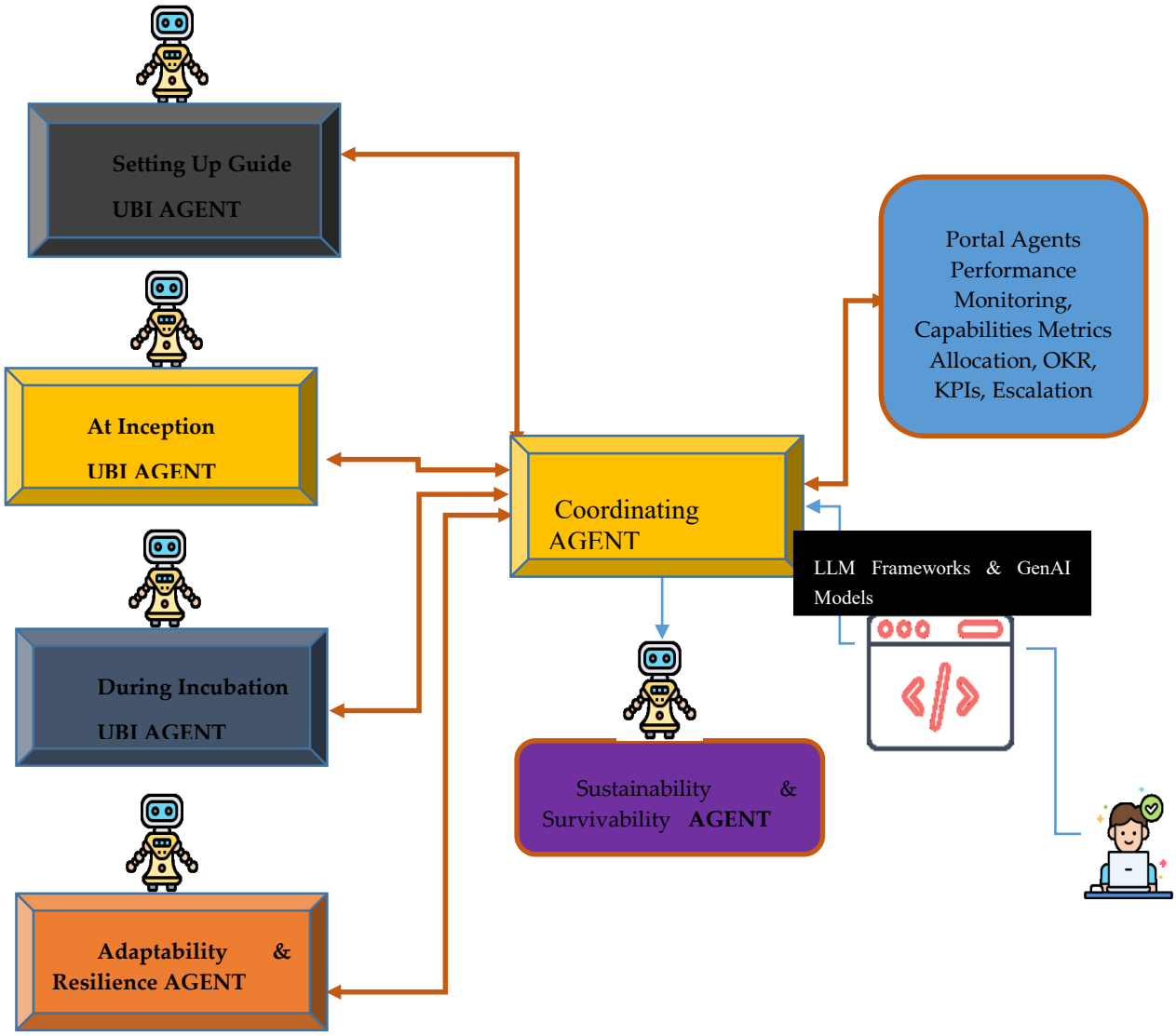

Figure 19. Shows the UBI Agents for Capabilities and processes automation and assessments(Source:Author' design).

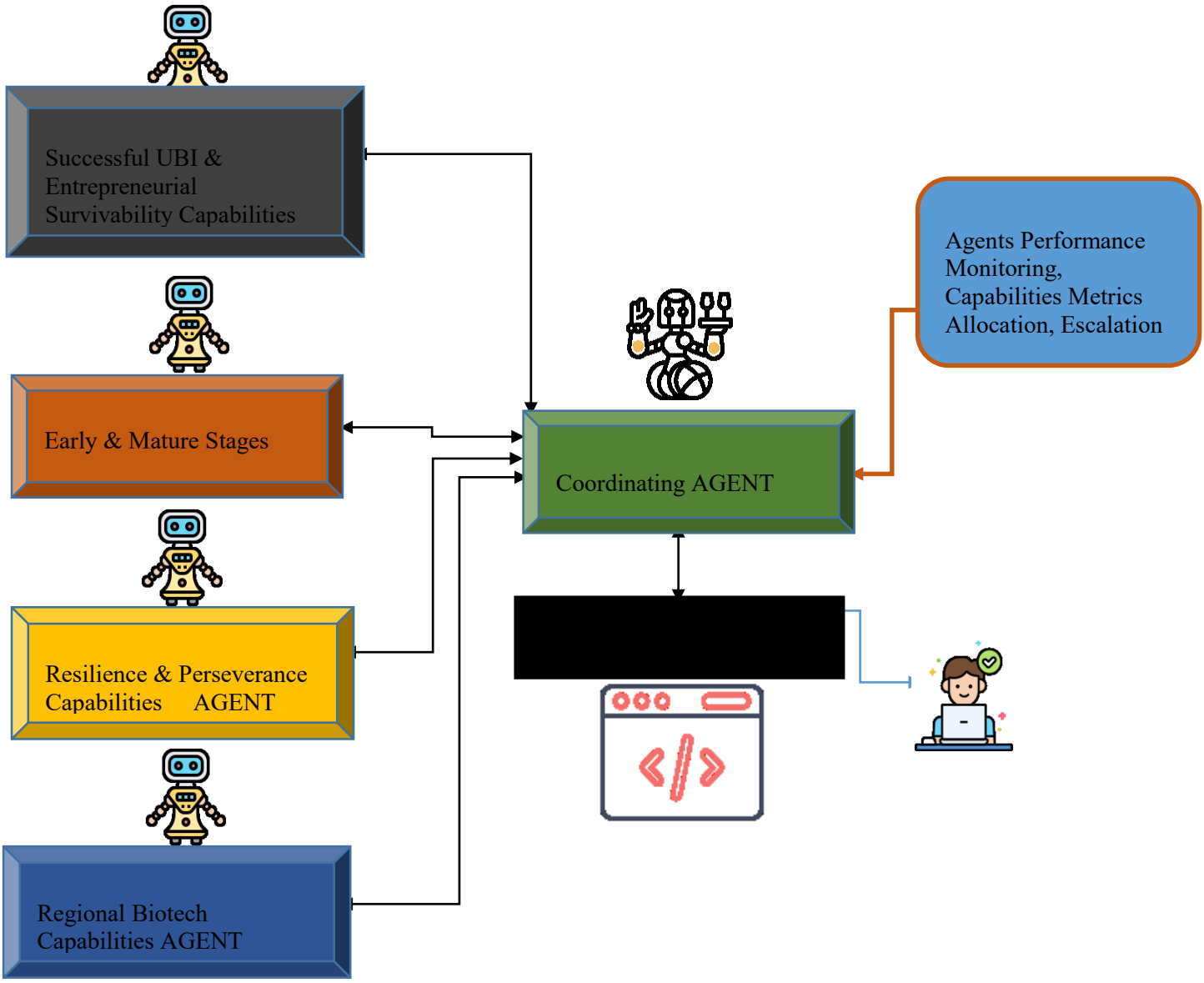

Figure 20. Biotech Based UBI and their Clusters Process and Capabilities Automation with Agentic AI framework(Source: Author's design).

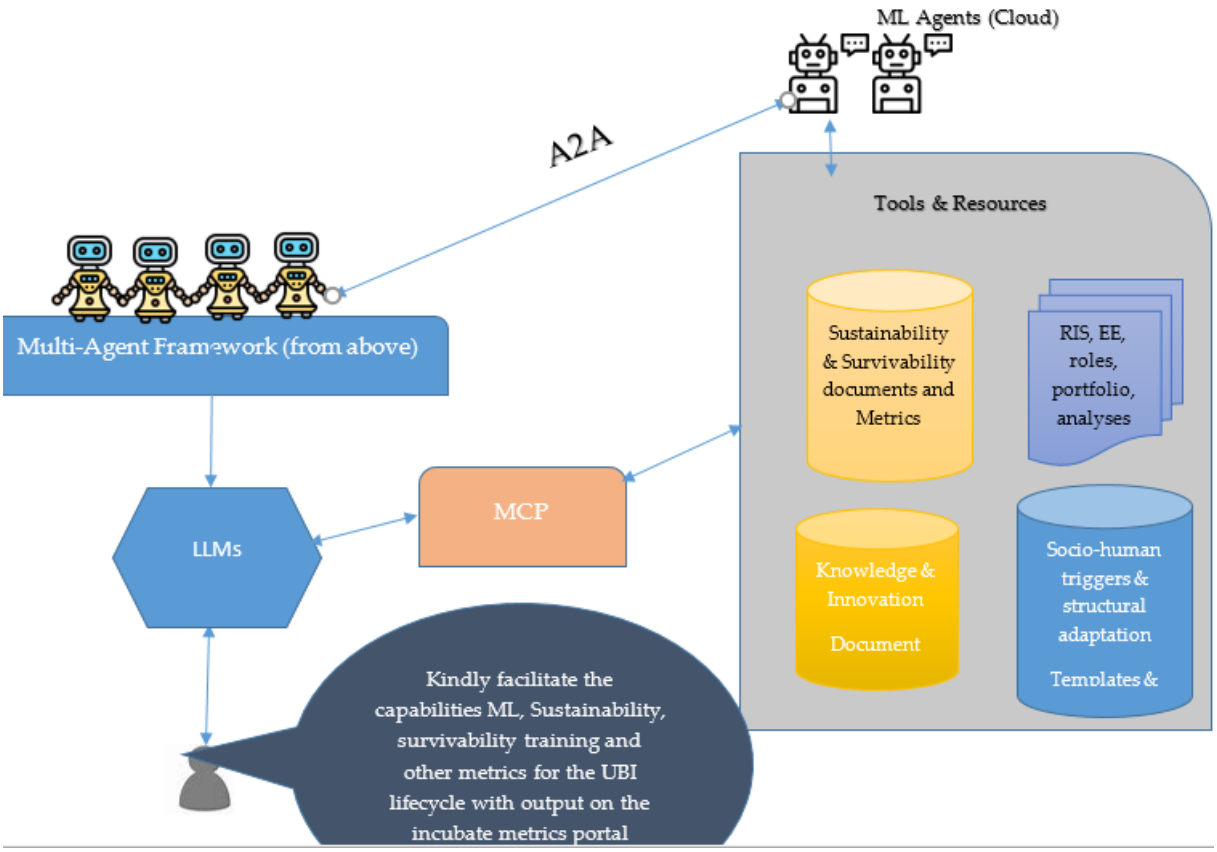

Figure 21. Client –Server architecture for UBIs using MCP with inter-agent communication using A2A(Source: Author's design).

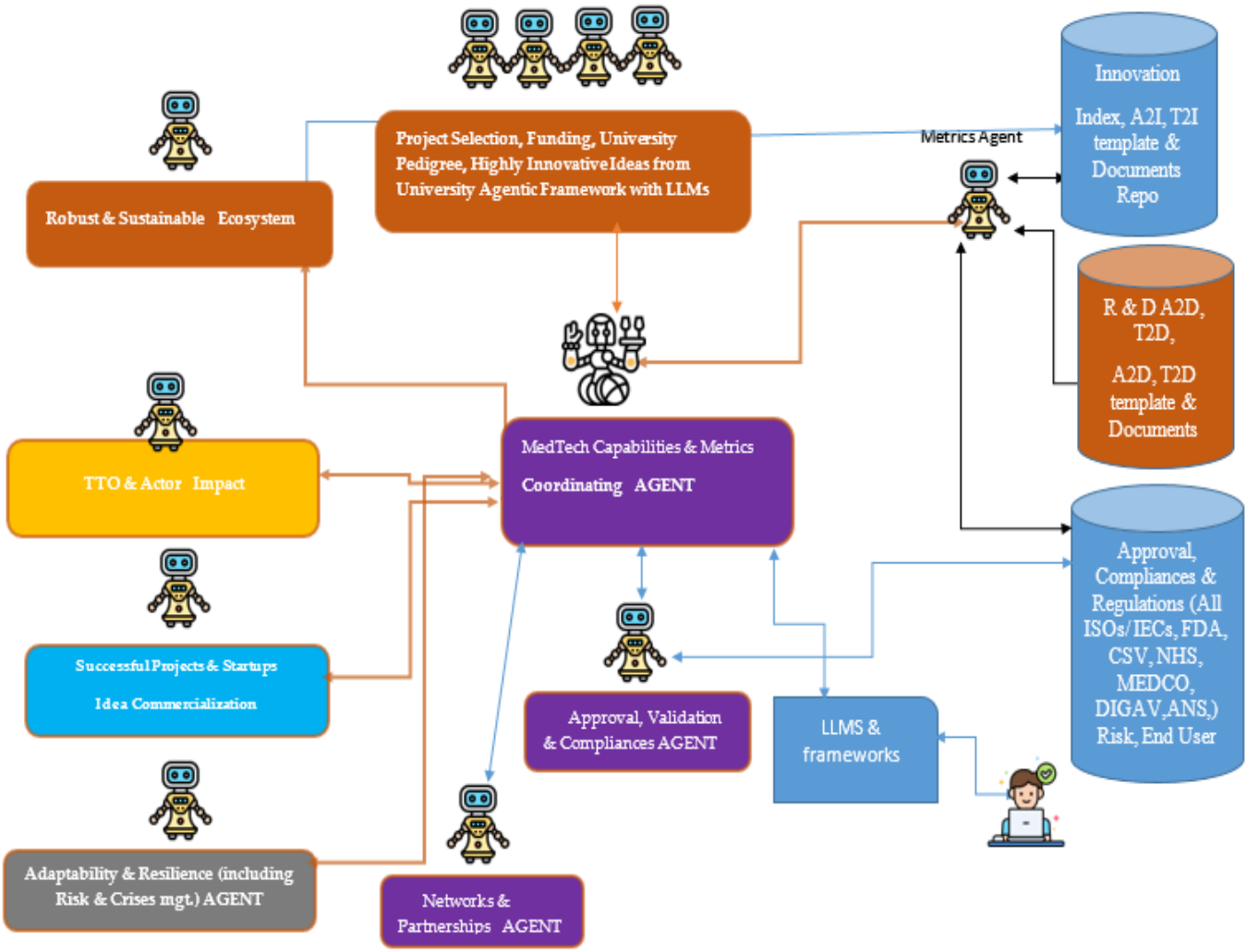

Figure 22. MedTech Based Cluster and UBI Agentic Framework for value chain and processes automation(Source:Author's design).

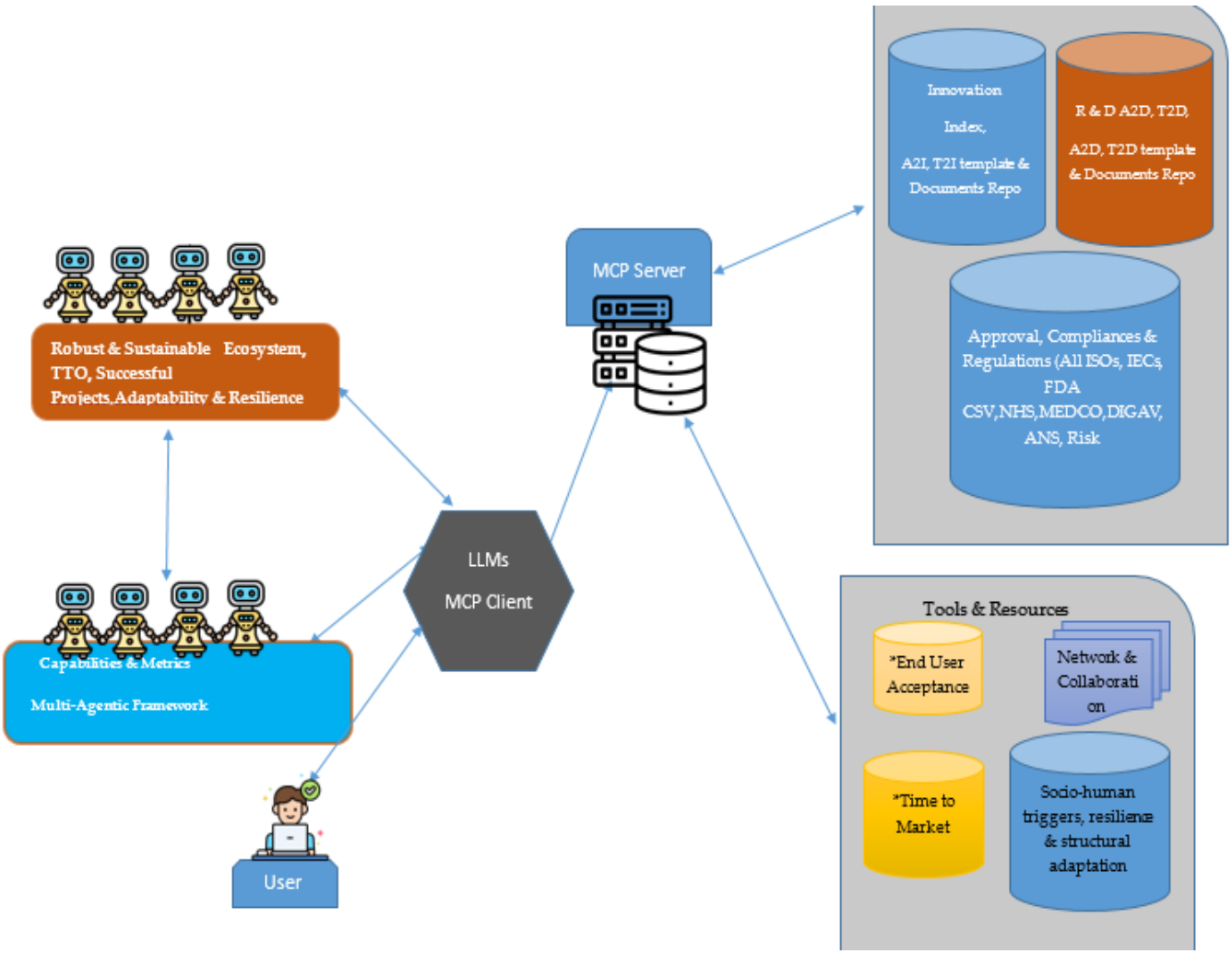

Figure 23. MedTech Based Cluster and their UBI Agentic Architecture with MCP(Source: Agent's Architectural design by the author).

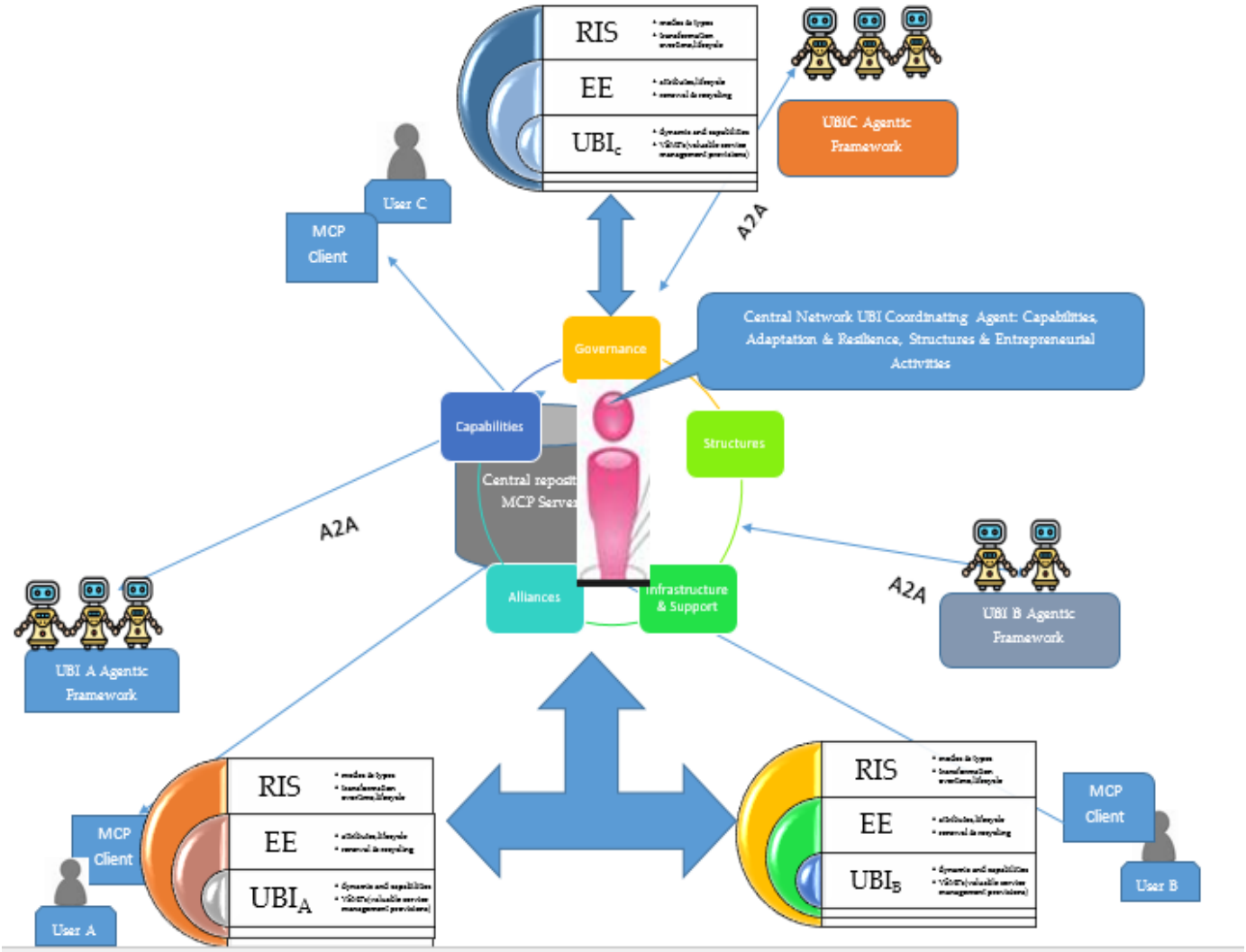

Figure 24. Shows the Network of UBIs MCP client server-architecture with A2A communication(Source: Agent's Architectural design by the author).

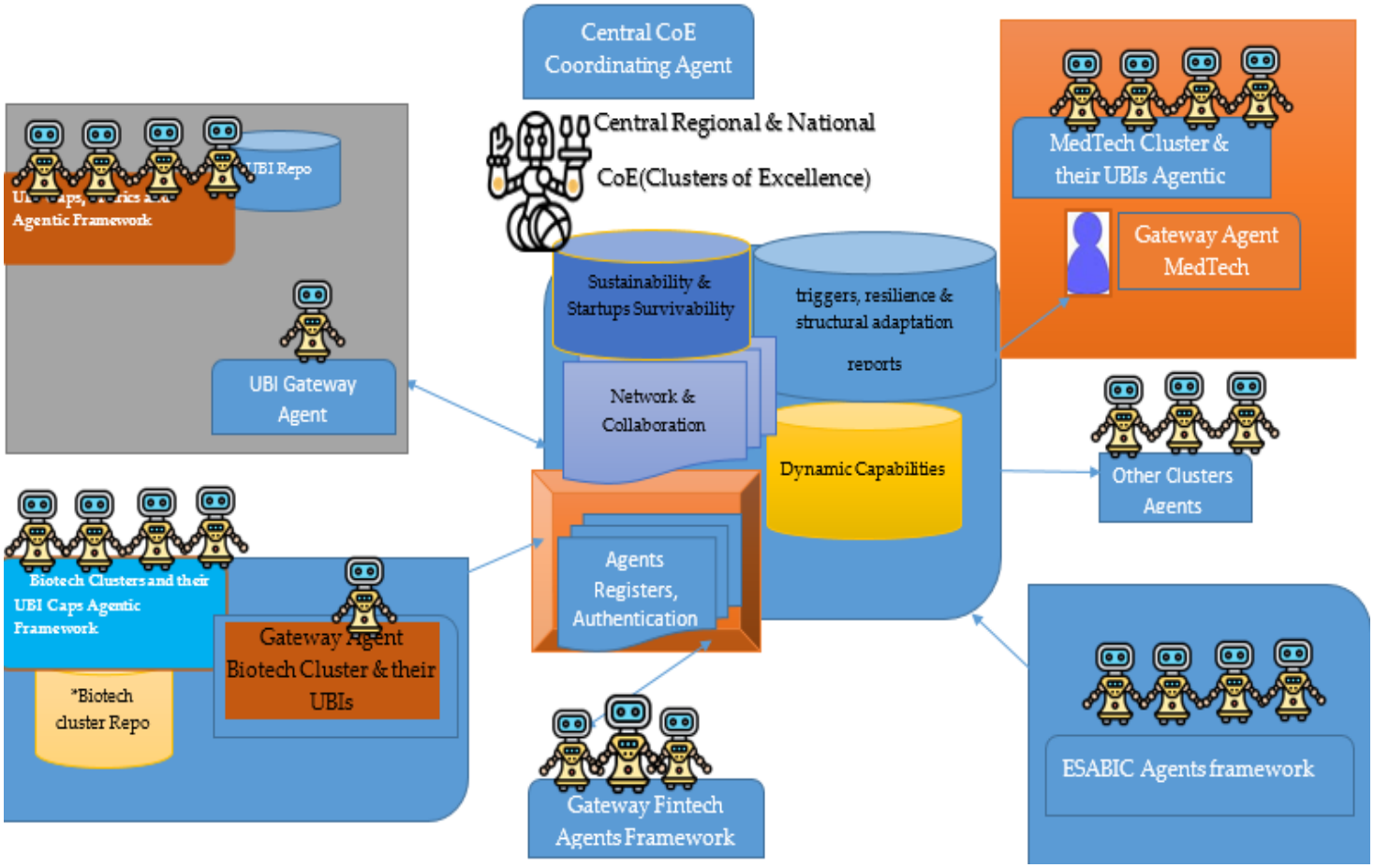

Figure 25. Inter-Clusters and their UBIs Agentic Framework Architecture(Source:Agent's Architectural design by the author).

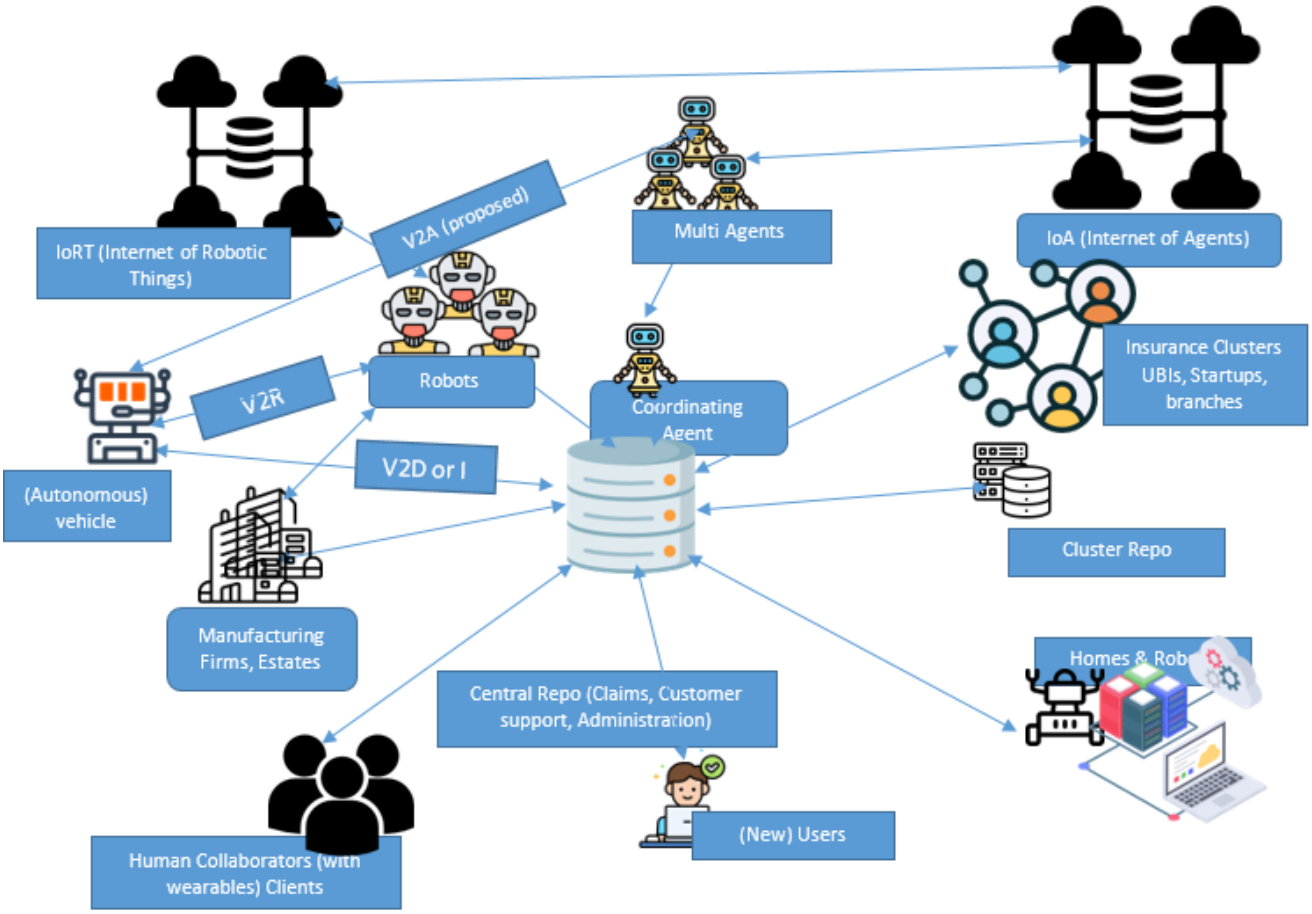

Figure 26. FintechSureTech Based interconnected Networks of Agents and Robots with their Clusters,UBIs, startups and Clients(Source: Agents architectural design by the author).

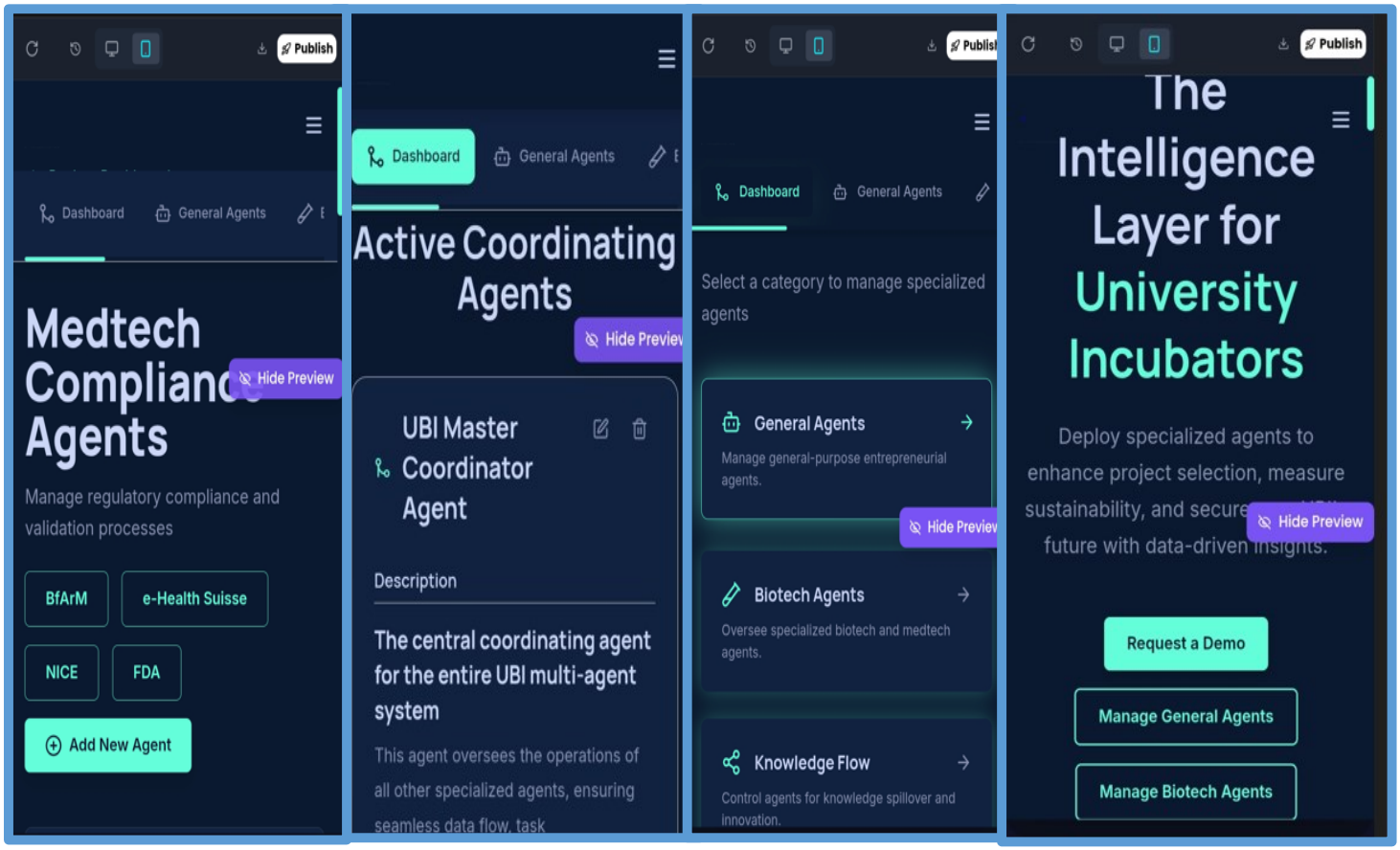

Figure 27. UBI Agentic Marketplace(Source: designed by the author).

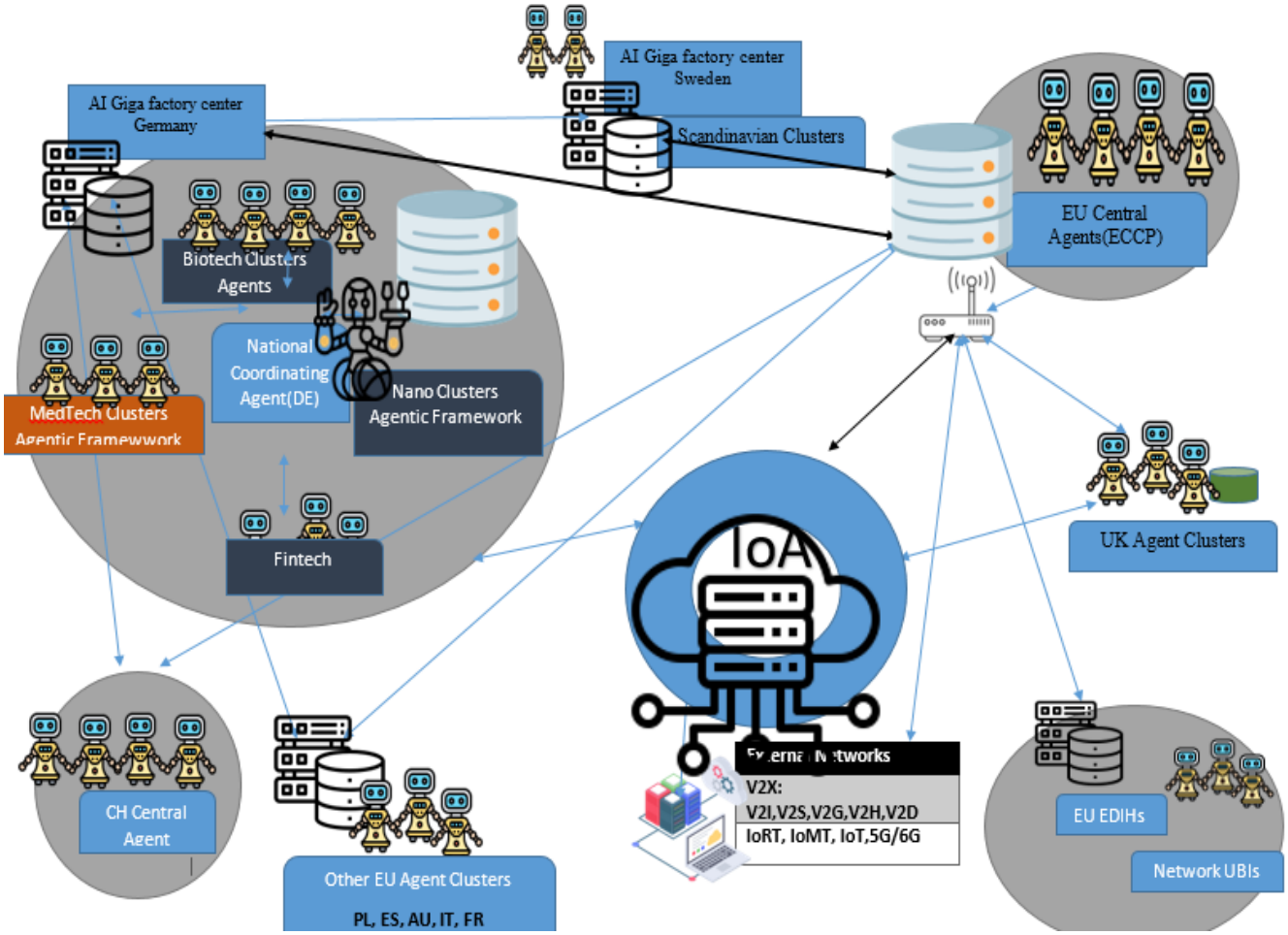

Figure 28. UBIs,National Clusters,EU Cluster Collaborations Partnerships & EU AI Gigafactory interconnections with AI Agents and Integration with IoA (Source: high level architecture designed by the author)

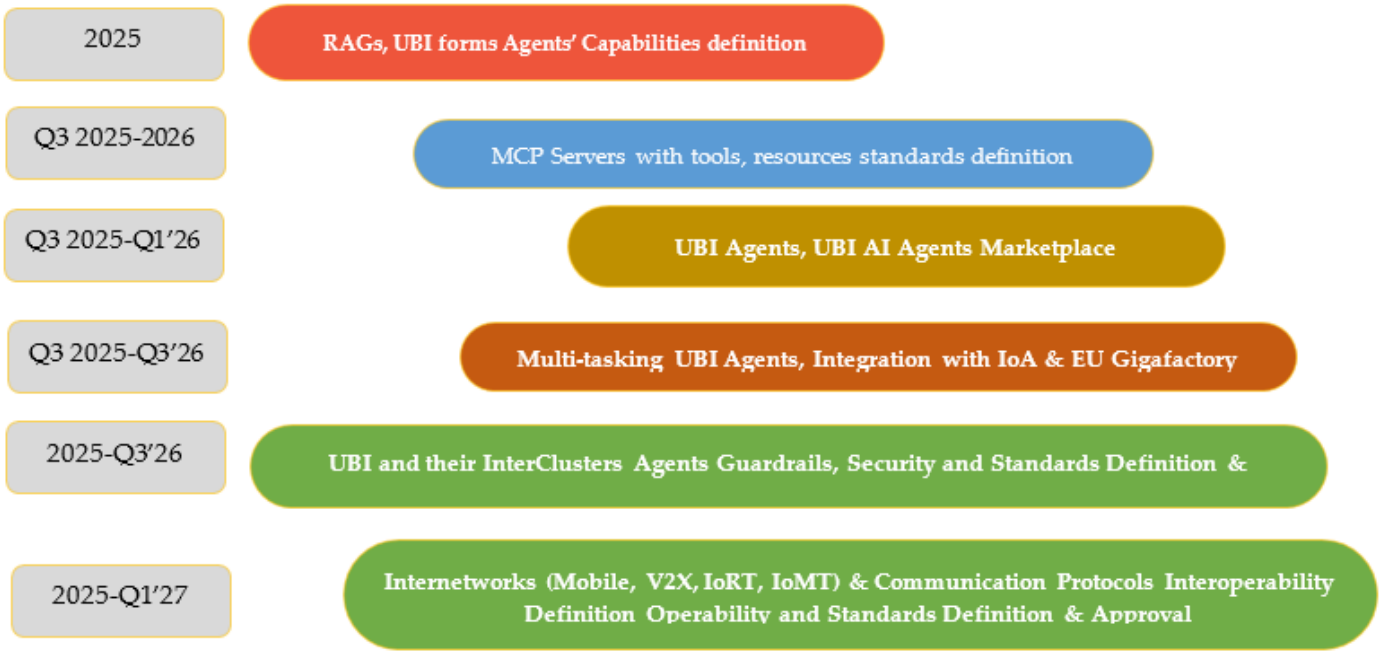

Figure 29. Roadmap towards UBI Agents' marketplace creation and Integration with IoA(Source: proposed by the author).

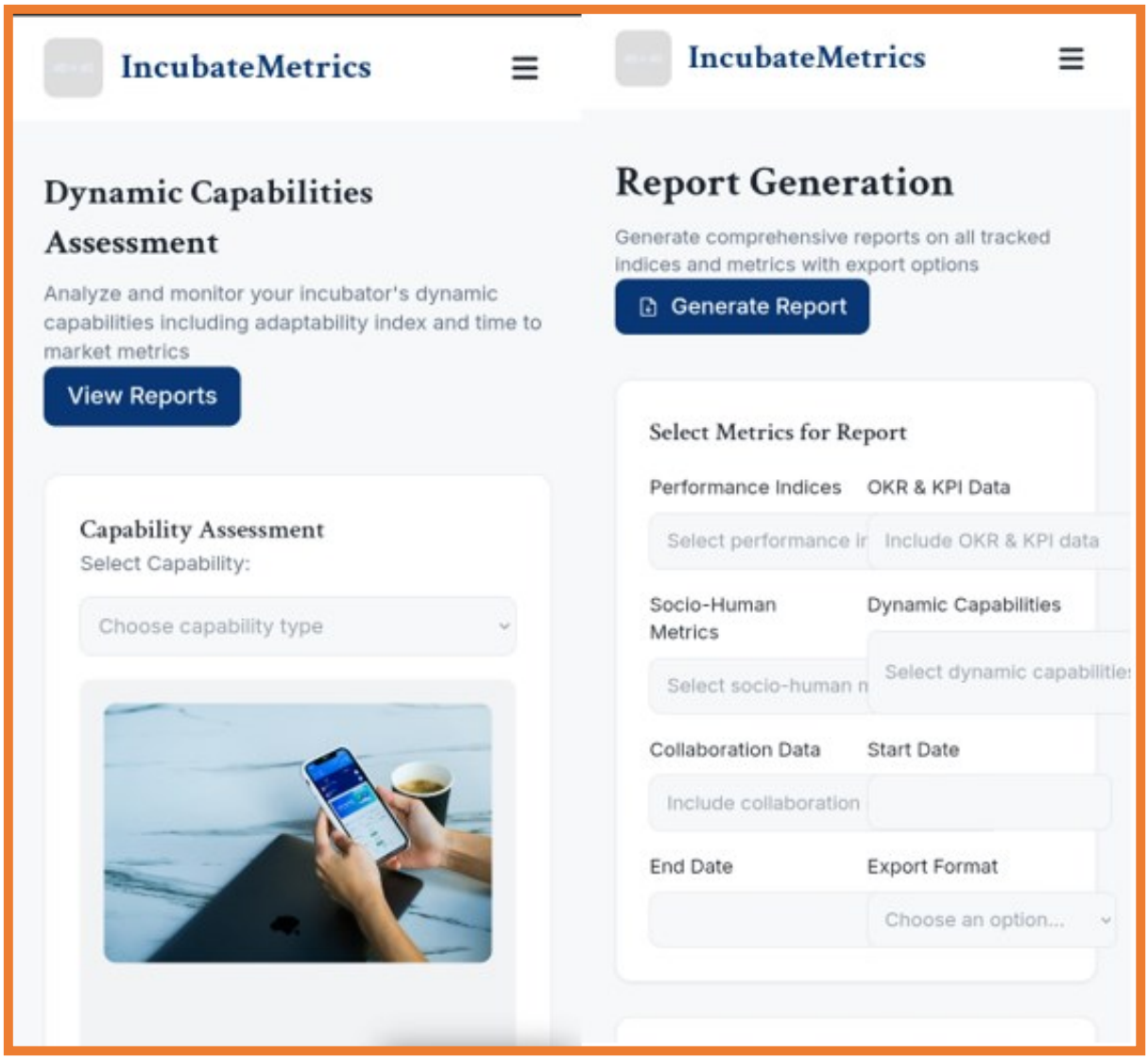

Figure 30. Portal for assessing UBI dynamic Capabilities, Metrics,KPI,OKRs and Socio-Human Structural Analyses(Source: Designed by the author)

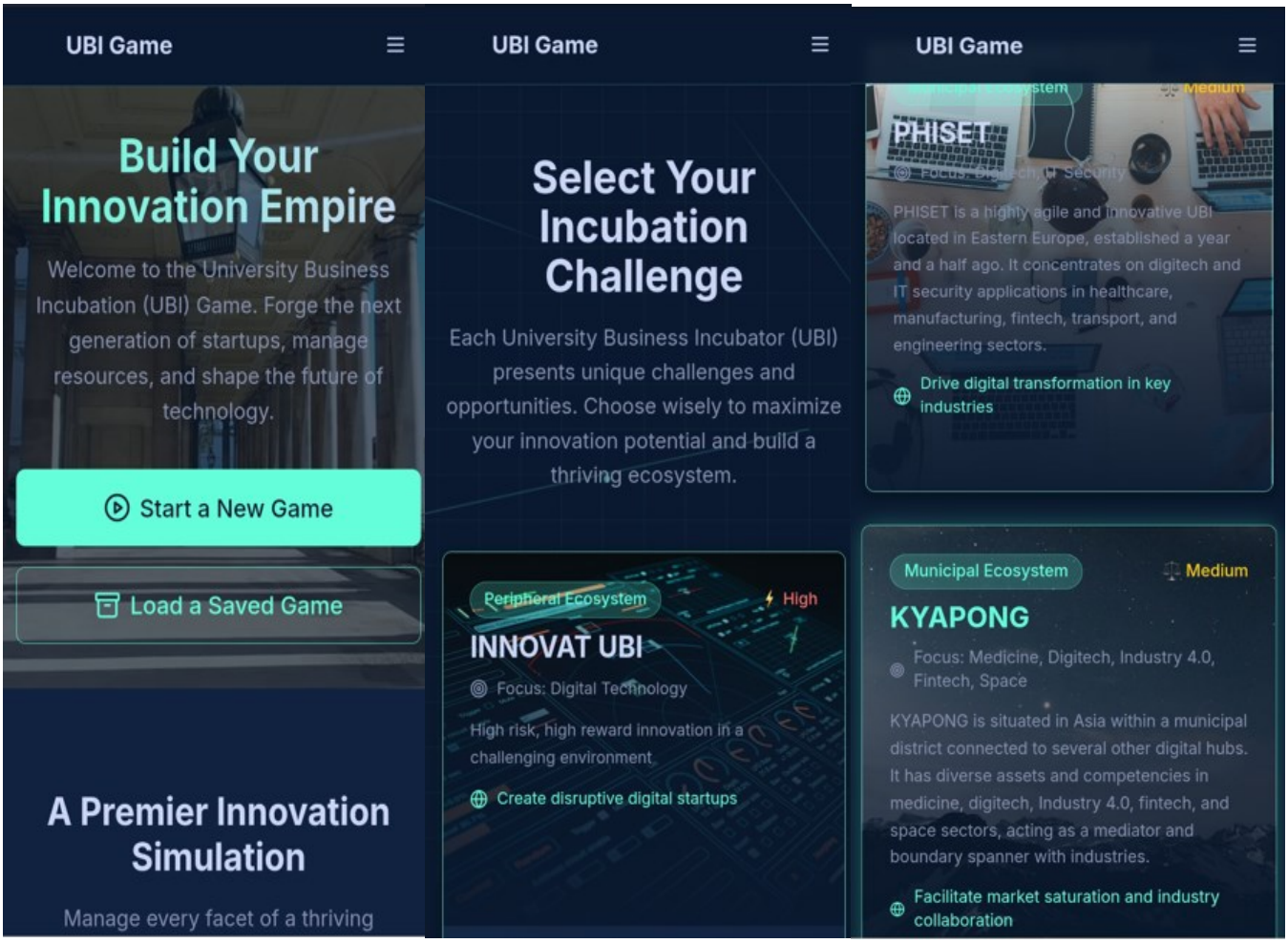

Figure 31. UBI Innovative Game Simulation(Source: designed by author)

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