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Barrier Factors Model of Innovation Process in the Furniture Industry Supply Chain (Case Study at PT. Duwa Atmimuda)

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ABSTRACT

PT. Duwa Atmimuda is a company engaged in manufacturing in producing stainless metal products and furniture frames. PT. Duwa Atmimuda is experiencing problems with the lack of application of technology in terms of marketing, seen from the absence of social media utilization, causing the company to find it difficult to expand market share. This study aims to identify the factors that hinder the company's innovation process using the Interpretive Structural Modeling (ISM) method and classify the model using MICMAC Analysis. The results showed that the ISM model of the barrier factor for the innovation process in the furniture industry supply chain has 6 levels. After the ISM model is obtained, the next process is to classify each variable indicator on the barrier factors of the innovation process with the help of MICMAC analysis. There are 4 classification clusters, the first cluster (autonomous indicators) has one indicator. While in the second cluster (dependent indicators) there is one indicator. In the third cluster (linkage indicators) there are 9 indicators. In the fourth cluster (independent indicators) there is one indicator. The third cluster (linkage indicators) is the highest cluster of indicator spreads where this indicator has high control and dependence. The conclusion of this study is that there are 12 inhibiting factors in the innovation process which are arranged into six levels of the ISM model and in the MICMAC analysis the third cluster is the highest distribution cluster.

1. Introduction

The growth of the furniture business in Indonesia is growing from year to year. Especially during the Covid-19 pandemic, Chairman of the Presidium of the Indonesian Furniture and Handicraft Industry Association (HIMKI) Abdul Sobur in the IDX Channel market review event revealed that the export market for the furniture industry has increased by 5-6 % (Rachmayanti, 2021). This increase is in accordance with the statement of the Indonesian trade minister, Muhammad Lutfi, who predicts the furniture industry has bright prospects in 2021. There are two main influencing factors, namely first, many consumers in the United States have a high rate of changing furniture considering that during the Covid-19 pandemic, they spent a lot of time at home compared to outside the home. The second factor is the reduced competition for furniture industry players in the United States, because

Vietnam as Indonesia's main competitor received sanctions from the United States due to suspected illegal raw materials for exporting furniture (Epede & Wang, 2022).

There are various kinds of furniture products in Indonesia based on the raw materials used, namely wood and processed wood furniture, rattan and bamboo furniture, furniture from other materials (metal and plastic). One of the advantages of furniture in Indonesia is a unique design that is not owned by other countries (Lu & Lu, 2017; Debnath, et. al., 2023). Design is the spearhead in the furniture industry which is a creative industry. The creative industry in Indonesia has an important role in developing the economy so that facilities are needed that support these potential advantages so that the creative industry in Indonesia can compete not only at the national level but at the international level (Fahmi, Koster & Dijk, 2016; Lobaccaro et al., 2019). To be able to survive in the competition, the company must be able to decide the right competitive strategy. One way that companies can do to win the competition is to implement an innovation strategy. Innovation is one of the keys to the success of a company (Vitaloka, 2020).

In this study, the main object is PT. Duwa Atmimuda which is a company engaged in manufacturing in producing stainless metal products and furniture frames. Referring to the company's vision, namely as a partner or strategic partner who is able to provide satisfaction and comfort for customers, one of the missions to make it happen is to produce innovative products. However, in carrying out this mission, there are several obstacles, including the machines used are often damaged, thus requiring repairs. The length of time for repair can range from days to even a week. This of course can affect the quality and quantity of the product produced. The lack of application of technology in terms of marketing also makes it difficult for the company to expand market share, based on data on the number of seat sales for the period August 2019 to July 2020, totaling 2446 sets of chairs per year where each month only produces 200-204 sets of chairs and there is no increase. Of these 2 constraints are the main factors that hinder companies in innovating, where machines are the main factor in carrying out the production process to produce products that will be marketed. Meanwhile, to reach the target market, companies need to improve marketing methods by utilizing the application of technology.

From the description of the problem above, then it will be developed a model of the barrier factors for the innovation process in the furniture industry supply chain using the ISM (Interpretative Structural Modeling) method. Some of the research that became the reference in this writing is shown in the Table 1.

Table 1. Previous research

Name	Title	Attribute
(Rashin & Ghina, 2018)	Identification of innovation and business performance in increasing competitiveness	Attributes in this study include product features, product design and design, product quality, production methods, distribution methods, product design changes, product promotions, prices, profitability, sales volume, and market share.
(Vitaloka, 2020)	The effect of innovation strategy on company operational performance (case study of MSME in Jambi)	Attributes in this study include leadership orientation, process innovation, product innovation, internal innovation sources, external innovation sources, and innovation implementation.

Some of these indicators are in accordance with this research, including: production methods, distribution methods, and product promotion. Meanwhile, in this study, 12 indicators were found which were inhibiting factors in the innovation process which can be seen in Table 2.

All previous research only used data analysis techniques using SPSS, in this study the ISM and MICMAC analysis methods were chosen to solve the problem by modeling the relationship of inhibiting factors to the innovation process, besides that research using the ISM and MICMAC methods has never made the furniture industry their research object.

Table 2. Innovation process indicators

No.	Innovation Process Indicators
1.	Tools
2.	Warehouse
3.	Production Technology
4.	Administration Technology
5.	Product Target and Realization
6.	Product Quality Standard
7.	R&D Division
8.	Human Resources
9.	Transportation
10.	Inventory Management System
11.	Communication
12.	Marketing

This study aims to identify the factors that barrier the company's innovation process using the Interpretive Structural Modeling (ISM) method and classify the model using MICMAC Analysis. Interpretive Structural Modeling (ISM) is used as a tool to overcome subjective problems and interpret complex relationships between the elements involved (Singh et al., 2020) The ISM method also helps in determining the order and purpose of each relationship between elements in a complex system (Haleem, Khan, & Khan, 2019; Yang & Lin, 2020). Therefore, the research contribution is to be used as a strategy for developing the innovation process in the furniture industry supply chain of PT. Duwa Atmimuda in achieving business success.

2. Method

The stages of the research will be explained in Fig. 1 that explain in detail how the steps for compiling the research flow are. The research methodology aims to make it easier for researchers to solve problems based on research that has been done.

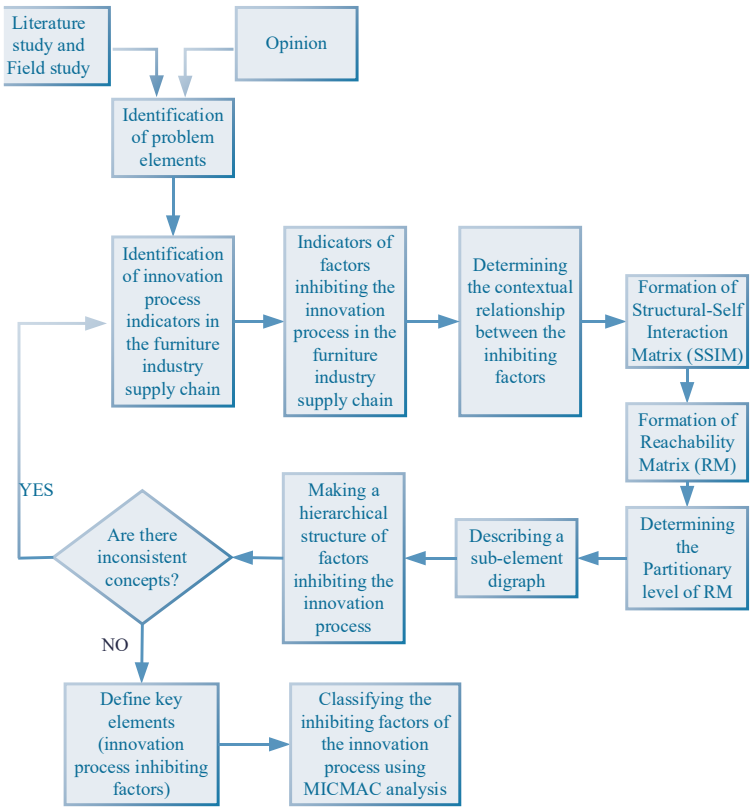

Fig. 1. Flowchart of Interpretive Structural Modeling (ISM) method

Fig. 1 is a flowchart of the Interpretive Structural Modeling (ISM) method which was developed through the author's thoughts and conducting literature studies. The research method to develop a model of the factors barrier the innovation process in the furniture industry supply chain is divided into three stages. The first stage is the identification of indicators of the innovation process in the furniture industry supply chain that can be broken down into barrier factors for the innovation process. The second stage is making a model of the barrier factors of the innovation process in the furniture industry supply chain with the help of the ISM method. The third stage is the classification of the barrier factors of the innovation process obtained using the MICMAC Analysis method. The explanation of the steps of the ISM method is as follows:

a. Identification of Innovation Process Indicators in the Furniture Industry Supply Chain

Table 3 shows the results of the innovation process indicators which are then broken down into the inhibiting factors of the innovation process in the furniture industry supply chain.

Table 3. Indicators of the innovation process in the furniture industry supply chain

No.	Innovation Process Indicators	Reference
1.	Tools	(Rashin & Ghina, 2018)
2.	Warehouse	(Rofaida et al., 2020)
3.	Production Technology	(Rofaida et al., 2020)
4.	Administration Technology	(Ulfa et al., 2021)
5.	Product Target and Realization	(Rashin & Ghina, 2018)
6.	Product Quality Standard	(Rashin & Ghina, 2018)
7.	R&D Division	(Rashin & Ghina, 2018)
8.	Human Resources	(Badri & Marjukah, 2017)
9.	Transportation	(Badri & Marjukah, 2017)
10.	Inventory Management System	(Badri & Marjukah, 2017)
11.	Communication	(Badri & Marjukah, 2017)
12.	Marketing	(Segara et al., 2019)

An in-depth interview was conducted with Mr. Ariyanto as the Head of Production for the furniture section regarding the relationship between the innovation process indicators which are the inhibiting factors for the innovation process through filling out the ISM questionnaire and content analysis was carried out on indicators of the innovation process in the furniture industry supply chain from various related literature sources. From the content analysis process, several indicators of the innovation process in the supply chain of the furniture industry will be produced. From the results of the innovation process indicators, it can be broken down into factors barrier the innovation process in the furniture industry supply chain which can be seen in Table 4.

Table 4. Indicators of Barrier Factors in the Innovation Process in the Furniture Industry Supply Chain

No.	Innovation Process Indicators	Barrier Factors in Furniture Industry Innovation Process	Code
1.	Tools	Manual tools and machines	H1
2.	Warehouse	There is no furniture storage warehouse yet	H2
3.	Production Technology	Lack of application of technology in the production process	H3
4.	Administration Technology	The bookkeeping process is still done manually	H4
5.	Product Target and Realization	Less stable fulfillment of auxiliary raw materials	H5
6.	Product Quality Standard	The product checking process is done manually	H6
7.	R&D Division	There is no research and development (R&D) department	H7
8.	Human Resources	Employee limitations in terms of experience and technological capabilities	H8
9.	Transportation	Limited driver and transportation facilities	H9
10.	Inventory Management System	IInventory management system is done manually	H10
11.	Communication	Decision making is done unilaterally by the company.	H11
12.	Marketing	The use of social media has not been implemented	H12

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b. Developing Contextual Relationships Between Barrier Factors in the Innovation Process in the Furniture Industry Supply Chain with Structural Self-Interaction Matrix (SSIM)

This stage is a contextual relationship for each element of the factors barrier the innovation process in the furniture industry supply chain. There are 4 symbols used in determining the direction between the factor's barrier the innovation process (i and j) as follows (Chen et al., 2021):

a) The letter V means that the barrier factor i affects the fulfillment of the barrier factor j, the barrier factor j does not affect the fulfillment of the barrier factor i.
b) The letter A means that the barrier factor i does not affect the barrier factor j, and the barrier factor j affects the barrier factor i.
c) The letter X means that the i and j barrier factors influence each other.
d) The letter O means that the barrier factors kei and kej do not affect each other.

After obtaining the indicators of the barrier factors of the innovation process, the next stage is the contextual relationship for each element of the factors barrier the innovation process in the supply chain of the furniture industry which can be seen in Table 5.

Table 5. Contextual relationship between factors barrier the innovation process

Code	H12	H11	H10	H9	H8	H7	H6	H5	H4	H3	H2
H1	A	O	O	O	X	O	X	X	O	X	O
H2	O	X	X	X	X	O	X	X	O	O	
H3	O	O	O	O	X	X	X	X	X		
H4	O	O	X	O	O	X	O	O			
H5	A	O	A	O	X	O	X				
H6	A	O	O	O	X	O					
H7	X	O	X	O	X						
H8	O	X	X	O							
H9	X	X	X								
H10	A	X									
H11	X										

c. Creating a Reachability Matrix (RM) and Checking Transitivity

This stage is related to the preparation of the reachability matrix with binary values because the V, A, X, and O codes in the SSIM are converted to values 0 and 1 with the following rules and shown in Table 6 (Jia et al., 2014):

a) If the SSIM element (i, j) is declared V then the element (i, j) in RM is worth 1 and element (j, i) becomes 0.
b) If the SSIM element (i, j) is declared A, then the element (i, j) in RM is 0 and element (j, i) becomes 1.
c) If the SSIM element (i, j) is declared X, then the element (i, j) in RM is worth 1 and element (j, i) becomes 1.
d) If the SSIM element (i, j) is declared O, then the element (i, j) in RM is 0 and element (j, i) becomes 0.

After the preparation of the initial reachability matrix is complete, the next step is to check the transitivity logically if variable A affects variable B, and variable B affects variable C, then variable A affects variable C. As an illustration, variable H1→H3 is worth 1, then H3→H4 also has a value of 1, then H1→H4 should also have a value of 1, because the initial reachability matrix table still has a value of 0 then it is changed to a value of 1 in the final reachability matrix table. The final results of the reachability matrix can be seen in Table 7. Processing of the final reachability matrix comes from the results of transitivity checks in Table 7. Then proceeds with calculating the total driving power value and dependence value. The driving power value is obtained by adding up the transitivity value of each variable horizontally, while to obtain the dependence value by adding up the transitivity value of each variable vertically (Mithun et al., 2020).

Table 6. Initial reachability matrix barrier factors for the innovation process in the furniture industry supply chain

Code	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12
H1	1	0	1	0	1	1	0	1	0	0	0	0
H2	0	1	0	0	1	1	0	1	1	1	1	0
H3	1	0	1	1	1	1	1	1	0	0	0	0
H4	0	0	1	1	0	0	1	1	0	1	0	0
H5	1	1	1	0	1	1	0	1	0	0	0	0
H6	1	1	1	0	1	1	0	1	0	0	0	0
H7	0	0	1	1	0	0	1	1	0	1	0	1
H8	1	1	1	1	1	1	1	1	0	1	1	0
H9	0	1	0	0	0	0	0	0	1	1	1	1
H10	0	1	0	1	1	0	1	1	1	1	1	0
H11	0	1	0	0	0	0	0	1	1	1	1	1
H12	1	0	0	0	1	1	1	0	1	1	1	1

Table 7. Final reachability matrix

Code	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	Driving Power
H1	1	0	1	1	1	1	1	1	0	1	1	1	10
H2	0	1	1	0	1	1	1	1	1	1	1	1	10
H3	1	1	1	1	1	1	1	1	0	1	1	1	11
H4	0	0	1	1	1	1	1	1	0	1	1	1	8
H5	1	1	1	1	1	1	1	1	0	0	0	0	8
H6	1	1	1	1	1	1	1	1	1	1	1	0	11
H7	0	0	1	1	1	1	1	1	0	1	0	1	8
H8	1	1	1	1	1	1	1	1	1	1	1	1	12
H9	0	1	0	0	1	1	0	0	1	1	1	1	7
H10	0	1	0	1	1	0	1	1	1	1	1	0	8
H11	0	1	0	0	0	0	0	1	1	1	1	1	6
H12	1	0	1	0	1	1	1	0	1	1	1	1	9
Dependence	6	8	9	8	11	10	10	10	7	11	9	9	

d. Determine Level Partition of RM

Table 8 is the result of the partitionary level of the reachability matrix. At this stage the final result of the reachability matrix is used to determine the partitionary level (P. Kumar et al., 2018). The first iteration at the level partitions of the final result of the reachability matrix which consists of reachability sets and the main antecedent sets. Reachability sets consist of the barrier factors themselves and other influencing factors, while the antecedent sets consist of the barrier factors themselves with other barrier factors influenced by other barrier factors. Level partitions iteration one was carried out on the variables 2, 5, 7, and 11. The results can be seen from the intersection sets values obtained from the reachability set values and the antecedent set values are the same (Digalwar et al., 2017). The iteration results are carried out by looking at the reachability set value which is the same as the intersection set value. Then the iterated variable will disappear in the next iteration.

Table 8. Level Partitions Iteration one

Code	Reachability Set	Antecedent Set	Intersection Set	Level
H1	1, 3, 4, 5, 6, 7, 8, 10, 11, 12	1, 3, 5, 6, 8, 12	1, 3, 5, 6, 8, 12	
H2	2, 3, 5, 6, 7, 8, 9, 10, 11, 12	2, 3, 5, 6, 7, 8, 9, 10, 11, 12	2, 3, 5, 6, 7, 8, 9, 10, 11, 12	1
H3	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 12	1, 2, 3, 4, 5, 6, 7, 8, 12	
H4	3, 4, 5, 6, 7, 8, 10, 12	1, 3, 4, 5, 6, 7, 8, 10	3, 4, 5, 6, 7, 8, 10	
H5	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8	1
H6	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 12	1, 2, 3, 4, 5, 6, 7, 8, 9	
H7	3, 4, 5, 6, 7, 8, 10, 12	1, 2, 3, 4, 5, 6, 7, 8, 10, 12	3, 4, 5, 6, 7, 8, 10, 12	1
H8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 10, 11	
H9	2, 5, 6, 9, 10, 11, 12	2, 6, 8, 9, 10, 11, 12	2, 6, 9, 10, 11, 12	
H10	2, 4, 5, 7, 8, 9, 10, 11	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12	2, 4, 7, 8, 9, 10, 11	
H11	2, 8, 9, 10, 11, 12	1, 2, 3, 6, 8, 9, 10, 11, 12	2, 8, 9, 10, 11, 12	1
H12	1, 3, 5, 6, 7, 9, 10, 11, 12	1, 2, 3, 4, 7, 8, 9, 11, 12	1, 3, 7, 9, 11, 12	

The calculation of the second iteration and so on is done by gradually removing the maximum number of reachability sets that match the intersection set, then proceeding to delete the variables in the antecendent and intersection sets. Do these steps until the last iteration (Chen et al., 2021). the second iteration can be seen in Table 9. At the level of partitions iteration 2, variables 9 and 10 become the eliminated variables for the next iteration process. The iteration process is carried out the same as in iteration one until all variables are eliminated. The iteration 3 to 7 can be seen in Table 10, Table 11, Table 12, Table 13, and for the final iteration as shown in Table 14.

Table 9. Level partitions iteration 2

Code	Reachability Set	Antecedent Set	Intersection Set	Level
H1	1, 3, 4, 6, 8, 10, 12	1, 3, 6, 8, 12	1, 3, 6, 8, 12	
H3	1, 3, 4, 6, 8, 10, 12	1, 3, 4, 6, 8, 12	1, 3, 4, 6, 8, 12	
H4	3, 4, 6, 8, 10, 12	1, 3, 4, 6, 8, 10	3, 4, 6, 8, 10	
H6	1, 3, 4, 6, 8, 9, 10	1, 3, 4, 6, 8, 9, 12	1, 3, 4, 6, 8, 9	
H8	1, 3, 4, 6, 8, 9, 10, 12	1, 3, 4, 6, 8, 10	1, 3, 4, 6, 8, 10	
H9	6, 9, 10, 12	6, 8, 9, 10, 12	6, 9, 10, 12	2
H10	4, 8, 9, 10	1, 3, 4, 6, 8, 9, 10, 12	4, 8, 9, 10	2
H12	1, 3, 6, 9, 10, 12	1, 3, 4, 8, 9, 12	1, 3, 9, 12	

Table 10. Level partitions iteration 3

Code	Reachability Set	Antecedent Set	Intersection Set	Level
H1	1, 3, 4, 6, 8, 12	1, 3, 6, 8, 12	1, 3, 6, 8, 12	
H3	1, 3, 4, 6, 8, 12	1, 3, 4, 6, 8, 12	1, 3, 4, 6, 8, 12	3
H4	3, 4, 6, 8, 12	1, 3, 4, 6, 8	3, 4, 6, 8	
H6	1, 3, 4, 6, 8	1, 3, 4, 6, 8, 12	1, 3, 4, 6, 8	3
H8	1, 3, 4, 6, 8, 12	1, 3, 4, 6, 8	1, 3, 4, 6, 8	
H12	1, 3, 6, 12	1, 3, 4, 8, 12	1, 3, 12	

Table 11. Level partitions iteration 4

Code	Reachability Set	Antecedent Set	Intersection Set	Level
H1	1, 4, 8, 12	1, 8, 12	1, 8, 12	
H4	4, 8, 12	1, 4, 8	4, 8	
H8	1, 4, 8, 12	1, 4, 8	1, 4, 8	
H12	1, 12	1, 4, 8, 9, 12	1, 12	4

Table 12. Level partitions iteration 5

Code	Reachability Set	Antecedent Set	Intersection Set	Level
H1	1, 4, 8	1, 8	1, 8	
H4	4, 8	1, 4, 8	4, 8	5
H8	1, 4, 8	1, 4, 8	1, 4, 8	5

Table 13. Level partitions iteration 6

Code	Reachability Set	Antecedent Set	Intersection Set	Level
H1	1	1	1	6

e. Describing Digraph

The preparation of the digraph is based on the iteration sequence and the variables that have been eliminated in that iteration (Awan et al., 2018). The initial digraph arrangement refers to the final level partitions. Preparation of the digraph by leveling that can show the relationship between variables. The preparation of the graph starts from the top level (top) iteration to the bottom level (bottom) position. Digraph can facilitate the suitability of the shape of the variable and the direction of the complexity of the relationship between variables (Taghavi, 2021). The digraph of the relationship between barriers to the innovation process in the supply chain of PT. Duwa Atmimuda's furniture industry can be seen in Fig. 2.

Table 14. Final level partitions

Code	Reachability Set	Antecedent Set	Intersection Set	Level
H1	1, 3, 4, 5, 6, 7, 8, 10, 11, 12	1, 3, 5, 6, 8, 12	1, 3, 5, 6, 8, 12	6
H2	2, 3, 5, 6, 7, 8, 9, 10, 11, 12	2, 3, 5, 6, 7, 8, 9, 10, 11, 12	2, 3, 5, 6, 7, 8, 9, 10, 11, 12	1
H3	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 12	1, 2, 3, 4, 5, 6, 7, 8, 12	3
H4	3, 4, 5, 6, 7, 8, 10, 12	1, 3, 4, 5, 6, 7, 8, 10	3, 4, 5, 6, 7, 8, 10	5
H5	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8	1
H6	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 12	1, 2, 3, 4, 5, 6, 7, 8, 9	3
H7	3, 4, 5, 6, 7, 8, 10, 12	1, 2, 3, 4, 5, 6, 7, 8, 10, 12	3, 4, 5, 6, 7, 8, 10, 12	1
H8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 10, 11	5
H9	2, 5, 6, 9, 10, 11, 12	2, 6, 8, 9, 10, 11, 12	2, 6, 9, 10, 11, 12	2
H10	2, 4, 5, 7, 8, 9, 10, 11	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12	2, 4, 7, 8, 9, 10, 11	2
H11	2, 8, 9, 10, 11, 12	1, 2, 3, 6, 8, 9, 10, 11, 12	2, 8, 9, 10, 11, 12	1
H12	1, 3, 5, 6, 7, 9, 10, 11, 12	1, 2, 3, 4, 7, 8, 9, 11, 12	1, 3, 7, 9, 11, 12	4

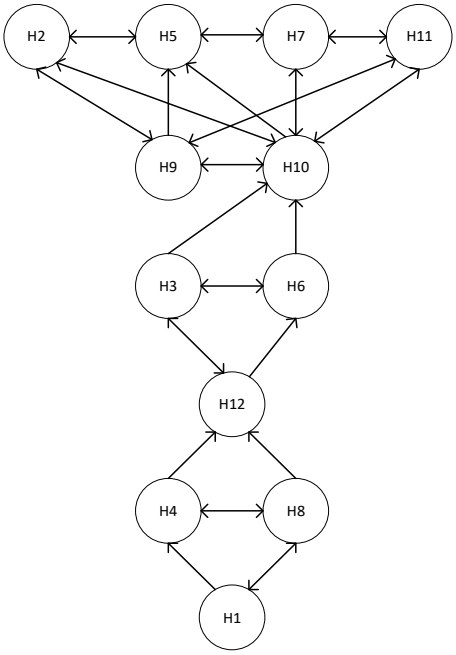

Fig. 2. Digraph of the Relationship Between Factors Barrier the Innovation Process in the Furniture Industry Supply Chain PT. Duwa Atmimuda

3. Results and Discussion

a. ISM Model Barriers of Innovation Process

After the digraph results are known, is then converted into Interpretative Structural Modeling (ISM) by replacing each variable node as a factor barrier the innovation process in the furniture industry supply chain according to the code for each variable node in the digraph. Then formed the ISM model of the barrier factor of the innovation process in the supply chain of the furniture industry (Ghalamsiah et al., 2020). The final stage of the ISM model is checked for conceptual inconsistencies, if the formed model is deemed inconsistent, then repeat the model preparation at the SSIM preparation stage, whereas if the results show consistency, then the ISM model can be accepted (Primadasa et al., 2019). Fig. 3 is a model of the relationship between factors barrier the innovation process in the supply chain of the furniture industry.

b. MICMAC Analysis

The step is to compile a driving power-dependence diagram in which the indicator classification process is carried out by considering the driving power (controlling power) and dependency classification (dependency classification) using the help of MICMAC Analysis (Khan & Haleem,

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2015). The indicators in this study are the barrier factors for the innovation process in the supply chain of the furniture industry. The obtained value of controllability and dependence is combined from the final result of the reachability matrix (M. Kumar & Rao, 2023). Each indicator will be classified into 4 groups, namely:

- Autonomous Indicators: the classification of dependence and control over these indicators is of little value. These factors tend to be unrelated to other indicators.
- Dependent Indicators: dependent indicator has a strong dependence but weak control power.
- Linkage Indicators: linkage indicators have high control and dependability.
- Independent Indicators: independent indicator has a weak dependence but high control power.

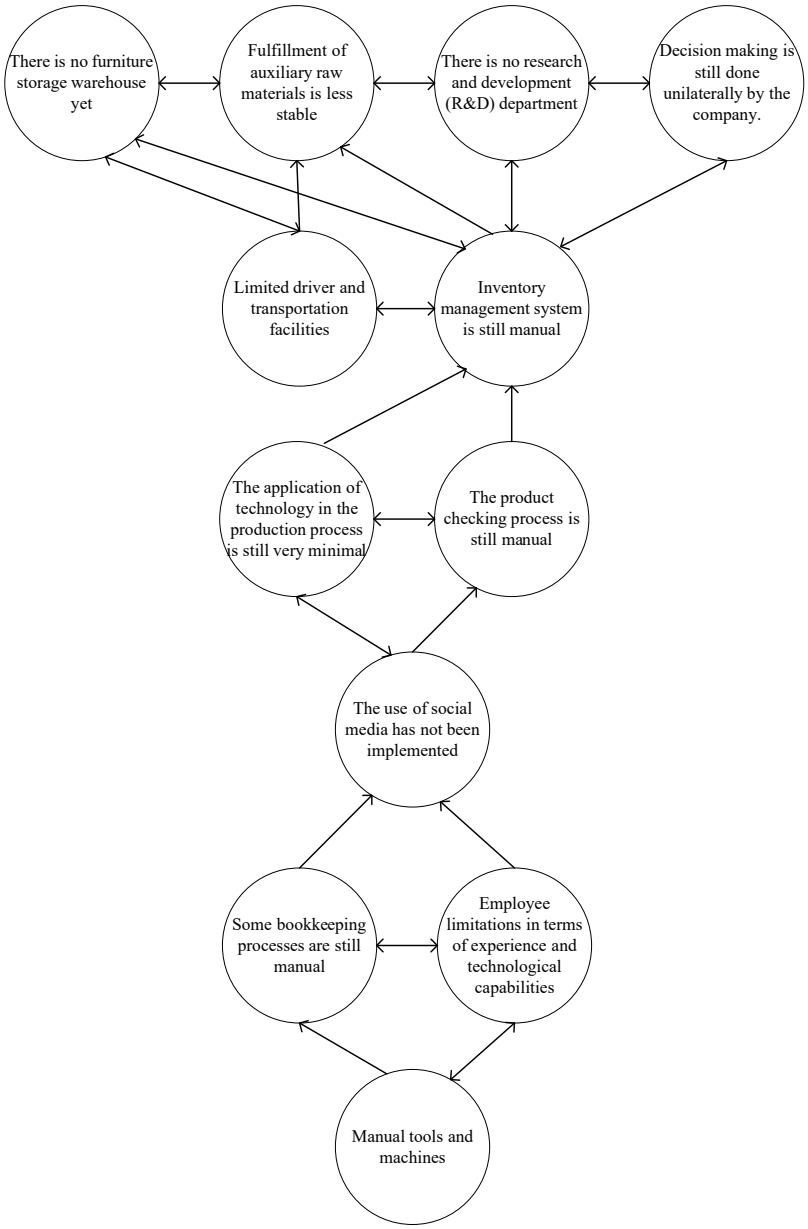

Fig. 3. ISM Model Relationship Between Barrier Factors in the Innovation Process in the Furniture Industry Supply Chain at PT. Duwa Atmimuda

Research from (Rashin & Ghina, 2018) found 11 innovation indicators focused on the fashion industry. These indicators include: product features, product design and design, product quality, production methods, distribution methods, changes in product design, product promotion, price, profitability, sales volume, and market share. Some of these indicators are in accordance with this

study including: manual tools and machines, no product storage warehouse, limited drivers and transportation facilities, manual inventory management systems, and the use of social media that has not been implemented.

From the results of data processing using the ISM approach, the ISM model of the factors barrier the innovation process in the furniture industry supply chain with 6 levels can be seen from the iteration results in the final level partitions which are then used as the basis for the preparation of digraphs to facilitate the suitability of variable shapes and directions. the complexity of the relationship between variables. The preparation of digraphs to model ISM starts from the top level to the lowest level, where level one includes warehouse variables, product targets and realization, r&d division, and communication then level 2 includes transportation and inventory management system variables, followed by level 3 covering production technology variables and product quality standards, level 4 includes marketing variables, level 5 includes administrative technology and human resources variables, and the last level or level 6 includes tools (equipment) variables as shown in Fig. 4.

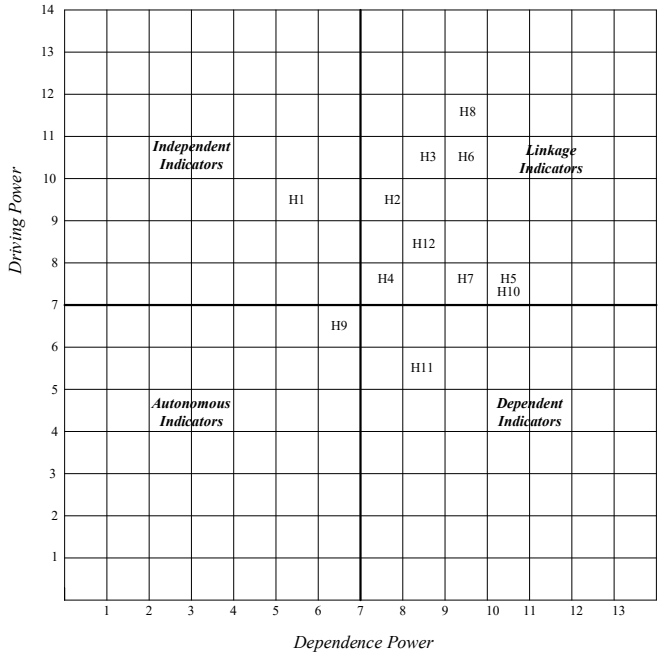

Fig. 4. Diagram diving-dependence power

This ISM digraph can show the direction of the relationship between variables that influence each other or not through checking by looking at the final reachability matrix value where if between variables is 0 then it has no effect and if it is 1 it means that the variables influence each other (Sun et al., 2020). The final stage of the ISM model is checked for conceptual inconsistencies, if the model formed is deemed inconsistent then the model is repeated at the SSIM preparation stage, whereas if the results show consistency, then the ISM model can be accepted. In this research process, validation was carried out by discussing the results of the model with an expert, namely Mr. Ariyanto as the Head of Production for the furniture section who was a source of information during interviews. The resulting model is consistent, so it can be accepted as an ISM model for the relationship between factors inhibiting the innovation process in the furniture industry supply chain at PT. Duwa Atmimuda.

After the ISM model is obtained, then the process of classifying each variable on the barrier factors of the innovation process with the help of MICMAC analysis. Each indicator will be classified into 4 clusters (P. Kumar et al., 2018), where in this study the most indicators are found in the third cluster (linkage indicators) which means this indicator has high control and dependence. In the first cluster (autonomous indicators) there is one indicator, namely the limitations of drivers and transportation facilities (H9), while in the second cluster (dependent indicators) there is one indicator

in it, namely decision making that is still done unilaterally by the company (H11), in the third cluster (linkage). Indicators there are 9 indicators which include there is no furniture storage warehouse (H2), the application of technology in the production process is still very minimal (H3), Some bookkeeping processes are still manual (H4), the fulfillment of auxiliary raw materials is less stable (H5), the product checking process is still manual (H6), there is no research and development (R&D) department (H7), limited employees in terms of experience and technological capabilities (H8), the inventory management system is still manual (H10), and the use of social media has not been implemented (H12), then for the last cluster (independent indicators) there is one indicator in it, namely tools and machines that operate love it manually (H10).

4. Conclusion

From the results of the study, it can be concluded that there are 12 indicators of factors barrier the innovation process in the supply chain of the furniture industry. From these inhibiting factors, a model of the relationship between barriers was constructed using the help of the interpretive structural modeling (ISM) method with six levels. The results using the MICMAC approach are indicators of factors barrier the innovation process that enter the first cluster (autonomous indicators) there is one indicator, in the second cluster (dependent indicators) there is one indicator, in the third indicator (linkage indicators) there are 9, while in the fourth cluster (independent indicators)) there is one indicator. Most indicators are found in the third cluster (linkage indicators), which means that these indicators have high control and dependability. This research only focuses on identifying the inhibiting factors of the innovation process in the furniture industry supply chain at PT. Duwa Atmimuda. So that due to time constraints, in the future it will be possible to identify the factors driving the innovation process at PT. Duwa Atmimuda.

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