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Exploring the influence of Reference Architecture Model for Industry 4.0 (RAMI4.0) in electronic manufacturing service sector

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ABSTRACT

In the last decade, the industrial world has faced the evolution of adapting full-stack development toward Industry 4.0. The cutting-edge technologies of the Reference Architecture Model for Industry 4.0 (RAMI4.0) are one of the significant components that can increase the manufacturing industry's productivity and sustainability. The objective of the research is to investigate how RAMI4.0 functions and determine relevant aspects influencing the sustainability of certain electronic manufacturing services (EMS) industries. However, adoption of RAMI 4.0 in an EMS firm is a complex decision as the RAMI 4.0 architecture involves various domains and multiple layers in the system integration. By utilizing the Decision Making Trial and Evaluation Laboratory (DEMATEL) methodology, a causal map of the conceptual influence is created, which visualizes the causal relationship between the key criteria. To further determine the key factors contributing to RAMI 4.0's appropriateness, an expert questionnaire survey was conducted with a group of experts in a Taiwanese EMS firm. The process of finding best practices for RAMI 4.0 can be used significantly to enhance the EMS firm’s competence. The study's findings, in particular, may be useful to EMS firm decision-makers interested in adopting RAMI 4.0 digital technologies to promote sustainable development

Keywords: Reference Architecture Model for Industry 4.0 (RAMI4.0), Electronic Manufacturing Service (EMS), Decision Making Trial and Evaluation Laboratory (DEMATEL)

Introduction

With the adoption of digitalization, the major manufacturing industries have experienced significant growth based on new innovations such as the Reference Architecture Model for Industry 4.0 (RAMI4.0), which is intended to serve as an Industry 4.0 ecosystem requires all parties involved to share information and data efficiently and effectively. RAMI 4.0 provides this unifying model for all components. By using technology-based communication and information, traditional production methods undergo digital transformation, allowing EMS firms to adapt to modern manufacturing processes. The flexible automation of electronic manufacturing and PCB assembly processes is essential for maintaining competitiveness and improving the overall production system. By an increasing global competition, EMS firm adopted Industry 4.0 can be characterized by using automated equipment to revolving around production costs and their product quality. EMS companies have taken note of this business competition and expanded their industry evolution plans because their customers are more demanding than they used to be. This is done with the goal of bringing in more money from operations.

The current trend of optimization and automation in EMS is still evolving. To make the adoption of automated equipment and smart technologies on the factory floor more widespread, numerous manufacturers decided to modify their strategic plans. There are several reasons for making these adjustments, including improving the quality of production processes and products, as well as saving costs and achieving a faster time to market. In the meantime, some EMS companies have come up with ways to make it easier for their customers and suppliers to work with them on the factory floor. They accomplish this by reconfiguring their goods and services and integrating the existing supply chain's infrastructure using the most advanced Internet of Things (IoT) technologies. IoT devices are based on the Internet, which is built into the equipment and production line. This lets different devices talk to each other and use big data technology to collect production parameters.

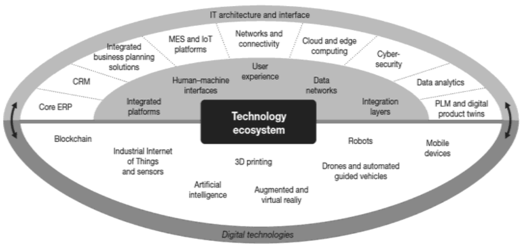

Figure 1. Technology ecosystem in Industry 4.0 (adapted from Pillsbury and Lübben, 2018)

Peraković, Periša and Cvitić (Peraković, Periša, & Cvitić, 2018) identified people, technology, operations, and customer solution characters as the key success factors of the firm that adopted Industry 4.0. Chen et al. (Chen, Wang, Feng, Li, & Liu, 2020) introduced the smart factory, which has five components: a manufacturing expert resource (coordination), on-site implementation (collection), the logistics process (control), production implementation (tracking), and quality assurance (monitoring). Furthermore, in complex EMS, coordination between an EMS firm and its supplier is typically difficult in Industry 4.0. Zhong et al. (Zhong, Xu, Klotz, & Newman, 2017) define the roles of Industry 4.0 as smart design in the development phase, production maintenance in real-time coordination, information control for data analytics, a transportation plan, and technology implementation and execution. In order to achieve a higher yield and more stable production, the manufacturing industry necessitates the use of emerging, advanced smart manufacturing technologies such as RAMI4.0 to increase the efficiency of traditional production processes. Furthermore, the implementation of smart factories should consider the financial status and customer requirements.

Literature Review

Industry 4.0 adoption by EMS firms focuses on enhancing their processes of manufacturing and assembling products through the use of smart manufacturing technology. In this vision, digital transformation refers to a world where all manufacturing is fully connected. Throughout the digital manufacturing environment, all of the equipment is online, intelligent, and capable of making decisions independently with varying degrees of autonomy (Boyes, Hallaq, Cunningham, & Watson, 2018). Increased digitization opens up new avenues for effectively responding to customer needs, allowing machines, computers, and even data itself to actively participate in manufacturing and production processes, reducing the need for human involvement and facilitating the creation of smart factories.

According to Kusiak (Kusiak, 2018), a smart factory offers considerable quality, resource, and economic advantages over conventional production systems. A network of cyber-physical based manufacturing system (CPMS) has enabled smart factories production systems to achieve high levels of automation. CPMS is primarily designed to manage manufacturing space intelligently, including smart planning in production processes, configuration of production factors, optimization of shop floor layout, scheduling production, and inventory management. Through a CPS-based production system, EMS manufacturing strength can be expanded and changed over time, making it possible for EMS companies to make their products fit the needs of their customers. Thus, all components of a smart factory will be organically connected to each other, which will facilitate an intelligent operating system and make the manufacturing data more transparent. Then the smart factory system can do the real-time production performance evaluation, by using web-enabled smart devices to determine if it is being performed to the highest productivity and quality standards as planned, or if there are any processes that can be improved.

The RAMI4.0 architecture, which is an initiative from industry stakeholders and German research institutions that aims to standardize smart factories, is a technological concept that serves as a three-dimensional map (Flatt, Schriegel, Jasperneite, Trsek, & Adamczyk, 2016; Peraković et al., 2018) to demonstrate important aspects of Industry 4.0. Another approach, the RAMI4.0 theory, is capable of exploring the industry 4.0 and interoperability dimensions. According to figure 2., A RAMI model consists of various hierarchy levels that represent the identified functionalities.

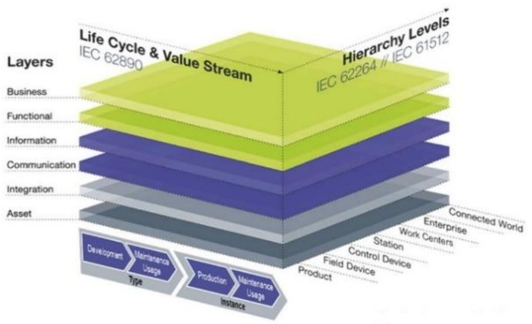

Figure 2. The RAMI4.0 framework
(source: standardization council industry 4.0)

For the purpose of analysis and design of smart factory solutions, RAMI4.0 are also classified according to various dimensions and abstraction levels, including micro (devices), meso (production facilities or modules), and macro (enterprises or industries). RAMI 4.0 is also defined as a standardization, such as modules, which are building blocks that can be grouped into different categories to solve business needs. It also highlighted a graphic concept for a three-dimensional solution that contained the key technological aspects based on IoT for smart factory applications that lie behind the industrial revolutions, such as the production data analytics and the integration of other technological functions in intelligent manufacturing needed. Therefore, RAMI 4.0 structure has been described as follows.

1. Business layer: This layer's objective is to ensure the consistency between business and operational models in the construction process, as well as to facilitate the mapping between firm’s business strategies and financial output. Along with a model for the regulations that the process must adhere to, the regulatory and compliance framework requirements are also provided. Additionally, this layer makes it easier for various business processes to communicate to other layers.

2. Function: This layer defines runtime manufacturing to represent the firm's service and application to the manufacturing system based the production planning, and it generates rules and decision-making for application logic.

3. Information: It provides for the operation and processing of projects and the execution of rules. Zezulka et al. (2016) described that the information layer provides a means for the formal description of business rules. Also for this layer's purpose, data is evaluated for its integrity, summarized in a new, structured, and organized information model, and made available for use by upper layers such as functional layers (Wang et al. 2017).

4. Communication: A key function of this layer is utilizing protocols to provide the standard information generated from the asset and integration layers (Zezulka et al. 2016), as well as OPC UA, it facilitates the upper layer’s I4.0 network process (Wang et al. 2017).

5. Integration: The integration layer is a process that involves supplying information pertaining to technical assets such as software and device network communication on an infrastructure basis. Moreover, all elements pertaining to information technology has been coordinated through high-level user interfaces that produce events based on the information acquired and perform final process control (Wang et al. 2017). Moreover, integration layer is responsible for managing the events produced by all assets, such as IIoT readers, sensors, and actuators, and for integrating user input (Zezulka et al. 2016).

6. Asset: The term "asset" refers to the physical Industry 4.0 representation of the IoT technology, as well as physical reality. For example, assembled products and

components are categorized in this layer based on the given machines/stations in the production process (Wang et al. 2017). The Integration Layer connects humans to the Asset Layer by utilizing identification technologies to verify and deliver assets layer information to the Integration Layer.

RAMI 4.0 was adopted by EMS, which can help with development by using a common concept and structure to constrain intelligence system architectures. For more benefits, utilizing RAMI 4.0 can help the firm understand the current situation deeper and make it easier for system implementation to go smoothly (Peraković et al., 2018). As RAMI 4.0 enables the standardization of major technological components from system developers to decision-makers through the construction of RAMI 4.0, the EMS manufacturing system is able to be integrated into a digital platform to enhance its advantages. To identify the key aspects, the research method is based on DEMATEL structural modeling, followed by the investigation of cause-and-effect relationships between the life cycle constituents, layers, levels, functions, and components of RAMI 4.0. DEMATEL technique can be used in order to confirm the existence of a relationship or interdependence among various dimensions / criteria or to reflect the relative level of interaction among them. DEMATEL method can therefore be used to tackle complicated problems that involve a number of interdependence or relationship in a multiple decision-making system. Using the DEMATEL method, cause-and-effect groups are created so that the correlation of key factors in a complex system can be identified.

Research Method

To identify the influence of Industry 4.0 on an EMS firm, this paper presents the DEMATEL approach. The DEMATEL approach was created at the Battelle Geneva Institute to address the complex decision-making problems facing modern society. With the DEMATEL technique, expert knowledge can be effectively combined to determine the degree of interdependence among multiple indicators and clarify the causal relationship between them. Furthermore, this technique has numerous applications, for examples, in industry policy and strategy, supply chain management, business planning, a firm's innovation adoption, and influential factors analysis. Meanwhile, DEMATEL is a graph theory with practical benefits that allows researchers to establish a network of influence relationships among the complexity of aspects and draw them into an influence relationship map (IRM). Through, the experts are invited to disclose their opinion of how the factor i influences the factor j. Pairwise comparisons of the i and j factors from the k experts are referred to as x_{ij}^{k}, which are five levels on the pairwise comparison scale, from No influence = 0, few influence = 1 to extremely high influence = 5. According to Tseng and Huang (Tzeng & Huang, 2012), before normalize the initial direct-relation matrix, the matrix in this research was defined the matrix $\boldsymbol{A}$ as initial direct influence, also known as the $n \times n$ initial direct influence relation matrix a_{ij}, this shows that a criteria is i^{th} not only affects j^{th}, but the criteria is also affected by others. As obtained through Equations (1)

$$\mathrm{A} = \begin{bmatrix} a_{11} & a_{1j} & \cdots & a_{1n} \\ a_{21} & a_{i2} & \cdots & a_{in} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{nj} & \cdots & a_{nn} \end{bmatrix} \tag{1}$$

The average matrix $\boldsymbol{A}$ obtained the normalized direct influence matrix $\boldsymbol{N}$ can be obtained through Equations (2) and (3),

$$z = \left\{ 1 \Big/ \max_{1\le i\le n} \sum_{j=1}^{n} a_{ij} , 1 \Big/ \max_{1\le j\le n} \sum_{i=1}^{n} a_{ij} \right\} \tag{2}$$

$$\boldsymbol{N} = z\mathrm{A} \, . \tag{3}$$

In this case, $\boldsymbol{N}$ is called the normalized matrix, since $\lim_{k\to\infty} \boldsymbol{N}^k = [0]$. in which all principal diagonal elements are equal to 0.

Then, the total relation matrix $\boldsymbol{T}$ is obtained using Equation (4),

$$\boldsymbol{T} = \boldsymbol{N} + \boldsymbol{N}^2 + \ldots + \boldsymbol{N}^k = \boldsymbol{N}(\boldsymbol{I} - \boldsymbol{N})^{-1} \tag{4}$$

Furthermore, $\boldsymbol{I}$ is the identity matrix.

where $\boldsymbol{I}$ represents the power, when $\boldsymbol{I}$ tends to ∞ and the matrix $\boldsymbol{T}$ will converge, through calculate the sum of rows and columns of matrix $\boldsymbol{N}$. The total influence relationship matrix $\boldsymbol{T}$, then can be defined through Equations (5), (6), and (7).

$$\boldsymbol{T} = [t_{ij}], \quad i, j \in \{1, 2, ..., n\} \tag{5}$$

$$\boldsymbol{r} = [r_i]_{n\times 1} = \left[\sum_{j=1}^{n} t_{ij} \right]_{n\times 1} \tag{6}$$

$$\boldsymbol{c} = [c_j]_{1\times n} = \left[\sum_{i=1}^{n} t_{ij} \right]_{1\times n} \tag{7}$$

where the r is the sum of each column in the total influence relationship matrix of T, whereas and c is the sum of each row in the total influence relationship matrix respectively.

Creating cause and effect diagrams, construct a cause-effect diagram, then calculating the (r+c, r-c) resulted that the the NRM can be drawn. As a result of adding r to c, which means a horizontal correlation index measures (r+c) the strength of aspects. It is the same process that is used to construct the vertical axis (r-c) the importance of a relationship between factors. In the case, if (r-c) positive value, the factor i is classified as a cause; otherwise, it is classified j as an effect. Once, the calculating result can be divided into 4 quadrants by computing the means of (r+c) and (r-c) to draw the causal-effect diagram. The complex interrelationships involve making decisions, according to the diagram result, which is easily identified. By the DEMATEL method, in particular, requires experts to determine the threshold value, then the influence relation matrix can be completed.

According to Tseng and Huang (Tzeng & Huang, 2012), introduced the hybrid MCDM method, DANP is DEMATEL-based the Analytic Network Process (ANP) for analyzing the influence weight of Industry 4.0 aspects. Assessing the importance of each factors based upon the survey questionnaires and identifying factors that influenced the decision of the firm. DANP is based on the ANP method, whereas the ANP is an extension of the analytic hierarchy process (AHP) uses attributes and structures alternatives within a hierarchy of attributes. Thus, as acting a nonlinear methodology that are widely been used on research for making decisions analysis. Also, this method has been used to solve real-world problems like business strategy, supply chain management, and optimal planning with great success. To determine the significant sequence of RAMI 4.0, a questionnaire survey, based on relevant literature, was conducted using the DANP method. The research process in this study can be divided into five steps: research methods and framework, research processes, research tools, data collection, and data analysis. A questionnaire survey was used in this study to collect relevant data from senior IT employees in Taiwanese EMS firm. The study is established by literature review to evaluate the relevant theoretical basis for the research dimension factors.

A Delphi method uses a structured communication process between a group of experts to address complex problems. In an objective application, the Delphi method works well for improving our understanding of problems, opportunities, and solutions, as well as for forecasting (Linstone & Turoff, 1975). The improved Delphi approach not only increases the amount of respondents compared to traditional Delphi methods, but also (1) minimizes conflicts brought on by group interactions, (2) ensures respondents' confidentiality of information in surveys, (3) minimizes biases resulting from group interactions, and (4) provides participants with effective results.

Experiment and Data Analysis

According to the Modified Delphi method, we first designed a questionnaire, offering detailed descriptions and examples of major research constructs and facilitating comprehensive comparisons among them. Based on the results of the modified Delphi process, we used a questionnaire to get the opinions of experts to investigate the IT employees of Taiwan's EMS firm. There were a total of 12 questionnaires collected, and then all of the research constructs were compared, so that their effects and influences could be measured.

Table 2. Background information of experts

Category/Classification	Number
Sex	
Male	8
Female	4
Age	
Less than 30 years	3
31 to 40 years	6
Over 40 years	3
Related IT experience	
Less than 5 years	2
6 to 10 years	8
Over 10 years	2
Education	
Bachelor	4
Master	7
PhD	1

Considered the consistency ratio, this research is used 12 where p denotes the sample of 12 experts, and a_{ij}^{p} represented the average influence matrix. Then, (1-α) could estimate the significant confidence, where is called α ; Through, confidence level is counted as 3.37%, representing 96.63% acceptance for this survey result.

By collecting all the data from the 12 questionnaires returned, a DEMATEL model and calculation are established to generate IRMs that represent influential relationships among criteria. By using DEMATEL model, obtain average matrix from experts as shown in Table 3, which is defined as the initial direct-relation matrix A, the process of calculation is established in order to generate IRMs that represent influential relationships among criteria. Normalize the average matrix to construct initial direct relation matrix, as shown in Table 4, furthermore, by using Equations (7 and 8), the total influence matrix for this research is shown in Table 5. To following the process, then discovering and deciding which key technologies are most important in developing RAMI 4.0 in the form of a ranking list. The study's findings can also be applied to an EMS company's IT resource deployment, which is based on the six layers on the vertical axis and two on the horizontal axis in RAMI 4.0's physical terms. Furthermore, visual identification of dominant influencing relations is done. Despite the fact that all parts interact, there are some important correlations. As shown in Figure 3., we summarized the driving factors from the IRMs, which are the factors of station, the control device data server, the virtual entity, and the Ethernet connection have been listed as the four main criteria of the of RAMI4.0. As shown in Table 6, identified the weight of DANP for the major criteria as following the factors of the station, the control device data server, the virtual entity, and the Ethernet connection respectively. In this way, the priorities normalized by criteria are equally distributed, which indicates that each criteria influenced from high to low relations can be categorized as asset layer, integration layer, information layer, and communication layer. Thus, these findings reflect the influence of EMS firms in developing of RAMI 4.0.

Discussion and Conclusion

The research examines how RAMI 4.0 enables the standardization of major technological components by IT experts through its construction so that the EMS manufacturing system is able to be integrated into a digital platform to enhance its advantages. The cause-and-effect relationships through the technical layers and components of RAMI 4.0 were analyzed to realize the existence of innovative adoption in a manufacturing firm and a complex decision-making process can be solved by identifying the key aspects in this research based on the DEMATEL structural modeling result. The database is used to store information regarding virtual representations, also referred to as information regarding the interaction of physical entities. To address this information layer, more technologies are needed, including semantic modeling, systems engineering, and product lifecycle management. To realize the cognitive capabilities, for instance, a unified ontology could be utilized to represent physical elements, virtual entities, and the topology between the components. Top-level ontologies can be used to combine many ontologies synced with virtual entities to facilitate cognitive decision-making.

The current study is focusing on how EMS firms' IT experts affect the development of RAMI4.0 rather than considering the impact of stakeholder groups who may influence the firm's decision to adopt this innovative technology. As a result, future research should consider how stakeholders may influence the adoption and decision-making of innovative technology in a manufacturing firm.

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Appendix

Table 3. The average matrix

	C11	C12	C13	C21	C22	C31	C32	C41	C42	C43	C51	C61
C11	-	4.44	5.11	3.67	2.89	2.67	4.11	4.67	2.78	6.11	3.11	5.44
C12	4.00	-	4.22	4.44	3.11	4.11	3.11	4.67	3.44	3.11	4.33	4.56
C13	6.11	3.22	-	4.22	3.33	3.56	3.89	3.00	2.00	4.67	3.33	4.89
C21	2.89	2.67	4.11	-	2.78	3.89	4.56	5.11	4.67	2.56	4.89	4.67
C22	2.78	4.67	4.22	4.11	-	3.78	3.56	4.33	5.56	4.11	5.22	3.33
C31	4.67	5.67	5.11	3.56	4.00	-	3.44	3.89	5.22	4.22	6.11	3.11
C32	3.89	2.56	-	6.00	4.89	3.89	-	4.44	4.22	5.78	4.56	6.44
C41	6.11	3.22	4.56	4.22	3.33	3.00	2.78	-	3.00	2.00	4.67	3.33
C42	3.44	4.22	4.33	4.67	3.11	3.56	3.22	4.67	-	5.33	6.00	4.11
C43	4.67	2.89	4.22	4.33	3.56	3.56	4.44	4.33	3.89	-	2.89	4.11
C51	4.44	3.89	5.56	4.67	4.78	4.44	5.56	4.78	5.11	3.11	-	4.33
C61	5.33	3.11	4.00	3.00	2.00	4.67	3.33	4.89	4.67	5.67	5.11	-

Table 4. Initial Direct-Relation Matrix (by normalized the average matrix)

	C11	C12	C13	C21	C22	C31	C32	C41	C42	C43	C51	C61
C11	0.000	0.054	0.062	0.045	0.035	0.032	0.050	0.057	0.034	0.074	0.038	0.066
C12	0.049	0.000	0.051	0.054	0.038	0.050	0.038	0.057	0.042	0.038	0.053	0.055
C13	0.074	0.039	0.000	0.051	0.041	0.043	0.047	0.037	0.024	0.057	0.041	0.060
C21	0.035	0.032	0.050	0.000	0.034	0.047	0.055	0.062	0.057	0.031	0.060	0.057
C22	0.034	0.057	0.051	0.050	0.000	0.046	0.043	0.053	0.068	0.050	0.064	0.041
C31	0.057	0.069	0.062	0.043	0.049	0.000	0.042	0.047	0.064	0.051	0.074	0.038
C32	0.047	0.031	0.000	0.073	0.060	0.047	0.000	0.054	0.051	0.070	0.055	0.078
C41	0.074	0.039	0.055	0.051	0.041	0.037	0.034	0.000	0.037	0.024	0.057	0.041
C42	0.042	0.051	0.053	0.057	0.038	0.043	0.039	0.057	0.000	0.065	0.073	0.050
C43	0.057	0.035	0.051	0.053	0.043	0.043	0.054	0.053	0.047	0.000	0.035	0.050
C51	0.054	0.047	0.068	0.057	0.058	0.054	0.068	0.058	0.062	0.038	0.000	0.053
C61	0.065	0.038	0.049	0.037	0.024	0.057	0.041	0.060	0.057	0.069	0.062	0.000

Table 5. Total relation matrix

	C11	C12	C13	C21	C22	C31	C32	C41	C42	C43	C51	C61
C11	0.589	0.553	0.623	0.623	0.557	0.543	0.626	0.645	0.582	0.653	0.604	0.700
C12	0.647	0.512	0.626	0.643	0.571	0.570	0.627	0.656	0.601	0.630	0.629	0.703
C13	0.651	0.534	0.558	0.622	0.557	0.548	0.618	0.619	0.568	0.630	0.600	0.687
C21	0.593	0.507	0.583	0.551	0.530	0.531	0.602	0.619	0.575	0.583	0.596	0.659
C22	0.654	0.584	0.646	0.662	0.554	0.585	0.654	0.675	0.646	0.662	0.661	0.712
C31	0.654	0.578	0.636	0.635	0.581	0.523	0.631	0.649	0.622	0.643	0.650	0.687
C32	0.641	0.539	0.575	0.657	0.586	0.564	0.587	0.651	0.608	0.656	0.629	0.719
C41	0.653	0.536	0.613	0.624	0.559	0.542	0.608	0.585	0.580	0.602	0.616	0.672
C42	0.637	0.557	0.623	0.642	0.567	0.560	0.625	0.653	0.557	0.651	0.644	0.693
C43	0.622	0.518	0.594	0.611	0.547	0.535	0.610	0.621	0.576	0.562	0.582	0.663
C51	0.702	0.600	0.687	0.696	0.634	0.617	0.704	0.709	0.667	0.682	0.629	0.755
C61	0.690	0.573	0.650	0.655	0.583	0.599	0.657	0.688	0.640	0.688	0.665	0.680

Table 6. Sum of rows and columns (total relation matrix)

R	C	*R+C*	*R-C*
11.68	12.45	24.13	-0.76
11.92	10.62	22.53	1.29
11.55	11.95	23.49	-0.40
11.08	12.28	23.36	-1.20
12.34	11.08	23.42	1.25
11.93	10.83	22.75	1.10
11.84	12.24	24.08	-0.40
11.58	12.50	24.08	-0.92
11.83	11.63	23.47	0.20
11.27	12.32	23.59	-1.04
12.92	12.02	24.93	0.89
12.46	13.48	25.95	-1.02

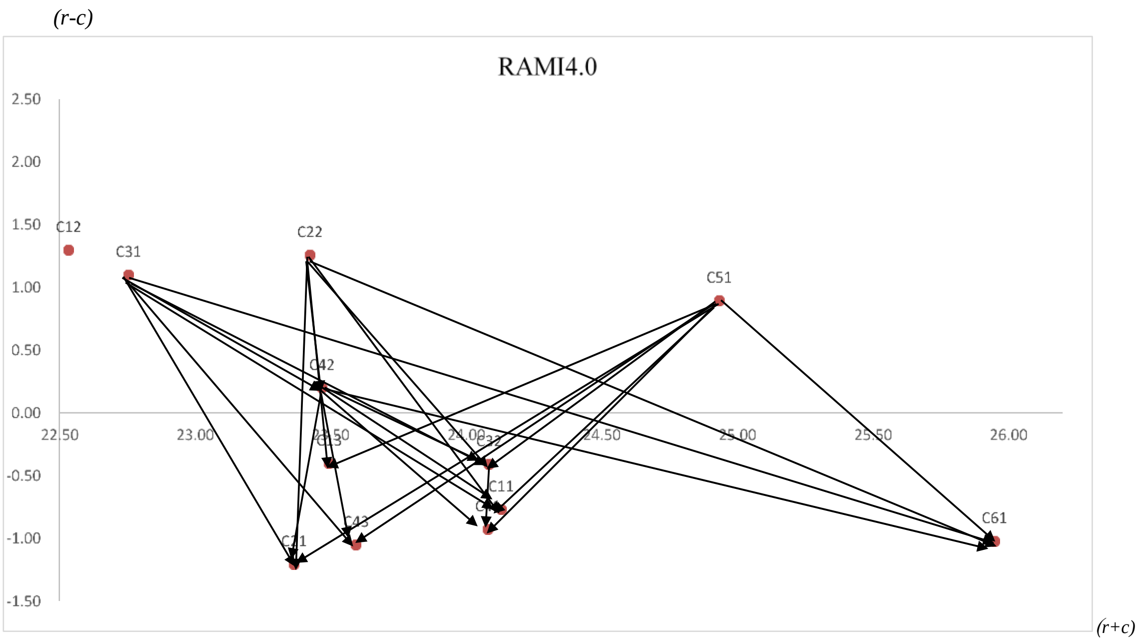

Figure 3. Influence Relationship Map of RAMI4.0

Table 6. Calculating result of DANP

	Dimensions/Criteria			**(D1)**			**(D2)**		**(D3)**		**(D4)**			**(D5)**	**(D6)**	
				(C11)	(C12)	(C13)	(C21)	(C22)	(C31)	(C32)	(C41)	(C42)	(C43)	(C51)	(C61)	Total
(D1)	**Asset layer**	(C11)	Equipment	0.589	0.553	0.623	0.623	0.557	0.543	0.626	0.645	0.582	0.653	0.604	0.700	7.298
		(C12)	Station	0.647	0.512	0.626	0.643	0.571	0.570	0.627	0.656	0.601	0.630	0.629	0.703	7.417
		(C13)	Product	0.651	0.534	0.558	0.622	0.557	0.548	0.618	0.619	0.568	0.630	0.600	0.687	7.192
(D2)	**Integration layer**	(C21)	DMOM	0.593	0.507	0.583	0.551	0.530	0.531	0.602	0.619	0.575	0.583	0.596	0.659	6.929
		(C22)	CDDS	0.654	0.584	0.646	0.662	0.554	0.585	0.654	0.675	0.646	0.662	0.661	0.712	7.694
(D3)	**Information layer**	(C31)	VE	0.654	0.578	0.636	0.635	0.581	0.523	0.631	0.649	0.622	0.643	0.650	0.687	7.489
		(C32)	HEN	0.641	0.539	0.575	0.657	0.586	0.564	0.587	0.651	0.608	0.656	0.629	0.719	7.412
(D4)	**Functional layer**	(C41)	GNO	0.653	0.536	0.613	0.624	0.559	0.542	0.608	0.585	0.580	0.602	0.616	0.672	7.189
		(C42)	ELS	0.637	0.557	0.623	0.642	0.567	0.560	0.625	0.653	0.557	0.651	0.644	0.693	7.408
		(C43)	EC	0.622	0.518	0.594	0.611	0.547	0.535	0.610	0.621	0.576	0.562	0.582	0.663	7.041
(D5)	**Communication layer**	(C51)	Ethernet	0.702	0.600	0.687	0.696	0.634	0.617	0.704	0.709	0.667	0.682	0.629	0.755	8.081
(D6)	**Business layer**	(C61)	SOA	0.690	0.573	0.650	0.655	0.583	0.599	0.657	0.688	0.640	0.688	0.665	0.680	7.766
		Total		7.733	6.589	0.598	0.642	0.580	0.545	0.638	0.648	0.605	0.647	0.618	0.708	

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