

# Development of Intelligence Data-Driven Analysis Platform in Food Industry using Data Ingestion Tools

Natdanai Homkong  
Department of Industrial Engineering  
Faculty of Engineering, Chiang Mai  
University  
Chiang Mai, Thailand  
natdanai\_homk@cmu.ac.th

Adul Premprasert  
Thanakorn Vegetable Oil Products  
Co., Ltd.  
Samut Prakan, Thailand  
adul@cook.co.th

Choncharoen Sawangrat  
Department of Industrial Engineering  
Faculty of Engineering, Chiang Mai  
University  
Chiang Mai, Thailand  
Choncharoen@step.cmu.ac.th

Thanawat Kaewwiroon  
Big Data Agency Co., Ltd.  
Chiang Mai, Thailand  
thanawat@bda.co.th

**Abstract—** On one issue of the industry 4.0 criterion, the electronic information exchange depended on manufacturing control functions. In other departments, enterprise functions should be transformed into digital. In the case of the food industry, the step of manufacturing operations management (level 3) has necessary action to upgrade business planning and logistics (level 4) as follow as ISA 95 standards. The issues contain mix-up and fragmented data from all departments within organization because data of supply chain management, manufacturing and facilities cannot link that data together. There is affected to lack data analytics for the board immediately. Thus, the digital platform of data-driven and robotic process automation technology must be installed to bring data from all departments into one place by using a global cloud. The 5C architecture development for Industry 4.0 have been applied with the data ingestion concept to integrate information of all departments for initial investigation on exploratory data analysis. An analytics management was successfully to training machine learning for data-driven. While working standards that reduce the chance of human error, decrease unnecessary workload by using robots and allow employees to focus on other tasks that create value for the company. Robots will work in the whole production process 24 hours a day. The working standard in the office is paperless which reduces overall costs. Moreover, using real-time analytics allows engineers, managers, and c-levels to immediately know what is happening in the factory without having to hold weekly meetings of all departments.

**Keywords—** Artificial intelligence Data-driven, Digitalization, Data ingestion, Robotic process automation

## I. INTRODUCTION

Industrial 4.0 conception is a revolutionary productivity for drive the economy. The increasing efficiency of technology in the industry allows access for the collection and analysis of machine data. There are a variety of high-end technologies that used in the manufacturing industry. This is essential to develop digital capabilities for competitiveness and profitability and also the beneficently manufacturing

industry for becoming digitalization enable including eliminating the recreation of models, reduction in cycle time, costs, errors and improved customer satisfaction [1, 2] However, customers still need to know the product quality information, green products, commitment of the company to environmental and social responsibility before deciding to purchase products [3]. Hence, companies would like to implement sustainability based on digitization that takes long-term improvement into consideration for overcome uncertainties and cost fluctuation.

The case study company, focused on Thanakorn Vegetable Oil Products Co., Ltd. (TVOP), food industry in Thailand. The issue of criterion is assessing the readiness of entrepreneurs with the Industry 4.0 Readiness Index of Thailand. It aims to enable the factory to develop its potential to I4.0 comprising 17 aspects of 6 dimensions. The result is a score of 3.47 but the recommended criterion under the Thailand i4.0 Index is 3.75. It was re-evaluated with the Smart Industry Readiness Index (SIRI) from Singapore, comprising 17 aspects of 9 dimensions with a score of 3.19 but the recommended criterion by SIRI was 3.40, respectively. Besides, TVOP's ISA 95 standards reported status of the factory that is currently in the step of manufacturing operations management (level 3) and the factory has necessary upgrade to business planning and logistics (level 4).

As mentioned above, the board of directors has a policy to modify machines to save energy and use renewable energy to reduce environmental impact and reduce greenhouse gas emissions. It also promotes research and development and in-house engineering design for elevation to international sustainability standards in accordance with sustainability certification such as GAP, FSC PEFCs, ISO22000, ISO14061 (SFM), etc. The goal of 23 projects is to reform within the organization with digitalization, investments in automation, digital to reduce costs, reduce processes, increase operational and production efficiency. It also invests in enhancing organizational efficiency in digital interfaces, reshaping information systems, transforming customer accessing and business models, presenting products, services outside of the traditional business network and looking for new partners in business. The aim of the above is to make the information available in end-to-end usable, fast, accurate and

insights-driven is illuminated. Hence, 23 projects have been activated to apply for I4.0 within Automation and Network Technology (production/service, automation and smart facility), Smart Operation (IT/ERP for enterprise, production and enterprise connectivity), Digital Technology in Production and Enterprise Process (supplier and customer, product life cycle and market analysis).

## II. RELATED WORK

### A. Industry 4.0

I4.0 is a management concept to improve the quantity and quality of products by using recent technologies. Information is exchanged and used by humans and machines [4]. All entities can identify and communicate through integration and can customize mass customization in manufacturing through IT [5]. There should be communication between products and equipment in the factory to drive production capacity. Products can be in the form of such as objects, devices and machines that are equipped with sensors including software for control via internet connection. The objective is to support industrial business processes to be able to work together and increase business networks related to Industry 4.0. It also requires multiple CPS which include the horizontal and vertical layers combined with important technology and applications [6]. The business value of Internet of Things (IoT) is greater than the device has recorded, specified by the number of devices such as sensors and microcontrollers to gather, share and analyze data to other devices. IoT technology can create new goods, services and business models. Second, the internet and appropriate communication technologies are included in the network layer. Thirdly, the IoT-based middleware layer contains a variety of functions, including platform portability, context awareness, interoperation, device management and security-related duties. Fourth, the service layer contributes to Software as a Service (SaaS) and cloud storage. Fifth, the analytics layer processes large amounts of data to do multi-cultural and predictive analysis. The user experience layer shares, disseminates knowledge to farmers and also facilitates communication [7]. The manufacturing organization can contribute to Industry 4.0 by improving its production plans [8]. Exchange and use of information provided by workshops allows for a certain degree of autonomy. Furthermore, technology is the most important part of cloud computing and mobile applications. It requires to reach market maturity while others such as additive manufacturing, robotics and augmented, virtual and mixed reality are still in their infancy [9]. It will also change to decentralized production planning and control, another highlight of Industry 4.0 [6].

### B. IoT

IoT applications will demonstrate real-time detection and execution capabilities, fast data transmission capabilities, facilitating remote production operations and communication with effective stakeholder communication [10, 11]. Cloud manufacturing and the IoT are connected but work focuses only on one task and uses another as part of the Technology Unit [12]. Using more sensors on physical products will help them to receive, process and communicate with humans and other physical systems. There have been many applications

that use sensors as these sensors provide real-time information that can be used preventative maintenance by detecting the wear of the device. It can also monitor inventory to avoid out of stock, have better capacity planning and evaluate product usability and functionality [13]. IoT products have a special identification number that specifies their origin, purpose and final destination. IoT is used to facilitate coordination with information flow coordination and synchronization. IoT-based CPS is used in smart manufacturing to enable recognition and access to a wide range of manufacturing resources [14], to connect multiple parties using social networks to promote open innovations [10], to improve the productivity of the microdevices assembly [11] and to manage dynamics in production logistics processes [12].

### C. Cloud for Manufacturing

Cloud manufacturing helps to build production networks of things, services, data and people over the Internet as part of the smart-networked world. Industry 4.0 and cloud manufacturing will have the greatest potential in the upcoming modern manufacturing industry [15]. Cloud technologies are widely used in Industry 4.0 to share information across company boundaries, to improve system performance reduce costs through online system [6, 14]. There was used in real-time production logistics synchronisation by combining production infrastructure on cloud manufacturing and IoT. A software control mechanism smart PLS control mechanism with multi-level dynamic adaptability has been enabled [16]. Additionally, the mobile service system as the third layer was integrated with the cloud computing technology and manufacturing device layers [4]. In this system, the manufacturing device layers are composed of physical devices such as a flexible conveyor belt, industrial robots and corresponding sensors which are connected to the cloud via the support of a wireless module. The manufacturing big data about customized manufacturing is calculated in the cloud to receive orders from customers and inquire about production information based on a mobile services platform. Finally, cloud-based smart manufacturing system for machining transmission was applied using advanced information and communication technologies such as cognitive agent, swarm intelligence and cloud computing are used to integrate, organize and allocate the machining resources [17]. With the increasing use of cloud computing technologies, storage optimization is needed. The use of flash memory is recommended with improved algorithms [18].

## III. RESEARCH METHODOLOGY

A qualitative method helps to better understand the experience of participants. It also helps to thoroughly explore areas that have not been researched, discovers relevant variables that can be used in the quantitative method and offers a comprehensive approach to study the phenomena [19]. Also, this method was used to collect the data, gain appropriate insight into the current situation and achieve the predetermined target for information within time and budget constraints and minimize researcher and respondent bias [20]. A research team has been established to explore and find the true causes of problems in organizations related to each type of work and work group. The information on complementary intangible assets of the corporate level is

essential to the successful adoption of data analytics through survey instrument. Additionally, the measurement of IT systems within big, established corporations, analyzing their contributions to digital transformation and consider how they affect the caliber of data architecture that underpins technical co-inventions using data on legacy information technology and software systems at the establishment level [21].

An explanation of research method infrared the similar way of conducting the interview's designing and apply the process in the same way. Each department of company was interviewed and asked to complete the questionnaire. The interview was partially categorized. Topics related to the provision of design and construction operation, service in an infrastructure were discussed. The interviews were related to the experiences and perceptions of basic information about infrastructure by employees and the complete digitization of the design process. Their statements have been carefully analyzed. The analysis of the interviews focused in particular on the personal experiences of each department with respect to organization workflow and routine operation process [22]. The survey will start from the most common and unresolved issues as raw data in the development platform on digitalization technologies. It will be a tool to create the active solution data to work with all aspects of the problem that personnel in the organization will face [23]. Phase of this research, 3 semi-structured interviews were conducted, followed by follow-ups via both of online video conferencing and onsite. Among the 44 interviewees from 16 departments of TVOP organization. The interview protocol consists of four sections: Infrastructure, Software, Data summarization and IT based system. To allows the interviewees to express their views and ideas and also the researcher to collect in-depth information on topic as following Table I.

TABLE I. THE FUNDAMENTAL QUESTION TOPICS OF INTERVIEW

Topics	Questions	Guideline of answer
Infrastructure and networking	Describe overall of computer server node networking and link of infrastructure	The big picture showing the server or node and its purpose with the network lining in and outside the organization
	Local Server Details	Server technology (VM, VDI), locations, OS license
	Cloud Server Details	Server technology, branding, OS
	The Data Storage/Data Centre/Database	Storage technology, branding, type of database
	Backup	Type of data backup (full or increment), data and software backup, availability policy, backup on cloud or local
Network and Security		Network equipment, network topology, IoT network, cellular 3G 4G 5G, LAN, Wifi, VLAN, access point location, the covering area, the

Topics	Questions	Guideline of answer
		security equipment (firewall), network policy (DMZ), network accessing in/out (VPN, 2 factor authentication)
Data summarization	Method of summary	Software and tools
	frequency of summary	Real/near real time, depend on time
	Issue of summary	management, evaluation, costing, etc
Software	Describe the overall software used in the company	Software type, application and tools
	Users level	Manager, operation, staff, etc
IT based system	Other IT system	CCTV, sensor, monitor, etc
	Software for management system	Software type

#### IV. ANALYSIS AND FINDINGS

The main plan of the organization's drive is the use of digital platform and robotic process automation (RPA). This is very important in reducing the burden by using robots and to help employees to focus on works for the company. It also reduces the chance of human error. The work was adjusted to paperless to reduce costs, can work 24 hours and increase work efficiency. Additionally, the scope of work should be contained of six sub-topics that is the weight scale automation platform (truck scale record) using optical character recognition (OCR) and license plate recognition (LPR) to assist in weighing trucks. Accounting must use workflow system to help in doing invoicing debit note and credit note on ERP system. E-Custom and Purchasing automation platform (PO creation) uses digital platform, RPA to help in documentation for export, import and create purchase order on ERP system which covering product that requires documentation. Production automation and Smart Bulk silo with IoT for tracking and product order creation IoT, RPA and workflow systems should be introduced to help extract data from machine processing systems, sensors to control the production process and create production orders at the ERP system (see Fig. 1).



Fig. 1. The conceptual design indention

The researcher shows a detailed concept in Fig. 2 which describes the data ingestion as a guideline for the organization's adaptation to I4.0. It has to be designed to work into four components that are data source, data flow, data storage and data usage. Each part works independently, able

to transmit, link data from the design and development of workflow systems. The data pipeline is used as a cloud server platform tool. It is the core of development until it is going to be reliable data which is stored in the refined zone and trusted zone. It is a database which is ready to connect to self-service BI via ODBC connector or used to develop ML/AI analytics. The concept of designing and managing a data-driven analysis that supports connections both internal and external organizations to cloud providers with enterprise security is to connect through cloud services, network security services to achieve access and the use of service information with username and password. Username and password give permissions for each user to access, manage and connect to data with single-sign-on (SSO). Management of data storage based on data lake and data warehouse. The organization should collect the TVOP data and external data into the data lake by using format of data and the data will be in a structured, unstructured or semi structure.

Bringing information to the process Extract-Transform-Load (ELT) starts with creating a data pipeline. ETL process development for various datasets must be fully connected to the data source. Then design and define the structure of the data to be imported into the system. The process of screening the data to make it clear is as follows: 1. Verify the data type and the data length to meet the requirements of the database structure 2. Check for nullable value 3. Check the range of data values 4. Check data value against standard values such as category code 5. Test the linking with other tables which are collaborative processes in the data lake, to verify that the key and foreign keys are related to the structure of the designed and defined data system.

Datasets imported into the system should use object storage format as the primary storage in the data lake. Datasets are structured and partitioned into a directory system based on data sets and use partition techniques to divide the data into buckets. The column bucket is designed according to the characteristics of each data set. For example, data that has a date and time will use year or month-year as the partition or data distributed by category use category as the partition. The design of the storage structure in a data lake is made for efficient storage and quick detection. It may be considered to create a common index for datasets that are frequently accessed, require speedy processing and finally separate by zone according to the quality of the data such as either raw data zone or trusted zone.

The data warehouse service (DWS) tool is recommended as a guide for a data warehouse to designing relational database systems, store filtered (query) and exploratory data analysis. The design of the data structure must be appropriate for each data set using the hierarchical structure model. It starts by defining the fact table that holds the most detailed data and defining the dimension table which is used to represent the meaning of the data values by storing data at different levels such as area, country, region, province, district, sub-district, followed by the name of various types of groups, product categories, and product name, respectively. The structure of this data warehouse stores reliable data. It also helps to support searching, filtering and processing. Moreover, it can be used to visualize data with BI software. DWS tools provide data services to external applications to use in exploratory data analysis (EDA) steps such as power BI, tableau, google data studios or provides applications from data analysts via python script or SQL application client. The

data can be shown in the form of reports or dashboards. It can also use big data to analyze or develop applications such as SCADA, SIM, smart factory, smart manufacturing, smart renewable energy, smart logistic and smart marketing.

The high level of architectural structures in the development of TVOP's intelligence data-driven platform as demonstrated in Fig. 2 consists of 4 large groups. Data source import (hybrid methods) will have a structural design to support the connection of data from the factory data centre and cloud data centre in a hybrid format with RDBMS connected directly to the database. The Connector will be installed to retrieve the agreed upon. No SQL will import a database with an unclear format into the system which is flexible data. Files are stored to file storage on the cloud server and specify the index stored and saved to the file storage database for easy use. The data agent will take a small program to install on the target machine to retrieve the data and then send it to the system. It is suitable for databases that are not directly accessible or coded or are old-fashioned programs that cannot be modified to retrieve such as the fortran language programming that are still available but cannot be edited. IoT systems will bring MQTT protocols to send data in the necessary messaging format for many sensors. It is a very flexible system because it can be used to send point-to-point data or distribute data to other systems. External data is a method of importing data outside the factory by using the API method that has already been developed. If it has not been developed, it can use the web scraping method which is a way to extract various information from public web pages.

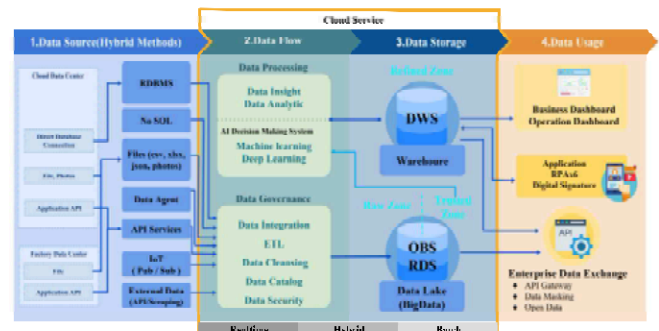


Fig. 2. The data-driven platform architecture.

In the development of data storage to be used as a tool is divided into 2 terms. The first part is the data lake. It is stored in text delimited or multimedia formats such as pictures, VDO, voice messages and logs. Object storage service (OBS) is a distributed storage system in file format and supports all file formats. It can also be used as a tool to access and search with SQL language. Relational database service (RDS) is used to store cloud-based relational data to support large amounts of data. It is flexible and can be customized, increased or decreased in size of space and processing units according to operating needs. Another part is the data warehouse that is processed through cleansing and ETL. This section is linked to a variety of data sources. Various data structures are designed before being stored in relational database systems which are designed for further use. DWS is used in relational databases that support data warehouse formats because they have the flexibility to scale, store and process. In addition, it can support heavy processing, support in-memory processing and suitable for data analysis with SQL language. The storage design of data storage is divided

according to the data quality characteristics. The hierarchy is raw data, trusted zone and refined zone.

Data usage development is the destination management of the platform to make it the most useful data by using information from 3 types of refined zones or trusted zones. The dashboard will be used as an external tool or program for specialized job analysis, reporting and integration of various information with other systems through the self-service business intelligence tool (e.g. business dashboard or operation dashboard). The data that is created and tested can be used to develop a web/mobile application such as a photo analysis program or OCR documents to forward data or store keywords or use it as a source for other RPAs of the organization. Enterprise data exchange is the sharing of information with agencies that are allowed to continue using corporate data by developing according to the principles of data exchange. There is an API service to hide important information, including opening data which is TVOP's data or web scraping but in a convenient format based on data security.

## V. DISCUSSION AND RECOMMENDATION

In the development of a platform based on digitalization from the beginning of the user that coordination with the RPA system until the development of the system installation. This paper recommends as followed as in Fig. 3 that should focus on data governance and developing data in perfect form according to the organization's agreement to be stored and used conveniently. Data governance's work will be the part before entering data storage. It will manage the connections of raw data from multiple sources and format and design ETL into large storage systems. It offers a variety of tools such as data cleansing, grouping, data types, catalog duplication monitoring and data protection such as encryption or masking sensitive data.

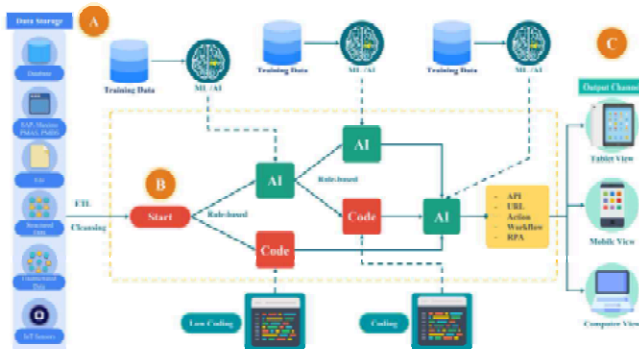


Fig. 3. Overall architecture of intelligence data-drive analysis.

After the data storage is saved, the data is processed in 2 main parts: 1. Doing an insight of information. It's taking insights from information to summarize what's going on and helping to assume what can make it happen. After that, we can test or decide on the best solution to the problem before using the data to develop AI. 2. AI decision-making system. It is an AI training system development based on low coding and zero coding. It consists of 3 important parts: Position A, an AI developer who can choose a data set from data storage by setting a filter to get the right amount of data for AI training by using machine learning theory. Position B is the developer who can bring AI after being organized into workflows to apply the most accurate answers. Position C is the result of B which can execute visualization via APIs or URLs, execute

machines or save values to run workflows or even as the beginning of RPA.

## VI. CONCLUSIONS

The system can develop databases to support big data on cloud service systems to create business value through real/near-time processing and create effective decision-making tools. AI development system design and development with low/zero coding capabilities. Workflow can customize a variety of algorithms to be the core for decision-making system tools. By having to support many AIs. Business intelligence is connected to data view as a result of the decision-making system. It will effectively display the results of management, planning, investment, development and expenditures with AI assisting in forecasting or anticipating executive decision-making. Platforms that support RPA development will have at least objection detection, OCR, LPR, automatic voice recognition, geo-location and fencing, face recognition and digital signature features. Organizations should digitize the business of products and services as much as possible starting by storing data and cleaning up it to make it ready to use. Finally, organizational culture should be adjusted to make decisions and start practicing ML/AI to make decisions. Results should also be measured to lead to more accurate ML/AI improvements (MLOps).

## REFERENCES

- [1] G. Harris, A. Yarbrough, D. Abernathy and C. Peters, "Manufacturing Readiness for Digital Manufacturing," *Manufacturing Letters*, vol. 22, Oct. 2019, pp. 16-18.
- [2] M. Saunila, M. Nasiri, J. Ukko and T. Rantala, "Smart technologies and corporate sustainability: The mediation effect of corporate sustainability strategy," *Computers in Industry*, vol. 108, Mar. 2019, pp. 178-185.
- [3] S. Wichaisri and A. Sopadang, "Sustainable logistics system: A framework and case study," in *Industrial Engineering and Engineering Management proceedings of the IEEE International Conference in Bangkok, Thailand, 2013*, IEEE, New York, pp. 1017-1021.
- [4] J. Wan, M. Yi, D. Li, C. Zhang, S. Wang and K. Zhou, "Mobile services for customization manufacturing systems: an example of Industry 4.0," *IEEE Access*, vol. 4, Nov. 2016, pp. 8977-8986.
- [5] J. Posada, C. Toro, I. Barandiaran, D. Oyarzun, D. Stricker, R.D. Amicis, E.B. Pinto, P. Eisert, J. Döllner and I. Vallarino, "Visual Computing as a Key Enabling Technology for Industrie 4.0 and Industrial Internet," *IEEE Computer Graphics and Applications*, vol. 35, no. 2, Mar. 2015, pp. 26-40.
- [6] Y. Liu and X. Xu, "Industry 4.0 and cloud manufacturing: a comparative analysis," *Journal of Manufacturing Science and Engineering*, vol. 139, no. 3, Oct. 2016.
- [7] V. Roblek, M. Meško and A. Krapež, "A complex view of Industry 4.0," *Sage Open*, vol. 6, no. 2, Jun. 2016.
- [8] M. Saunders, P. Lewis and A. Thornhill, *Research Methods for Business Students*, Pearson Education, London, UK, 2016.
- [9] T. D. Oesterreich and F. Teuteberg, "Understanding the implications of digitisation and automation in the context of Industry 4.0: a triangulation approach and elements of a research agenda for the construction," *Computers in Industry*, vol. 83, Oct. 2016, pp. 121-139.
- [10] C. Yang, S. Lan, W. Shen, G.Q. Huang, X. Wang and T. Lin, "Towards product customization and personalization in IoT-enabled cloud manufacturing," *Cluster Computing*, vol. 20, Feb. 2017, pp. 1717-1730.
- [11] Y. Lu and J. Cecil, "An Internet of Things (IoT)-based collaborative framework for advanced manufacturing," *International Journal of Advanced Manufacturing Technology*, vol. 84, Sep. 2015, pp. 1141-1152.
- [12] T. Qu, S. P. Lei, Z. Z. Wang, D. X. Nie, X. Chen and G. Q. Huang, "IoT-based real-time production logistics synchronization system

under smart cloud manufacturing,” *International Journal of Advanced Manufacturing Technology*, vol. 84, May. 2015, pp. 147-164.

- [13] C. C. Lin, D. J. Deng, Z.Y. Chen and K.C. Chen, “Key design of driving Industry 4.0: joint energy-efficient deployment and scheduling in group-based industrial wireless sensor networks,” *IEEE Communications Magazine*, vol. 54, no.10, Oct. 2016, pp. 46-52.
- [14] F. Tao, Y. Zuo, L. D. Xu and L. Zhang, “IoT-based intelligent perception and access of manufacturing resource toward cloud manufacturing,” *IEEE Transactions on Industrial Informatics*, vol. 10, no. 2, Feb. 2014, pp. 1547-1557.
- [15] X. Yue, H. Cai, H. Yan, C. Zou and K. Zhou, “Cloud-assisted industrial cyberphysical systems: an insight,” *Microprocessors and Microsystems*, vol. 39, no.8, Sep. 2015, pp. 1262-1270.
- [16] P. J. Mosterman and J. Zander, “Industry 4.0 as a cyber-physical system study,” *Software and Systems Modeling*, vol. 15, no. 1, Oct. 2015, pp. 17-26.
- [17] H. S. Park and N. H. Tran, “Development of a cloud based smart manufacturing system,” *Journal of Advanced Mechanical Design, Systems and Manufacturing*, vol. 9, no.3, 2015.
- [18] J. He, G. Jia, G. Han, H. Wang and X. Yang, “Locality-aware replacement algorithm in flash memory to optimize cloud computing for smart factory of Industry 4.0,” *IEEE Access*, vol. 5, Aug. 2017, pp. 16252-16262.
- [19] J.W. Creswell, *A concise introduction to mixed methods research*, SAGE Publishing, Thousand Oaks, California, 2015.
- [20] A. Bryman and E. Bell, *Business research methods (4th Ed.)*, Oxford University Press, Oxford, UK, 2015.
- [21] R. Caoa and M. Iansitib, "Digital transformation, data architecture, and legacy systems," *Journal of Digital Economy*, vol. 3, no. 1, Jun 2022, pp. 1-19.
- [22] B. Orzeł and R. Wolniak, "Digitization in the Design and Construction Industry—Remote Work in the Context of Sustainability: A Study from Poland" *Sustainability*, vol. 14, no. 3, Jan 2022, pp. 1332-1357.
- [23] U. Sekaran and R. Bougie, *Research Methods for Business (6th Ed.)*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2013.