Identifying Critical Success Factors in Implementing Air Conditioning Servitization to Encourage Business Model Innovation

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Abstract

In Indonesia, the air conditioning market has barely grown in the last decade. This stagnant market will result in tough competition for air conditioning companies. Some companies begin to realize service offering is able to increase their profit through integrating goods and services to satisfy customer's needs and enhance customer's productivity. This business model called servitization will change the point-of-view of distributors from product-centered to service-centered. Servitization business model in Indonesia's air conditioning market is not new, but not widely implemented and some implementation is not successful. There are still a few numbers of studies regarding ventilation and air conditioning business model in Indonesia. It is important to recognize the elements of successful servitization implementation and their impact on successful implementation. This paper aims to identify and evaluate the critical success factors of ventilation and air conditioning servitization in Indonesia and how those factors will help the stakeholders. Through literature reviews, interviews with experts, and surveys, the author will determine a set of candidate success factors. Then, the DEMATEL method is used to identify and rank the critical success factors. This research will contribute to the understanding of the servitization business model in Indonesia and encourage the innovation towards servitization model.

Keywords
Servitization, Ventilation, Air Conditioning, Critical Success Factors, DEMATEL

1. Introduction
In the modern era of competitive Air Conditioning market, where demand is stagnant and the market volume stays the same, companies are struggling to maintain their position in the market. Indonesia air conditioning market grew around 1% yearly for residential products and -1,8% for commercial products. This growth is far lower than Indonesia's GDP growth, which is around 5% yearly. This situation is presented in table 1 and table 2 from JRAIA (2019).

Table 1. Market inquiries for residential AC

	2013	2014	2015	2016	2017	2018	2013-2018
	x 1000	x 1000	x 1000	x 1000	x 1000	x 1000	Growth
Global	91,432	90,704	86,244	88,807	96,405	96,071	5%
Asia	12,379	13,196	13,724	14,923	15,983	16,121	30%
Indonesia	2,153	2,198	2,109	2,209	2,253	2,254	5%

Table 2. Market inquiries for commercial AC

	2013	2014	2015	2016	2017	2018	2013-2018
	x 1000	x 1000	x 1000	x 1000	x 1000	x 1000	Growth
Global	12,935	13,086	13,111	13,505	14,567	14,900	15%
Asia	1,293	1,344	1,422	1,488	1,621	1,696	31%
Indonesia	93	89	93	91	84	85	-9%

Biardeau et al. (2020) ranked 219 different countries based on their cooling degree days or CDD within 5 km x 5 km area, and the result in table 3 shown that Indonesia was positioned third after India and China. The CDD method is used to find the requirement needed for the daily air conditioning intake and correlate it with the amount of population of the country. The distributors inside the market will increase, while the volume inquiries grow slowly, thus creating a highly competitive market.

An established market can be noticed by the competitiveness in price between competitors in the same market sector. Replying to the challenge itself, distributors will compete to create a more valuable product to the customer with higher price or decreasing their price which leads to less amount of profit obtained by the company (Porter, 1982).

Table 3. Country rank based on their CDD

No.	Country	Population (in millions)	Population-weighted annual CDDs	Product of population and CDDs (in billions)	Global share (%)
1	India	1309	2848	3728	28
2	China	1397	1009	1410	10
3	Indonesia	258	3284	848	6
4	Nigeria	181	3429	621	5
5	Pakistan	189	2504	474	4
6	Brazil	206	2108	434	3
7	Bangladesh	161	2644	426	3
8	Philippines	102	3266	332	2
9	United States	302	867	277	2
10	Vietnam	94	2777	260	2

The competitiveness in the market and high demand from the customer have made a lot of company come up with different and innovative strategies, among them is to give a service solution in their arsenal to open a new way to get more profit, stable cash flow and give them a unique approach different from their competitors from customer point of view (Oliva & Kallenberg, 2003; Pistoni & Songini, 2017; Robinson et al., 2016).

Some of the examples of product integration and service solution can be found aerospace industry, as Rolls-Royce Aerospace incorporate maintenance, repair, and overhaul to deliver power by the hour. Xerox offers Managed Print Service that puts forward cost-efficiency by handling print consumables, service, and maintenance and reducing waste (Pistoni & Songini, 2017).

From these examples, we can deduce a bundling offers provided by the companies which included product dan come with services integration to meet buyer needs and expectation can give companies and sellers a new opportunity to compete in the market (Shihundla et al., 2019). This strategy method of business is called *Sertivization*, a business model based on product-service integration.

In Indonesia, a few companies have introduced the concept of servitization in the VAC (ventilation and air conditioning) sector since the last decade. The companies or contractors of air conditioning who used to only selling air conditioning products began adding service solutions in their bundling consist of consultation, design, installation, maintenance, temperature set-point, and spare parts management in a high-level agreement of contract coined as *Cold Contract*. The transition of VAC companies' business model to servitization is shown in Figure 1 and 2.

Indonesian VAC contractors remain hesitant to adopt servitization and some projects resulted in a servitization paradox that does not generate income as expected (Gebauer et al., 2005; Visnjic Kastalli & Van Looy, 2013). The major issue that leads to confusion is what needs to be prioritized in implementing servitization. There are still very few researches that address this perplexity as most research focus on the performance and efficiency of VAC products and there is yet research regarding a novel business model in the air conditioning industry. Although some researches

explore VAC servitization concerning financial performance, supplier relationship, and the cause and effect of VAC servitization, guidance to achieve successful VAC servitization is rare.

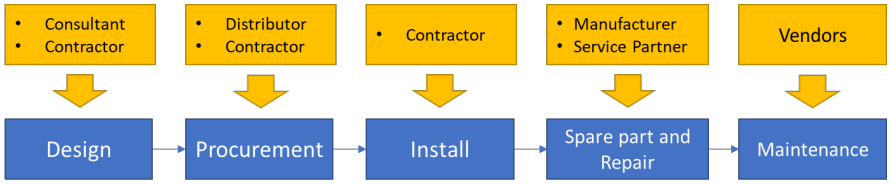

Figure 1. Actors and process flow in conventional VAC business

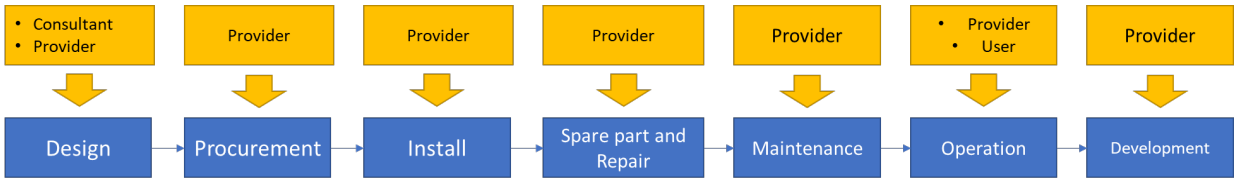

Figure 2. Actors and process flow in VAC servitization

There are different key factors in each industry affected by national background and business model. Therefore, the study evaluates the implementation of VAC servitization in Indonesia to:

1. Find the critical success factors and their interdependence so companies can focus on these CSF to achieve successful servitization.
2. Prioritize the CSF according their importance so companies can allocate their resources accordingly.

The remainder of this paper is organized as follows. Section II explores servitization regarding critical success factors and HVAC. Section III explains the methodology used in this paper, and finally, Section IV presents the conceptual model based on experts' interviews and Section V presents the conclusion of this research.

2. Literature Review

Servitization is an activity where they sell one whole package service solution to satisfy customer expectations and needs, not only selling the product itself (Vandermerwe et al., 1989). Meanwhile according to Prester (2010), the quantity of service has a positive relationship with income. Experts also state that customer retention on durables product will increase according to their vendor's value of service (Rodrigo et al., 2014)

The transition of a business from traditional to servitization business values more on how the customer knows what they can achieve or get from the benefit of the product, not from the asset value of the product itself. From this point of view, the company doing the servitization business can focus more on how to sell the benefit of their service and product rather than the asset value of the product itself (Smith et al., 2014).

VAC (Ventilating and Air Conditioning) industry consists of several companies including manufacturers, distributors, consultants, contractors, and retailers where every party has each responsibility in procurement, installation, maintenance and designing, and Air Conditioning system.

In the literature review process, we analyse 26 articles from quality journals and proceedings. We did descriptive analysis, category selection and material evaluation based on Mayring (2003) in El-Abidi (2019). The result is a set of selected success factors which grouped into seven factors: (1) corporate leadership, (2) business model, (3) corporate capability, (4) people, (5) technology enhancement, (6) corporate culture, and (7) value co-generation. Table 4 depicts a summary of variables from the literature.

Recent research on servitization in the air conditioning industry has been conducted usually using logistic regression method and hierarchical regression (Kim & Toya, 2019). Study case and literature review (Frank et al., 2019; Rodrigo

et al., 2014; Wuni & Shen, 2020), AHP (El-Abidi et al., 2019) and longitudinal econometric approach (Visnjic Kastalli & Van Looy, 2013).

3. Methods

Critical success factors are different between industries and enterprises operating in a specific industrial context, thus there is no fixed rule to identify critical success factors. However, previous studies (Chua, 1999; Na Lu, 2008; Shen & Liu, 2003) has developed a systematic procedure that we can adopt. The procedures are outlined in five steps: (1) identify selected success factors, (2) validate the selected success factors, (3) illustrate the relationship and nature of criteria, (4) weigh criteria and (5) validate the critical success factors with experts. Figure 3 illustrates the process of this research.

Specifically, the process of the research was conducted as follow:
1. Identify selected success factors through literature review based on quality journals. Determining the factors will be based on literature from the previous studies. 11 criteria were used in previous studies followed by 7 variables that correlate to servitization of air conditioning. The list of criteria and variables can be seen in the Table 4.
2. Conduct an interview with experts on VAC servitization to consolidate Selected Success Factor (SSF).
3. Use the DEMATEL method to determine the Selected Success Factor variables and their correlation between the criteria.
4. Use the DEMATEL weighting method based on Dalalah (2011) and Kobryń (2018) and compare the results.
5. Analyse, validate and interpret the critical success factors.

Table 4. Research on critical success factor of servitization

Variable	Criteria	Source
Corporate Leadership	Innovative	Kim & Toya, 2019
	Articulate Vision	Kim & Toya, 2019; El-Abidi et al, 2019
	High Expectation	Kim & Toya, 2019
	Inspiring and participative	Kim & Toya, 2019
Business Model	Subscription Model	El-Abidi et al, 2019; Zhang & Banerji, 2017
	Long Term Plan	El-Abidi et al, 2019
	Project Selection	El-Abidi et al, 2019
	Outcome-Based Contract	Schuh et al., 2019; Schuh et al., 2020
Technology Enhancement		Schuch et al., 2020
Corporate capability	Effective Control	Zhang & Banerji, 2017
	Effective Internal Communication	Kim & Toya, 2019
	Technical Capability	Kim & Toya, 2019; Kastalli & v, Looy, 2013
	Quality of Service	Chalal et al., 2015
Corporate Culture	Innovative Culture	Palo et al., 2019
	Customer-oriented	Chalal, 2015
Value Cogeneration	Relationship Quality	Grandinetti et al., 2020
	Understanding Consumer	Zhang & Banerji, 2017

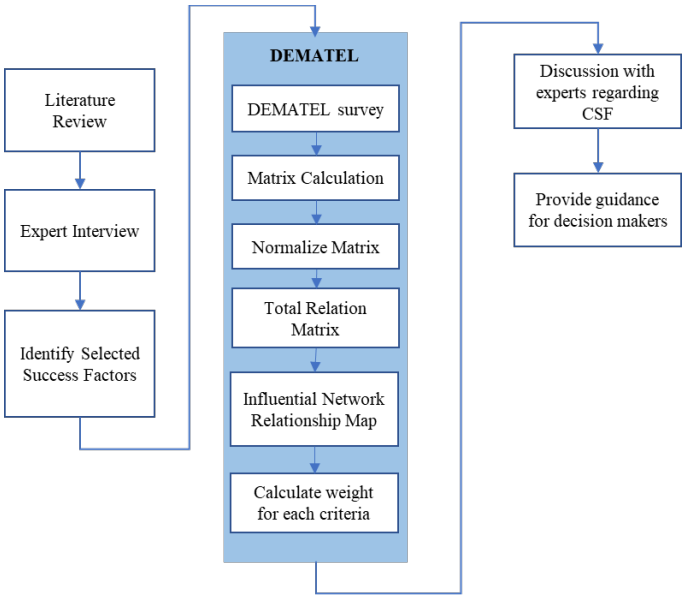

Figure 3. Flow Process of Research

3.1 Conduct an interview with experts to consolidate Selected Success Factor

From the literature study, it is yet to be found research on how VAC servitization can be done in Indonesia. The interview with experts is used to clarify which variables are influencing the success rate of servitization in regards to VAC industries in Indonesia.

Expert's interview was completed with pilot study with contribution from 2 directors and 3 project managers of VAC contractors. We asked the respondents to give their input on the actual condition based on the Critical Success Factor in HVAC servitization. In this process, the factors that were not important were eliminated. In the end, the result of this interview gave the Selected Success Factors for servitization of the VAC sector in Indonesia.

3.2 Determining the Correlation of Attributes and Weight in CSF using DEMATEL

DEMATEL method is used to prioritize the variable based on their correlation each other and their influence on each other. With matrix and diagram, this method will illustrate the cause and effect and analyze the dominance between variables in their correlation within the system. The step of using DEMATEL method is:

Step 1: Compose Questionnaire
Questionnaire in this research is a close questionnaire with Likert Scale from 0-4 to get the factor and sub-factor that influence the success rate of servitization in Air Conditioning with “no impact (0),” “Low impact (1),” “Medium degree impact (2),” “High impact (3),” to “Very high impact (4).”

Step 2: Compose Direct Correlation Matrix (Matrix A)
Direct Correlation Matrix is composed from questionnaire and input from the experts

Step 3: Normalize Direct Correlation Matrix (X)
Normalize the Direct Correlation matrix can be done with:

$$\boldsymbol{X} = k.\boldsymbol{A} \quad (1)$$

$$k = \frac{1}{\max\limits_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}} \quad (2)$$

Table 5. Direct Correlation Matrix.

	Criteria 1	Criteria 2	Criteria 3	Criteria 4	D	$\sum_{j=1}^{n} a_{ij}$
Criteria 1						
Criteria 2						
Criteria 3						
Criteria 4						
R						

Step 4: Calculate Total Correlation Matrix (T)
Total Correlation Matrix is calculated with:

$$\boldsymbol{T} = \boldsymbol{X}(\boldsymbol{I} - \boldsymbol{X})^{-1} \tag{3}$$

Step 5: Compose Cause and Effect Diagram

$$D = \left[\sum_{j=1}^{n} t_{ij}\right] \text{ dan } R = \left[\sum_{i=1}^{n} t_{ij}\right], i, j = 1,2, \dots, n \tag{4}$$

Table 6. Cause-and-Effect Matrix

	D	R	D-R (t^+)	D+R (t^-)
Criteria 1				
Criteria 2				
Criteria 3				
Criteria 4				

The value from Column D+R shows how much the Criteria is correlating with other criteria. Meanwhile, Column D-R shows the position of Criteria as the influence giver or the influence receiver. A positive D-R value will show that the criteria is influencing other criteria, and a negative D-R value will show that the criteria is being influenced by other criteria. From the result of the table, a Diagram of cause and effect will be made where the Value of D+R is the X-axis and the value of D-R is the Y-axis.

Step 6: The Determination of Weight
DEMATEL can be used to determine the weight of each criteria (Baykasoğlu et al., 2013; Dalalah et al., 2011) using the following equation

$$\omega = ((t^+)_i^2 + (t^-)_i^2))^{1/2} \tag{5}$$

but in this equation, (D-R) takes on negative and non-negative values. This method will result in less accuracy for weighing objects. Since the role of D+R and D-R is to indicate the importance and relationship between criterion, it is possible to use the average value of D+R and D-R to determine the weight of criterion using the following equation (Dos Santos & Coelho, 2020; Kobryń, 2017, 2020).

$$t_i^{average} = \frac{1}{2}(t^+ + t^-) \tag{6}$$

The equation will be normalized using following equation

$$W_i = \frac{t_i^{average}}{\sum_{i=i}^{n} t_i^{average}} + \delta, with\ 0 \le \delta \le \min t_i \tag{7}$$

4. Result and Discussion

From experts' interview, the selected success factors are modified to the actual condition of Air Conditioning market in Indonesia in the table 7.

Table 7. Variable of Critical Success Factor from Interview with Experts

Variables	Code	Criteria
Corporate Leadership	CL1	Innovative
	CL2	Articulate Vision
	CL3	Inspiring and participative
Business Model	BM1	Financial Planning
	BM2	Long Term Plan
	BM3	Project Selection
	BM4	Outcome Based Contract
Corporate Capability	CC1	Effective Control
	CC2	Quality of Service
Value Cogeneration	VC1	Relationship Quality
	VC2	Understanding Consumer

Based on experts' interview, a hypothesis conceptual model between the Critical Success Factor and Success Rate of servitization on Air Conditioning is illustrated on the Figure 4.

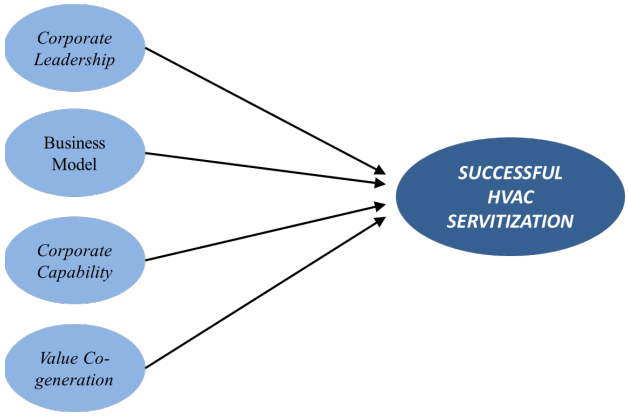

Figure 4. Hypothesis Conceptual Model

The initial direct relation matrix obtained from five experts is summarized in table 8 and the total relation matrix is shown in table 9.

The average sample gap (Liu et al., 2020; Yang et al., 2018) can be found with $\frac{1}{n(n-1)}\sum_{i=1}^{n}\sum_{j=1}^{n}\left(\frac{\left|t_{ij}^{p}-t_{ij}^{p-1}\right|}{t_{ij}^{p}}\right) x\ 100\%$ = with n is the number of criteria, p is the number of experts we get index of 1.2% < 5% consensus and resulted in confidence level 98.8% which is greater than the recommended minimum 95%.

The threshold is decided using one standard deviation above the mean (Govindan & Chaudhuri, 2016; Xia et al., 2015), 0.44 to reflect the relationship between criteria. The summary of importance and relation between criteria is shown in table 9. Criteria with dispatcher nature (cause) are innovative leadership, ability to articulate vision, inspiring and participative leadership, subscription model, outcome-based contract, and customer relationship. Whereas, criteria with receiver nature (effect) are long-term plan, project selection, effective control, service quality, and relationship quality. Based on table 10, we create a digraph to illustrate the relationship between criteria in figure 5.

Table 8. Direct Relational Matrix

	CL1	CL2	CL3	BM1	BM2	BM3	BM4	CC1	CC2	VC1	VC2	Total
CL1		2	2.4	3	3	2.4	2	2.4	1.8	0.6	3	22.6
CL2	3		3.4	1.2	3	1.6	2.8	1.6	2.4	1.6	1.2	21.8
CL3	3.2	2.2		0.8	2.4	2.4	2.4	2.6	2.6	2.2	1.4	22.2
BM1	0.2	0	0.2		4	3.2	3.2	1.8	3.4	3	1	20
BM2	0.4	0.2	0.4	3		3.4	2.8	3	3.2	2.6	2.2	21.2
BM3	0.2	0	0.2	2.6	3.8		3	3.4	3.2	2.2	2.4	21
BM4	0.6	0.2	0	3.4	4	3.8		2.8	3.4	3.6	3.6	25.4
CC1	0.2	0	0.2	0.6	2	1.8	0.6		2.2	1.4	1.4	10.4
CC2	0	0	0	0.2	1.8	2.2	1.6	2.6		3.6	1.6	13.6
VC1	0.4	0.2	0.2	1.00	2	2.2	2.2	2.8	2.8		3	16.8
VC2	1.4	0.4	0.2	1.6	3.6	3.2	3.6	2	3.6	3.8		23.4

Table 9. Total Relational Matrix

	CL1	CL2	CL3	BM1	BM2	BM3	BM4	CC1	CC2	VC1	VC2	D
CL1	0.08	0.11	0.14	0.34	0.49	0.44	0.39	0.43	0.45	0.37	0.39	3.63
CL2	0.20	0.05	0.18	0.28	0.47	0.40	0.40	0.39	0.45	0.39	0.33	3.54
CL3	0.20	0.12	0.06	0.26	0.45	0.42	0.38	0.42	0.46	0.41	0.33	3.50
BM1	0.06	0.02	0.04	0.20	0.46	0.42	0.37	0.36	0.45	0.41	0.29	3.07
BM2	0.07	0.03	0.05	0.31	0.33	0.43	0.37	0.41	0.46	0.41	0.33	3.22
BM3	0.06	0.02	0.04	0.30	0.46	0.31	0.37	0.42	0.45	0.39	0.34	3.18
BM4	0.09	0.04	0.04	0.37	0.54	0.51	0.33	0.46	0.53	0.50	0.43	3.84
CC1	0.04	0.01	0.02	0.13	0.24	0.22	0.16	0.16	0.25	0.21	0.18	1.63
CC2	0.04	0.01	0.02	0.14	0.28	0.28	0.23	0.29	0.22	0.33	0.23	2.07
VC1	0.06	0.03	0.03	0.20	0.34	0.33	0.30	0.34	0.38	0.26	0.31	2.59
VC2	0.12	0.04	0.05	0.30	0.50	0.47	0.43	0.42	0.51	0.49	0.29	3.61
R	1.02	0.50	0.67	2.84	4.54	4.23	3.75	4.10	4.60	4.17	3.44	

Table 10. DEMATEL result on criteria importance and relation

Criteria	Kode	D	R	D+R	D-R
Innovative	**CL1**	3.63	1.02	4.66	2.61
Articulate Vision	**CL2**	3.54	0.50	4.03	3.04
Inspiring and Participative	**CL3**	3.50	0.67	4.17	2.84
Subscription Model	**BM1**	3.07	2.84	5.91	0.24
Long Term Plan	**BM2**	3.22	4.54	7.76	-1.33
Project Selection	**BM3**	3.18	4.23	7.41	-1.06
Outcome Based Contract	**BM4**	3.84	3.75	7.59	0.10
Effective Control	**CC1**	1.63	4.10	5.73	-2.47
Service Quality	**CC2**	2.07	4.60	6.67	-2.54
Relationship Quality	**VC1**	2.59	4.17	6.76	-1.58
Customer Understanding	**VC2**	3.61	3.44	7.05	0.16

The criteria in quadrant I are identified as core factors. The subscription model has adequate importance while customer understanding and the outcome-based contract have high importance. All these criteria influence the other criteria. Corporate Leadership and all its criteria are identified as autonomous givers because they have low importance but high relation. The receivers are located in quadrant IV as they receive influence from other criteria (Si et al., 2018).

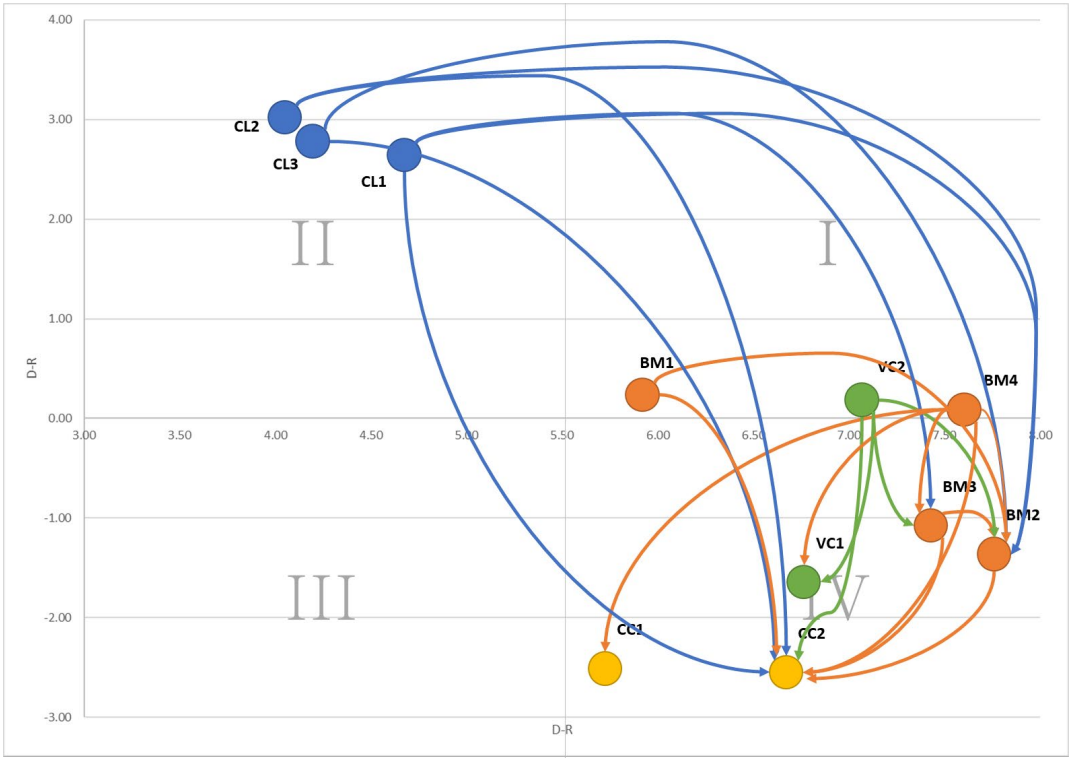

Figure 5. Impact-Relations Map

To determine the weight of each criteria we use both Dalalah (2011) and Kobryń (2017) method. As can be seen in table 11, although outcome-based contract rank first in both methods but the other criteria ranked differently. We presented table 11 to the five experts. The validation from experts is in line with Korbyn method that outcome-based contract, customer understanding, leadership factors, and subscription model have a significant impact on successful VAC servitization.

5. Conclusion

Implementation result of VAC servitization in Indonesia still has diverse result and some of them resulted in servitization paradox. An analysis of the critical success factors can act as guidance for companies to improve their performance. The obtained results showed what factors companies should prioritize their resources to achieve successful VAC servitization.

The obtained result shows that the top five criteria make up 54% of total weight. These criteria can be classified as leadership and the value proposition of servitization. From Table 11, we can determine that the implementation of an outcome-based contract (BM4) is the top priority with 0.113 weight. The second important factor is understanding what is the customer's need (VC2). Both BM4 and VC2 are the basis of servitization concept and are closely related. The main focus is finding customer's needs and create a business contract that helps customers to achieve their goals. Corporate leadership factor and all its criteria (CL1, CL2, and CL3) are drivers in this model as in the phase of transition, charismatic leadership will direct the business model and relationship with the customer.

Table 11. Criteria weight based on DEMATEL

Criteria	Baykasoğlu (2013) and Dalalah (2011)				Kobryń (2017) and Santos (2020)		
	ω	W	RANK		t avg.	W	RANK
Innovative	5.34	0.074	9		3.63	0.107	3
Articulate Vision	5.05	0.070	10		3.54	0.104	4
Inspiring and Participative	5.04	0.070	11		3.50	0.103	5
Subscription Model	5.91	0.083	8		3.22	0.095	6
Long Term Plan	7.87	0.110	2		3.07	0.091	8
Project Selection	7.48	0.104	3		3.18	0.094	7
Outcome-Based Contract	7.59	0.106	1		3.84	0.113	1
Effective Control	6.24	0.087	7		1.63	0.048	11
Service Quality	7.14	0.100	6		2.07	0.061	10
Relationship Quality	6.94	0.097	5		2.59	0.076	9
Customer Understanding	7.05	0.098	4		3.61	0.107	2

Some limitations still exist within this research. We use data from experts in Indonesia, but data from other countries or other industries should be a good comparison to this research. The current research is based on expert panels with a limited number of experts. For future research, it will be a good improvement to address more stakeholders. We will use another method for weighting in future research as DEMATEL's foremost function is to explore relationship between criteria.

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