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Smart factory Introduction of logistics automation ISP consulting module development through case analysis

[1]Heon-Wook Lim

[1]Prof. Dept. of Liberal Arts, Hansei Univ., Korea
3795879@hanmail.net

Abstract

The purpose of this study is to create and present a standardized module of ISP (Information Strategy Plan), a smart factory logistics automation consulting method that is helpful to companies or consultants who will build logistics automation.In order to develop the module, first, cases of smart factories, smart logistics, supply chain management(SCM), consulting methodology (ISP), and logistics center construction consulting methods were investigated step by step. In order to develop the module, first, cases of smart factories, smart logistics, supply chain management (SCM), consulting methodology (ISP), and logistics center construction consulting methods were investigated step by step. As a result, ISP (Information Strategy Plan), a consulting methodology, was linked to Deming's PDCA. For the first stage of PLAN(contingency analysis and purpose, problems with logistics center operation), for the second stage DO(establishment of consulting plans and explanation of proposals, derivation of strategic tasks that are master plans), for the third stage CHECK(establishment of detailed implementation plans, consulting output) and for the fourth stage ACT(project management) were applied (post management). The limitation of the study is that the reliability of the mapping results is limited because the relevant data were compared to develop the consulting methodology as a standardized module, but FGI analysis through experts or Delphi surveys are not conducted.

Keywords: *Smart Factory, Logistics Automation, SCM, Case Analysis, ISP Consulting, Module Development*

1. INTRODUCTION

1.1 Purpose of research

The purpose of this study is to help companies or consultants who will build logistics automation in smart factories. In other words, it creates and presents a standardized module of ISP(Information Strategy Plan) a smart factory logistics automation consulting method. To this end, we would like to propose a consulting model for establishing a logistics automation system by finding effective linkage measures with related environments such as production logistics management, material handling, and automation systems in the smart factory preparation stage.

1.2 Research procedures

This study is to create a consulting methodology m∟odule for logistics automation in smart factories. To this end, we will conduct a case study to create a standardized module for logistics ISPs and examine the

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Corresponding Author: 3795879@hanmail.net
Tel:+82-031-450-5161
Associate Professor, Dept. of Liberal Arts, Hansei Univ., Korea

logistics ISPs created through case analysis. To this end, As shown in Table 1, the first stage was to understand smart factories, the second stage was to understand smart logistics, the third stage was supply chain managemen(SCM) to understand smart factory logistics, the fourth stage was to understand and type of consulting methodology, and the fifth stage was to investigate similar logistics consulting methods. Based on this, the logistics ISP was derived in step 6 and the logistics ISP was verified through case analysis in step 7.

Table 1. Research method

Process	a case study					Case Analysis	
	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
	a smart factory	Smart logistics	Supply Chain Management (SCM),	Consulting Methodology	A Methodology for Distribution Center Construction Consulting	Consulting Methodology Comparison	Verification
Reason	Understanding of this study	A Study on the Case Analysis of Automation of Logistics	A survey to understand logistics automation	ISP-related research	Research on similar logistics ISPs	Comparison of consulting methodologies	Verify logistics isp on site

2. UNDERSTANDING OF RESEARCH

2.1 Smart Factory

The term "smart factory" means an intelligent factory, etc. that controls and improves the manufacturing process of products based on manufacturing data. (Act on Promotion of Smart Manufacturing Innovation of Small and Medium Enterprises, Article 2, 4) In other words, it refers to an intelligent factory that improves corporate productivity and product quality by applying information and communication technologies such as Internet of Things (IoT), artificial intelligence (AI), and big data to all or part of the manufacturing process from planning or design to production, distribution, and sales. All situations in the production process can be defined as future factories that can improve productivity and meet the quality of products by allowing information to be collected in real time[1].

2.2 Smart Logistics

Logistics refers to the entire process of moving from one point to another. In other words, it can be said to be a wide range of processes such as transportation, unloading, storage, packaging, distribution, and information processing that deliver products from suppliers to consumers. The core of the logistics system is to flexibly link cargo, information, and fund flows throughout the logistics process. Accordingly, smart logistics refers to automating and intelligent logistics with the latest IT technologies such as artificial intelligence (AI), big data, Internet of Things (IoT), and cloud [1].

2.3 Supply Chain Management (SCM)

The operational performance of a supply chain management(SCM) company is to derive a business strategy by focusing on the core competencies of the production sector in promoting the company's business strategy based on the production capacity theory. Cost, quality, flexibility, and supply capacity (compliance with delivery) are common production factors that should be dealt with in this production strategy decision-making process[2].

2.4 Consulting Methodology and Smart Factory Construction ISP Research

According to the Small and Medium Business Consulting Industry White Paper (2008) of the Small and

Medium Business Administration, consulting is defined as an act of presenting practical solutions to identify and solve various problems in the corporate management and helping them be implemented in a timely manner. ISP (Information Strategy Planning), a consulting methodology, refers to the establishment of strategies to effectively achieve organizational goals and is the most widely used methodology so far, starting with James Martin's Strategic Information Planning Methods (1982) [3][4]. Consulting methodology is also defined as a collection of tools that develop and utilize optimal and effective methodological knowledge for problem-solving considering the entire ecosystem. The types of consulting methodology are models, modules, toolkits, best practices, solutions, and diagnostic tools, organizational tools, factor tools, reference tools, and creative tools. Various auxiliary methodologies are used to develop or utilize the methodology, including project management methodology, quantitative statistical research methodology, qualitative analysis methodology, big data analysis methodology, insight, observation, and meditation [5][6]. Furthermore, the smart factory ISP (Information Strategy Plan) strategy (Lim Heon-wook 2023) can be carried out with PDCA. The first stage of Plan (Environment, Status Analysis) is to analyze the current situation and identify the purpose of introduction, problems in factory operation, The second phase of Do (Future Model Goal Establishment) involves establishing a consulting plan and explaining proposals, deriving strategic tasks (Master Plan), The third step is to establish detailed action plans (implementation system and schedule plan), consulting output, consulting evaluation and performance report, The four-stage Act (post management) can be established by post-management consulting[7].

2.5 A Study on the Consulting Methodology for Construction of Distribution Center

Companies build factory automation systems to improve management efficiency and productivity as a major strategy for sustainable growth. However, most companies undergo various trials and errors as they carry out projects without sophisticated preparatory steps for factory automation. Jaeho-Ko(2015) developed a smart factory logistics ISP strategy using the Milan model and the Stage-Gate model. In addition, it was intended to contribute to the performance of the resulting system by processing effective infrastructure automation projects of production, material handling systems, and energy-saving systems through expert review when preparing materials, and promoting project planning. In summary, the first stage proposed contact, meeting, industrial environment analysis, market environment analysis, product and service analysis, project analysis, proposal submission, and consulting contract work to determine the value of project selection for entry. In the second stage, issue diagnosis, data collection, customer demand analysis, data analysis, corporate strategy, operation, competency organization, customer vulnerability, business-based analysis, business economics evaluation, and customer feedback were proposed for the question of reasonable consulting authorization for diagnosis and proposal selection. The third stage proposed an idea concept, alternative materialization, process modeling, project detail definition, organizational composition, and master plan establishment as to what the business outlook is for the proposal decision. Step 4 proposed implementation process planning, project team formation, change management, implementation (coordination), material handling work, specification preparation, construction progress confirmation, education and training, operation plan, resource plan establishment, and strategic alternative development to determine the appropriateness of the master plan. In the last five stages, evaluation work for the quality efficiency of the project was proposed to determine completion[8].

3. EMPIRICAL RESEARCH

3.1 Derivation of Smart Factory Logistics Consulting Methodology (ISP)

In order to derive the smart factory logistics consulting methodology, as shown in Table 2, the smart factory logistics consulting methodology(ISP) was derived by comparing and analyzing the smart factory construction ISP thesis case, the logistics center construction consulting paper case (D door), and the

logistics consulting company website case. First, in the first stage of the consulting methodology(ISP) PLAN (Environmental Analysis), P1 The purpose of current status analysis and introduction (logistics center review, characteristics and functional analysis of logistics center), P2 The identification of problems in corporate operation (logistics process and unit analysis, volume survey, and analysis) was applied. In the second stage of DO (target model establishment), D3 Consulting proposal explanation (unit design, storage plan), and D4 Master plan, strategic task derivation (master plan establishment, CAPA setting for each facility in the center) were applied. In the third stage of CHECK (implementation plan establishment), C5 Detailed action plan (implementation process plan, automation action plan according to volume) and C6 Consulting output (As-Is To-Be model process, investment cost, and expected effect analysis) were applied. In the fourth stage of ACT (Project Management), A7 Follow-up management (reviewing automation plans and deriving suitability) was applied[9][10].

Table 2. Case study

Remarks	Smart Factory Construction ISP Paper Case (A)	Practical case of logistics consulting firm's website (B)	Case of Consulting Paper on the Establishment of Distribution Center (C)	Distribution Center Construction Consulting Practical Case DDoor (D)	Derivation of Smart Factory Logistics Consulting Methodology (ISP)
PLAN Environmental Analysis Current Status Survey	1. Current Status Analysis and Purpose of Introduction	1. Position : Vision Workshop	Project Selection (Entry) 1. Logistics Center Review 2. Environmental Analysis (Industry, Market) 3. Diagnosis and analysis (including issues, business base, and affordability)	1. Logistics Center Review	P1. Current Status Analysis and Purpose of Introduction - Logistics Center Review - Characteristics and Functional Analysis of Distribution Center
			4. Analysis of corporate strategies and vulnerabilities 5. Product and Service Analysis	2. Characteristic Analysis of Distribution Center 3. Setting up distribution center functions	P2 - Identifying the problems of the operation of the distribution center - Logistics Process and Unit Analysis - Survey and analysis of volume of goods
	2. Identify the problems of factory operation	2. Scope : Project scope definition and determination	Selection of proposals (Diagnosis) 6. Submission of proposals and consulting amendments and contracts	4. Logistics Process Analysis 5. Logistics Unit Analysis 6. Survey and analysis of volume of goods	
DO Establishment of target model	1. Establishment of consulting plan and explanation of proposal	3. Model : AS-IS Process Modelling, To-Be Process Modelling, and Issue Organization 4. Analyze To-Be process, investment costs, and expected effects	Action Planning 1. Idea concept, strategy 2. Analyzing Process Modeling Benefits 3. Implementation of project details	7. Unit Design Module Setting (Archival Plan)	D3. Explain the consulting proposal - Unit Design Module Setting (Archival Plan)
	2. Development of strategic tasks (master plan)	5. Optimization: Create optimal solutions and blueprints	6. Master Plan Establishment 7. Resource Planning	8. Target volume setting 9. Facility plan in the center 10. CAPA settings by facilities in the center	D4. Derivation of strategic tasks (master plan) - Master Plan Establishment - CAPA settings by facilities in the center
CHECK Establishment of implementation plan Facility design	1. Establish detailed action plan (Promotion System and Schedule Plan)		Termination 1. Plan the execution process	11 Establishment of automation plan according to volume of goods	C5. Establish detailed action plans - Plan the execution process - Establishment of automation implementation plan according to volume of goods
	2. consulting output ·(Compare AS/IS, TO/BE) 3. Consulting Evaluation and Performance Reporting		2. Change Management and Coordination 3. Create Specifications 4. Material handling work	12 Request/Review Automation Company Information	C6. Consulting output - (As-Is To-Be) Model Process, - Investment Cost and Expected Effect Analysis
ACT Project Management	1. Consulting follow-up management		1. Evaluation	13 Review automation plan and draw suitability	A7. Follow-up management - Review automation plans and draw suitability

Source A: Smart Factory ISP Method, B: E&C GLS Co., Ltd, C: Proposal of consulting methodology for efficient construction of automated logistics systems for high-residence equipment (modification), D: Company D's logistics center construction consulting methodology

3.2 Application of smart factory logistics consulting methodology (ISP)

In order to apply the smart factory logistics consulting methodology (ISP), it was applied as shown in table 3, focusing on the case of D door.

Table 3. Derivation of ISPs for logistics consulting in smart factories (centered on D door cases)

Remarks	Create Smart Factory Logistics ISP
PLAN **Environmental Analysis** **Current Status Survey**	1. Current Status Analysis and Purpose of Introduction ○ Logistics Center Review - Analysis of the target distribution center's deposit/exit and basic data (For designing work processes and operational schedules) ○ Characteristics and Functional Analysis of Distribution Center - Distribution Center Design · Size of distribution center: required throughput and amount of stored goods, size of distribution center (floor area/total floor area) · Functions and handling items of the distribution center: Inventory placement strategy (CDC/RDC/Depot, inventory/cross-docking, consolidation), items handled by the distribution center · Basic Operation Concept of Distribution Center : In/Outbound Logistics and Handling Items · inbound logistics: the treatment and conditions by warehousing type, the types of warehousing vehicles (transport, return, import, warehousing), and warehousing constraints · outbound Logistics: Forwarding type and processing, conditions, forwarding vehicle types (shipping, transporting, exporting, forwarding time), forwarding constraints 2. Identify the problems of the operation of the distribution center ○ Logistics Process and Unit Analysis - Work process analysis: warehousing → shipping → returns → additional logistics services - Analysis of the number of days of incoming and outgoing operations: Monthly → by unit operation → Strategy ULS analysis during the concentration time of daily operation - Analysis of handling units · Information processing survey and analysis : Unit of Measure (UOM), purchase/sales unit price, Lot/ BOM, etc · Distribution Unit Survey and Analysis : Handling Unit (Pallet/Box/Inner Box/Piece), Logistics Container (Pallet/Box/Large/Delivery Box, etc.), Load Spec (Standard/CBM/Weight/Delivery/Loading Quantity) - Handling characteristics analysis: Temperature (room temperature, refrigerated, frozen), handling (general, expensive, dangerous goods) weight and volume (Manual, machine), storage, and handling availability - ULS Analysis: ULS (Unit Load System) and ULS Analysis by Inbound and Outbound Work Process ○ Survey and analysis of volume of goods - Item ULS Data and Analysis : Unit, Packaging Type, Occupancy, Delivery Unit, Logistics Container Type - Item handling characteristics analysis: Handling temperature, presence of dangerous substances, QC target, bar coat attachment, Lot management - Demand Data Collection: Annual volume, incoming and outgoing, and return (annual, monthly), average inventory (random sampling) - Analysis of the traffic volume pattern: Analysis by type and handling characteristics, analysis of the traffic volume pattern, inventory analysis, ABC analysis (Item rotation by handling characteristics), EIQ analysis (Entry, Item, Quantity)
DO **Establishment of target model**	3. Establishment of consulting plan and explanation of proposal ○ Unit Design Module Setting (Archival Plan) - Unit Design Module Setting : Storage Schema Design, Analysis of Storage Facilities Characteristics, and Location Operation Schema Design - Target volume setting: Volume volume vs. Target design volume setting considering handling items 4. Development of strategic tasks (master plan) ○ Master Plan Establishment - Receiving → Inspection → Load storage → Export → Picking → Transfer → Classification → Packaging → Shipping-1 ○ CAPA settings by facilities in the center - Requirements of production CAPA analysis table: Facility name, facility capacity and specification, production production plan, C/V, revolution, UPH, time required, number required, number required, delivery unit price, sales amount, etc
CHECK **Establishment of implementation plan** **Facility design**	5. Establish detailed action plan ○ Action Process Planning (WMS) Logistics Warehouse Management System (WMS) (pre-receiving processing, automatic receiving processing, and proper location instruction) - Storage management: Storage policy by item, Expiration date management, history management by item, inventory management, cross-docking - Placement management: warehousing storage policy, automatic location selection, storage location management, proper list - Order management: Priority order management, inventory allocation by order, and order characteristics analysis - Picking management : Export location instruction, picking option, job batch processing, picking list - Establishment of automation implementation plan according to volume of goods 6. consulting output ○ (As-Is To-Be) Model Process, - As-Is Analysis: On-site Visit Survey (Factory & Logistics Center), Operations and Layout Check, Data Analysis - To-Be Design : Derivation of problems and presentation of improvement plan, and design of optimal improvement logistics system

	○ Investment Cost and Expected Effect Analysis : - Investment Effect Analysis
ACT Project Management	7. follow-up management ○ Review automation plans and draw suitability : - Establishing automation directions

4. CONCLUSION

4.1 Conclusion

In order to develop a smart factory logistics consulting methodology (ISP), a consulting methodology (ISP) was developed centering on the D-door case. The ISP (Information Strategy Plan), a consulting methodology, is similar to Deming's PDCA, and the first stage of PLAN (Environmental Analysis and Purpose, Problems in Logistics Center Operation), the second stage of DO (Counseling Plan Establishment and Proposal Explanation, Master Plan Development), the third stage of CHECK (Implementation Plan Establishment) (Detailed Action Plan Establishment, Consulting Output), and the fourth stage of ACT (Project Management) (Post Management) were developed.

4.2 Limitations of Research

The limitation of the study is that the reliability of the mapping results is limited because the relevant data were compared to develop the consulting methodology as a standardized module, but FGI analysis through experts or Delphi surveys are not conducted.

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