FINAL PROJECT – TI 141501

DESIGNING AND ASSESSING KNOWLEDGE MANAGEMENT USING KNOWLEDGE VALUE CHAIN FRAMEWORK AND DATA ENVELOPMENT ANALYSIS (DEA) IN FURNITURE SMES IN PASURUAN CITY

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Surabaya

2018

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VALIDATION SHEET

DESIGNING AND ASSESSING KNOWLEDGE MANAGEMENT USING KNOWLEDGE VALUE CHAIN FRAMEWORK AND DATA ENVELOPMENT ANALYSIS (DEA) IN FURNITURE SMES IN PASURUAN CITY

FINAL PROJECT

Proposed to Fulfil the Requirement to Obtain The Bachelor Degree of Engineering
in Bachelor Program of Industrial Engineering Department
Faculty of Industrial Technology
Institut Teknologi Sepuluh Nopember
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SURABAYA, JULY 2018

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DESIGNING AND ASSESSING KNOWLEDGE MANAGEMENT USING KNOWLEDGE VALUE CHAIN FRAMEWORK AND DATA ENVELOPMENT ANALYSIS (DEA) IN FURNITURE SME IN PASURUAN CITY

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ABSTRACT

In Pasuruan city, the city that included in Bakorwil IV area of East Java. In this city, the largest contribution for the PDRB is by furniture industry that contributed around 51, 14%. The problem that happen in Pasuruan city is that the SMEs don't know what are the knowledge that they already have and what knowledge that they needed to develop their business in order to compete more and growing up their business. Implementing Knowledge Management could help the furniture SMEs to share and identify their knowledge, the SME could improve their competitive advantage and develop the system that could transform their knowledge as the intangible asset to improve their performance.

In this research aim to plan the knowledge management using Knowledge Value Chain framework that aligned with its business strategies, to assess the critical knowledge of the enterprises by using Analytical Network Process (ANP), and to assess knowledge performance of the enterprises using the DEA (Data Envelopment Analysis) method.

Based on the data collecting and processing results, the Knowledge Value Chain framework is done by knowledge audit and database for Acquisition process, integration trajectories for Integration process, training needs analysis for Innovation process, documentation and Geographical Indication Intellectual Property Right (GI IPR) registration for Protection process, Communities of Practice (COP) for Dissemination process, and Knowledge Officer for Infrastructure. And for the result of identification of critical knowledge, in general there are 14 knowledge, from 14 knowledge, there are 6 key knowledge that required in furniture SMEs. And for the efficiency measurement result using DEA, there are still inefficient SMEs in implementing the Knowledge Management that using Knowledge Value Chain framework.

Keywords: Analytical Network Process (ANP), Critical Knowledge, Data Envelopment Analysis (DEA), Knowledge Management, Knowledge Value Chain, Small Medium Enterprises (SME).

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PREFACE

Bismillahirrahmanirrahim.

Praise the Mighty Lord, Allah SWT, for all of His blessing, guidance and also empowerment given to the author for helping on finishing the final project which entitled "Designing and Assessing Knowledge Management Using Knowledge Value Chain Framework and Data Envelopment Analysis (DEA) In Furniture SMEs in Pasuruan City" to accomplish the bachelor degree in Industrial Engineering ITS.

Beside of that, author wants to thank for those who have part, give support, and give help in finishing this final project research.

1. Mr. Dr. Ir. Bambang Syairudin, M. T. as the final project supervisor for all of his knowledge, patience, guidance, affection for author to do this final project research on the right path.
2. Mr. Agus as the Kadin Secretary, for all of support, patience, guidance, assistance, and data given for completing the final project research.
3. Mrs. Hesti, as Head of CV. Sinar Mas, Mr. Rifqi, as head of CV. Wijaya Mebel, and Mr. Daning as head of UD. Mardi Jaya, for all of support, patience, guidance, assistance, and data given for completing the final project research.
4. Diesta Iva S.T., M.T., Dr. Ir. Sri Gunani Partiwi M.T., Dr. Ir. I Ketut Gunarta, M.T. and Mr. Arief Rahman S.T., M.Sc. as a lecturer assessors during the final project proposal presentation and final project presentation.
5. Mr. Nurhadi Siswanto S.T., MSIE., Ph.D, as Head of Industrial Engineering Department of ITS Surabaya.
6. H.R. Iding Badrudin and Hj. Cicih Hernayani as author's parents and author's siblings for all the love and knowledge given, and the sincere prayers that always prayed, and also the patience that given.

7. All of author’s friends for supporting, cheering, accompanying the campus life and tasks.

Surabaya, July 2018

Author

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CHAPTER 1
INTRODUCTION

This chapter explains contents which related to the background, problem formulation, aims, benefits, limitations, and assumptions used in this research. As the addition, there will be the outline of the research report that depicts the research writing mechanism.

1.1 Background

Indonesia is one of the developing countries in the world that has the big potential to become the largest economy country in world, based on the gross domestic product of Indonesia, it has growth rates that remain strong at approximately five percent; the economy grew by 0.2 percent over 2015, although it has slowed from 6.2 percent in 2011. Maintaining a GDP growth rate of between five and six percent will see Indonesian GDP double every fifteen years, thus putting the country on track to become the fourth-largest economy by 2050, as measured by nominal GDP. Based on the data of *Kementerian Koperasi dan UKM*, SME has contributed in around 97, 22 % for employment in Indonesia and it contributed around 60, 34 % for the gross domestic product Indonesia in Indonesia. SMEs has become an important factor in developing the economic sector, by means of that, the SME's become the center of Indonesia's economic gear to develop more and creating more employment for the workers in Indonesia.

According to the documentation of the Economic Census of Indonesia 2016 (SE2016) on table 1.1 below, 60, 74 % industries are located in Java Island.

Table 1.1 Distribution of Industry based on a scale in Indonesia

Island	SME	LME	Total	Distribution
Sumatera	4.897.457	74.276	4.971.733	18,61%
Java	15.931.889	291.697	16.223.586	60,74%
Bali and Nusa Tenggara	1.495.526	22.088	1.517.614	5,68%
Kalimantan	1.352.324	26.645	1.378.969	5,16%
Sulawesi	2.134.579	25.110	2.159.689	8,09%
Maluku and Papua	451.874	7.536	459.410	1,72%
Total	26.263.649	447.352	26.711.001	100,00%

Source: SE Indonesia 2016

SME's become an important drive in developing the economic sector of Indonesia, not only because SME's are giving employment for many people, SME's also flattening the level of economic for society and it gives foreign exchange to the country. From the data of *Kementerian Koperasi dan UKM,* the existence of the SME's is assisting the government in order to flatten the level of economic, because the amount of SME's that larger than the large enterprises and it is distributed more in every region of Indonesia. The SME's give foreign exchange for the country around Rp 88, 45 billion (from data of *Kementerian Koperasi dan UKM*). From the table 1.1, it can be seen that the distribution of SME's itself is centered in Java island compared to the other island in Indonesia.

Table 1.2 Distribution of Industry based on a scale in Java

Province	SME	LME	Total	Distribution
DKI Jakarta	1.154.792	80.859	1.235.651	7,62%
West Java	4.564.958	69.849	4.634.807	28,57%
Central Java	4.131.727	42.483	4.174.210	25,73%
Special Region of Yogyakarta	524.935	8.735	533.670	3,29%
East Java	4.608.754	63.672	4.672.426	28,80%
Banten	946.723	26.099	972.822	6,00%
Total	15.931.889	291.697	16.223.586	100,00%

Source: SE Jawa Timur 2016

In Java island itself refer to table 1.2 above, from six province, the distribution of the small-medium scale enterprises are 28, 93 % for East Java, 28, 65 % for West Java, 25, 9372 % for Central Java, 7, 25 % for Jakarta, 5, 94 % for Banten and 3, 29 % for Yogyakarta. For the large-scale enterprises, the distribution are 27, 72 % for Jakarta, 23, 95 % for West Java, 21, 83 % for East Java, 14, 56 % for Central Java, 8, 95 % for Banten and 2, 99 % for Yogyakarta. Based from the SE2016 of Indonesia and Java itself, it can be seen that it is dominated by the small-medium scale enterprises, and by a large amount of the small medium enterprises, it can be said that the employment in Indonesia dominated by the SME.

In East Java, the distribution of the small medium scale enterprises is divided by four region, it is called *Bakorwil* I (consist of Pacitan regency, Ponorogo, Trenggalek, Tulungagung, Blitar, Nganjuk, Madiun, Magetan, Ngawi, Blitar city and Madiun city) , *Bakorwil* II (consist of Kediri regency, Mojokerto, Jombang, Bojonegoro, Tuban, Lamongan, Kediri city and Mojokerto city), *Bakorwil* III (consist of Malang regency, Lumajang, Jember, Banyuwangi, Bondowoso, Situbondo, Probolinggo, Pasuruan, Malang city, Probolinggo city, Pasuruan city and Batu city) and *Bakorwil* IV (consist of Sidoarjo regency, Gresik, Bangkalan, Sampang, Pamekasan, Sumenep and Surabaya city).

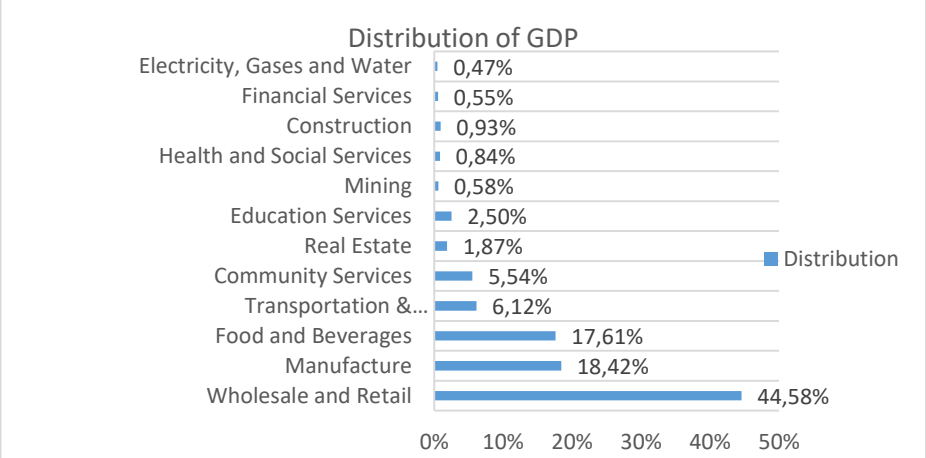

Figure 1.1 Distribution of GDP based on industry sector in East Java
Source: SE Jawa Timur 2016

From the data of SE2016 of East Java that represent in figure 1.1, the East Java distribution of small-medium scale enterprises based on KBLI 2015, it is dominated by wholesale and retail trade; repair and maintenance cars and motorcycle with 2, 08 million enterprises or 44, 58 % from all amount of enterprises, manufacturing industry with 18, 42 % and food and beverages industry is around 17, 61 % and the rest of 19, 40 % are other enterprises categories. The distribution of the small medium enterprises based on the four regions of East Java is 34, 83 % in *Bakorwil* III, 25, 08 % in *Bakorwil* IV, 20, 90 % for *Bakorwil* I and 19, 17 % in *Bakorwil* II.

Pasuruan city, the region that included in the *Bakorwil* III has big potential in the sector of manufacturing industry, especially in the furniture industry. Based

from the BPS book of *Produk Domestik Regional Bruto Kota Pasuruan Menurut Lapangan Usaha* 2012 – 2016 that are represented in table 1.3 below, the economic structure of the Pasuruan city is supported by two industrial sectors, there are Wholesale and retail; Maintenance of car and motorcycle sector and manufacturing sector. This two sector almost dominating around 50 % of *Produk Domestik Regional Bruto* (PDRB) based on the prices applied. The rest of its distribution are distributed evenly to other 15 sectors.

Table 1.3 Industrial Sector Contribution of Pasuruan GDP

No	Industry	2012	2013	2014	2015*	2016**
A	Agriculture. Forestry and Fishing	2. 84	2. 76	2. 70	2. 64	2. 52
B	Mining and Quarrying	0. 04	0. 04	0. 04	0. 03	0. 03
C	Manufacturing	21. 05	20. 85	21. 07	21. 06	20. 61
D	Electricity and Gas	0. 08	0. 07	0. 07	0. 06	0. 06
E	Water Supply. Sewerage. Waste Management and Remediation Activities	0. 30	0. 28	0. 26	0. 25	0. 24
F	Construction	6. 14	6. 10	6. 20	6. 10	6. 29
G	Wholesale and Retail Trade. Repair of Motor Vehicles and Motorcycle	28. 46	28. 32	27. 99	27. 91	28. 32
H	Transportation and Storage	5. 44	5. 55	5. 70	5. 75	5. 78
I	Accommodation and Food Service Activities	4. 12	4. 42	4. 81	5. 08	5. 33
J	Information and Communication	7. 99	7. 99	7. 76	7. 67	7. 65
K	Financial and Insurance Activities	7. 14	7. 46	7. 59	7. 66	7. 76
L	Real Estate Activities	2. 84	2. 80	2. 63	2. 66	2. 57
M. N	Business Activities	0. 59	0. 60	0. 59	0. 59	0. 60
O	Public Administration and Defence. Compulsory Social Security	5. 09	4. 83	4. 43	4. 39	4. 34
P	Education	4. 06	4. 16	4. 26	4. 24	4. 15
Q	Human Health and Social Work Activities	0. 88	0. 89	0. 89	0. 88	0. 85
R. S. T. U	Other Services	2. 93	2. 90	3. 02	3. 02	2. 89
Gross Regional Domestic Product		100	100	100	100	100

Source: BPS Jawa Timur 2016

In 2016, the contribution of manufacturing sector to PDRB in Pasuruan city are have decreased compared to the year before, from the data of BPS Pasuruan that represented in the table 1.3 above, it is decreased from 21, 06 % to 20, 61 %. This sector is dominated by the subsector that is furniture industry, it has contributed

around 51, 14 %. While for the food and beverages industry subsector contributed around 22, 53 %. It can be seen in table 1.4 below, that the furniture industry is giving a large contribution to the PDRB of Pasuruan compared to another manufacturing industrial subsector.

Table 1.4 Sub Manufacturing Sector Contribution to Pasuruan PDRB

Industry		2012	2013	2014	2015*	2016**
1	Manufacture of Coal and Refined Petroleum Products	0	0	0	0	0
2	Manufacture of Food Products and Beverages	20, 82	20, 57	20, 42	21, 38	22, 53
3	Manufacture of Tobacco Products	0	0	0	0	0
4	Manufacture of Textiles and Wearing Apparel	0, 89	0, 92	0, 93	0, 92	0, 94
5	Manufacture of Leather and Related Products and Footwear	0, 46	0, 48	0, 51	0, 51	0, 52
6	Manufacture of Wood, Products of Wood and Cork and Other	7, 77	7, 73	7, 65	7, 30	6, 83
7	Manufacture of Paper, Paper Products, Printing and Reproduction of Recording Media	2, 20	2, 08	1, 97	1, 91	1, 88
8	Manufacture of Chemicals and Pharmaceuticals and Botanical Products	3, 13	3, 00	3, 00	2, 93	2, 74
9	Manufacture of Rubber, Rubber Products and Plastic Products	0, 19	0, 18	0, 16	0, 16	0, 14
10	Manufacture of Other Non-Metallic Mineral Products	0, 27	0, 27	0, 26	0, 25	0, 23
11	Manufacture of Basic Metals	0	0	0	0	0
12	Manufacture of Fabricated Metal Products, Computer, and Optical Products and Electrical Equipment	10, 98	11, 06	10, 84	10, 43	9, 74
13	Manufacture of Machinery and Equipment	0	0	0	0	0
14	Manufacture of Transport Equipment	0, 75	0, 74	0, 70	0, 68	0, 67
15	Manufacture of Furniture	49, 58	50, 06	50, 73	50, 82	51, 14
16	Other Manufacturing, Repair and Installation of Machinery and Equipment	2, 98	2, 82	2, 82	2, 72	2, 65
Manufacturing Industry		100	100	100	100	100

Source: BPS Jawa Timur 2016

From the table 1.4 above, the subsector of furniture industry has positive growth in percentage distribution of the manufacturing industry subsector to PDRB of Pasuruan city for 2012 – 2016. Every year, the furniture industry contribution to

PDRB has always increased even in small amount but it has positive growth compared to another subsector of manufacturing industry. From the BPS, it is said that the furniture industry becomes the biggest contributor to the region because the furniture industries have exported their product to another country such as America and Europe. From the data above, it can be said that the SME in the Pasuruan gives many contributions in developing the economy of the city itself.

In Pasuruan city, the allocation of the SME of furniture industry is in four sub-districts, there are Gadingrejo, Panggungrejo, Purworejo, Bugul Kidul. In each sub-districts, there are divided by some urban village. Based from the table 1.5, in 2014, it can be seen that the Gadingrejo sub-district is the area that has the largest amount of SME furniture industry with the amount of 1136, then followed by Purworejo with 108, Panggungrejo with 59 and Bugul Kidul with 37. In the Gadingrejo sub-district, the urban village that has the largest amount of SME is in the Bukir, with the amount of 482 SMEs, in the site of Pasuruan city government, it is said that in Bukit is the center of the furniture industry of Pasuruan. In Bukir, there is a market that specialized in selling the furniture products of Pasuruan.

Table 1.5 Detail of Furniture Industry in Pasuruan

No	Sub District/ Urban Village	Total Industry	Product Value (000 Rp)	Investment Value (000 Rp)	Raw Material Value (000 Rp)	Total Worker
I	**GADINGREJO**	**1136**	**1.274.262.664**	**158.511.185**	**489.451.496**	**9581**
1	Karangketug	73	59.321.833	11.115.295	35.482.929	842
2	Gadingrejo	43	61.506.596	5.274.046	23.708.915	660
3	Gentong	58	190.935.618	32.366.735	110.075.259	951
4	Sebani	149	327.828.025	15.410.895	106.309.991	1.019
5	Bukir	482	392.923.620	70.032.842	98.749.201	3.968
6	Krapyakrejo	148	75.047.245	11.740.162	26.439.487	983
7	Randusari	102	108.801.515	7.556.099	42.786.750	580
8	Petahunan	81	57.898.212	5.015.111	45.898.964	578
II	**PANGGUNG REJO**	**59**	**69.176.073**	**14.637.562**	**31.004.741**	**707**
1	Mayangan	2	3.012.000	361.000	1.908.000	10
2	Karanganyar	16	49.194.113	2.939.602	21.094.836	279
3	Trajeng	7	2.741.600	1.847.150	1.717.825	141
4	Kebonsari	18	3.989.960	8.119.560	2.638.475	174
5	Banglian	1	85.000	216.000	16.400	4
6	Petamanan	2	152.000	560.000	44.000	40
7	Bugul Lor	1	1.000.000	37.500	200.000	8
8	Mandaranrejo	8	7.642.500	472.500	2.746.000	33
9	Kandangsapi	4	1.358.900	84.250	639.205	18

Table 1.5 Detail of Furniture Industry in Pasuruan (cont'd)

No	Sub District/ Urban Village	Total Industry	Product Value (000 Rp)	Investment Value (000 Rp)	Raw Material Value (000 Rp)	Total Worker
III	**PURWOREJO**	**108**	**325.465.485**	**13.214.854**	**171.978.401**	**802**
1	Tembokrejo	3	722.000	242.000	474.000	48
2	Wirogunan	12	56.769.320	4.130.320	12.506.200	119
3	Kebonagung	54	125.109.610	2.965.975	64.557.561	295
4	Pohjentrek	4	7.430.000	1.168.500	2.000.000	21
5	Sekargadung	13	3.925.930	754.026	782.000	132
6	Puturejo	6	25.742.850	844.372	38.906.000	61
7	Purworejo	16	105.765.775	3.109.661	52.752.640	126
IV	**BUGUL KIDUL**	**37**	**16.913.184**	**3.533.128**	**7.561.053**	**307**
1	Bugul Kidul	23	12.977.714	3.049.013	5.506.128	231
2	Tapaan	3	2.284.470	151.815	1.310.625	17
3	Kepel	2	534.000	155.000	129.300	22
4	Blandongan	2	170.500	66.300	126.000	8
5	Krampyangan	1	110.000	17.000	54.000	7
6	Bakalan	6	836.500	94.000	435.000	22
Jumlah		1.340	1.685.817.406	189.896.729	699.995.691	11.397

Source: BPS Jawa Timur 2016

In its relation to the external stakeholder that could affect the business and the development of its internal growth. From the figure 1.2, SMEs, in general, have many correlations to other stakeholders that have different functions. It is the plan that designed by the government in Pasuruan city coordinating with the other stakeholders. The SMEs correlation to *Kamar Dagang dan Industri* (*Kadin)* has to be considered because of its correlation that functioned as On Job Training, Marketing and Mentoring. In Pasuruan city, there is a problem in the correlation of the SMEs and the *Kadin*, it is that the mentoring and on the job training from the *Kadin* to the SMEs is not meet the target from each side. It happens because of the *Kadin* itself, doesn't know what are the SMEs needed to develop their business and it also often happens that the *Kadin* give the SMEs training that the SMEs don't need anymore. The flow of information in terms of knowledge stored and knowledge needed between the SMEs and *Kadin* is not going well. The SMEs itself don't know what are the knowledge that they already have and what knowledge that

they needed to develop their business in order to compete more and growing up their business.

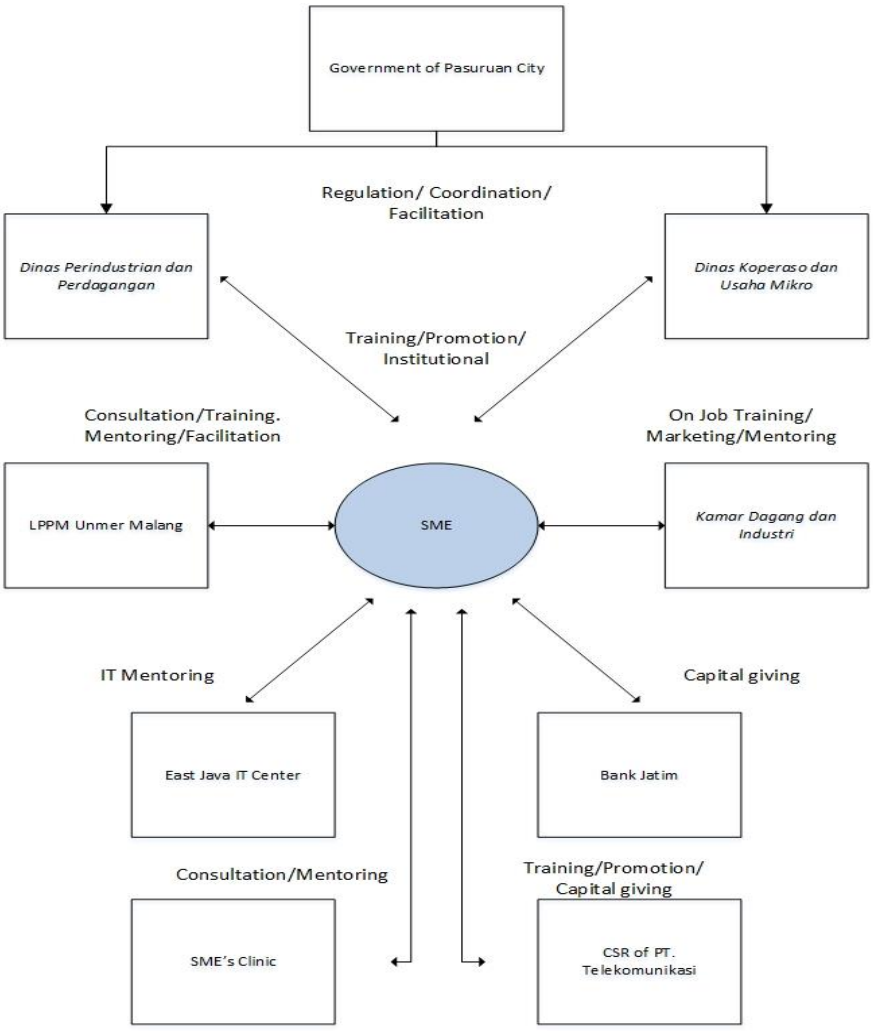

Figure 1.2 Correlation between stakeholder in SME
Source: Author's Document

In some research, Small and medium scale enterprises (SMEs) are particularly subject to the deterministic constraints of the competitive environment, especially the international ones (Ruzzier et al., 2007). In its internal, SMEs don't have a culture to share the knowledge they have to the new worker or for sharing in some training. Later, it very often results in most knowledge being kept in the minds of the owner and some key employees rather than recorded or shared through substitution arrangements (Wong & Aspinwall, 2004).

Most SMEs have no explicit policy targeted at strategic KM, and they tend to treat KM on an operational level at the level of systems and instruments (Beijerse,

2000; Hutchinson & Quintas, 2008). SMEs tend to place more emphasis than larger firms on the management of tacit knowledge, and communication channels in SMEs are more likely to be between firms, rather than internal to the organization. In some cases, managers of smaller firms also try to prevent outflow of knowledge from the company and thereby block knowledge sharing (Bozbura, 2007). This can undermine the potential benefits of KM.

Based on the researchers and the statements from the experts, SMEs in Pasuruan city need to manage their knowledge with good management, it will help the SMEs to compete in the market with the larger firms and to create a better management of the SMEs in order to gain the benefit from the knowledge and the management of the knowledge in firms. In Implementing KM, management support is the most important factor of systematic knowledge management. In SMEs one person is usually in charge of knowledge management, combining both ownership and managerial function (Gomezelj and Antoncic, 2008). Thomas et al. (2001) noted that performance differences across firms may be attributed to differences in knowledge and the implementation of knowledge management. By implementing the knowledge management, the SME could improve their competitive advantage and develop the system that could transform their knowledge as the intangible asset to improve their performance.

1.2 Problem Formulation

According to the background, it is found that the problem formulation which intended to be solved on this research is to how to create and identify Knowledge Value Chain framework for the enterprises, assess the critical knowledge of the company and assess the performance of knowledge management in the company.

1.3 Aims of Research

The aims of research will be in accordance with the background and problem formulation:

1. To create and identify Knowledge Value Chain framework for the enterprises.
2. To assess the critical knowledge of the enterprises.

3. To assess knowledge performance of the company using the DEA (Data Envelopment Analysis) method.

1.4 Benefits of Research

The benefits of research will be obtained after completing the research:

1. SMEs able to know the performance of the knowledge management framework that has been implemented.
2. SMEs able to implement new knowledge management initiatives through its framework.
3. SMEs able to evaluate the knowledge management performance through its projection improvement.

1.5 Limitation and Assumption of Research

Limitation and assumption which used in this research are:

1.5.1 Limitation

In this subchapter will inform the limitations that are used in the research:

1. The object of the research is SME which located in Pasuruan.
2. The SME that will be observed is CV Sinar Mas, Wijaya Mebel, and UD Mebel Mardi Jaya.
3. The research is focused on designing KM-initiatives activity for SME.

1.5.2 Assumption

In this subchapter will inform the assumptions that are used in the research:

1. Existing Condition of SME considered same as the first observation which done by the researcher on the period of February 2018 until June 2018.
2. The respondents understand the condition of SME.

1.6 Report Outline

To depict the writing mechanism of this research below is provided by the outline for writing mechanism.

CHAPTER 1 – INTRODUCTION

On this chapter, the information about background, problem formulation, aims of the research, benefits of research, limitation, and the assumption that used

in this research will be provided. Beside of that, the outline of writing mechanism will be also depicted in chapter one.

CHAPTER 2 – LITERATURE REVIEW

On this chapter, all of the literature review which used for conducting the research will be provided. A literature review is needed for explaining the theory that relates to the method used and problem. The keywords of literature review such as knowledge, knowledge management, knowledge audit, value chain, knowledge value chain and data envelopment analysis.

CHAPTER 3 – RESEARCH METHODOLOGY

On this chapter, there will be provided the method on flow diagram and its explanation which used on conducting the research.

CHAPTER 4 – DATA COLLECTION AND PROCESS

On this chapter, the data needed will be gathered and collected to be processed so there will be the result of the research.

CHAPTER 5 – DATA ANALYSIS

On this chapter, the result of data processing will be analyzed so it can be used to conduct the improvement procedure.

CHAPTER 6 – CONCLUSION AND SUGGESTION

On this chapter, the conclusion after doing analyzing will be provided and also the suggestion for the future research.

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CHAPTER 2
LITERATURE REVIEW

On this chapter, the explanation about each keyword used on conducting the research will be explained in detail. The keywords are used to be used on solving the problem given such as Knowledge, Knowledge Management, Knowledge Audit, Knowledge Value Chain, Analytical Network Process, Pareto Analysis and Chart, KM Performance Measurement, and Data Envelopment Analysis.

2.1 Knowledge

Knowledge is different from “data” and “information’, even though these three terms are sometimes used interchangeably. Based on Irma Becerra and Rajiv of Knowledge Management Systems and Process and Bryan Bergeron Essentials of Knowledge Management books, the difference between data, information and knowledge and the hierarchy that constitutes knowledge are:

1. Data: representing raw numbers, numerical quantities, compromise facts, observations or perceptions (that can be incorrect) that can be a meaning of a thing or devoid of context. Even though data sometimes are devoid of context, it can be easily captured, stored and can be communicated by using media and electronic.
2. Information: the next step of processing the data, the data in context. It became the subset of data that has more meaning. It is the manipulation of raw data and processing the data to become a more meaningful pattern in the data. Information and data depend on an individual who uses these things.
3. Metadata: the data about information. It includes descriptive summaries and high-level categorization of data and information. That is, metadata is information about the context in which information is used.
4. Knowledge: information that is organized, synthesized or summarized to enhance comprehension, awareness or understanding. It refers to information that enables action and decisions or information with direction. Knowledge is a combination of metadata and an awareness of the context in which metadata can be applied successfully.

5. Instrumental understanding: is the clear and complete idea of the nature, significance, or explanation of something. It is a personal, internal power to render experience intelligible by relating specific knowledge to broad concepts.

The hierarchy in defining concepts of knowledge is shown in the figure 2.1 below, with data at the bottom of hierarchy and understanding at the top. In general, each level of the hierarchy involves greater contextual richness. For example, in medicine the hierarchy could appear as:

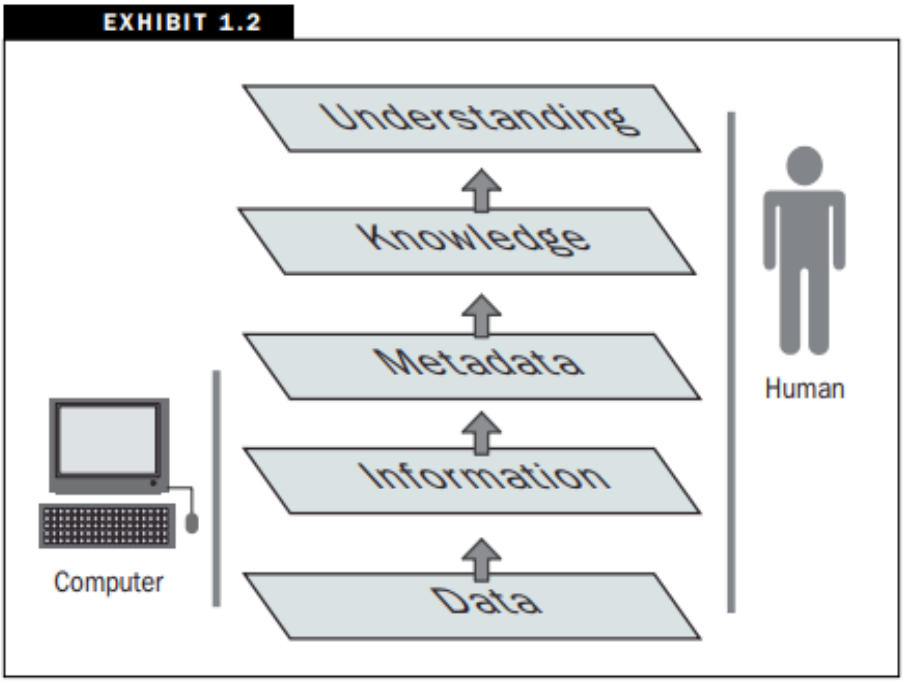

Figure 2.1 Hierarchy of Knowledge
(Source: Process and Bryan Bergeron Essentials of Knowledge Management book)

1. Data. Patient Temperature: 102° F; Pulse: 109 beats per minute; Age: 75.
2. Information. “Fever” is a temperature greater than 100° F; “tachycardia” is a pulse greater than 100 beats per minute; “elderly” is someone with an age greater than 75.
3. Metadata. The combination of fever and tachycardia in the elderly can be life-threatening.
4. Knowledge. The patient probably has a serious case of the flu.

5. Instrumental understanding. The patient should be admitted to the hospital ASAP and treated for the flu.

Knowledge can be divided into two types namely, tacit knowledge and explicit knowledge. Tacit knowledge is a knowledge possessed by someone but difficult to articulate and tend to be very personal (Budihardjo, 2016). Tacit knowledge can be said to lie in the "subconscious" of man because it is not easy to express, explain, expose concretely, articulated, and making it difficult to transfer or transform (Bergeron, 2003). Thus, tacit knowledge can be said to be related to various factors, including feelings, intuition, values, experiences, beliefs, and experiences. In contrast to the tacit knowledge that can be categorized as personal knowledge, explicit knowledge is the knowledge that has been codified in the form of documents or other forms such as formulas, tapes, and product or manual specifications, so that it can easily be transferred knowledge and distributed by using various media. This is supported by the statement Nonaka & Takeuchi (1995) that explicit knowledge is formal and systematic so it can be easier to express greeting words or numbers. Nonaka and Takeuchi (1995) also suggested differences in tacit knowledge and explicit knowledge as follows:

Table 2.1 Difference Between The Tacit Knowledge and Explicit Knowledge

Tacit Knowledge	Explicit Knowledge
1. Based on experience	1. Based on rationality
2. The knowledge that comes together	2. Sequential knowledge
3. Knowledge-based on practice	3. Knowledge of theory

Source: (Nonaka & Takeuchi, 1995)

Table 2.1 defines the difference of tacit knowledge with explicit knowledge. Both types of knowledge, by Nonaka and Takeuchi, can be converted into four types, namely socialization, externalization, combination, and internalization.

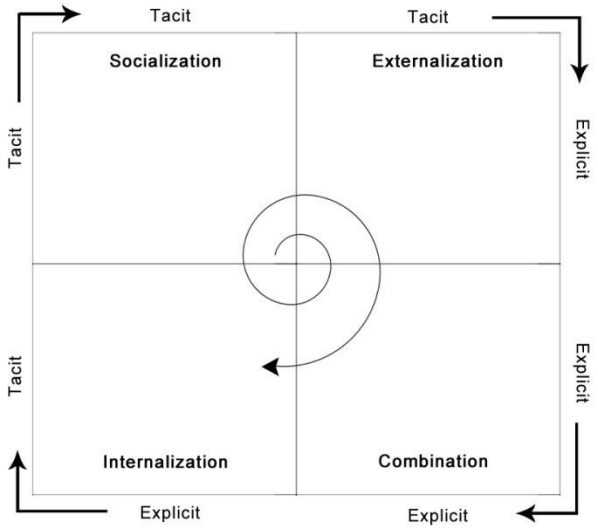

Figure 2.2 Knowledge Conversion
Source: (Nonaka & Takeuchi, 1995)

Figure 2.2 is a description of the relationship between tacit knowledge and explicit knowledge with the following explanation:

1. Socialization (Socialization)

Socialization is the process of transferring knowledge from tacit to tacit. In this process is expected an individual can capture the tacit knowledge possessed by others and vice versa. Some examples of the process of socialization among human resources (HR) in the organization is to hold face-to-face meetings, internship activities, and the provision of training and education activities. These activities are good to do because it can speed up the process of activities, improve coordination, and foster a learning culture.

2. Externalization (Externalization)

Externalization is the process of transferring knowledge from tacit to explicit. This process transforms tacit knowledge into explicit knowledge through models, analogies, and metaphors. This form of the process can be seen in the documentation activities of meeting minutes. Minutes meeting is an explicit form of knowledge created during a meeting. Minutes of the meeting may be made into electronic form and may be distributed to all members of the organization.

3. Combination (Combination)

The combination is the process of transferring knowledge from explicit to explicit. This combination process is characterized by a systematic concept-making activity into a structured knowledge. In the organization, this process occurs when a manager will put forward a business concept, the manager will discuss with several speakers and then search information to create a breakthrough or innovation business concept more effective and efficient.

4. Internalization (Internalization)

Internalization is the process of transferring knowledge from explicit to tacit. The real example of this process is the learning by doing the process. If there is someone who at first should always look at the manual when going to operate a machine, but after a few months doing the same job, the person is able to operate the machine without looking at the manual it can be said that someone has gained tacit knowledge.

2.2 Knowledge Management (KM)

Knowledge management is a field that is more aimed at developing and maintaining the dynamics and competitiveness of the company. Nawawi (2012) explains that knowledge management is the basis for generating innovation, improving activity response to customer and stakeholder needs, and improving employee productivity and competence. According to Davenport & Prusak (1998), knowledge management is an attempt to do something useful about knowledge in order to achieve organizational goals through people, technology, and knowledge consisting of effectively collecting, distributing and using knowledge. Knowledge management is important to do because it can show initiatives and procedures work activities that are clear, easy to understand, and structured. Nawawi (2012) mentions some advantages/benefits of knowledge management in the company, namely:

1. Improve the quality of decision making
2. Improving the quality of customer handling
3. Produce a better way of working

4. Increase productivity
5. Accelerate response to important business issues

From some of the advantages/benefits above can be said the main mission of the existence of knowledge management is to develop a better system in order to create, capture, and disseminate knowledge within the organization. In an organization, the success of knowledge management will be influenced by several factors. Factors supporting knowledge management are as follows (Nawawi, 2012):

1. Human factor.

   This factor is a major factor because knowledge comes from the human mind, so the more intelligent and professional human beings in the company will increasingly affect the company.
2. Leadership.

   The development of a strong vision is a very critical role because vision is the goal to be achieved by the company so that the vision can move all members of the organization and resources owned by the organization.
3. Technology.

   This factor is a medium of knowledge distribution in executing various knowledge management process.
4. Organization.

   All operational aspects are used in knowledge management creation activities.
5. Organizational learning.

   Factors in the form of systematic problem-solving activities, testing new approaches, learning from past experiences, learning from best practice, and fast and efficient knowledge transfer activities throughout the organization. Nawawi's statement above supports Skyrme's (1999) statement of a framework that can be used to develop knowledge management.

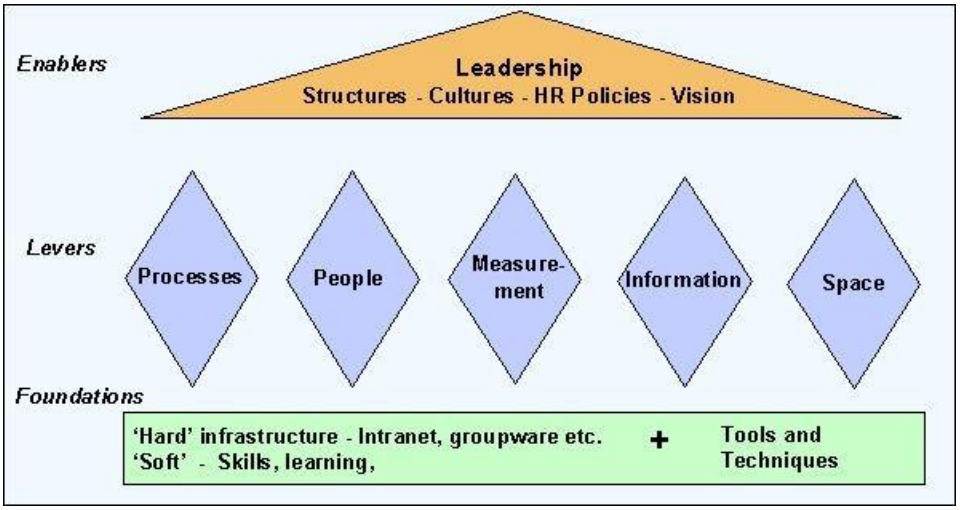

Figure 2.3 Knowledge Management Hierarchy Level
Source: Skyrme's (1999)

There are three parts in Figure 2.3, ie, enablers, levers, and foundation. At the top of the chart, there is a section of enablers, the key to the enablers is leadership. Leadership is meant the values that exist in the company. Companies know that knowledge can contribute to the company so that in its application required organizational structure, organizational culture, organizational vision, and existing regulations to help the procurement of knowledge management. Then on the levers, there are several factors that will strengthen the contribution of knowledge management to the company. In levers, there is a process that facilitates the flow of knowledge, effective ways to disseminate information, and measurement systems. The important point in this section is the management of tacit knowledge and explicit knowledge in different ways from each other, this is because in the concept of tacit knowledge and explicit knowledge are two different things. The third section is a foundation that provides the ability to put knowledge on the company's infrastructure. Examples are on the intranet, groupware, one's ability, and learning.

According Setiarso (2009) advances and competitiveness of many organizations determined by knowledge management that can respond to environmental and market system changes. Implementation of knowledge management is a long process, which includes changes in the behavior of all parties related to the organization. Therefore it takes good cooperation among the parties related to knowledge management to be applied.

2.3 Knowledge Audit

One of the tools that exist in knowledge management is knowledge audit. Knowledge audit is an analysis of the needs of knowledge on the company, assets or sources of knowledge that have been owned by the company, the flow of knowledge, future knowledge, knowledge gap, and human behavior on the activities of sharing knowledge and creating knowledge (Sharma & Chowdhury, 2007). According to Thomas Stewart that many companies throw away millions of knowledge owned by employees, this is because there is no method that can accommodate personal knowledge, which can be called as tacit knowledge, in order to become explicit knowledge that can be documented and published to others (Foo, et al., 2007). Paramasivan (2003) defines several objectives of the procurement of knowledge audit, namely:

1. To provide a statement regarding the qualitative characteristics of knowledge with special specifications.
2. To provide scientific estimates of the quantitative characteristics of knowledge with special specifications
3. To provide meaningful data input for the strategic planning of knowledge processing.

There are several methods for the implementation of knowledge auditing activities, some of which are as follows:

Table 2.2 Methods of Knowledge Audit

No.	Knowledge Analysis Method	Use of Knowledge Audit
1	Questionnaire	To find the knowledge that needed and current condition of the knowledge.
2	Semi-structured interview	To find how the staff work and what knowledge that they need.
3	Workshops	To find the most effective way to capture data and information.
4	Focus Group	To get some details insight on knowledge asset of KM practice.
5	Document Analysis	To find the knowledge by looking at the purposes, strategies and organization process.

Source: (Skyrme, 2007)

When viewed from the results in Table 2.2, the most widely used method is the questionnaire and semi-structured interview, because by completing the

questionnaire will know what knowledge is being needed by the company and the current state of knowledge, then with semi-structured activities interviews can be known what knowledge is owned by employees, what knowledge is used by employees in doing their work, and what knowledge is needed by employees to support their work. Here are ways to identify knowledge with the following questions (Ragsdell, et al., 2013):

	Participant 1 (Time at organisation: 4 Years)	Participant 2 (Time at organisation: 1 Year)
1. What are the processes that you are responsible for?	Consistency technically across projects Overseeing projects Learning from projects Feedback into projects Engaging with members	Getting information to members Keeping people in the loop Organise presentations and seminars Two way dialogue Understand member requirements Writing headline insight documents Upgrade the Member Portal system
2. What knowledge do you need to use to perform your role and how do you acquire it?	External environment End system look like Future requirements	Member Portal documents Direct conversations Board and Technical Committee
3. How do you organise and share the knowledge that you possess?	Shared drive Advisory groups Emails Presentations Technical Committee Personal stores of information	Talk to and email people Headline insights Member engagement plans
4. Once knowledge has been shared and used, how do you incorporate the feedback from this into the organisation's existing knowledge?	Advisory group papers Technical Committee papers Intranet Member Portal	Member engagement plans
5. Which information, documents and systems do you use within your role?	-	Shared drive Email Member portal Team meeting Documents

Figure 2.4 Knowledge Audit Questionnaire Example
Source: (Ragsdell, et al., 2013):

When referring to Figure 2.4, some questions that can be asked in the identification of knowledge are as follows:

1. What processes are your responsibility?
2. What knowledge is needed in your work? And how do you get it?
3. How do you share and manage your knowledge?
4. Once your knowledge is shared and used, how do you incorporate existing feedback into the company's knowledge?
5. What information, documents, and systems are used in your work?

The results of knowledge audit are the identification of knowledge assets and how the knowledge flow, the identification of information gaps and knowledge required, and opportunities to improve access and coordination of shared knowledge are needed.

2.4 Knowledge Value Chain

In the knowledge process of knowledge management, Ching and Yang (2000) distinguish five successive constituent processes: knowledge acquisition, knowledge innovation, knowledge protection, knowledge integration and knowledge dissemination. Knowledge value chain consists of KM infrastructure and the KM process's activities and knowledge performance. These infrastructure components and activities are the building blocks by which a corporation creates a product or provides service valuable to its customers. Knowledge performance can be measured in two categories (van Buren, 1999). One is financial performance. The other is non-financial measures including operating performance outcomes and direct measures of learning.

According to Lee, Ming-Chang and Han, Mei-Wen, 2014 from the Ching and Yang knowledge value chain model, Knowledge innovation process is from tacit knowledge to tacit knowledge, from tacit knowledge to explicit knowledge, from explicit knowledge to explicit knowledge, and from explicit knowledge to tacit knowledge. Knowledge protection is legal and IT protection. Corporations should contract with employees regarding confidential information and their tenure in case of they leave. They develop other protocols and policy guidelines which recognize and promote rights of knowledge. Knowledge integration is that this cumulative manufacturing, sales, and service experiences from different departments, together with information gathered from outside sources, can be integrated into the KVC of the organization. Knowledge dissemination have the following status: to create a knowledge sharing environment, to show its commitment for sharing knowledge, to foster the employee's willingness to share and contribute to the knowledge base, to reward structures and performance metrics need to be created which benefit those individuals who contribute to and use a shared knowledge base. The figure 2.5 is the knowledge value chain model by Ching and Yang (2000).

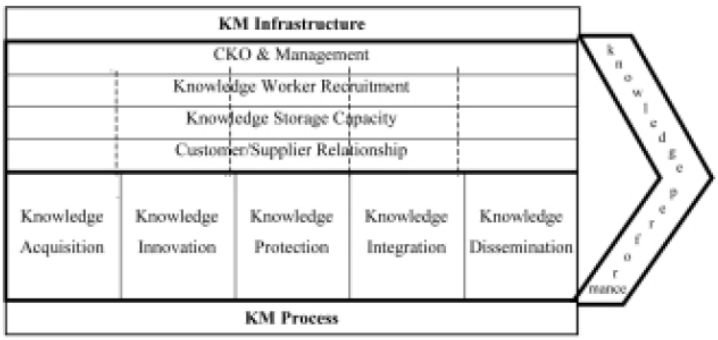

Figure 2.5 Knowledge Value Chain Framework
Source : (Ching and Yang, 2000).

In the Lee, Ming-Chang, and Han, Mei-Wen, 2014, they modified the KVC model from the Ching and Yang (2000), the modified KVC model will be described in the figures 2.6 and 2.7 below.

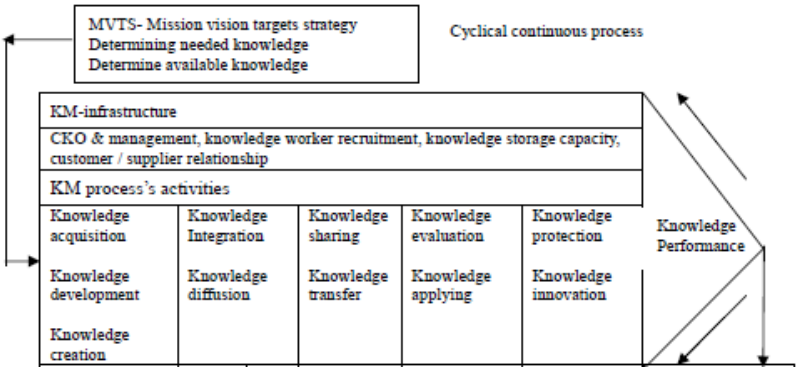

Figure 2.6 Modified Knowledge Value Chain Framework
Source : (Lee, Ming-Chang, and Han, Mei-Wen, 2014)

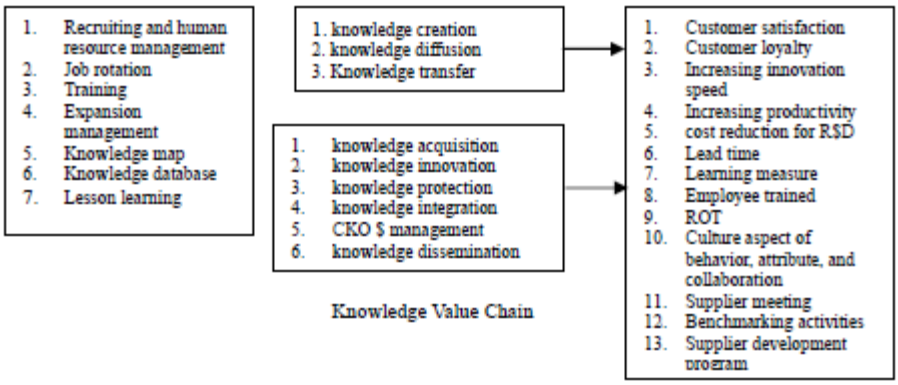

Figure 2.7 Modified Knowledge Value Chain Framework (cont'd)
Source : (Lee, Ming-Chang, and Han, Mei-Wen, 2014)

Based on the Ching and Yang (2000) the explanation about the KM infrastructure and KM Process activities are:

2.4.1 Components of KM Infrastructure

In this subchapter, it will be explained about the components of KM infrastructure that support the management to implement the KM process activities.

2.4.1.1 Knowledge Worker Recruitment

The term knowledge worker refers to the worker who possesses competencies, knowledge, and skills in the organization such as computer engineers, accountants, etc. If a person leaves the organization, their knowledge goes with them. Knowledge is acquirable and renewable. It is the source of innovation and creativity. This is the traditional focus of many training and education programs. In the knowledge economy, knowledge permeates through everything important – people, products organizations. There have always been people who worked with their minds rather than their hands. In knowledge era, these are the majority of the workforce. Already, almost 60 percent of American workers are knowledge workers. Recruiting knowledge workers in organizations is a key activity in the long term.

2.4.1.1 Knowledge Storage Capacity

Knowledge storage capacity is organizational memory and capabilities for people to store and reuse information and knowledge. It involves the organization's routine operations and structures that support employees' quests for optimum intellectual performance and, therefore, overall business performance. An individual can have a high level of knowledge, but if the organization has poor systems and procedures by which to track his or her actions, the overall knowledge resource will not reach its fullest potential. Knowledge storage capacity is owned by the organization. It is retained by the organization when employees leave.

There exist two organizational structures, formal and informal. Informal organizations, people easily access explicit knowledge. Informal organizations are rich in tacit knowledge, which usually is the source of innovation. It is difficult to articulate in writing and is acquired through personal experience. It is shared by intensive face-to-face communication. To keep the costs of knowledge transfer low,

managers try to turn inherently tacit knowledge into explicit knowledge. There are different approaches to implement KM, it depends on what kind of knowledge your people rely on to solve the problem. When employees rely on explicit knowledge to do their work, the people-to- documents approach makes the most sense. When people use tacit knowledge most often to solve problems, the person-to-person approach works best.

2.4.1.3 Customer/Supplier Relationship

Customer/supplier relationship refers to the organization's relationships with its customers/suppliers. It might include customer/supplier loyalty for services or products, the purchasing/sale patterns of different customer/supplier groups, customer/supplier service reputation, warranties and undertakings by customer/supplier, and database for customer/supplier.

The relationship between a corporation and its suppliers is very important and can be regarded as an intangible and agile asset of the corporation. It enables the corporation to meet the needs of customers at a lower cost. Owning more stable and close relationship with suppliers than its competitors means that the corporation has gained a superior competitive position over its competitors. In other words, the supplier relationship is mainly for cost control purposes.

Understanding better than anyone else what customers want in a product or a service is what makes someone a business leader as opposed to a follower. Turning knowledge into new customized products and services will maximize a corporation's market value.

2.4.1.4 CKO and Management

As a corporation undertakes a KM program, the position of chief knowledge officer (CKO) is emerging to coordinate the KM infrastructure components and The CKO is entrusted with the role of transforming the intellectual property into a business value. In other words, The CKO is responsible for the overall knowledge assets of a company and for defining the area in which the knowledge capabilities of the organization should evolve, based on its ongoing mission and vision. The CKO has the ultimate corporation-wide responsibility for the controlled vocabulary and knowledge directory and tackles the difficult issues associated with cross-

department or cross-corporation processes that have unique knowledge-sharing requirements.

The CKO also is responsible for ensuring that an appropriate technology infrastructure is in place for effective KM. The CKO has two principle design competencies: He is a technologist or environmentalist. The breadth of career experience, familiarity with his organization, and infectious enthusiasm for his mission are characteristic of the CKO.

2.4.2 The Process of Knowledge Management

As noted in Figure 2.5, the process of KM consists of five activities – knowledge acquisition, integration, innovation, protection, and dissemination.

2.4.2.1 Knowledge Acquisition

In order to do something, we need to track down and analyze all the information and explicit knowledge that is available. This will lead to beginning the process of knowledge acquisition via knowledge management infrastructure. It will be discussed on two processes through which organizations acquire information or knowledge: searching and organizational learning. Organizational information acquisition through searching can be viewed as occurring in three forms (Huber, 1991):

(1) Scanning;

(2) Focused search; and

(3) Performance monitoring.

Scanning refers to the relatively wide-ranging sensing of the organization's external environment. Focused searching occurs when organizational members or units actively search in a narrow segment of the organization's internal or external environment, often in response to actual or suspected problems or opportunities. Performance monitoring is used to mean both focused and wide-ranging sensing of the organization's effectiveness in fulfilling its own pre-established goals or the requirements of stakeholders. Noticing is the unintended acquisition of information about the organization's external environment, internal conditions, or performance.

Organizational learning plays a vital role in knowledge acquisition. The need for organizations to change continuously, which was emphasized by Drucker, has long been the central concern of organizational learning theorists. Just as with individuals, organizations must always confront novel aspects of their circumstances (Cohen, 1991).

It is widely agreed that learning consists of two kinds of activity. The first kind of learning is obtaining know-how in order to solve specific problems based on existing premises. The second kind of learning is establishing new premises (paradigms, schemata, mental models, or perspectives) to override the existing ones.

These two kinds of learning have been referred to as ‘‘Learning I’’ and ‘‘Learning II’’ (Bateson, 1972) or ‘‘single-loop learning’’ and ‘‘double-loop learning’’ (Argyris and Schon, 1978). From our viewpoint, knowledge acquisition and knowledge innovation certainly involve interaction between these two kinds of learning, which forms a kind of dynamic spiral. Senge (1990) recognized that many organizations suffer from ‘‘learning disabilities’’. To cure the diseases and enhance the organization’s capacity to learn, he proposed the ‘‘learning organization’’ as a practical model. He argued that the learning organization has the capacity for both generative learnings (i.e. active) and adaptive learning (i.e. passive) as the sustainable sources of competitive advantage.

2.4.2.2 Knowledge Innovation

In a strict sense, knowledge is created only by individuals. An organization cannot create knowledge without individuals. The organization supports creative individuals or provides contexts for them to create knowledge. Organizational knowledge innovation, therefore, should be understood as a process that ‘‘organizationally’’ amplifies the knowledge created by individuals and crystallizes it as a part of the knowledge network of the organization. There are actually three levels of knowledge-creating entities including individual, group, and organization. On the other hand, the conversion of tacit knowledge to explicit knowledge is a key process in creating new knowledge. A knowledge-innovation spiral emerges when the interaction between tacit and explicit knowledge is elevated dynamically from a lower level knowledge- creating an entity to higher levels.

The assumption that knowledge is created through the interaction between tacit and explicit knowledge leads to four different modes of knowledge conversion. The four modes actually are four realizations:

(1) From tacit knowledge to tacit knowledge, which is called socialization;

(2) From tacit knowledge to explicit knowledge, or externalization;

(3) From explicit knowledge to explicit knowledge, or combination; and

(4) From explicit knowledge to tacit knowledge, or internalization.

2.4.2.3 Knowledge Protection

Protection of knowledge is important because it protects creativity and the interests of knowledge owners. In legal systems protection of knowledge means protection of Intellectual Property Rights (IPR) such as copyrights and patents, which includes provision for a right of legal action against infringers of IPR and provisions detailing persons or corporations empowered to authorize the commercial use of IPR and allowing the owner of IPR to charge fees for such commercial uses. In a sophisticated information technology (IT) system, knowledge will be protected by filename, by username, by password, etc., so that knowledge can be reused when it receives a request and checks against the standard file-sharing users and group table to determine what rights the user has.

In addition to legal and IT protection, corporations should contract with employees regarding confidential information and their tenure in case if they leave, and should also develop other protocols and policy guidelines which recognize and promote rights of knowledge, and then implement them by staff awareness and education campaigns.

2.4.2.4 Knowledge Integration

Latest advances of information technology can facilitate the processes such as acquiring and disseminating knowledge; however, the final burden is on people deciding how to translate this raw knowledge into actionable knowledge by means of an acute understanding of their business context. This is an internal knowledge integration process. Corporations have always had some process to synthesize their experience and integrate it with knowledge acquired from outside sources (e.g. inventions, purchased patents). A corporation acquires knowledge from years of experience in such things as manufacturing, sales, and service. This cumulative

experience from different departments, together with information gathered from outside sources, can be integrated into the KVC of the organization, which is an inter-sub-KVC integration process, eventually being the base of KM infrastructure.

2.4.2.5 Knowledge Dissemination

The most effective way to disseminate knowledge and best practice is through systematic transfer. That is, to create a knowledge-sharing environment.

It is no coincidence that IT has blossomed at the same time that knowledge is becoming recognized as the most valuable of a corporation's assets. Explicit knowledge can be shared through an IT system. However, tacit knowledge is best shared by people. The more ''valuable'' the knowledge, the less sophisticated the technology that supports it. Dissemination of tacit knowledge is a social process. People must contribute knowledge to become part of a knowledge network. IT alone will not remove significant KM barriers. IT will not change people's behaviors, increase management's commitment, nor create a shared understanding of its strategy or its implementation.

To show its commitment to sharing knowledge, an organization should foster the employee's willingness to share and contribute to the knowledge base. This may be the most difficult obstacle to overcome. Current performance and rewards systems exemplify an individual's personal achievement and rarely take into account an individual's contribution to or participation in formal collaboration efforts. Reward structures and performance metrics need to be created which benefit those individuals who contribute to and use a shared knowledge base. Those who excel at knowledge sharing should be recognized in public forums such as newsletters and e-mails. By effective communication, the knowledge disseminated flows to the acquirers who are searching for and learning knowledge or information they need. Employees must be made to understand that the success and advancement in their career will be based on KM principles. KM skills must be seen to be as important to career advancement as continuing education and communication skills.

2.5 Analytical Network Process (ANP)

Analytical Network Process (ANP) is a mathematical theory that allows a decision maker to face the factors of interrelated (dependence) and feedback (feedback) systematically (Yulianti, 2013). ANP is a generalization of Analytical Hierarchy Process (AHP) (Saaty & Vargas, 2006). According to Yulianti (2013), the advantages of ANP from other methods is its ability to assist decision makers in measuring and synthesizing a number of factors in the hierarchy or network. In general, research with a qualitative approach only describes the findings that exist in the field without doing a deeper synthesis. When compared with the AHP method, the advantages of the ANP method are more objectively generated comparisons, more accurate predictive capabilities, and more stable results. In addition, ANP is more general because it uses multi-criteria decision analysis and ANP structure using network approach without having to set level like hierarchy on AHP. Saaty & Vargas (2006) revealed that ANP is used to solve problems that depend on existing alternatives and criteria, ANP uses paired comparisons on alternatives and project criteria.

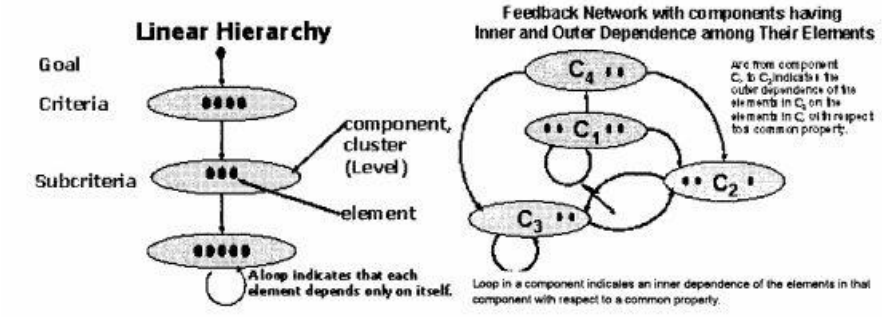

Figure 2.8 Differences between hierachy structure and network structure
Source: (Saaty & Vargas, 2006)

From Figure 2.8 above, it can be seen that for a hierarchical structure it has a relationship between goal, criteria, and subcriteria that is perpendicular from top to bottom. When compared to the network structure, each criterion has a relationship and has feedback to be provided. By using feedback networks, elements can be dependent or tied to components such as hierarchical networks and can also depend on each other. Furthermore, an element may depend on other elements present in a component. The other components are shown on a straight line connecting C4 to other clusters is C3 and C2 are outer dependencies. While the

elements to be compared are in the same component, so that the elements form a "loop" relationship called inner dependence (Saaty & Vargas, 2006). Here is an ANP comparison scale:

Table 2.3 ANP importance value

Importance value	Definition	Details
1	*Equal Importance*	Both elements are equally important
3	*Moderate Importance*	The one element is more important than some of the other elements, the experience, and the judgment slightly support one element in comparison other elements
5	*Strong Importance*	One element is more important than others, experience, and judgment very strongly supporting one element compared to other elements.
7	*Very Strong*	One element is clearly more absolutely essential than any other element, one element a strongly supported and dominant look in practice.
9	*Extreme Importance*	One element is absolutely essential other elements, supporting evidence element one against another element has the highest level of affirmation which might be corroborating.
2,4,6,8		Values between two values those considerations close together. This value is given when available two compromises between two options.
Reverse		If for activity i get one number compared with activity j, then j has the opposite value compared with i

Source: (Saaty & Vargas, 2006)

Weighting with ANP requires a model that represents the interconnection between the criteria and sub-criteria it has. There are two controls that need to be considered in modeling the system you want to know the weight. The first control is the hierarchy of controls that indicate the relevance of the criteria and sub-criteria. Other controls are linkages that show the interconnectivity between criteria or clusters. If it is assumed that a system has N Cluster or component where elements in each component interact or have influence or are influenced by some or all elements of other components by considering the interaction of the whole system, and if component h is denoted by Ch where h = 1, 2,..., N, has nh elements denoted by eh1, eh2, ..., ehn, then the effect of a set of elements in a component on another element in a system can be represented by a ratio vector priority ratio taken from

comparison in pairs (Pratiwi, 2014). Each priority vector is placed in the column vector position in a supermatrix. Each column is a principal Eigenvector that describes the effect of all elements in the component in each jth element. Here are the steps in decision making using ANP:

1. Model making and troubleshooting.

   Problems need to be structured into key components. The relevant and alternative criteria are structured in the form of hierarchy, where the higher the level the more strategic the decision is. The top element is broken down into sub-components and attributes. The model formation will require the formation of attributes at each level and the definition of the relationship.

2. Formation of pairwise comparison matrix from interdependent component levels.

   In this second phase, the decision maker is asked to respond to a pairwise pair of ratios by looking at higher or lower level control criteria. In case of interdependence. Components in the same level will be seen as control components for other components. To compare the two elements, both ANP and AHP use the ratio measurement scale from Saaty. ANP assumes that decision makers should make a comparison of interests between two possible attribute pairs, using a verbal scale (from the most important to the least important) to each variant. Decision makers also make similar comparisons for all sub-criteria pairs for each criterion. The information obtained in this process is used to calculate scores for sub-criteria, by looking at each criterion. If pairwise comparisons are complete, the w priority vector is calculated by the formula:

   $$A,w = \lambda_{max} + W \qquad (2.1)$$

   A is the result of a pairwise comparison matrix and λmax is the largest eigenvalue of A. Eigenvector is the priority weight of a matrix which is then used in the preparation of supermatrix.

3. Consistency Ratio Calculation

   Consistency Ratio (CR) value held must be a maximum of 10 percent or 0.1. If the value exceeds 10 percent of the meal should be improved on the

assessment of decision data. In the consistency matrix, λmax = n while in the matrix not every variation of w will bring the change of value to λmax. The λmax deviation of n is a Consistency Index (CI) parameter as follows:

$$CI = \frac{\lambda \max - n}{n-1} \quad (2.2)$$

Where:

CI = Consistency Index

λ_{max} = Biggest eigenvalue

n = Amount of element that compared

The value of CI is meaningless if there is a standard to indicate whether CI represents a consistent matrix. Saaty & Vargas (2006) provides a benchmark by doing a random comparison of over 500 samples. Saaty argues that a matrix resulting from randomly generated comparisons is an absolute inconsistent matrix. From the random matrix is also obtained the value of CI, called Random Index (RI). By comparing CI and RI, there is a benchmark for determining the consistency level of a matrix, called Consistency Ratio (CR), by the formula:

$$CR = \frac{CI}{RI} \quad (2.3)$$

Dimana,

CR = Consistency Rate

CI = Consistency Index

RI = Random Index

RI Value can be seen in the table 2.3

Table 2.4 Random Index

N	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Source: (Saaty & Vargas, 2006)

4. Supermatrix Formation

ANP uses the formation of a supermatrix to give the resolution of the interdependence effect of groups from the decision network hierarchy. Supermatrix consist of submatrix-submatrix arranged from a set of

relationships between elements derived from paired comparisons with certain control criterions, arranged both vertically and horizontally, according to their components in supermatrix. Each vector taken from a pairwise matrix is a part of the supermatrix column showing the effect by considering the control criteria of a component element on a single element of the same or different components found at the top of the supermatrix (Saaty & Vargas, 2006).

5. Alternative Selection

The choice of alternative will be determined by the final value for each alternative choice of the final supermatrix results obtained.

2.6 Pareto Analysis and Chart

The Pareto Chart was developed by Vilfredo Frederigo Samoso at the end of the 19th century. The Pareto diagram is a logical approximation of the early stages of the process of repairing a situation described in the form of a histogram known as the vital few and useful to get the underlying cause. Pareto charts are best used to determine priorities due to resource constraints, generate consensus or final decisions, and place decisions on quantitative data. Stages in the use of Pareto diagrams are as follows (Poerwanto, n.d.):

1. Looking for facts from the data that measured.
2. Determine the cause of the problem from the previous stage and group according to the period.
3. Establish an evaluation histogram from the initial condition of the problem encountered.
4. Standardize the results of the improvements that have been set and determine the next theme

The Pareto principle is also known as the 80/20 rule. This rule means that 20% of jobs can generate 80% of the benefits of the job. Examples of such practices as 80% of customer complaints arise 20% of products/services or 20% of products/services for services, 80% of the profits earned.

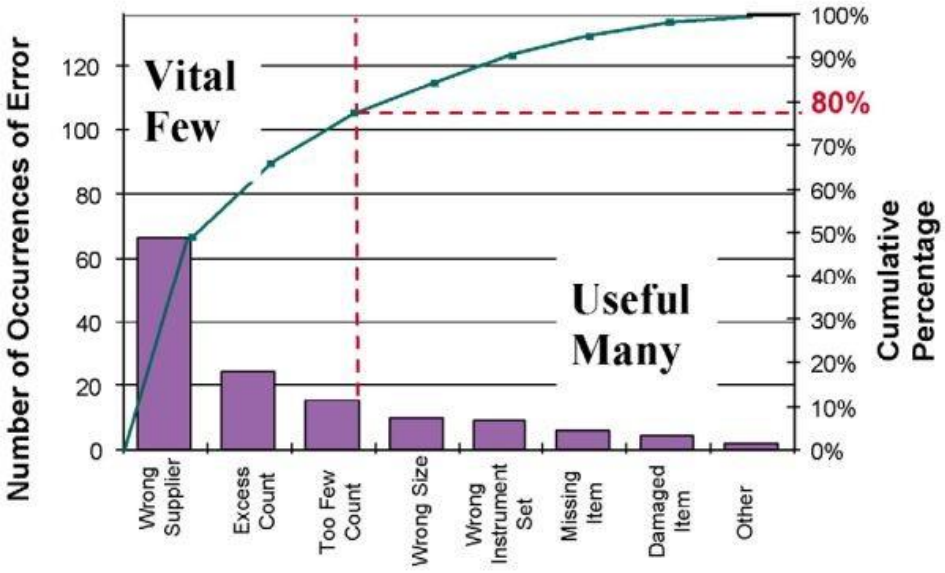

Figure 2.9 Pareto Chart Example
Source: (Improvement, 2004)

The Pareto Diagram is a standard method of quality control to obtain maximum results or select key issues and again be regarded as a simple approach that can be understood by less educated workers, and as a solving device in a fairly complex field. Pareto diagram is an image that sorts the classification of data from left to right in order of rank highest to lowest. This can help find the most important issues to be resolved (highest ranking) to the ones that do not need to be resolved (the lowest rank). In addition, the Pareto Diagram can also be used to compare process conditions, eg process mismatches, before and after corrective actions taken for the process.

2.7 KM Performance Measurement

Performance measurement is crucial in KM as it serves as the foundation that enables an organization to evaluate, control, and improve its knowledge processes (Pervaiz et al., 1999; Wong, 2005). Improving KM will ultimately lead to organizational improvements. To measure it, however, is not a simple mission due to its characteristics that include subjectivity, transferability, embeddedness, self-reinforcement, spontaneity, and perishability, which are all intangible (Kluge et al., 2001).

There is no standard in categorizing performance measurement models in KM. Chen and Chen (2005) classified KM performance measurement into eight categories, namely qualitative analysis, quantitative analysis, financial indicator analysis, non-financial indicator analysis, internal performance analysis, external performance analysis, project-oriented analysis, and organizational oriented analysis. Robinson et al. (2005) categorized it into two categories - measures for knowledge assets and measures for KM; and three approaches – metrics approaches, economic approaches, and market value approaches.

Qualitative research usually refines the indications and findings from a pilot study in an organization and from a review by researchers in organizational learning (Chen and Chen, 2005). The advantages of qualitative research include its effectiveness in identifying intangible factors and its capability to produce complex textual descriptions about the "human" side of KM, such as culture, behavior, practice, opinion, and experience. The most common qualitative approaches for internal KM assessment include questionnaire (Changchit et al., 2001), survey (Darroch and McNaughton, 2002; Darroch, 2003), and expert interview (Booker et al., 2008). Changchit et al. (2001) utilized a questionnaire to investigate the effect of an expert system in facilitating the transfer of internal control knowledge to managers whose work experiences are outside of accounting and control systems.

In KM, these approaches are used to measure explicit knowledge and the extent of its impact on both decision making and task performance of organizations or individuals with both non-financial and financial indicators (Chen and Chen, 2005). KM performance measurement tools that have been developed based on this approach are such as Skandia Navigator (Edvinsson, 1997), User-Satisfaction-Based KM Performance Measurement System (USBS) (Chin et al., 2010), and KP3 Methodology (Ahn and Chang, 2004). There is no standard on what metrics to use for KM performance measurement; however, non-financial metrics can be broadly grouped into four categories - customer, structural, human, and development (Von Krough et al., 1999; Roos et al., 1998; Pervaiz et al., 1999; Robinson et al., 2005).

Another quantitative method is the financial approach. It evaluates the costs and benefits of KM and whether the benefits exceed the costs. Costs in KM are such as hardware and software costs for KM systems, research and development costs,

and training costs; while benefits are the positive outcomes of KM, examples are cost savings and returns on investments (ROI) (Laitamaki and Kordupleski, 1997). An example of KM performance measurement method that has been developed based on the financial approach is IMPaKT (Improving Management Performance through Knowledge Transformation) assessor, which comprises a cause-and-effect map linking KM initiatives to strategic business objectives, and a roadmap for selecting the most appropriate evaluation technique to quantify the value of KM (Robinson et al., 2002; Carrillo et al., 2003).

In the table 2.5, it will explain the difference between each tool based on the focus, measurement approach and advantage or drawback.

Table 2.5 Comparison Of KM Performance Measurement Tools

Tools	Focus	Measurement Approach	Advantage / Drawback
Balance Score Card (BSC)	1. Financial Performance	Qualitative	No explicit explanation on how to
	2. Internal Business Process	Quantitative (Financial)	conduct evaluation of the key
	3. Customer		areas
	4. Learning and Growth		
Skandia Navigator	1. Financial	Qualitative, Quantitative (metrics, financial)	Capable of measuring the hidden
	2. Customer		dynamic factors,easy
	3. Process		
	4. Renewal and Development		to
			implement, but too many
			measures might cause confusing
	5. Human aspects		interpretations
Intangible Asset Monitor	A. Intangible Assets	Quantitative (metrics, non-financial)	Too many measures might cause confusing interpretations
	1. External structure		
	2. Internal structure		
	3. Individual competence		
	B. Measurement Indicators		
	1. Growth and renewal		
	2. Efficiency		
	3. Stability		

Table 2.5 Comparison Of KM Performance Measurement Tools(Continue)

Tools	Focus	Measurement Approach	Advantage / Drawback
Tobin's q	1. Market value of asset	Quantitative (financial)	Ignores replacement costs for intangible assets
	2. Replacement cost of asset		
Human Resource Accounting (HRA)	Economic value of employees	Quantitative (financial and non-financial)	Helps to convert employees' knowledge and experience into monetary value
User Satisfaction Based System	1. USB core values	Qualitative	Provides an alternative way to evaluate KM solely based on knowledge users.
	2. Critical Success Factors		
	3. KM Process		
KP3	1. Knowledge	Qualitative, Quantitative (metrics, financial and non-financial)	Relation between knowledge and business performance is shown more explicitly
	2. Product		
	3. Process		
	4. Performance		
Knowledge Management Performance Index (KMPI)	1. Knwoledge creation	Qualitative, Quantitative (metrics, financial and non-financial)	Explicitly establishes and evaluates KCP
	2. Knowledge accumulation		
	3. Knowledge sharing		
	4. Knowledge utilization		
	5. Knowledge internalization		

Source:(Kuah and Wong, 2011)

2.8 Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a technique presented in 1978 by Charnes et al. (1978) that used mathematical programming to evaluate the relative performance of enterprises/organizations. DEA technique is a non-parametric method to measure the efficiency of the organizations. DEA usually used to measure the relative efficiency of the organizations, the formula of to measure the relative efficiency is the weighted sum of outputs divided by weighted sum of inputs. While the main applications have been in the evaluation of not-for-profit organisations, the technique can be successfully applied to other situations

competing with other techniques as cost benefit analysis and multi criteria decision making as can be seen, for instance, in a recent study about the best choice for traffic planning, namely, the design and location of a highway in Memphis (Bougnol et al. 2005).

DEA is suited for this type of evaluation because it enables results to be compared making allowances for factors (Thanassoulis and Dunstan 1994). In DEA, the organisational units that being observed and assessed are called the Decision Making Units (DMUs). It becomes a technique that based on the comparison of each DMU, it assumes that each DMU produces Y outputs by X inputs.. DEA result could identify the efficient and inefficient units in an organization/framework. It provides the organization an information that used as a base of comparison between efficient units (peer group) and the inefficient units. From the comparison, the role model units can become the object to be studied in order to identify the success factors from the input or the output that can be used as a reference for the inefficient units.

In the ratio analysis of DEA, when the calculation of efficiency is done by output over input with placing emphasis on reduction of inputs to improve efficiency, this is called input orientation. It assumes that the organizations have the resources to control over the inputs. Furthermore, when the organizations choose to augment their output (for example the output is the reputation on quality of services), with it given capacities of inputs, it can increase the number of customers and increase their organization's efficiency, this is called the output orientation.

In the development of DEA, there are large number of researches and papers which have been extended and applied the DEA methodology. Furthermore, in 1978, Charnes, Cooper and Rhodes were proposed a model that assumed to be constant returns to scale (CRS). Later, in 1984, Banker, Charnes and Cooper proposed a variable returns to scale (VRS) model. These two models have two orientation in the calculation, there are input orientation and output orientation. The two models of DEA will be informed more based on these figure 2.10.

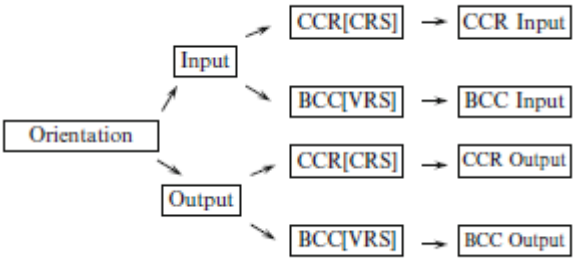

Figure 2.10 DEA orientation
(Source: Ozcan, Y.A. 2014)

1. Constant Returns to Scale (CRS)

   The Constant Return to Scale model was developed by Charnes, Cooper, and Rhodes (therefore, the CRS model may also be referred to as the CCR model) in 1978. And Yumanita and Ascarya (2005) stated "This model assumes that the ratio between the addition of input and output is constant (constant returns to scale) ". That is, if any additional inputs x times, then the output will increase by x times as well. Another assumption used in this model is any company or decision-making unit (DMU) operates at an optimum scale.

   There are two orientation in this model are:

   A. CCR Input Orientation
   B. CCR Output Orientation

2. Variable Returns to Scale (VRS)

   This model was developed by Banker, Charnes, Rhodes (hence can also called the BCC model) in 1984 and is the development of the model CRS. This model assumes that the ratio between input and output additions is not the same (variable returns to scale). That is, adding an input of x times will not cause output increases by x times, may be smaller (decreasing returns to scale) or greater of x times (increasing returns to scale). There are two orientation in these model that are:

   A. BCC Input Orientation
   B. BCC Output Orientation

The DEA model used as a tool for measuring performance has several advantages over other models. According to Cooper et al. (2007) these advantages are:

The DEA model used as a tool for measuring performance has several advantages over other models. According to Cooper et al. (2007), these advantages are:

A. Can measure many input variables and output variables. According Handoyo (2008) DEA assumes that each DMU uses a combination of different inputs for resulting in different output combinations. This is to overcome a disadvantage possessed by a ratio analysis that is only capable of providing information that DMU has the ability to convert one type of input to one type specific outputs as well as multiple regression analyzes that combine multiple outputs into one whereas the merger is not possible.
B. Be able to identify the source and number of inefficiencies in each input and output for each organization (DMU).
C. Be able to identify which DMUs can be used as benchmarks by other DMUs that is inefficient.

However, in addition to having advantages, DEA also has limitations (Herlita, 2009), those limitations are:

A. It is sample specific that only applies to the group of research objects compared only. So for example when in the calculation level of efficiency some DMU formerly efficient status, could later be changed into inefficient, and vice versa when DMU formerly inefficient status, it might turn out to be efficient. This change can occur if in the comparable DMU group there are new DMUs that more efficient in relative terms.
B. It is an extreme point technique, where DEA requires all inputs and outputs should be specific and measurable (same as ratio analysis and analysis requirements). An error in inputting and output will result the measurement information is incorrect. For example, a DMU is not efficiently become efficient or otherwise visible. Therefore, the input specifications and the output to be measured by the DEA technique must be properly constructed.

C. DEA only measures the relative efficiency of the DMU and not the absolute efficiency.
D. If this method is used to measure the relative efficiency level with the amount small sample, then this method is very sensitive to the difference between the amount DMU being studied and the number of input and output variables calculated.
E. Do not include random error, the consequences is the DEA approach cannot taking into account factors such as price differences across regions, differences regulations, good behavior bad data, extreme observation, and so forth as inefficiency factors.
F. A statistical hypothesis test of DEA results is difficult.

CHAPTER 3
RESEARCH METHODOLOGY

On this chapter, there will be an explanation about the research methodology which used on conducting the research.

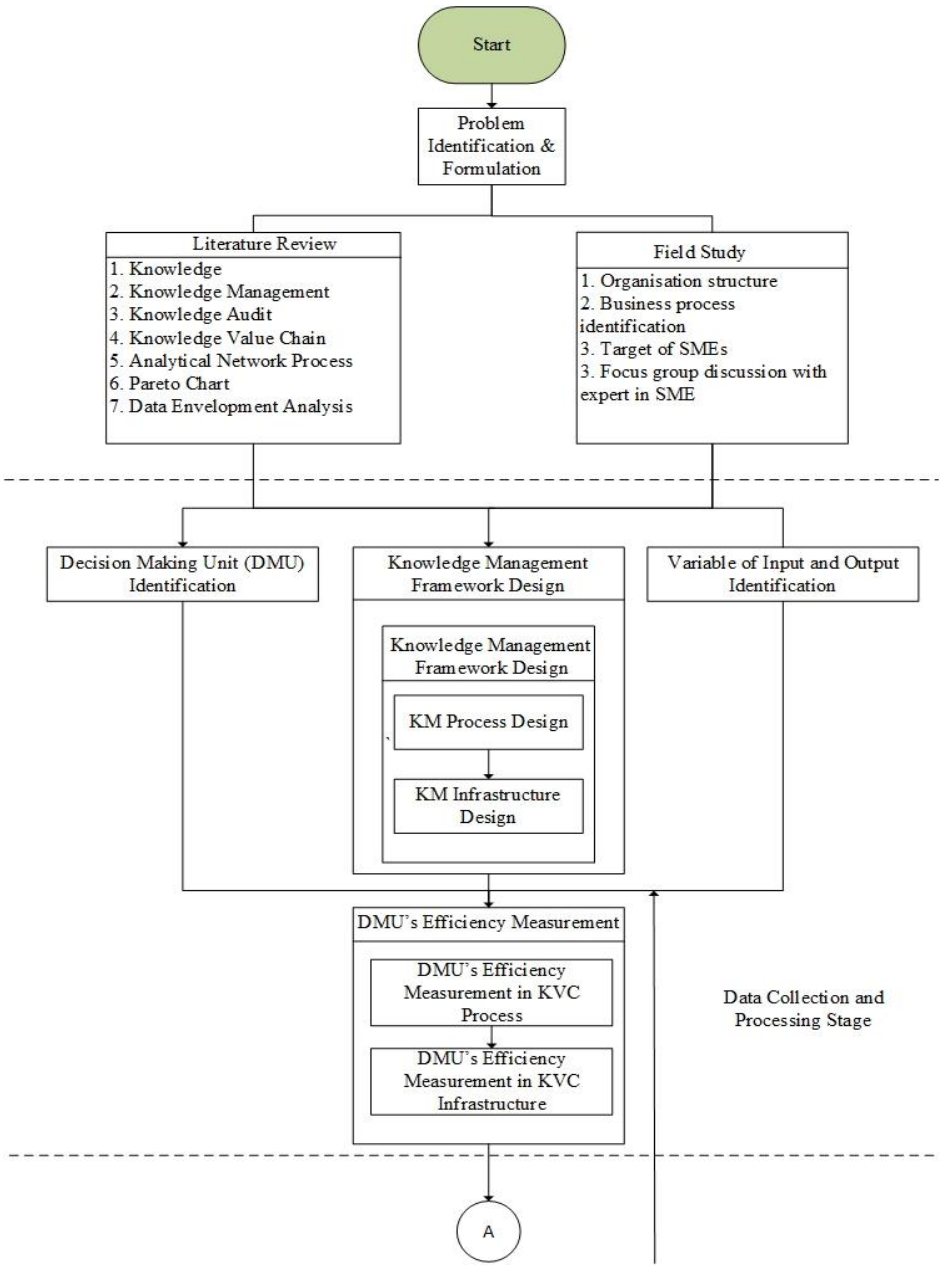

Figure 3.1 Flowchart of research methodology

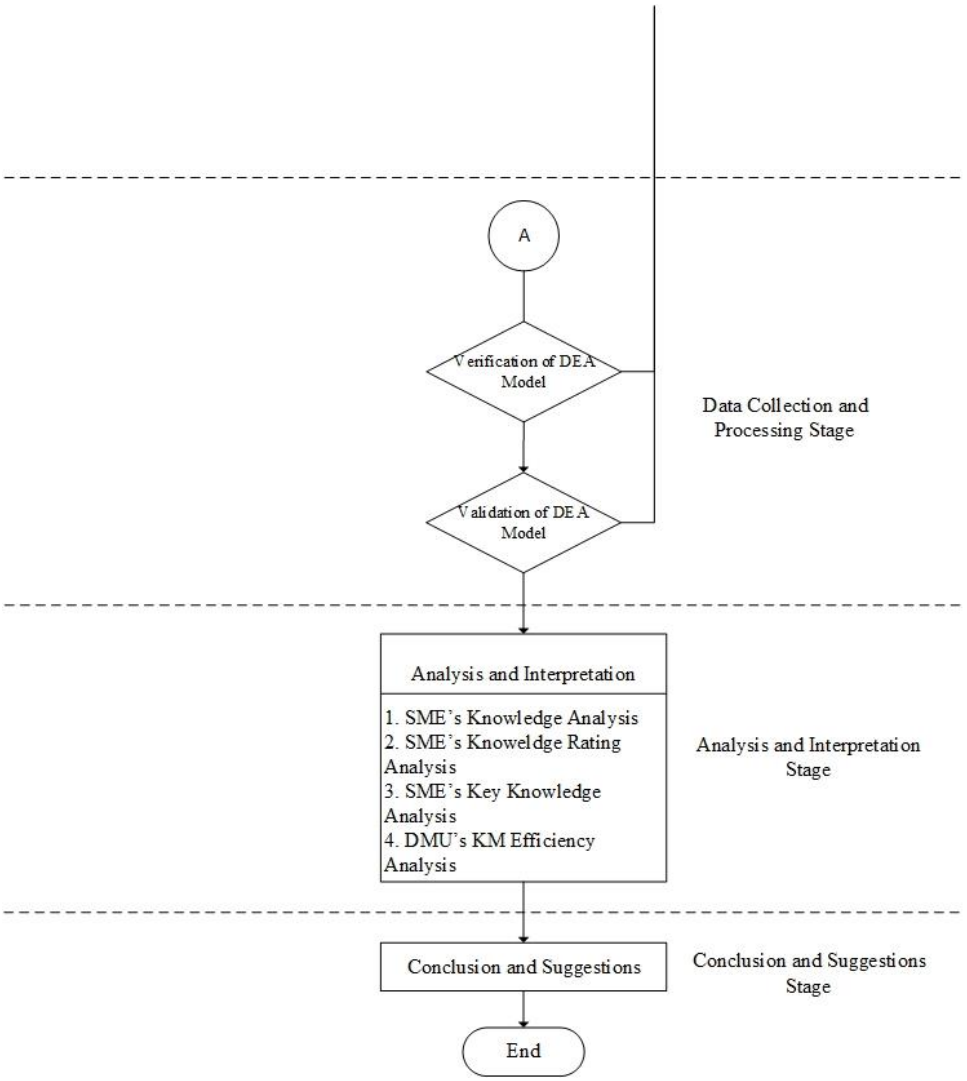

Figure 3.2 Flowchart of research methodology (cont'd)

3.1 Preliminary Stage

On figure 3.1, the activities which involved in this stage such as problem identification based on the observation of the existing condition of the data which is happened in the SME. The literature review that is done parallel in this research is to find the suitable theory which can be used to solve the problem. The observation and interview in SME will be done to know the problem which occurred and used as the object of these research. It is done by doing an interview with the Kadin (Kamar Dagang dan Dinas Industri) Kota Pasuruan, interview the worker of the SME and the director of the SME. The literature review is gathered and found by searching and gathering the literature from many sources that used to

conduct the problem-solving activity. It helps to support the data processing and analyzing to find the result of the research. The literature review which done in the research is about knowledge, knowledge management, knowledge audit, knowledge value chain, analytical network process, Pareto analysis and chart, KM performance measurement and data envelopment analysis (DEA). The sources that used to gather the literature review are by searching on the internet, direct interview and book. After the problem has already been identified then the problem can be formulated through the structured mechanism.

3.2 Data Collection and Process Stage

Data which needed to conduct the research will be collected and will be used as the input for the data processing later. The data will be collected by using questionnaire, observation and interview. The data that will be collected in these research are existing business process, organization structure of the SME, type of activities which need some knowledge to do, variable of input and output for the research and the Decision Making Unit (DMU) for the research. The result of the current condition through an assessment that collected will be processed and analyzed.

3.2.1 Knowledge Management Framework Design

In this step, business process and the data of knowledge needed for each job will be gathered as input for the Knowledge Management framework that using Knowledge Value Chain for the SME. The framework will be designed by two divisions that are processes and infrastructure. The processes are about how the knowledge captured, processed, documented, implemented and shared. For the infrastructures are about how the management of the SME in managing the knowledge.

3.2.2 Identification of Knowledge

In this step, from the worker job description, it will be used to capture the knowledge that needed for each job description that must be done. The identification of knowledge will be used to mapping the knowledge of the SME in each job description that later will be used for the input in the Knowledge Acquisition of KM Value Chain process stage. The knowledge that has been

identified will be used as the reference for defining the output of the DEA process itself.

3.2.3 Key Knowledge Identification

The knowledge that has been identified will be gathered and categorized using the methodology of Analysis Network Process and Pareto chart that based on the questionnaire, the SME will know the knowledge that most important for the business process activities.

3.2.4 Decision-Making Unit Identification

The decision making unit is identified by interviewing the Kadin for criteria of the SME that appropriate to be assessed and to implement the knowledge management framework.

3.2.5 Input and Output Identification

Input and output of DEA process will be identified by knowing knowledge value chain process and infrastructure input and output of SME and discussion with the knowledge experts of the SME. The input and output will be verified by the knowledge experts of the SME.

3.2.6 Efficiency of Knowledge Management

In measuring the efficiency of the Knowledge Management framework that has been implemented in the SME, it is done by measuring the output divided by input, the result will inform the management of the SME of the KM framework, whether it is already efficient or not. The calculation and measurement of the efficiency is done by using software.

3.2.7 Verification of DEA Model

In verifying the model of DEA, the DEA model will be tested whether it is corresponding or not in the software running, it is checking the model whether the model run or not and checking if there any mistakes from the model.

3.2.8 Validation of DEA Model

In validating the model of DEA, it will be discussed with the experts of the SME itself, whether the model is already corresponding with the output of KM performance that the experts required.

3.3 Analysis and Interpretation Stage

On this stage, the result obtained from the previous stages, which are analysis existing knowledge available in the SME, analysis the knowledge rating of the SME, analysis result of key knowledge of the SME, and analysis of efficiency for each KM value chain process and infrastructure of SME. Each of them will be explained thoroughly and clearly.

3.4 Conclusion and Suggestion Stage

This last stage is conclusions which can take from answering the aims of research while the suggestions are for the company where the research took place and for better further research on the same topic.

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CHAPTER 4
DATA COLLECTION AND PROCESSING

This chapter consists of data collection for the research and also provides the data processing for answering the problem formulation. According to the methodology explanation, it can be concluded this research has three main steps, each of them will be explained and done in detailed, which is divided onto subchapters.

4.1 SME's Profile

In this sub chapter, it will inform the profile of the Small Medium Enterprises that are used in this research, the profile will contain the general profile of the SMEs, organization structure of the SMEs and the production process of the SMEs that will be explained briefly.

4.1.1 CV Sinar Mas

CV Sinar Mas is company that run the business in furniture subsector of the manufacturing industry. It was established in year of 1997. Here is the organization structure of the company.

- Address : Jl. Cemara No.1 Bugul Lor, Kota Pasuruan
- Mobile : 08125260007
- E-Mail : sinarmasfurniture@gmail.com

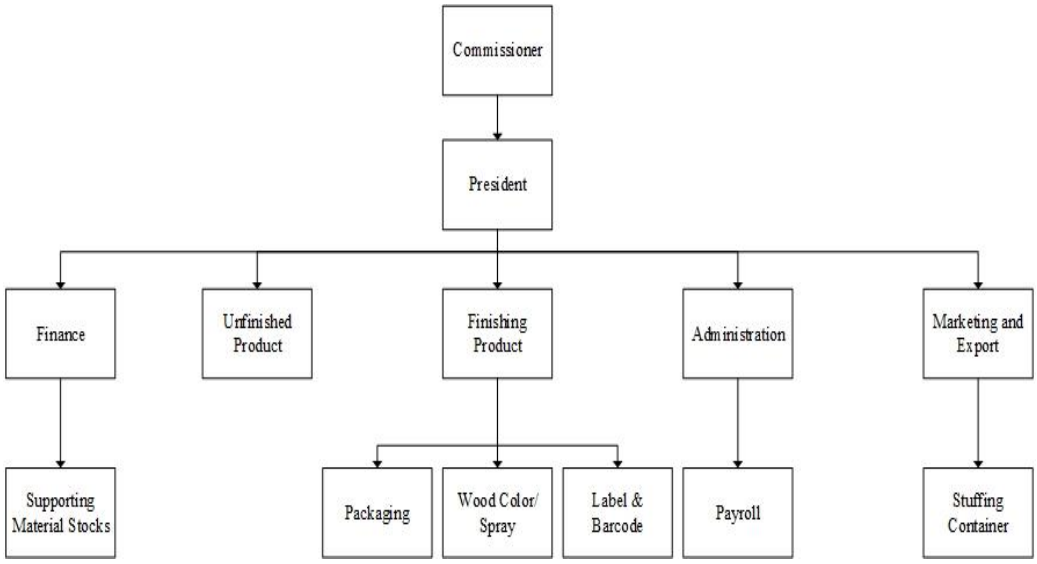


Figure 4.1 Organization structure of CV. Sinar Mas

From the figure 4.1, it can be seen that in the CV. Sinar Mas, the organization structure is consist of several units. There are Finance unit that consist of the supporting material stocks sub unit, Unfinished product unit, Finished Product unit that consist of packaging, wood colour, and label and barcode sub units, Administration Department that consist of payroll sub unit, Marketing and Export that consist of stuffing container sub unit.

Here is the production process of CV. Sinar Mas.

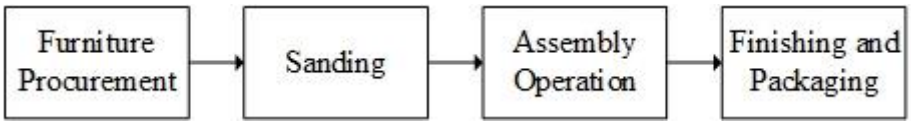


Figure 4.2 Production process of CV. Sinar Mas

In CV. Sinar Mas, the production process is only focusing in finishing work unit. CV. Sinar Mas order the unit that is already been assembled and in half-finished condition product. After the procurement of furniture, then the product goes to sanding unit to refine the product surface and internal parts of the product, after the product already refined, it goes to assembly operation. In the assembly operation, it only assemble the complementary parts such as handle of the product. The final process is the finishing and packaging of the product, the finishing product is done by giving the product colour and the packaging is done by using Styrofoam and carboard.

4.1.2 CV. Wijaya Mebel

On May 26, 2016 a company was founded which is named CV. Wijaya Utama located at Pasuruan Kota with the Notary Deed of Notary Ny. Widjanarti, S.H.

- Address : Jl Urip Sumoharjo 20 RT 01 RW 01 Bukir, Kota Pasuruan
- Mobile : 085749220000 - 081235005223
- E-Mail : admin@wijaya-mebel.com

CV. Wijaya Utama is company engaged in the field procurement of goods and services in furniture sector, Interior Design that serves medium and enterprises

big companies both private and government. Here is the vision and the mission that CV. Wijaya Utama create.

Vision

Menjadi Perusahaan yang Bertumbuh kembang, Unggul dan Terpercaya sebagai penyokong kelancaran operasional dan tumbuh bersama klien.

Mission

1. *Menjalankan bisnis pengadaan barang dan jasa di bidang perabotan rumah tangga (meubelair), dan bidang lain yang terkait, berorientasi pada kepuasan pelanggan dan perusahaan.*
2. *Menjadikan skill serta dedikasi personel dan kekuatan jaringan sebagai media untuk meningkatkan produktifitas pelanggan.*
3. *Menjaga kepercayaan dan loyalitas terhadap pelanggan*

Here is the organization structure of the CV. Wijaya Utama.

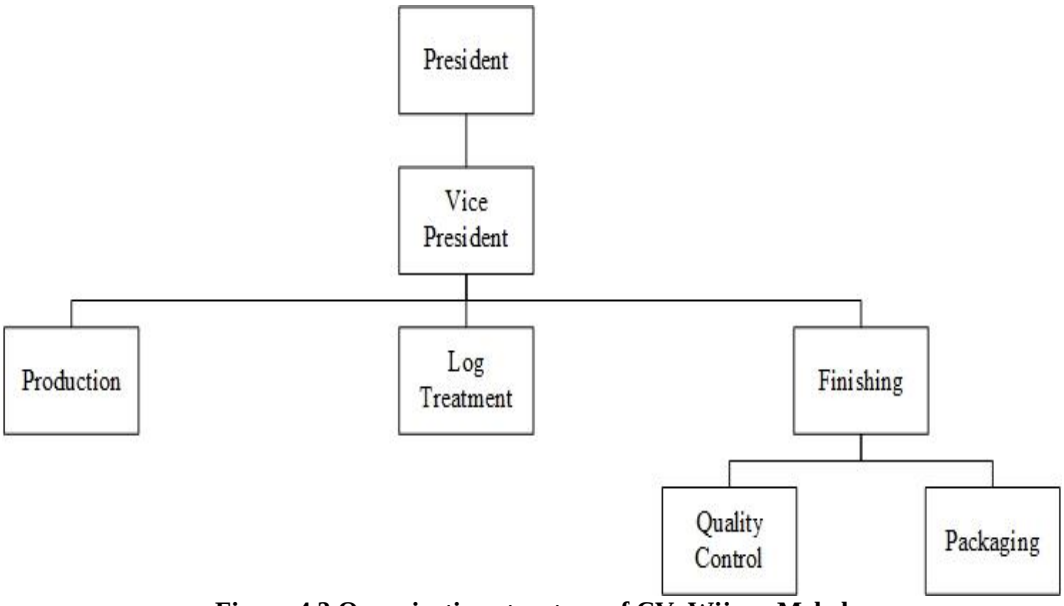


Figure 4.3 Organization structure of CV. Wijaya Mebel

In the figure 4.3 above, it can be seen that the organization structure consist of the President, Vice President, Production unit, Log Treatment unit, and Finishing unit. The finishing unit, consist of the quality control function and the packaging sub units.

Here is the production process of the CV. Wijaya Mebel that shown in the figure 4.4 below.

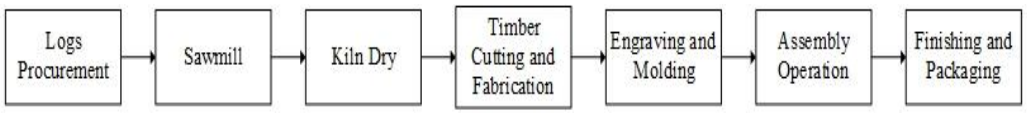


Figure 4.4 Production process of CV. Wijaya Mebel

The production process of the CV. Wijaya Mebel started by the procurement of log that appropriate with the specification of log types, diameter and log size from the product design. Then, the logs go through the sawmill process, to cut the log manually using traditional saw or using the saw machine that more precise and can cut the product faster. The logs been cut corresponding to the product types and designs. Next, the logs that have been cut are dried naturally using heat from the sunlight. When it has dried, it is the most ideal time for wood to be split and cut. In this process must be known precisely the component sizes. After the wood has been cut and selected material is given epoxy glue for construction and assembly. Then after that, the engraving process is done by using another log to create the different carved design that fit with the design using different carve knife that adjust the complexity of the design. Then in assembly process, the logs that has been cut corresponding to the design is glued and the engraved log is glued to the logs that has been assembled. After that, the finishing process is done by sanding process, staining process and coloring/coating process that differentiated by the design of the products itself. And the packaging done manually by using oil paper, Styrofoam and cardboard.

4.1.3 UD Mardi Jaya

UD. Mardi Jaya is company engaged in the production of goods and services in furniture sector. It is established in year of 1990. Here is the organization structure of UD. Mardi Jaya. It is located on Jl. Gatot Subroto Petahunan Gg.2, Gadingrejo, Pasuruan.

From the figure 4.5, it can be seen that in the UD. Mardi Jaya, the organization structure is consist of several units that are consist of president, secretary, production supervisor, procurement supervisor and finishing supervisor.

In the production supervisor, it is consist of several sub units that are construction and assembly, engraving and basic gluing. For the finishing supervisor, it is consist of several sub units that are finishing and sanding.

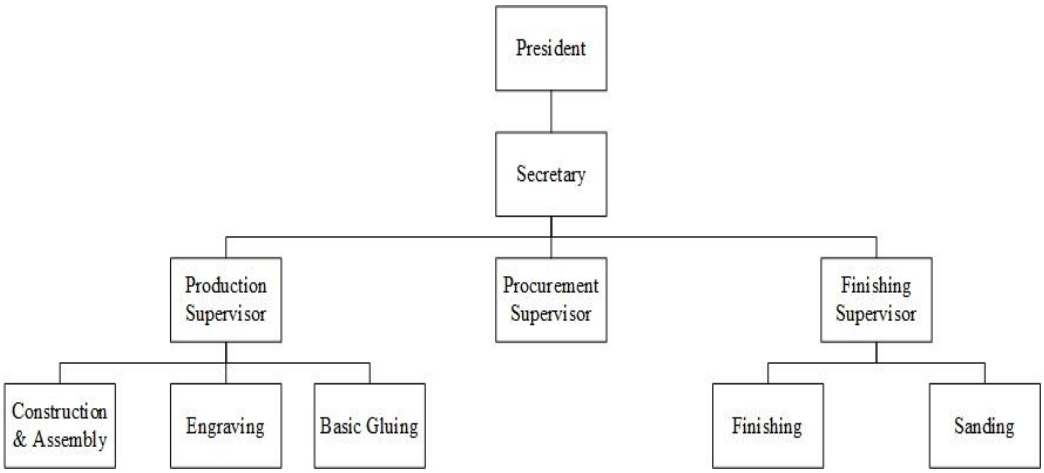


Figure 4.5 Organization structure of UD. Mardi Jaya

Here is the production process of the UD. Mardi Jaya that shown in the figure 4.6 below.

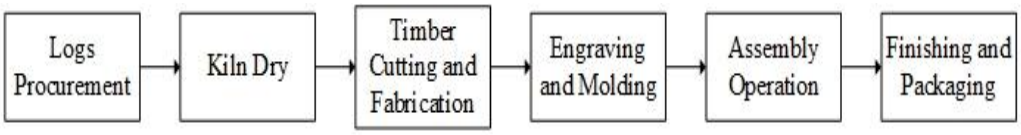


Figure 4.6 Production process of UD. Mardi Jaya

The production process of the UD. Mardi Jaya is almost the same with the CV. Wijaya Mebel production process in general, the difference is that in UD. Mardi Jaya, there is no Sawmill operation process, it is because that the UD. Mardi Jaya procure the log that already been cut and procure the log size corresponding the demand of the customer and the design of the product itself.

4.2 Knowledge Value Chain Framework Design

In this sub chapter, it will explain the knowledge value chain framework design that consist of knowledge management process design and knowledge infrastructure design. It explain the implementation of the Knowledge Value Chain in enterprises for each process of the Knowledge Value Chain and the infrastructure

needed in the SME in applying the Knowledge Value Chain. Here is the Knowledge Value Chain Framework that shown in the figure 4.7.

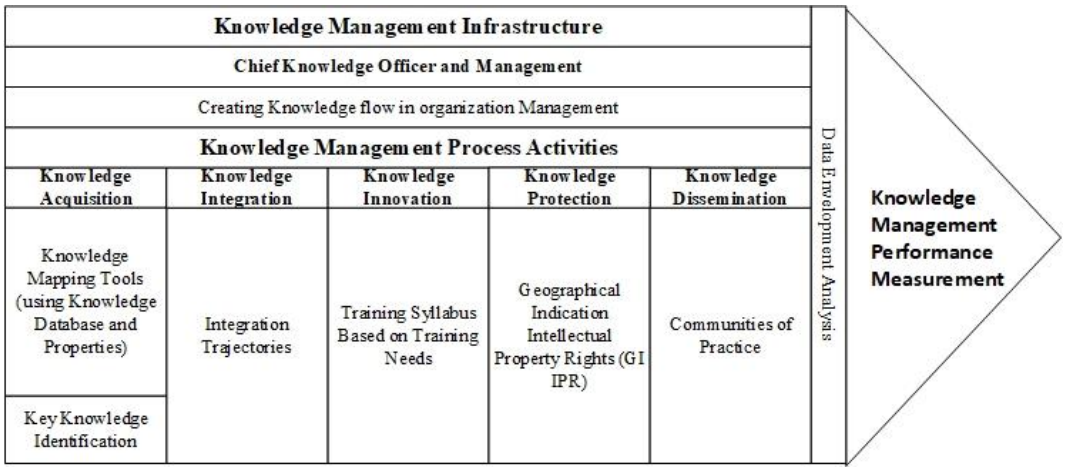


Figure 4.7 Knowledge Value Chain framework for the SMEs

The explanation of the framework designing process activities will be explained in the sub chapter below.

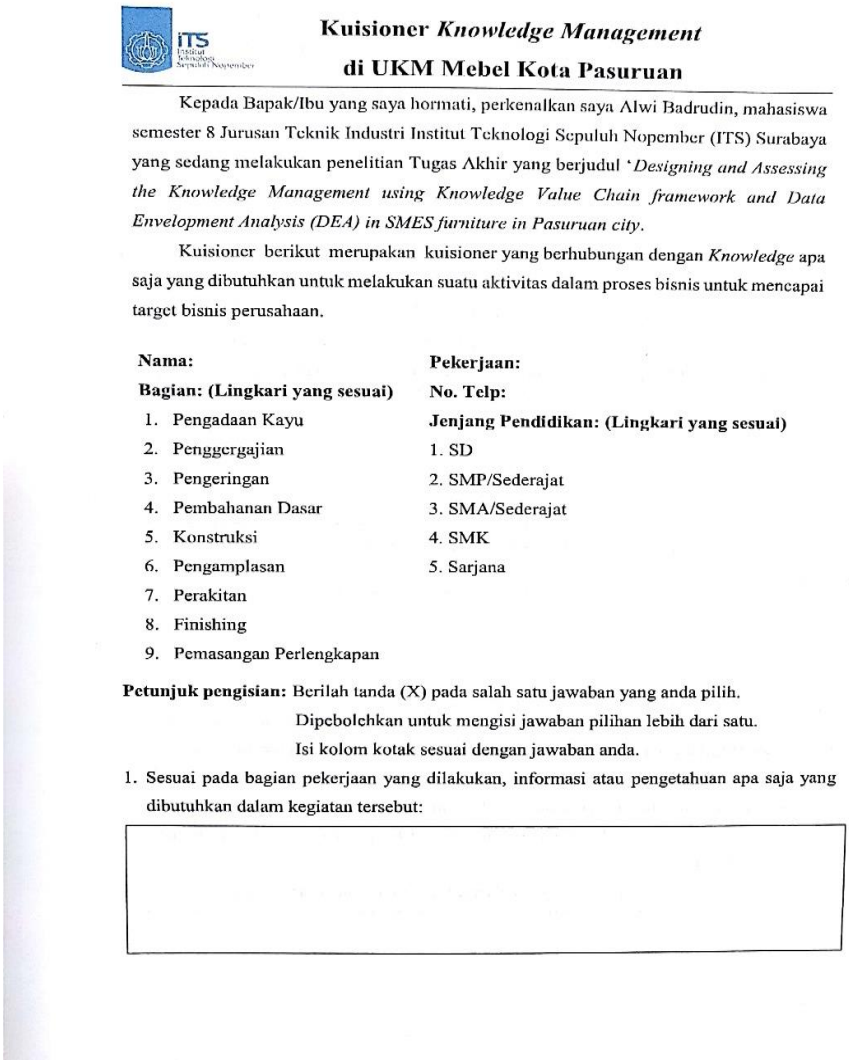
4.2.1 Knowledge Management Process Design

In this sub chapter, it will explain the knowledge management process design that consist of knowledge acquisition process, knowledge integration process, knowledge innovation process, knowledge protection process and knowledge dissemination process.

4.2.1.1 Knowledge Acquisition Process

In the process of Knowledge Acquisition, this process has purpose to track down and analyze all the information or knowledge that the SME has in the production process of the business. In this research, the knowledge acquisition process is done by using knowledge identification and knowledge mapping tools to create database of knowledge and the properties of knowledge for the SME.

Database of knowledge is designed from the knowledge audit method, from the audit method that using interview and questionnaire. From that method, the knowledge that the worker used in each production process and the knowledge needed to improve the production process can be identified. The questionnaire and interview will be conducted and spread to the Knowledge Expert and the worker itself. The example question that used in the interview and the example of questionnaire is shown in 4.8.



Kuisioner *Knowledge Management*
di UKM Mebel Kota Pasuruan

Kepada Bapak/Ibu yang saya hormati, perkenalkan saya Alwi Badrudin, mahasiswa semester 8 Jurusan Teknik Industri Institut Teknologi Sepuluh Nopember (ITS) Surabaya yang sedang melakukan penelitian Tugas Akhir yang berjudul '*Designing and Assessing the Knowledge Management using Knowledge Value Chain framework and Data Envelopment Analysis (DEA) in SMES furniture in Pasuruan city.*

Kuisioner berikut merupakan kuisioner yang berhubungan dengan *Knowledge* apa saja yang dibutuhkan untuk melakukan suatu aktivitas dalam proses bisnis untuk mencapai target bisnis perusahaan.

Nama: **Pekerjaan:**
Bagian: (Lingkari yang sesuai) **No. Telp:**
1. Pengadaan Kayu
2. Penggergajian
3. Pengeringan
4. Pembahanan Dasar
5. Konstruksi
6. Pengamplasan
7. Perakitan
8. Finishing
9. Pemasangan Perlengkapan

Jenjang Pendidikan: (Lingkari yang sesuai)
1. SD
2. SMP/Sederajat
3. SMA/Sederajat
4. SMK
5. Sarjana

Petunjuk pengisian: Berilah tanda (X) pada salah satu jawaban yang anda pilih.
Dipcbolehkan untuk mengisi jawaban pilihan lebih dari satu.
Isi kolom kotak sesuai dengan jawaban anda.

1. Sesuai pada bagian pekerjaan yang dilakukan, informasi atau pengetahuan apa saja yang dibutuhkan dalam kegiatan tersebut:

Figure 4.8 Knowledge identification questionnaire

4.2.1.1.1 Knowledge Database of CV. Sinar Mas

The result of the interview and questionnaire is data of the knowledge that used in the production process and the knowledge needed in order to improve the performance of the worker and to improve the production process. The database of the knowledge in the CV. Sinar Mas is shown in the table 4.1.

Table 4.1 Knowledge database of CV. Sinar Mas

Work Unit	Sub Work Unit	Knowledge Index	Knowledge	Knowledge Description
Finishing Unit	Sanding Function	FU-K-01	Sanding Operation	Knowledge in how to refine the surface of the wood using sandpaper

Table 4.1 Knowledge database of CV. Sinar Mas (Cont'd)

Work Unit	Sub Work Unit	Knowledge Index	Knowledge	Knowledge Description
		FU-K-02	Wood Sanding Machine	Knowledge in using the tools and the sandpaper in machine
		FU-K-03	Sanding Tools	Knowledge in the materials and specification of the tools that used (sandpaper 400cw, 600cw)
	Staining Function	FU-K-04	Staining	Knowledge in the how to staining the wood
		FU-K-05	Staining tools	Knowledge in materials and tools that used for stain
	Coloring and Coating Function	FU-K-06	Coloring and Coating	Knowledge in how to coloring/coating the wood
		FU-K-07	Coloring and Coating tools	Knowledge in materials that used for coloring and coating (aqua politur walnut, dark brown, clear doff)

(source: Author's document)

From the knowledge database of CV. Sinar Mas, it can be seen that in finishing unit, there are ten knowledge in the finishing unit of CV. Sinar Mas. There are many different knowledge that needed in each sub unit of finishing unit.

4.2.1.1.2 Knowledge Properties of CV. Sinar Mas

From the knowledge database of CV. Sinar Mas that shown the knowledge needed in each sub units of the finishing unit in CV. Sinar Mas. To explain more about the knowledge needed in each sub units and the purpose of each knowledge, the knowledge properties are created for each knowledge. In these several tables below, it will show ten knowledge properties in each sub unit of finishing unit in CV. Sinar Mas.

Table 4.2 Knowledge properties of CV. Sinar Mas Sanding Operation

Knowledge Properties	
Knowledge	Sanding Operation
Knowledge Description	Knowledge in how to refine the surface of the wood using sandpaper
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.3 Knowledge Properties of CV. Sinar Mas Wood Sanding Machine Operation

Knowledge Properties	
Knowledge	Wood Sanding Machine
Knowledge Description	Knowledge in using the tools and the sandpaper in machine
Purpose	Worker know how to refine the surface of the wood using wood sanding machine
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.4 Knowledge properties of CV. Sinar Mas Sanding Tools

Knowledge Properties	
Knowledge	Sanding Tools
Knowledge Description	Knowledge in the materials and specification of the tools that used (sandpaper 400cw, 600cw)
Purpose	Worker know what is the materials that used for sanding process
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

Table 4.5 Knowledge properties of CV. Sinar Mas Staining Operation

Knowledge Properties	
Knowledge	Staining Operation
Knowledge Description	Knowledge in the materials that used for stain and how to staining the wood
Purpose	Worker know how to stain the surface of the wood
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.6 Knowledge properties of CV. Sinar Mas Staining tools

Knowledge Properties	
Knowledge	Staining tools
Knowledge Description	Knowledge in materials and tools that used for stain

Table 4.6 Knowledge properties of CV. Sinar Mas Staining Operation (cont'd)

Knowledge Properties	
Purpose	Worker know what is the tools and the materials that used in staining process
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

Table 4.7 Knowledge properties of CV. Sinar Mas Coloring and Coating Operation

Knowledge Properties	
Knowledge	Coloring and Coating Operation
Knowledge Description	Knowledge in materials that used for coloring and coating and how to coloring/coating the product (aqua politur walnut, dark brown, clear doff)
Purpose	Worker know how to coloring /coating the product
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.8 Knowledge properties of CV. Sinar Mas Coloring and Coating Tools

Knowledge Properties	
Knowledge	Coloring and Coating tools
Knowledge Description	Knowledge in materials that used for coloring/coating (aqua politur walnut, dark brown, clear doff)
Purpose	Worker know what is the materials that used for coloring/coating
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

4.2.1.1.3 Knowledge Database of CV. Wijaya Mebel

Here is the knowledge database in CV. Wijaya Mebel that shown in the table 4.9.

Table 4.9 Knowledge database of CV. Wijaya Mebel

Work Unit	Sub Work Unit	Knowledge Index	Knowledge	Knowledge Description
Production Unit	Log Procurement Function	PU-K-01	Log Specification	Knowledge in choosing the log based the size, quality and type of log and the cubic calculation of the log
	Sawmill Function	PU-K-02	Sawmill Operation	Knowledge in how to saw the log based the design specification
	Engraving Function	PU-K-03	Engraving Operation	Knowledge in how to carve the wood corresponding to the design
		PU-K-04	Engraving Tools	Knowledge in choosing the right tools for carve that corresponding to the design
	Gluing Function	PU-K-05	Gluing Operation	Knowledge in how to glue the wood to create a product that appropriate to the design
		PU-K-06	Gluing Tools	Knowledge in tools/materials that used in glue operation (Epoxy Glue)
	Assembly Function	PU-K-07	Assembly Operation	Knowledge in how to assembly the wood corresponding to the design (use of planer machine)
Finishing Unit	Sanding Function	FU-K-01	Sanding Operation	Knowledge in how to refine the surface of the wood using sandpaper
		FU-K-02	Wood Sanding Machine	Knowledge in using the tools and the sandpaper in machine
		FU-K-03	Sanding Tools	Knowledge in the materials and specification of the tools that used (Sandpaper no 60, 80, 150 until 320)
	Staining Function	FU-K-04	Staining	Knowledge in the how to staining the wood
		FU-K-05	Staining tools	Knowledge in materials and tools that used for stain
	Coloring and Coating Function	FU-K-06	Coloring and Coating	Knowledge in how to coloring/coating the wood (Melamine, Duco and Polish)
		FU-K-07	Coloring and Coating tools	Knowledge in materials that used for coloring and coating (Melamine, Duco and Polish)

From the table above, it can be seen that the knowledge database of CV. Wijaya Mebel came from two units that are production and the finishing unit. In CV. Wijaya Mebel, there are 17 knowledge that came from several sub work units of the work unit. In this SME, it is become the SME that used as the reference in the general knowledge needed in the furniture SMES because the production process in this SME is the one with the most comprehensive production process in general.

4.2.1.1.4 Knowledge Properties of CV. Wijaya Mebel

Knowledge database of CV. Wijaya Mebel show the knowledge needed in each sub units of the production unit and finishing unit. In the knowledge properties, each knowledge will be described more. Here is the knowledge properties of CV. Wijaya Mebel that shown in the several tables below.

Table 4.10 Knowledge properties of CV. Wijaya Mebel Log Specification

Knowledge Properties	
Knowledge	Log Specification
Knowledge Description	Knowledge in choosing the log based the size, quality and type of log and the cubic calculation of the log
Purpose	Worker know how to choose the log based the size, quality and type of log and the cubic calculation of the log
Knowledge Types	Tacit Knowledge
User	Production Unit
How	Experience
Update frequency	-

Table 4.11 Knowledge properties of CV. Wijaya Mebel Sawmill Operation

Knowledge Properties	
Knowledge	Sawmill Operation
Knowledge Description	Knowledge in how to saw the log based the design specification
Purpose	Worker know how to saw the log based the design specification
Knowledge Types	Tacit Knowledge
User	Production Unit
How	Experience
Update frequency	-

Table 4.12 Knowledge properties of CV. Wijaya Mebel Engraving Operation

Knowledge Properties	
Knowledge	Engraving Operation
Knowledge Description	Knowledge in how to carve the wood corresponding to the design
Purpose	Worker know how to carve the wood corresponding to the design
Knowledge Types	Tacit Knowledge
User	Production Unit
How	Experience
Update frequency	-

Table 4.13 Knowledge properties of CV. Wijaya Mebel Engraving Tools

Knowledge Properties	
Knowledge	Engraving Tools
Knowledge Description	Knowledge in choosing the right tools for carve that corresponding to the design
Purpose	Worker know how to use right tools for carve that corresponding to the design
Knowledge Types	Explicit Knowledge
User	Production Unit
How	Standard of the enterprise
Update frequency	-

Table 4.14 Knowledge properties of CV. Wijaya Mebel Gluing Operation

Knowledge Properties	
Knowledge	Gluing Operation
Knowledge Description	Knowledge in how to glue the wood to create a product that appropriate to the design
Purpose	Worker know how to glue the wood to create a product that appropriate to the design
Knowledge Types	Tacit Knowledge
User	Production Unit
How	Experience
Update frequency	-

Table 4.15 Knowledge properties of CV. Wijaya Mebel Gluing Tools

Knowledge Properties	
Knowledge	Gluing Tools
Knowledge Description	Knowledge in tools/materials that used in glue operation (Epoxy Glue)

Table 4.15 Knowledge properties of CV. Wijaya Mebel Gluing Tools (cont'd)

Knowledge Properties	
Purpose	Worker know the tools/materials that used in glue operation (Epoxy Glue)
Knowledge Types	Explicit Knowledge
User	Production Unit
How	Standard of the enterprise
Update frequency	-

Table 4.16 Knowledge properties of CV. Wijaya Mebel Assembly Operation

Knowledge Properties	
Knowledge	Assembly Operation
Knowledge Description	Knowledge in how to assembly the wood corresponding to the design
Purpose	Worker know how to how to assembly the wood corresponding to the design
Knowledge Types	Explicit Knowledge
User	Production Unit
How	Standard of the enterprise
Update frequency	-

Table 4.17 Knowledge properties of CV. Wijaya Mebel Sanding Operation

Knowledge Properties	
Knowledge	Sanding Operation
Knowledge Description	Knowledge in how to refine the surface of the wood using sandpaper
Purpose	Worker know how to refine the surface of the wood using sandpaper
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.18 Knowledge properties of CV. Wijaya Mebel Wood Sanding Machine

Knowledge Properties	
Knowledge	Wood Sanding Machine
Knowledge Description	Knowledge in using the tools and the sandpaper in machine
Purpose	Worker know how to refine the surface of the wood using wood sanding machine
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.19 Knowledge properties of CV. Wijaya Mebel Sanding Tools

Knowledge Properties	
Knowledge	Sanding Tools
Knowledge Description	Knowledge in the materials and specification of the tools that used (Sandpaper no 80 and 120)
Purpose	Worker know what is the materials that used for sanding process
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

Table 4.20 Knowledge properties of CV. Wijaya Mebel Staining Operation

Knowledge Properties	
Knowledge	Staining Operation
Knowledge Description	Knowledge in the how to staining the wood
Purpose	Worker know how to staining the wood
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.21 Knowledge properties of CV. Wijaya Mebel Staining Tools

Knowledge Properties	
Knowledge	Staining tools
Knowledge Description	Knowledge in materials and tools that used for stain
Purpose	Worker know what is the tools and the materials that used in staining process
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

Table 4.22 Knowledge properties of CV. Wijaya Mebel Coloring and Coating Operation

Knowledge Properties	
Knowledge	Coloring and Coating Operation
Knowledge Description	Knowledge in how to coloring/coating the wood (sanding, base coat, top coat)
Purpose	Worker know how to coloring/coating the product
Knowledge Types	Tacit Knowledge
User	Finishing Unit

Table 4.22 Knowledge properties of CV. Wijaya Mebel Coloring and Coating Operation (cont'd)

Knowledge Properties	
How	Experience
Update frequency	-

Table 4.23 Knowledge properties of CV. Wijaya Mebel Coloring and Coating Tools

Knowledge Properties	
Knowledge	Coloring and Coating tools
Knowledge Description	Knowledge in materials that used for coloring and coating (sanding, base coat, top coat)
Purpose	Worker know what is the materials that used for coloring/coating
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

4.2.1.1.5 Knowledge Database of UD. Mardi Jaya

Here is the knowledge database of UD. Mardi Jaya that shown in the table 4.24.

Table 4.24 Knowledge database of UD. Mardi Jaya

Work Unit	Sub Work Unit	Knowledge Index	Knowledge	Knowledge Description
Production Unit	Log Procurement Function	PU-K-01	Log Specification	Knowledge in choosing the log based the size, quality and type of log and the cubic calculation of the log
	Engraving Function	PU-K-02	Engraving Operation	Knowledge in how to carve the wood corresponding to the design
		PU-K-03	Engraving Tools	Knowledge in choosing the right tools for carve that corresponding to the design
	Gluing Function	PU-K-04	Gluing Operation	Knowledge in how to glue the wood to create a product that appropriate to the design
		PU-K-05	Gluing Tools	Knowledge in tools/materials that used in glue operation (Epoxy Glue)

Table 4.24 Knowledge database of UD. Mardi Jaya (cont'd)

Work Unit	Sub Work Unit	Knowledge Index	Knowledge	Knowledge Description
Production Unit	Assembly Function	PU-K-06	Assembly Operation	Knowledge in how to assembly the wood corresponding to the design
Finishing Unit	Sanding Function	FU-K-01	Sanding Operation	Knowledge in the tools used and how to refine the surface of the wood using sandpaper
		FU-K-02	Wood Sanding Machine	Knowledge in using the tools and the sandpaper in machine
		FU-K-03	Sanding Tools	Knowledge in the materials and specification of the tools that used (Sandpaper no 80 and 120)
	Staining Function	FU-K-04	Staining	Knowledge in the how to staining the wood
		FU-K-05	Staining tools	Knowledge in materials and tools that used for stain (sanding sealer)
	Coloring and Coating Function	FU-K-06	Coloring and Coating	Knowledge in how to coloring/coating the wood
		FU-K-07	Coloring and Coating tools	Knowledge in materials that used for coloring and coating

From the table 4.24 above, it can be seen the knowledge database of UD. Mardi Jaya. There are 15 knowledge needed that came from each sub units of the production process in the UD. Mardi Jaya.

4.2.1.1.6Knowledge Properties of UD. Mardi Jaya

Knowledge properties will described more the knowledge needed from the knowledge database. Here is 15 knowledge properties of UD. Mardi Jaya that shown in the several tables below.

Table 4.25 Knowledge properties of UD. Mardi Jaya Log Specification

Knowledge Properties	
Knowledge	Log Specification

Table 4.25 Knowledge properties of UD. Mardi Jaya Log Procurement (cont'd)

Knowledge Properties	
Knowledge Description	Knowledge in choosing the log based the size, quality and type of log and the cubic calculation of the log
Purpose	Worker know how to choose the log based the size, quality and type of log and the cubic calculation of the log
Knowledge Types	Tacit Knowledge
User	Production Unit
How	Experience
Update frequency	-

Table 4.26 Knowledge properties of UD. Mardi Jaya Engraving Operation

Knowledge Properties	
Knowledge	Engraving Operation
Knowledge Description	Knowledge in how to carve the wood corresponding to the design
Purpose	Worker know how to carve the wood corresponding to the design
Knowledge Types	Tacit Knowledge
User	Production Unit
How	Experience
Update frequency	-

Table 4.27 Knowledge properties of UD. Mardi Jaya Engraving Tools

Knowledge Properties	
Knowledge	Engraving Tools
Knowledge Description	Knowledge in choosing the right tools for carve that corresponding to the design
Purpose	Worker know how to use right tools for carve that corresponding to the design
Knowledge Types	Explicit Knowledge
User	Production Unit
How	Standard of the enterprise
Update frequency	-

Table 4.28 Knowledge properties of UD. Mardi Jaya Gluing Operation

Knowledge Properties	
Knowledge	Gluing Operation
Knowledge Description	Knowledge in how to glue the wood to create a product that appropriate to the design

Table 4.28 Knowledge properties of UD. Mardi Jaya of Gluing Operation (cont'd)

Knowledge Properties	
Purpose	Worker know how to glue the wood to create a product that appropriate to the design
Knowledge Types	Tacit Knowledge
User	Production Unit
How	Experience
Update frequency	-

Table 4.29 Knowledge properties of UD. Mardi Jaya Gluing Tools

Knowledge Properties	
Knowledge	Gluing Tools
Knowledge Description	Knowledge in tools/materials that used in glue operation (Epoxy Glue)
Purpose	Worker know the tools/materials that used in glue operation (Epoxy Glue)
Knowledge Types	Explicit Knowledge
User	Production Unit
How	Standard of the enterprise
Update frequency	-

Table 4.30 Knowledge properties of UD. Mardi Jaya Assembly Operation

Knowledge Properties	
Knowledge	Assembly Operation
Knowledge Description	Knowledge in how to assembly the wood corresponding to the design
Purpose	Worker know how to how to assembly the wood corresponding to the design
Knowledge Types	Explicit Knowledge
User	Production Unit
How	Standard of the enterprise
Update frequency	-

Table 4.31 Knowledge properties of UD. Mardi Jaya Sanding Operation

Knowledge Properties	
Knowledge	Sanding Operation
Knowledge Description	Knowledge in how to refine the surface of the wood using sandpaper
Purpose	Worker know how to refine the surface of the wood using sandpaper
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience

Table 4.31 Knowledge properties of UD. Mardi Jaya Sanding Operation (cont'd)

Knowledge Properties	
Update frequency	-

Table 4.32 Knowledge properties of UD. Mardi Jaya Wood Sanding Machine

Knowledge Properties	
Knowledge	Wood Sanding Machine
Knowledge Description	Knowledge in using the tools and the sandpaper in machine
Purpose	Worker know how to refine the surface of the wood using wood sanding machine
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.33 Knowledge properties of UD. Mardi Jaya Sanding Tools

Knowledge Properties	
Knowledge	Sanding Tools
Knowledge Description	Knowledge in the materials and specification of the tools that used (Sandpaper no 80 and 120)
Purpose	Worker know what is the materials that used for sanding process
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

Table 4.34 Knowledge properties of UD. Mardi Jaya Staining Operation

Knowledge Properties	
Knowledge	Staining Operation
Knowledge Description	Knowledge in the how to staining the wood
Purpose	Worker know how to staining the wood
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.35 Knowledge properties of UD. Mardi Jaya Staining Tools

Knowledge Properties	
Knowledge	Staining tools

Table 4.35 Knowledge properties of UD. Mardi Jaya Staining Tools (cont'd)

Knowledge properties	
Knowledge Description	Knowledge in materials and tools that used for stain
Purpose	Worker know what is the tools and the materials that used in staining process
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

Table 4.36 Knowledge properties of UD. Mardi Jaya Coloring and Coating Operation

Knowledge Properties	
Knowledge	Coloring and Coating Operation
Knowledge Description	Knowledge in how to coloring/coating the wood (sanding, base coat, top coat)
Purpose	Worker know how to coloring /coating the product
Knowledge Types	Tacit Knowledge
User	Finishing Unit
How	Experience
Update frequency	-

Table 4.37 Knowledge properties of UD. Mardi Jaya Coloring and Coating Tools

Knowledge Properties	
Knowledge	Coloring and Coating tools
Knowledge Description	Knowledge in materials that used for coloring and coating (sanding, base coat, top coat)
Purpose	Worker know what is the materials that used for coloring/coating
Knowledge Types	Explicit Knowledge
User	Finishing Unit
How	Standard of the enterprise
Update frequency	-

4.2.1.1.7Weighting the Knowledge

The rating of the knowledge in each work unit will be obtained by using ANP method, it can be done after having the knowledge database. It using ANP to give rating that more objective and to see the relation between the inner dependence and outer dependence. In determining the rating of knowledge, first determined the relationship between knowledge in each work unit with the method of discussing with knowledge expert. Then, the linkage is incorporated into the super decisions

software and will result in a paired comparison scale assessment. The assessment of the scale will be filled by the knowledge expert, the result of the weighting of pairwise comparison scale can be seen in the Appendix. Then after the assessment is filled, then the value will be included in the software super decisions and the final weight of the knowledge can be seen. The data relation will be valid if, the inconsistency value is less than 0.1 (n< 0.1). Below is a relation on each element (Knowledge) in cluster (Work Unit) and relation in each element to other element in other cluster.

Table 4.38 Knowledge relationship with other knowledge

Knowledge	Affected By	Description
Sawmill Operation	Log Specification	Sawmill operation will be affected by the log specification in how the logs should be cut
Engraving Operation	Engraving Tools	Engraving operation will be affected by the tools that the worker used
	Sanding Operation	Engraving Operation will be affected by the sanding operation in how the design of carved on the object
	Sanding Tools	Engraving Operation will be affected by the sanding tools in how the design of carved on the object
Gluing Operation	Gluing tools	Gluing operation time will be affected by the glue tools/materials that used by the worker
	Log specification	Gluing operation will be affected by the log specification in what materials of gluing tools used for the log
Assembly Operation	Engraving Operation	Assembly operation will be adjusted on the corresponding to different engraving operation
	Engraving Tools	Assembly operation will be adjusted on the corresponding to different engraving operation that needed different tools
	Gluing Operation	Assembly operation will be adjusted to the basic glue operation and tools in how the worker will construct and assembly each part of product
	Gluing Tools	
Sanding Operation	Log Specification	Sanding operation will be affected by the log specification in how much the log needs to be smoothed
	Sanding Tools	Sanding tools will affecting the sanding operation because there are many sanding tools and each type has different functions and result

Table 4.38 Knowledge relationship with other knowledge

Knowledge	Affected By	Description
Sanding Operation	Wood Sanding Machine	Wood sanding machine will make the sanding operation faster and used for the large part of the product that will affect the sanding operation
	Sawmill Operation	Sanding operation will be affected by the sawmill operation in how the sawmill operation is done using different operation
Staining Operation	Sanding Operation	Staining operation time duration will be affected in the sanding operation result and quality
	Sanding Tools	Staining operation time duration will be affected by the smoothness of the wood's surface that determined by the sanding tools
	Wood Sanding Machine	Staining operation time duration will be affected by the smoothness of the wood's surface that determined by the wood sanding machine
	Staining Tools	Staining operation quality and time duration will be affected in what the materials used
	Log Specification	Staining operation will be affected by the log specification on how the worker stain the wood that has different characteristics
Coloring and Coating Operation	Sanding Operation	Coloring and coating quality and result will be affected by the sanding operation
	Sanding Tools	Coloring and coating quality and result will be affected by the tools that used in the sanding operation
	Wood Sanding Machine	Coloring and coating quality and result will be affected by the tools that used in the sanding operation
	Staining Operation	Coloring and coating quality and result will be affected by the staining operation
	Staining Tools	Coloring and coating quality and result will be affeted by the tools that used in staining operation
	Coloring and Coating Tools	Coloring and coating quality and result will be affected by the tools/ materials used in the process
	Log Specification	Coloring and coating operation will be affected by the log specification on how the worker coloring and coating the wood that appropriate with wood characteristics

Table 4.38 shows the relation between each element (knowledge). Then, once known each inter-linking elements will be established network on super software decisions. In making the network, for Cluster will be filled as Work Unit in the production process while for Node will be filled with existing knowledge on each KPI. The following model linkage results in software super decisions:

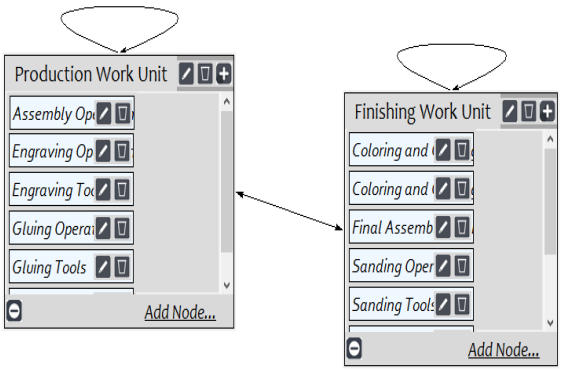


Figure 4.9 Linkage result of knowledge in ANP using Superdecisions

Figure 4.10 below show the relationship between each cluster (Work unit) and node (Knowledge). After determining the linkage, pairwise comparison can be done on the cluster and node that has a relationship, the result of pairwise comparison can be seen in the Appendix. Pairwise Comparison is a charging paired comparison value that will be filled by Knowledge Expert. The result of pairwise comparison is a priority for each knowledge. Below are the priorities of each of these knowledge.

Here are the priorities.

Icon	Name	Normalized by Cluster	Limiting
No Icon	Coloring and Coating Operation	0.20834	0.153944
No Icon	Coloring and Coating Tools	0.17022	0.125777
No Icon	Sanding Operation	0.18887	0.139554
No Icon	Sanding Tools	0.20199	0.149252
No Icon	Staining Operation	0.11659	0.086150
No Icon	Staining Tools	0.05431	0.040133
No Icon	Wood Sanding Machine	0.05967	0.044088
No Icon	Assembly Operation	0.01885	0.004921
No Icon	Engraving Operation	0.09497	0.024796
No Icon	Engraving Tools	0.06219	0.016239
No Icon	Gluing Operation	0.02045	0.005339
No Icon	Gluing Tools	0.01740	0.004542
No Icon	Log Specification	0.60488	0.157936
No Icon	Sawmill Operation	0.18127	0.047329

Figure 4.10 Result of pairwise comparison using Superdecisions

Based on the figure 4.10, there are two weights that are generated, the weight on Normalized by Cluster and Limiting weights. Weight of Normalized by Cluster is the weight of each element of each cluster, while the weight of Limiting are the weights that are compared with all other elements. Thus, the weight of knowledge is the weight that is in the Normalized by Cluster value, while the weight of Limiting is the global weight, it is the weights that have considered all the interconnections on each element.

4.2.1.1.8 Assigning Critical Knowledge

Critical or key knowledge is the knowledge that has big impact to other knowledge in the work unit. In the knowledge acquisition process, the critical knowledge determination is done to know the knowledge that has critical effect to the production process of the furniture industry. Critical knowledge will be obtained by giving rating to all of the knowledge and from the knowledge which obtained from the 'Limiting' data from the super decisions software. The rating will be summed up cumulatively to know the percentage. The percentage will be used in the Pareto Chart method. The data that used in Pareto Chart is the Limiting weight data that will be shown in the table 4.39. The percentage calculation of the Pareto Chart will be shown below:

Weight Cumulative Percentage of FU-K-06

$$\frac{Bobot\ Limiting PU-K-01 + Bobot\ Limiting\ PN-K-06}{Total\ Bobot\ Limiting} \text{ x } 100\% \qquad (4.1)$$

Table 4.39 Weight of knowledge

Knowledge Index	Name	Normalized By Cluster	Limiting	Cumulative
PU-K-01	Log Specification	0,60488	0,157936	15,79%
FU-K-06	Coloring and Coating Operation	0,20834	0,153944	31,19%
FU-K-03	Sanding Tools	0,20199	0,149252	46,11%
FU-K-01	Sanding Operation	0,18887	0,139554	60,07%
FU-K-07	Coloring and Coating Tools	0,17022	0,125777	72,65%
FU-K-04	Staining Operation	0,11659	0,08615	81,26%
PU-K-02	Sawmill Operation	0,18127	0,047329	85,99%
FU-K-02	Wood Sanding Machine	0,05967	0,044088	90,40%
FU-K-05	Staining Tools	0,05431	0,040133	94,42%
PU-K-03	Engraving Operation	0,09497	0,024796	96,90%
PU-K-04	Engraving Tools	0,06219	0,016239	98,52%
PU-K-05	Gluing Operation	0,02045	0,005339	99,05%
PU-K-07	Assembly Operation	0,01885	0,004921	99,55%
PU-K-06	Gluing Tools	0,0174	0,004542	100,00%

Then the result of cumulative percentage of the table above will be used as the input data in creating the Pareto Chart. The figure 4.11 below is the Pareto Chart of the knowledge in production process of furniture SMES.

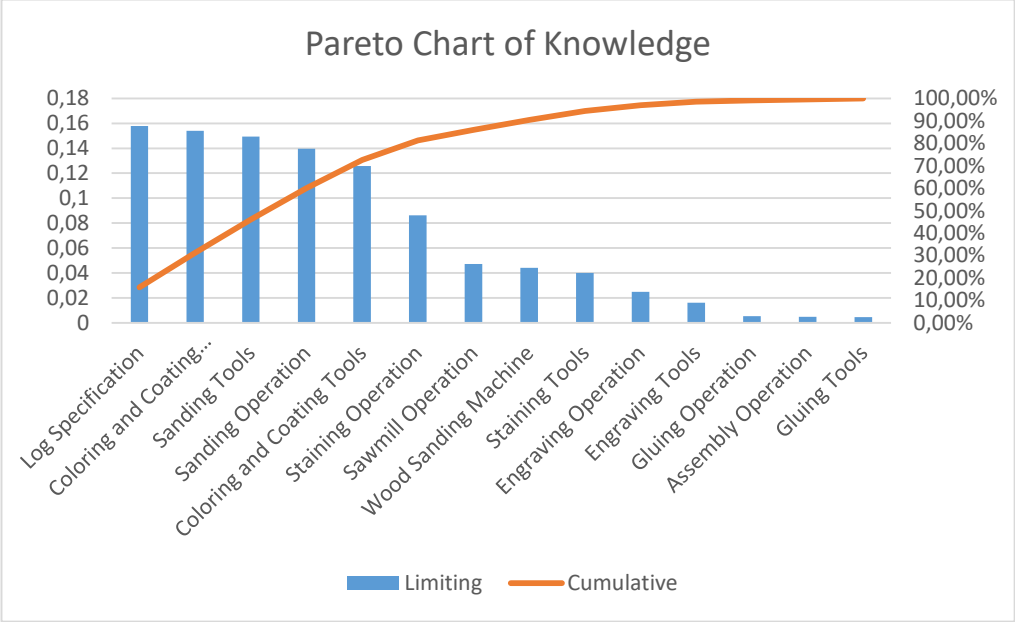


Figure 4.11 Pareto Chart of knowledge

From the figure 4.11 above, it can be seen that from fourteen knowledge needed, there are six key knowledge from different work unit, which are Log Specification (PU-K-01), Coloring and Coating Operation (FU-K-06), Sanding Operation (FU-K-01), Sanding Tools (FU-K-03), Coloring and Coating Tools (FU-K-07) and Staining Operation (FU-K-04).

4.2.1.2 Knowledge Integration Process

Integration of knowledge process is the process of creating synergy between different units that has different knowledge and different level of knowledge understanding to create a possibility of improving performance for the whole units through an effective sharing of knowledge among units. From the integration process itself, the organization can establish better relationship with the purpose of achieving better overall results. The result of this can be adequate for knowledge creation, transfer and deployment at the right place and time. In this research, the integration of the knowledge process uses the integration trajectory concept. It focused on how to translate this raw knowledge into actionable knowledge by means of an acute understanding of their business context. This is an internal

knowledge integration process. Organizations have always had some process to synthesize their experience and integrate it with knowledge acquired from outside sources Organizations acquires knowledge from years of experience in such things as manufacturing, sales, and service. This cumulative experience from different departments, together with information gathered from outside sources, can be integrated into the KVC of the organization.

In this research, the integration trajectory that used is the “core first” trajectory, it is obtained from the result of discussion with the Knowledge Expert of the SMEs. In this trajectory, the integration is done from the core of the process then continue with more peripheral integration activities. In this research, it is done from the core of production process of the furniture SMEs. The concept of integration trajectories from the core process is shown in the figure 4.12 below.

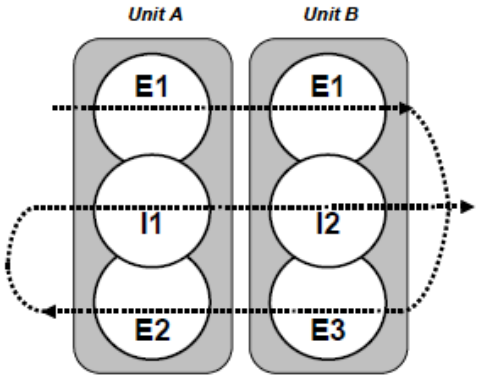


Figure 4.12 Core type integration trajectories

Core process of the production process in the furniture SMEs is consist of production work unit and the finishing work unit. In each work unit, it consist of several sub work units. For the production work unit, it consist of log procurement, sawmill, drying, engraving and assembly. For the finishing work unit, it consist of sanding, staining, coloring/coating, final assembly and packaging. In creating the core first integration trajectories, the needs of integration for each work unit/sub work units in the SMEs have to be identified first, so that the integration trajectories will have clear flow in integrate the knowledge of each unit in the SMEs itself. Considering the core process of each work unit, hereby is the needs of integration

for each sub work unit in each work unit of the SMEs that shown in table 4.40 and 4.41.

Table 4.40 Integration needs in production unit

Production Unit	
Integration Unit	**Integration Needs**
Engraving & Assembly Function	Knowledge in terms of engraving such as carving quality and complexity will affect how the assembly process, so it needs the integration of knowledge between each sub work unit
Sawmill & Assembly Function	Knowledge in terms of this assembly will affect how the sawmill process of the wood in terms of log size, therefore in the assembly process the integration of knowledge between assembly and sawmill is required
Sawmill & Glue Function	Knowledge in terms of sawmill will affect how the process of glue as the basic material of the assembly, from the sawing process will be known type of wood and wood shape to be given the glue material

Table 4.41 Integration needs in finishing unit

Finishing Unit	
Integration Unit	**Integration Needs**
Coloring/Coating Unit & Staining Function	Knowledge in terms of colouring/coating will affect how the staining process (basic colouring) is done, such as what the basic colour is required and what material is needed
Staining & Sanding Function	Knowledge in terms of Staining (basic colouring) will affect the sanding process in how smooth the sanding process is performed to facilitate the basic staining process

From the table 4.40 and 4.41 above, it can be seen the unit that integrate with the other unit and the integration needs of each units. In the figure 4.13 below, it will show the core integration trajectories of the sub units of the production unit and the integration trajectories of the sub units of the finishing unit.

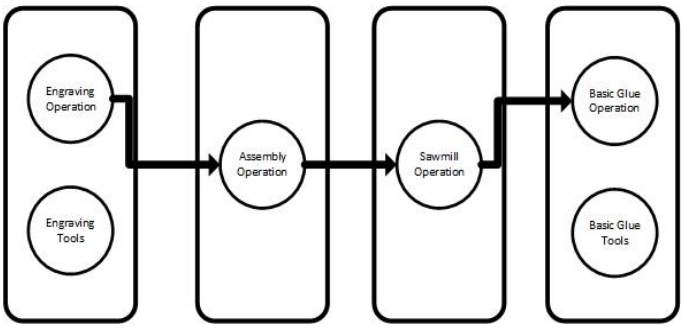


Figure 4.13 Integration trajectories of production unit

The integration that happen does not consider the flow of the production process in production unit, but it consider the “core” process of the production unit production process. From these considerations, the integration trajectories flow can be goes forward then goes backward.

The integration trajectories in the production unit starts with engraving operation in engraving sub work unit, it starts from the engraving operation because it is the operation that become the core in the furniture production process, it gives the product a “sign’ of the product that makes it different from the other product. After the engraving operation, it goes to the assembly operation in assembly sub work unit. From the integration of engraving and assembly sub work units, then it goes to the sawmill operation in the sawmill sub work unit. After that, it goes to the gluing operation in the glue sub work unit.

Figure 4.14 below show the integration trajectories of sub units in the finishing unit.

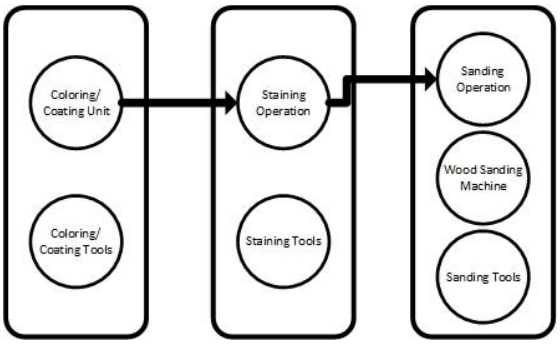


Figure 4.14 Integration trajectories of finishing unit

Integration trajectories in the finishing unit starts in the coloring/coating operation from the coloring/coating sub work unit. It starts from the coloring/coating operation because it depending on the previous process that are the staining operation and the sanding operation. After the coloring/coating operation, it goes to the staining operation in staining sub work unit. Then the final integration is goes to sanding operation in sanding sub work unit.

4.2.1.3 Knowledge Innovation Process

Knowledge Innovation process is aim to create new knowledge from internal sources or from the external sources of the organizations. The organization should supports creative individuals or provides contexts for them to create knowledge. After doing the discussion with the Knowledge Expert of the SMEs, in this research the knowledge innovation process will be done by creating the training syllabus that based from the needs of the SME member. The needs of training for the SME are obtained from the result of discussion and brainstorming with the member of the SME. In the table 4.43 below it will show the training syllabus for the staff, managers and the president of the SME. The innovation of knowledge will come from the external sources that will be processed and applied by different thought from each member of the SME. Here is the training syllabus for the SME that shown in the table 4.43.

Table 4.42 Training needs analysis in SME

No	Ideal Condition	Existing Condition	Gap	Course	Objective	Content Description	Training Method	Participants
1	SMEs have at least a written organizational structure, have a clear job description, have planning in training needs	SMEs don't have an organizational structure and do not have clear job descriptions and proper training needs planning	There are no organizational structure, job descriptions and training needs planning	Human Resource Management	There are organizational and employee development plans (improvement of employee competency and performance), through training on employee job description, employee planning and development through employee training needs analysis	Organizational structure, Job description employees, employee development planning, training needs	Seminars, case studies, group discussions, exercises	Leaders, managers and all staff

Table 4.42 Training needs analysis in SME (cont'd)

No	Ideal Condition	Existing Condition	Gap	Course	Objective	Content Description	Training Method	Participants
2	SME leaders and employees already have the confidence and able to think creatively to improve productivity	Employees do not have self-confidence and creative thinking concept	There are no knowledge about self-confidence and self-productivity and creative thinking	Personal productivity development	There is an understanding of the concept of self-productivity, creative thinking, problem solving, enhancement of self confidence	Concept of Self Productivity, problem solve, confidence	Seminars, case studies, group discussions, exercises	Leaders, managers and all staff
3	Leaders and employees of SMEs already know the concept of marketing in general and marketing methods	Employees don't have knowledge in marketing and marketing methods	There are no knowledge about marketing and marketing methods	Marketing	There are marketing planning, marketing strategy and concept of segmentation, targeting and positioning	The basic concepts of marketing, marketing planning, marketing strategy, the concept of segmentation, targeting and positioning	Seminars, case studies, group discussions, exercises	Leaders, managers and all Staff

Table 4.42 Training needs analysis in SME (cont'd)

No	Ideal Condition	Existing Condition	Gap	Course	Objective	Content Description	Training Method	Participants
4	SMEs already have a f good financial statements and know the method of financial planning	Employees do not know the concept of financial statements and financial planning methods	There are no knowledge about the financial statements and methods of financial planning	Finance	There are financial management, financial reporting, budgeting and financing methods	Basic concepts of accounting, financial reporting techniques, methods of planning, preparation and control of the budget	Seminars, case studies, group discussions, exercises	Staff

4.2.1.4 Knowledge Protection Process

In the knowledge protection process, in this research, from the discussion Knowledge Expert of the SMEs. The SMEs do the protection by creating documentation of each production process that explain each step of the production process and the information/knowledge that needed in each production process. The documentation of the production process for the product can be obtained by using the database of knowledge as the reference for the knowledge needed in each process of the production. The example of documentation will be shown in the table 4.42.

Table 4.43 Knowledge documentation as tool for knowledge protection

Design	Unit	Sub Unit	Detail Process	Knowledge Needed	User	Sources
Cupboard	Production	Log Procurement Function	Log selection size process according to the required design	Knowledge in choosing the log based the size, quality and type of log and the cubic calculation of the log	Staff of Log Procurement	Experience
		Sawmill Function	The process of cutting the log into the appropriate size according to the design for the assembly process	Knowledge in how to saw the log based the design specification	Staff of Sawmill	Experience
		Engraving Function	The process of engraving logs to be more aesthetic that give value to the product	Knowledge in how to carve the wood corresponding to the design	Staff of Engraving	Experience
				Knowledge in choosing the right tools for carve that corresponding to the design	Staff of Engraving	Standard of Company

Table 4.42 Knowledge documentation as tool for knowledge protection

Design	Unit	Sub Unit	Detail Process	Knowledge Needed	User	Sources
		Gluing Function	The process of gluing to paste parts of the product before the assembly	Knowledge in how to glue the wood to create a product that appropriate to the design	Staff of Gluing	Experience
				Knowledge in tools/materials that used in glue operation (Epoxy Glue)	Staff of Gluing	Standard of Company
		Assembly Function	Process to assemble the component of product	Knowledge in how to assembly the wood corresponding to the design (use of planer machine)	Staff of Assembly	Experience
	Finishing	Sanding Function	The sanding process of the product to refine the product, so the product become smoother	Knowledge in how to refine the surface of the wood using sandpaper	Staff of Sanding	Experience
				Knowledge in using the tools and the sandpaper in machine	Staff of Sanding	Standard of Company
				Knowledge in the materials and specification of the tools that used (Sandpaper no 60, 80, 150 until 320)	Staff of Sanding	Standard of Company

Table 4.42 Knowledge documentation as tool for knowledge protection

Design	Unit	Sub Unit	Detail Process	Knowledge Needed	User	Sources
		Staining Function	Process of giving the color base to the product	Knowledge in the how to staining the wood	Staff of Staining	Experience
				Knowledge in materials and tools that used for stain	Staff of Staining	Standard of Company
		Coloring and Coating Function	The process of painting on the product according to the design	Knowledge in how to coloring/coating the wood (Melamine, Duco and Polish)	Staff of Coloring/ Coating	Experience
				Knowledge in materials that used for coloring and coating (Melamine, Duco and Polish)	Staff of Coloring/ Coating	Standard of Company

The other protection of knowledge that SMEs do is to apply their product into the Intellectual Property Rights (IPR) that consider the Geographic Indication factor for the protection. Based on the *Direktorat Jendera Kekayaan Intelektual in Kementrian Hukum Dan Hak Asasi Manusia*, the Intellectual Property Rights that based on Geographical Indication, the Geographical Indication (GI) is Geographical indication is a sign indicating the origin of an item and / or product due to geographical environmental factors including natural factors, human factors, or a combination of these two factors, providing reputation and quality, and certain characteristics of the goods and / or products produced, it is suitable for furniture products in Pasuruan city because that the production process contain the engraving process, coloring/coating that can become a product sign of the furniture that has origin from the Pasuruan city. Based on *UU nomor 15 tahun 2001 and PP no 51 tahun 2007* regarding to geographical indication, here is the procedure of the GI IPR registration that shown in the figure 4.15 below.

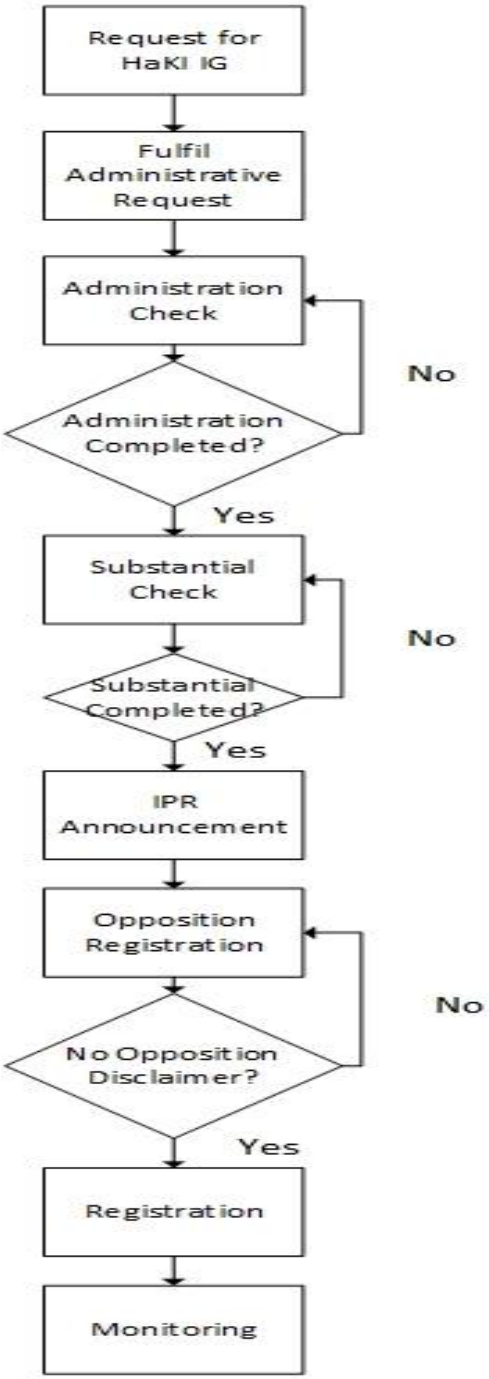


Figure 4.15 Flowchart of registration to GI IPR

4.2.1.5 Knowledge Dissemination Process

In this process, it has a purpose to create a knowledge sharing environment in the organization. In this research, after discuss with the Knowledge Expert in the SMEs, the knowledge dissemination process is done by using the one of knowledge management toolkit that is Communities of Practice (COP). Communities of Practice is a group of people that has a commitment in following the group to be active in the certain same interest in each other's expertise based on their work or practices.

The COP in general, has three characteristics that are crucial in organization that wanted to create a COP in their organizations. The three characteristics are the domain, which is an interest or topic that has been committed by the member of communities, the community that is the thing that the group in COP called for, in the community the members have to build their relationship based on the domain to help each other and learn from other. The last is the practice that means the members of the COP have to share their expert in each of their practices.

The COP as the communities has the basic structure of their communities that consist of the Core Group, Inner Circle and the Outer Circle of the COP.

In the Pasuruan furniture SMEs, the COP characteristics will be informed in the table 4.44.

Table 4.44 COP characteristics

Characteristics	
Community	Furniture SMEs, buyer and government
Domain	Exchange information in furniture aspect
Practice	Employee and president of SMEs

In the figure 4.16, it will inform the basic structure of the communities of practice of Furniture SMEs in the Pasuruan city. Core group of the COP that consist of SME's President, Kadin and Disperindag Kota Pasuruan has function to manage the group based on coordination mandate that coordinates the activities of the COP. Inner Circle of the COP that consist of Furniture SMEs has function to coordinate the members with an informal structure and meeting.

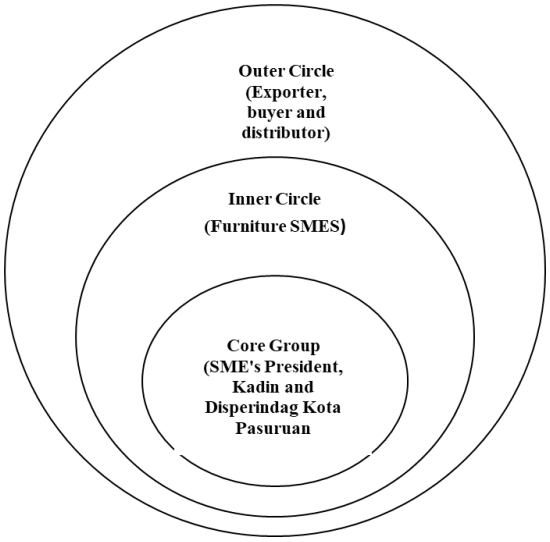


Figure 4.16 COP basic structure

Inner circle members could contact with the core group on demand. The outer circle of the COP that consist of exporter, buyer and distributor has function as a group of interested people that forming a loose network. The three structure of

In starting the communities of practice in the enterprises/organizations, there are several phases that has to be done in order to maintain the good COP. The phases that has to be done in the COP of the furniture SMEs in Pasuruan city will be informed in the table 4.45.

Table 4.45 COP phases

Phases	Plan
Creation of peers with different parties but with same interest	Creation of peers between Kadin, Disperindag and furniture SME
Start a discussion of a domain in core group and discover common interest of it	Discussion of interest in how to improve the productivity, Human resources and in Change of furniture design type
Contact potentially interested people or parties	Contact and search the SME that need mentor and need to learn more
Design the interactions and result	Creation of formal and informal structure of meeting/seminar
Organize workshops	Creating furniture workshops to attract attention of new possible buyer, investor and government

4.2.2 Knowledge Management Infrastructure Design

In the knowledge management infrastructure, it will focus on how the management create and manage the knowledge of the enterprises. It will be explained in the sub chapter below.

4.2.2.1 Chief Knowledge Officer and Management

In managing the knowledge in the organization such as Small Medium Enterprises, it is better to create role as the chief of knowledge/knowledge officer in the top management level. SME's will need more the knowledge officer from the top management level to manage all the knowledge management process in the enterprises. In this research, it will be better if the head of the SME become as the knowledge officer of the head of production. It because that in those role, it needed to know every knowledge aspect in their production process and the process in their knowledge management. The knowledge officer will have roles and objectives in managing the knowledge management of the organizations, the roles and the objectives are:

1. Roles:

a. Supervise the process of sharing and conversion of the knowledge
b. Leading KM process to maximize the creation and dissemination of knowledge
c. Creating and evaluate comprehensive KM strategy based upon organization's objectives

2. Objectives:

a. To increase profitability and growth through higher efficiency in knowledge sharing and innovation.
b. To mitigate knowledge loss with the organization documentation system

4.3 DMU's Efficiency Measurement

In this sub chapter, it will explain the DMU's identification, variable of input and output identification and the value of DMU's efficiency in each KVC Process.

4.3.1 DMU's Identification

Decision Making Unit (DMU) in Data Envelopment Analysis is the object that being measured. In these research, the DMU's identification is done by choosing the three furniture SMEs the DMUs of this research. Considering several aspects such as the sales area of the SME, the quality of the product that SME has and considering the level of each SME's that is being measured does the selection of DMU.

4.3.2 Variable of Input and Output Identification

Input and output variable identification is done with considering the aspects that needed in KVC process and discussion with the knowledge experts in the SME itself. In this research, there are three inputs and three outputs that suitable for measuring the five processes in KVC. The variable of input and output is divided in several indicators.

Table 4.46 Variable of Input and Output

No	Indicator	Accomplishment
Discussion		
1	Amount of discussion/meeting in each month	
2	Intensity of opinions that expressed in discussion	
File and Document		
3	Average interval of document creation	
4	Amount of file and document completeness	
Innovation and Solution		
5	Amount of new design or product	
Training, Seminar and Other Activities		
6	Amount of training, seminar and other activities that followed each year (in Hour)	
7	Mention the training, seminar and other activities that you have followed:	

After identification of input and output is done, then the input and output have to categorize into the more specific input and output for each KVC process,

so it can be measured based on the input and output for each process of the KVC. Each input and output variable can be categorized as input and output for more than one process of the KVC. In the table 4.47, it will show the input and output categorize for each KVC process.

Table 4.47 Variable category of Input and Output

No	Aspect	Variable	KVC Process & Infrastructure			I/O
1	Discussion	Amount of discussion/ meeting in each month	Knowledge Integration	Knowledge Innovation	Knowledge Officer	I1
2		Intensity of opinions that expressed in discussion	Knowledge Acquisition	Knowledge Innovation	Knowledge Dissemination	O1
3	File and Document	Average interval of document creation (in weeks)	Knowledge Protection	Knowledge Dissemination		I2
4	File and Document	Amount of file and document completeness	Knowledge Dissemination	Knowledge Protection	Knowledge Officer	O2
5	Innovation and Solution	Amount of new design or product	Knowledge Innovation	Knowledge Integration		O3
6	Training, Seminar and Other Activities	Amount of training, seminar and other activities that followed each year (in Hour)	Knowledge Acquisition	Knowledge Innovation	Knowledge Officer	I3

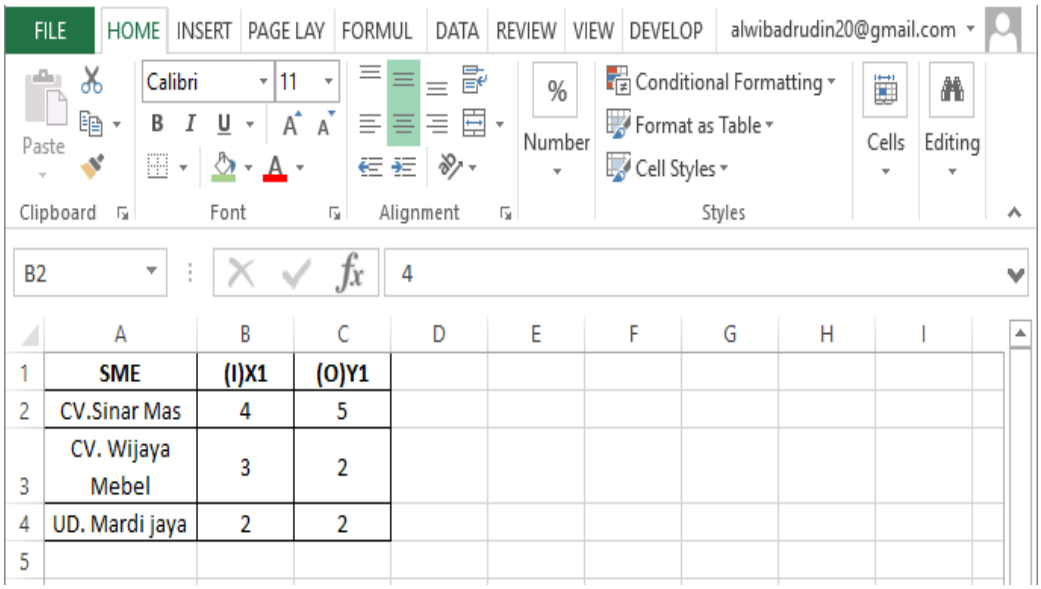
4.3.3 DMU's Efficiency in Each KVC Process & Infrastructure

In measuring the efficiency of KVC implementation in the furniture SMEs, the measurement is done by using the DEA-Solver Learning Version 8 (LV8). It using the DEA-Solver LV8 because of its accessibility and its ease of use and the features that are applicable in the software. The DEA efficiency measurement in

this research is using the CCR input orientation. It using the CCR input orientation because it fit in the SMEs condition in implementing the Knowledge Value Chain process. SMEs need to evaluate how many input quantities can be reduced proportionally without changing the number of inputs. The SMEs itself, couldn't control the output of the KVC process. The process of efficiency measurement in each KVC Process will be shown in several figures below:

1. Create the worksheet for the KVC Process that want to be measured

In the figure 4.17 below is the datasheet for the Knowledge Acquisition Process measurement using the DEA-Solver Learning Version 8 (LV8). It can be seen in the datasheet that in the A cell there is the Decision Making Unit. In the B cell there is the Input and the Output of the DEA model, in DEA-Solver LV8 the input and output must be written as (I) for the Input and (O) for the Output.



	A	B	C	D	E	F	G	H	I
1	**SME**	**(I)X1**	**(O)Y1**						
2	CV.Sinar Mas	4	5						
3	CV. Wijaya Mebel	3	2						
4	UD. Mardi jaya	2	2						
5									

Figure 4.17 Worksheet of DEA model in excel

2. Running the DEA solver for the datasheet

In running the DEA-Solver LV8, after enabling the content on the Excel and then enable the macros on the Excel that will be informed when the software is run. After the software has been run, the dialog box will show as the figures 4.18 and 4.19, and when it already start, the researcher click the OK button to go to the next step.

Figure 4.18 DEA Solver starts dialog box

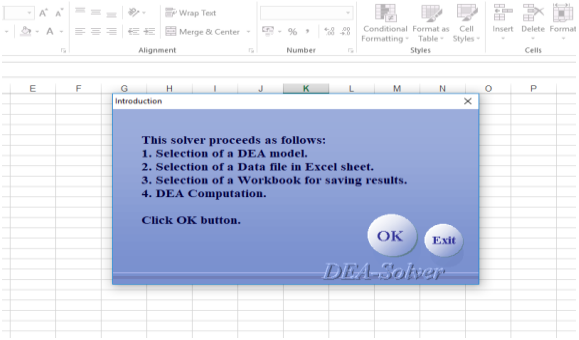


Figure 4.19 DEA Solver procedures dialog box

3. Choosing the DEA method orientation in DEA Solver

In the figure 4.20 below, it inform the dialog box of the option in choosing the DEA method orientation in DEA-Solver LV8. There are many method orientation in DEA-Solver LV8, in this research it is using the CCR-I methodology. Then after choosing the method orientation, the next dialog box that shown in figure 4.21 will inform to select the excel workbook in the document.

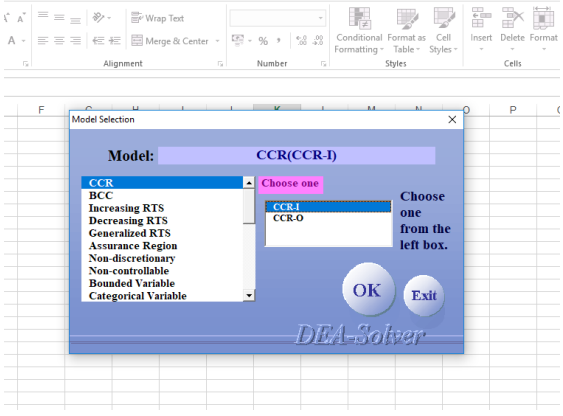


Figure 4.20 Method orientation dialog box option

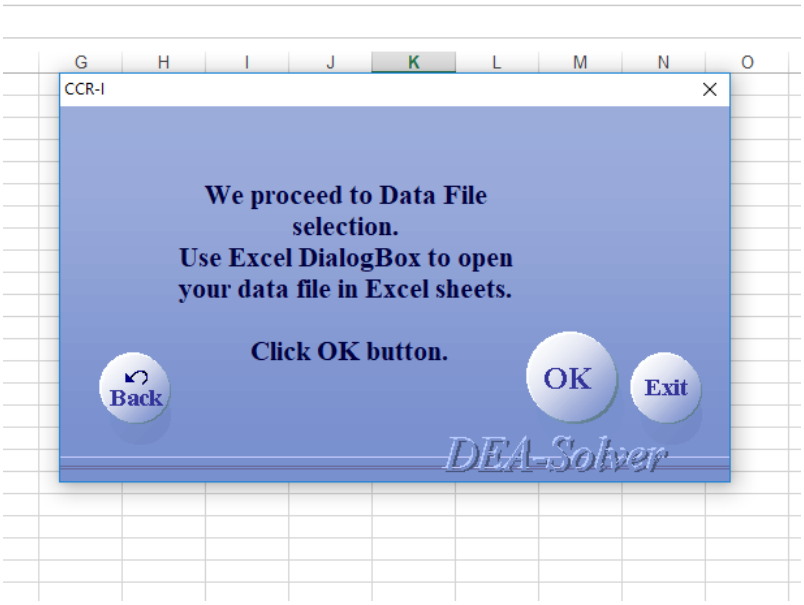


Figure 4.21 Worksheet selection dialog box option

4. Choosing the workbook in the document

From the figure 4.22 and 4.23, it can be seen the dialog box of the software will appear for the option to choose the excel workbook file that want to be measured/processed.

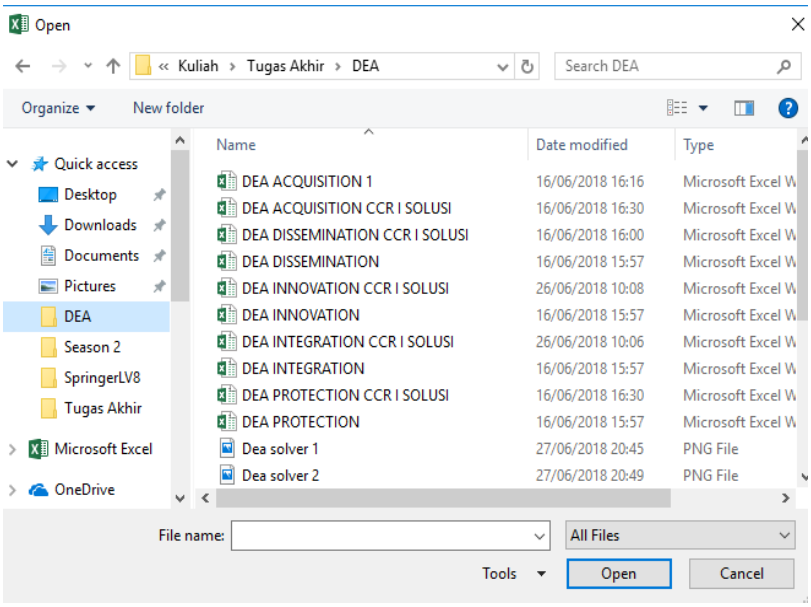


Figure 4.22 Worksheet choosing dialog box option

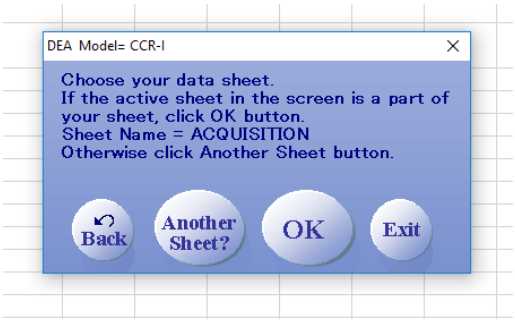


Figure 4.23 DEA solver worksheet checking dialog box

5. Choosing the workbook in document as the result file of computation

Next step, the dialog box will appear to inform the option to choose the new excel workbook as the file for the computation result of DEA-Solver LV8. It can be seen in the figure 4.24 and 4.25.

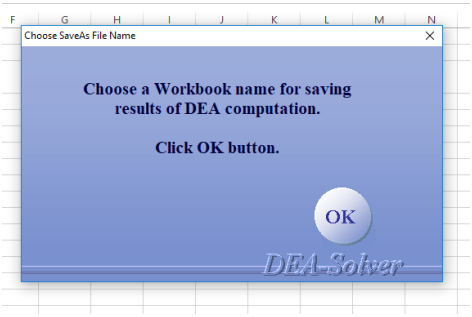


Figure 4.24 DEA Solver worksheet result dialog box

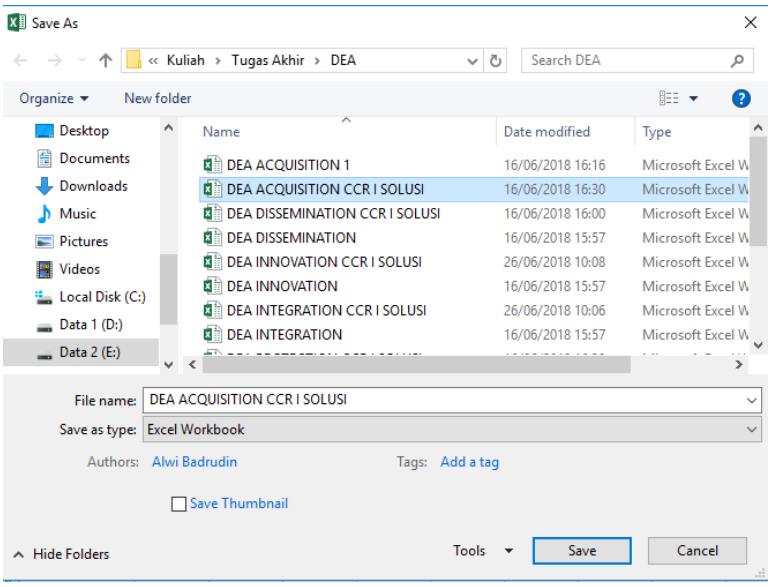


Figure 4.25 Worksheet calculation result dialog box

6. Run the DEA- Solver Computation

After choosing the file for the computation result, the run dialog box will appear to inform the option to be choose, is it click the run button to process the computation or click back button to choose another workbook as the file for computation result.

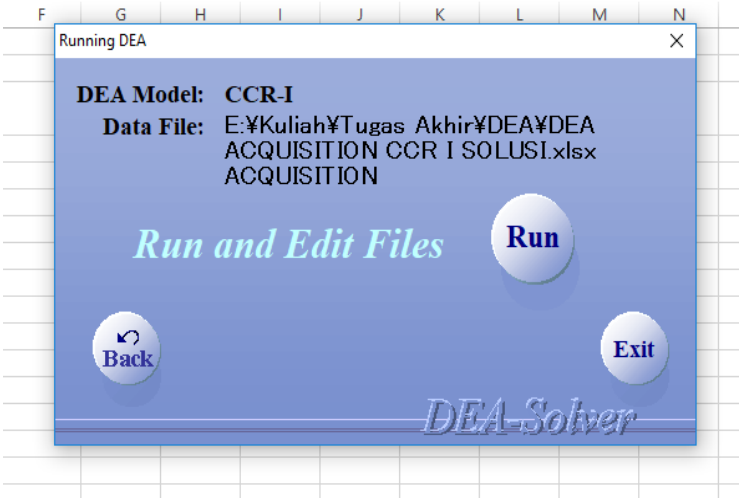
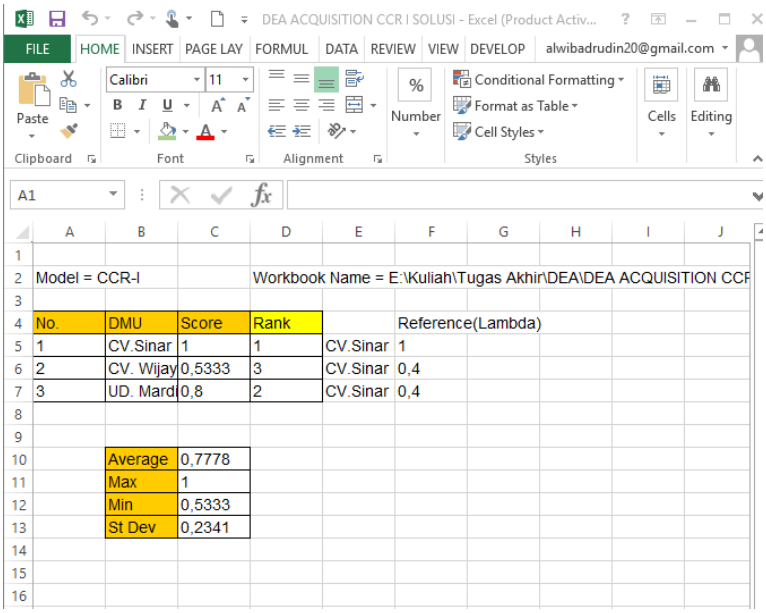


Figure 4.26 Running DEA solver calculation dialog box

7. Observe the result of the DEA-Solver LV8 computation

In the figure 4.27, it is the result of the DEA-Solver LV8 computation using CCR-I method. It show the score and the rank of each DMU.



	A	B	C	D	E	F
1						
2	Model = CCR-I			Workbook Name = E:\Kuliah\Tugas Akhir\DEA\DEA ACQUISITION CCF		
3						
4	No.	DMU	Score	Rank		Reference(Lambda)
5	1	CV.Sinar	1	1	CV.Sinar	1
6	2	CV. Wijay	0,5333	3	CV.Sinar	0,4
7	3	UD. Mardi	0,8	2	CV.Sinar	0,4
8						
9						
10		Average	0,7778			
11		Max	1			
12		Min	0,5333			
13		St Dev	0,2341			
14						
15						
16						

Figure 4.27 DEA Solver worksheet result

The SMEs Knowledge Value Chain Process Efficiency computation result using CCR-I method that processed using DEA-Solver V8 will be explained below.

4.3.3.1 Knowledge Acquisition Process Measurement

Input and output data of Knowledge Acquisition are amount of discussion/meeting in each month and amount of training, seminar and other activities that followed each year (in hour) for the input and intensity of opinions that expressed in discussion/meeting. The input has value of 4 discussion/month for the CV. Sinar Mas, 3 discussion/month for the CV. Wijaya Mebel and 2 discussion/month for the UD. Mardi Jaya. And for the amount of training hour, CV. Sinar Mas has score of 20 hours training/year, CV. Wijaya Mebel has score of 10 hours of training/year and UD. Mardi Jaya has score of 8 hours training/year. As for the output, it has value 5 for the CV. Sinar Mas which means that the intensity of opinions expressed is very high, for the CV. Wijaya Mebel, and UD. Mardi Jaya, it has value of 2 which means that the intensity of opinions expressed is rare. Here is the input and Sutput data of the Knowledge Acquisition Process.

Table 4.48 Input and output of Knowledge Acquisition Process

SME	(I)I1	(I)I3	(O)O1
CV.Sinar Mas	4	20	5
CV. Wijaya Mebel	3	10	2
UD. Mardi Jaya	2	8	2

Here is the result of Knowledge Acquisition Process measurement. In the table 4.49, it can be seen the score and rank of each DMU. As for the rank 1 with the score of 1 is the CV. Sinar Mas and UD. Mardi Jaya, for rank 3 with the score with the score of 0, 8 is the CV. Wijaya Mebel.

Table 4.49 DMU score of Knowledge Acquisition Process

No.	DMU	Score	Rank
1	CV.Sinar Mas	1	1
2	CV. Wijaya Mebel	0,8	3
3	UD. Mardi Jaya	1	1

4.3.3.2 Knowledge Integration Process Measurement

Input and output data of Knowledge Integration Process measurement are amount of discussion/meeting in each month as the input and amount of new designs/products as the output. For the input value, the CV. Sinar Mas has 4 discussions/meetings per month, for the CV. Wijaya Mebel, it has 3 discussions/meetings per month and for the UD. Mardi Jaya, it has 2 discussions/meetings per month. As for the output, it has 2 new designs/products for CV. Sinar Mas, for CV. Wijaya Mebel, it has 4 new designs/products and for UD. Mardi Jaya, it has 4 new designs/products.

Table 4.50 Input and output of Knowledge Integration Process

SME	(I)I1	(O)O3
CV.Sinar Mas	4	10
CV. Wijaya Mebel	3	6
UD. Mardi Jaya	2	4

Here is the result of Knowledge Integration Process measurement. In the table 4.51, it can be seen the score and rank of each DMU. As for the rank 1 is the CV. Sinar Mas with the score of 1, for the rank 2 is the CV. Wijaya Mebel and UD. Mardi Jaya with the score of 0, 8

Table 4.51 DMU score of Knowledge Integration Process

No.	DMU	Score	Rank
1	CV.Sinar Mas	1	1
2	CV. Wijaya Mebel	0,8	2
3	UD. Mardi Jaya	0,8	2

4.3.3.3 Knowledge Innovation Process Measurement

Input and output data of Knowledge Innovation Process measurement is amount of training, seminar and other activities that followed each year (in hour) as the input. And for the output are intensity of opinions that expressed in discussion/meeting and amount of new design/product. As for the input, CV. Sinar Mas has 20 hours of training/seminar that has been followed. CV. Wijaya Mebel has 10 hours of training/seminar that has been followed. While UD. Mardi Jaya and has 8 hours of training that has been followed. For the output in intensity of opinions

expressed in discussion/ meeting, CV. Sinar Mas has score of 5, CV. Wijaya Mebel has score of 2 and UD. Mardi Jaya has score of 2. For output in amount of new design/ product, CV. Sinar Mas has score of 10 new designs/products, CV. Wijaya Mebel has score of 6 new designs/products and UD. Mardi Jaya has score of 4 new designs/products.

Table 4.52 Input and output of Knowledge Innovation Process

SME	(I)I3	(O)I1	(O)O3
CV.Sinar Mas	20	5	10
CV. Wijaya Mebel	10	2	6
UD. Mardi Jaya	8	2	4

Here is the result of Knowledge Innovation Process measurement. In the table 4.53, it can be seen the score and rank of each DMU. In this process, all of the DMU that observed are in the same ranking, it is because all of DMU get the same score that is 1.

Table 4.53 DMU score of of Knowledge Innovation Process

No.	DMU	Score	Rank
1	CV.Sinar Mas	1	1
2	CV. Wijaya Mebel	1	1
3	UD. Mardi Jaya	1	1

4.3.3.4 Knowledge Protection Process Measurement

Input and output data of Knowledge Protection are the average interval of document creation for the input and amount of file and document completeness for the output. The input has value of 4 weeks for the CV. Sinar Mas, 10 weeks for the CV. Wijaya Mebel and 9 Weeks for the UD. Mardi Jaya. As for the output, 20 documents for CV. Sinar Mas, 8 documents for the CV. Wijaya Mebel and 10 documents for UD. Mardi Jaya. Here is the input and output data of Knowledge Protection Process.

Table 4.54 Input and output of Knowledge Protection Process

SME	(I)I2	(O)O2
CV.Sinar Mas	4	20
CV. Wijaya Mebel	10	8
UD. Mardi Jaya	9	10

Here is the result of Knowledge Protection Process measurement. In the table 4.55, it can be seen the score and rank of each DMU. As for the rank 1 is CV. Sinar Mas with score of 1, for the rank 2 is UD. Mardi Jaya with the score of 0, 222 and for rank 3 is CV. Wijaya Mebel with the score of 0, 16.

Table 4.55 DMU score of Knowledge Protection Process

No.	DMU	Score	Rank
1	CV.Sinar Mas	1	1
2	CV. Wijaya Mebel	0,16	3
3	UD. Mardi Jaya	0,2222	2

4.3.3.5 Knowledge Dissemination Process Measurement

Input and output data of Knowledge Dissemination Process measurement are average interval of document creation for the input and for the output are intensity of opinions that expressed in discussion/meeting and amount of file and document completeness. As for the input, CV. Sinar Mas has 4 weeks, CV. Wijaya Mebel has 10 weeks and UD. Mardi Jaya has 8 weeks. As for the output, CV. Sinar Mas has score of 5 in level of intensity of opinions expressed, and has 20 documents complete. For CV. Wijaya Mebel, it has score of 2 in level of intensity of opinions expressed and has 8 documents complete. And for UD. Mardi Jaya, it has score of 2 in level of intensity of opinions expressed and has 10 documents complete.

Table 4.56 Input and output of Knowledge Dissemination Process

SME	(I)I2	(O)O1	(O)O2
CV.Sinar Mas	4	5	20
CV. Wijaya Mebel	10	2	8
UD. Mardi Jaya	9	2	10

Here is the result of Knowledge Dissemination Process measurement. In the table 4.57, it can be seen the score and rank of each DMU. As for rank 1 is the CV.

Sinar Mas with the score of 1. For rank 2 is the UD. Mardi Jaya with the score of 0, 25 and for rank 3 is CV. Wijaya Mebel with the score of 0, 16.

Table 4.57 DMU score of Knowledge Dissemination Process

No.	DMU	Score	Rank
1	CV.Sinar Mas	1	1
2	CV. Wijaya Mebel	0,16	3
3	UD. Mardi Jaya	0,2222	2

4.3.3.6 Knowledge Officer Infrastructure Measurement

For the Knowledge Officer Infrastructure, the input are the amount of discussions/meetings in each month and the amount of training, seminar and other activities followed in year (in hour). And for the output is the amount of document completeness. From the table 4.58, it can be seen that for input in amount of discussions/meetings in each month, for CV. Sinar Mas has score of 4 discussions/meetings, CV. Wijaya Mebel has score of 3 discussions/meetings in each month and UD. Mardi Jaya has score of 2 discussions/meetings in each month. For input in amount of training, seminar and other activities followed in each year (in hour), CV. Sinar Mas has score of 20 hours, CV. Wijaya Mebel has score of 10 hours and UD. Mardi Jaya has score of 8 hours. As for the output, CV. Sinar Mas has score of 20 files complete, CV. Wijaya Mebel has score of 8 files complete and UD. Mardi Jaya has score of 10 files complete.

Table 4.58 Input and output of Knowledge Officer Infrastructure

SME	(I)I1	(I)I3	(O)O2
CV. Sinar Mas	4	20	20
CV. Wjaya Mebel	3	10	8
UD. Mardi Jaya	2	8	10

Here is the result of Knowledge Officer Infrastructure measurement. In the table 4.59, it can be seen that the score and the rank of the DMU. As for the rank 1 is the CV. Sinar Mas and UD. Mardi Jaya with the score of 1 and for rank 3 is the CV. Wijaya Mebel with the score of 0, 64.

Table 4.59 DMU score of Knowledge Officer Infrastructure

No.	DMU	Score	Rank
1	CV. Sinar Mas	1	1
2	CV. Wjaya Mebel	0,64	3
3	UD. Mardi Jaya	1	1

4.3.4 Verification and Validation of DEA Model

In this sub chapter, it will be explained about how the DEA model is being verified and validated.

4.3.4.1 Verification of DEA Model

Verification of DEA model in this research is done by checking the software of DEA Solver-LV8, whether the calculation of the process could run or not and whether the input and output of the model is not defying the rules of the DEA model in DEA Solver-LV8. The verification process in this research will be explained below.

1. Choose the worksheet to be processed

When doing the verification process, procedures of verification process is all the same with the efficiency calculation process in DEA Solver-LV8. The first step is to choose the worksheet to be processed.

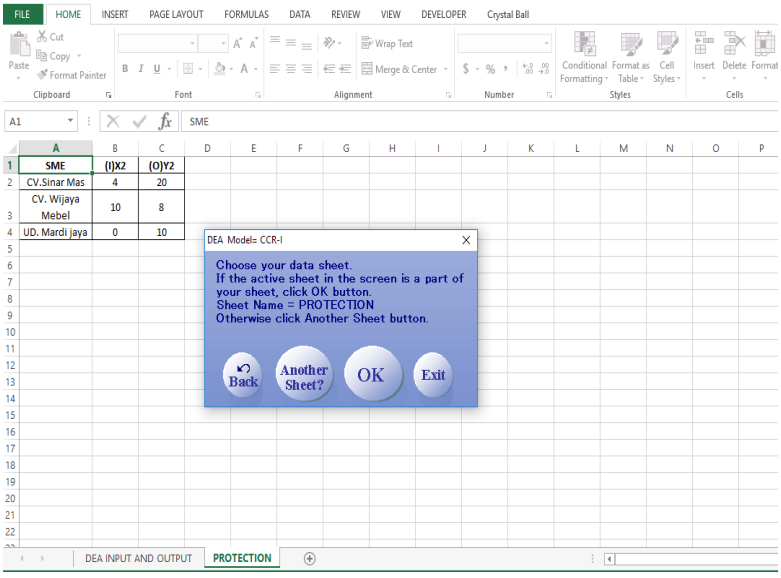


Figure 4.28 Worksheet to be processed dialog box

2. Run the DEA Solver-LV8

After choosing worksheet to be processed, choose the location file for the result of the worksheet calculation result. After it is done, then run the DEA Solver-LV8 calculation process by clicking the ‘run’ option in the dialog box that shown in the figure 4.29 below.

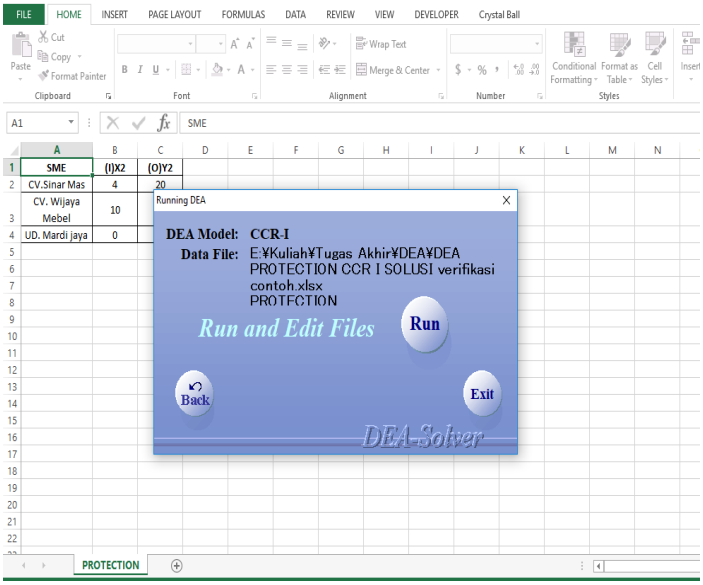


Figure 4.29 Running the DEA Solver

3. Check the result of the solver process

In the calculation process, it can be seen in the figure 4.30 below that the calculation process is not completed and it appear the error dialog box with the ‘run-time error 6 overflow’ information in the dialog box. The dialog box can be seen in the figure 4.30 below.

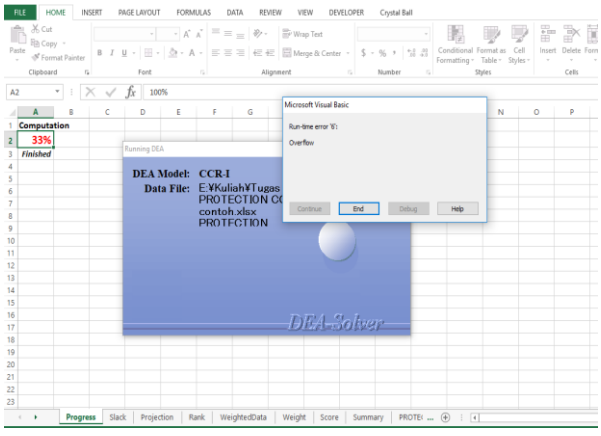
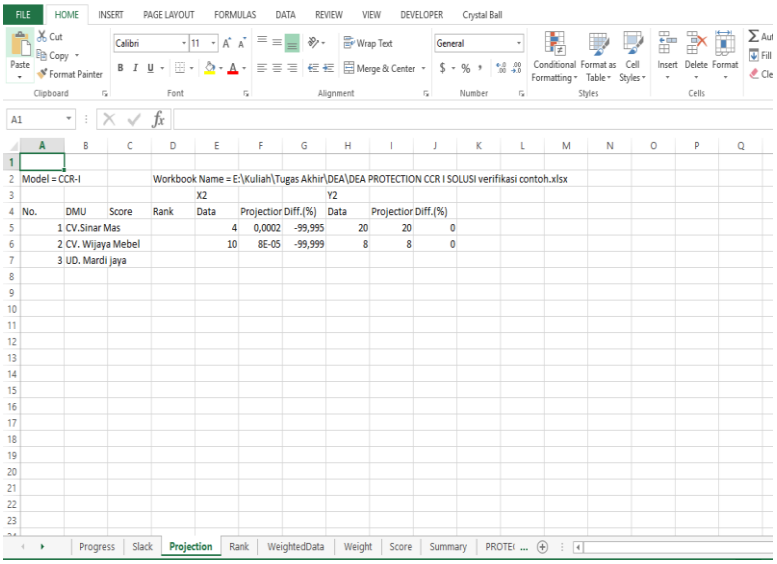


Figure 4.30 Error message in running DEA Solver

After that, the next step is to check the result and find the cause of error. In the figure 4.31 below, in the projection sheet, it can be seen that the DEA Solver does not calculate the UD. Mardi Jaya efficiency in the calculation process, based on the figure 4.31 below, it can be seen that the UD. Mardi Jaya has the value of 0 in the input. In using DEA Solver-LV8, it is not allowed to have input or output with value of 0 when using the CCR and BCR model with input or output orientation.



Model = CCR-I			Workbook Name = E:\Kuliah\Tugas Akhir\DEA\DEA PROTECTION CCR I SOLUSI verifikasi contoh.xlsx							
				X2			Y2			
No.	DMU	Score	Rank	Data	Projection	Diff.(%)	Data	Projection	Diff.(%)	
1	CV.Sinar Mas			4	0,0002	-99,995	20	20	0	
2	CV. Wijaya Mebel			10	8E-05	-99,999	8	8	0	
3	UD. Mardi jaya									

Figure 4.31 Worksheet of DEA that error

If in the calculation process using the DEA Solver-LV8, there is no problem that appear in the figure 4.31 above and the calculation process can generate the result of the calculation, it means that the software is run well and not having any error.

4.3.4.2.Validation of DEA Model

The validation of DEA model process in this research is done by discussion with the knowledge experts and the president of each SME. The discussion is about the SMEs actual condition comparison with the result of efficiency measurement that based from the actual input and output of DEA model.

CHAPTER 5
ANALYSIS AND DATA INTERPRETATION

In this chapter, it will explain the data interpretation and analysis from the result of the data collection and processing in the chapter before.

5.1 SMEs Knowledge Analysis

In this sub chapter, it will explain why the SME's need the knowledge in their production process that consist in production work unit and finishing work unit. Here is the analysis of knowledge of the SME's production work unit:

1. Log Specification (PU-K-01)

In log specification sub work unit of production work unit, the employee and the manager must have the knowledge of the log specification, which is the knowledge in choosing the logs based on the size, types, and quality of the log and the cubic calculation of the log. That is because in choosing the log, it is important to know the size needed, the type that fit the design, the quality of the log that requested by the customer. When the worker know the knowledge of log specification. The log specification process will be done corresponding to the standard of the customer and the enterprise and it will affect the other production process too.

2. Sawmill Operation (PU-K-02)

Sawmill operation knowledge is important in order to produce the product corresponding to the design. It because in the sawmill operation, the employee must cut the log corresponding to the needs of the product design, different product design will need different types of cut and size of the log that used to produce the product.

3. Engraving Operation (PU-K-03)

Knowledge of engraving operation is very important in the production process of the furniture industry. Engraving operation can create a different in each product design that create a different value added for each product, it create a sign for the product that created by each SME. If the engraving operation knowledge in

one SME is deeper and wider than other SME's, it will give big competitive advantage for the SME.

4. Engraving Tools (PU-K-04)

Engraving tools knowledge is important in doing the engraving operation. Knowing the right tools for doing the engraving process will make it become easier and done better because the engraving process done by using the right tools for different design of engraving.

5. Gluing Operation (PU-K-05)

Knowledge in gluing operation is needed in how the log that has been cut according to the size needed will be assembled. In order to assembly the log, the worker needed to know how and where the glue material needed to be put on the log, so that the log could be assembled into one product.

6. Gluing Tools (PU-K-06)

Knowledge in gluing tools is needed in making the gluing operation is done by considering the right tools needed to do the gluing operation that refer to the material of the wood. With the right gluing tools, the gluing operation will be done much easier and the wood that has been glued could be assembled with better result.

7. Assembly Operation (PU-K-07)

In Assembly unit, the needs of knowledge in assembly operation is important. The worker of this unit must know how to assemble the wood after it has been glued and how to assemble the wood corresponding to the design of the product.

Here is the analysis of the SME's knowledge in the finishing work unit:

1. Sanding Operation (FU-K-01)

Sanding operation knowledge is so important in the finishing work unit. The worker must know well how to do the sanding operation. In the sanding operation, it has to be done following the wood grove not done in contrary to the wood grove. The worker has to be thorough too in observing the parts of the wood that need to be smoothed. In wood product, the smoothness of the surface and the inside part of the product will become the key in differentiate each product and it will affect the staining and coloring and coating process that depends on the smoothness of the product.

2. Wood Sanding Machine (FU-K-02)

Wood sanding machine operation knowledge is useful in making the sanding operation is easier and faster. When the worker is skilled in operating the wood sanding machine, the smoothness of the product surface will have a smoother surface and better result.

3. Sanding Tools (FU-K-03)

Sanding tools knowledge is very important in the sanding operation. It affected in the operation of the wood sanding machine too. The worker has to know well the right tools in smoothing the word. Because the wood product has many different characteristics in the smoothness level of it surface. If the worker know the right sanding tools for the wood, the sanding operation and wood sanding machine operation can be done in a better result and faster too.

4. Staining Operation (FU-K-04)

Staining operation knowledge is the knowledge to applying a chemical substance as the base of the wood color. It is important in giving the wood a base layer before it being colored or coated. If the staining operation that is done in the product spread evenly, the coloring and coating process will have the better result and quality.

5. Staining Tools (FU-K-05)

In staining operation, the worker need to know the right materials that used for the product. As the worker know the right materials, it will gives the better result in creating the base layer for the product before being colored. And it will gives the product a shiny color as the first layer of the product.

6. Coloring and Coating Operation (FU-K-06)

In finishing work unit, the coloring and coating operation take a big part as it decide the quality of the product and it needs to be colored corresponding to the design and the customer requirements. The knowledge of coloring and coating operation will useful for worker in creating the color that spread evenly in every surface and inside parts of the product. The coloring and coating operation must be done very carefully. It because that in coloring the wood, the wood groove and the smoothness of the wood will affecting the quality of the coloring and coating result.

7. Coloring and Coating Tools (FU-K-07)

In doing the coloring and coating operation, the worker need to know the right tools to coloring the wood. The wood has many different characteristics when it applied to some color or substance of the color. For example the Teak wood must not be colored white, because if it colored white, the latex from the teak wood will come out the longer the wood been colored and it will make the white color become yellow.

5.2 Knowledge Weighting Analysis

The weighting method used in this research is with Analytical Network Process. Weighting is done by looking at the relevance of each element between the interconnection criteria (Knowledge) and between Clusters (Work Unit). There are two weights generated namely Normalized by Cluster weight and Limiting weight.The weighting of the knowledge in the furniture SMEs will be shown in the table 5.1.

Table 5.1 Weighting of the knowledge

Work Unit	Knowledge Index	Name	Normalized By Cluster	Limiting
Finishing Unit	FU-K-01	Sanding Operation	0,18887	0,139554
	FU-K-02	Wood Sanding Machine	0,05967	0,044088
	FU-K-03	Sanding Tools	0,20199	0,149252
	FU-K-04	Staining Operation	0,11659	0,08615
	FU-K-05	Staining Tools	0,05431	0,040133
	FU-K-06	Coloring and Coating Operation	0,20834	0,153944
	FU-K-07	Coloring and Coating Tools	0,17022	0,125777
Production Unit	PU-K-01	Log Specification	0,60488	0,157936
	PU-K-02	Sawmill Operation	0,18127	0,047329
	PU-K-03	Engraving Operation	0,09497	0,024796
	PU-K-04	Engraving Tools	0,06219	0,016239
	PU-K-05	Gluing Operation	0,02045	0,005339
	PU-K-06	Gluing Tools	0,0174	0,004542
	PU-K-07	Assembly Operation	0,01885	0,004921

In the table 5.1, it is known that the Weight Normalized by Cluster is the normalization weight on the knowledge compared to one cluster only, while for the weight of Limiting is the weight of knowledge to all other elements both to each

knowledge and also to each existing work unit. It can be seen in table 5.1, for weighting Normalized by Cluster, in each work unit there is Knowledge with the highest weight of the main concern on the work unit. For production work unit, knowledge with highest weight is found in Log Specification knowledge (PU-K-01) with value 0, 60488. Knowledge of Log Specification is so important in the production work unit, it because that many production unit activities are depend on the specification of the log that used. By understanding the specification of the log that used in the production activities, it affect the Sawmill Operation (PU-K-02) in the how the log cut by considering the specification and the types of wood. Gluing Operation (PU-K-05) will affected by the log specification in how much the tools/ materials needed to be glued in the wood and how the worker put on the glue in the surface of the wood, it because different wood has different characteristic on how strong the adhesive power of the wood when it has glued. The second highest weight is found in Sawmill Operation Knowledge (PU-K-02) with value of 0, 18127. The sawmill operation has big effect to the other production process. It cut the log with different types and sizes that corresponding to the design that will become the input of the other production process.

In the finishing unit, the highest weight is found in Coloring and Coating Operation Knowledge (FU-K-06) with value of 0, 20834. Knowledge of coloring and coating operation is important in the finishing unit because it gives the product final touch and a signature for the product that differentiate it with another product. The worker needs to know how to coloring the wood product following the products different wood groove and different wood types. The coloring and coating operation operation needs to be supported with other knowledge such as the Sanding Operation Knowledge (FU-K-01) and Coloring and Coating Tools Knowledge (FU-K-07) to create the better coloring for the product. Sanding Operation Knowledge with the weight value of 0, 1888 will affecting the coloring and coating operation quality based on the wood smoothness level. If the wood has been smoothed well, the coloring process will give the better result in the product. For the Coloring and Coating Tools Knowledge with the weight value of 0,17022 will affecting the coloring and coating operation in how the worker do the coloring and coating operation, and it will differentiate the product by the quality of the tools.

5.3 Key Knowledge Analysis

Key Knowledge is derived from the cumulative percentage value in Limiting weights. To find the cumulative percentage value of Knowledge 2, the weight of Limiting Knowledge 1 plus the weights of Limiting Knowledge 2, then the sum will be divided by the total weight of Limiting, which is equal to 1. Key Knowledge is some of the most important knowledge in the production process of the furniture SMEs.

There are six Key Knowledge in the furniture SMEs that consist from production unit and finishing unit. The key knowledge is obtained from the weighting between the criteria (knowledge) and cluster (work unit). First is Log Specification knowledge (PU-K-01) with the score of 0, 15749. It becomes key knowledge because of the effect of the specification of the logs to the other process that need to follow the different characteristics for each log have, it is the first consideration in designing the product. If the specification of the log is appropriate with the design that wanted by the customer the production process will be more efficient because the worker know the best tools and the best method in processing the woods. Second is, Coloring and Coating Operation knowledge (FU-K-06) with the score of 0, 1539, it becomes the key knowledge because it gives the product a signature and finishing touch that functioned as a protection for the wood surface and it gives the product added value because the coloring pattern of the product will differentiate the quality of the product itself. Third is Sanding Tools knowledge (FU-K-03) with the score of 0, 1492, it is important in affecting the duration, speed and the smoothness result of the log. Then, it is Sanding Operation knowledge (FU-K-01) with the score of 0, 1395, it is important because it affecting the quality of the coloring and coating result later because it related to the smoothness level of the wood itself. Next, it is Coloring and Coating Tools knowledge (FU-K-07) with the score of 0, 1257, it is important in giving the product color that fit with the wood groove and wood surface characteristics. Last, it is Staining Operation knowledge (FU-K-04) with the score of 0, 08615, it is important because of it is the base layer of the wood surface before it being colored.

5.4 DMU's Knowledge Management Efficiency Analysis

In this sub chapter, it will inform the analysis of the DMU's knowledge management efficiency in each process and infrastructure of KVC framework. In the analysis, it will explain the projection of each DMU that processed using the CCR-I DEA Solver LV8 that still not efficient in every KVC process and infrastructure in order to become efficient unit.

5.4.1 Knowledge Acquisition Process Efficiency Analysis

From the table 5.2, it can be seen the projection of input improvement in Knowledge Acquisition Process, the projection column in each DMU is functioned as a suggestions for the DMU. The projection cell has different amount in the input unit of the DMU that still not efficient, that means that it is the amount of input reduction needed to each DMU to become efficient units. In the Knowledge Acquisition Process, the DMU that still not efficient is CV. Wijaya Mebel. The projection for CV. Wijaya Mebel is 46, 67 % amount of reduction in input of I1 (amount of discussion/meeting in each month) from the actual input. It means that from 3 times amount of discussion/meeting in each month in CV. Wijaya Mebel, it should be reduced to amount of 1, 6 meeting/discussions or rounded up to 2 meetings/discussions in each month. And for the I3, the projection for CV. Wijaya Mebel is 20 % amount of reduction. It means that from 10 hours of training, seminar and other activities followed, it should be reduced to 8 hours training, seminar and other activities needs to be followed. The projection for UD. Mardi Jaya is 20 % amount of reduction in input I1 from the actual input. It means that from the 2 times meetings/discussion in each month, it should be reduced to amount of 1, 6 or rounded down to 1 because the actual data for I1 in UD. Mardi Jaya is 2.

Table 5.2 DMU projection of input improvement in Knowledge Acquisition Process

				I1			I3		
No.	DMU	Score	Rank	Data	Projection	Diff.(%)	Data	Projection	Diff.(%)
1	CV.Sinar Mas	1	1	4	4	0	20	20	0
2	CV. Wijaya Mebel	0,8	3	3	1,6	-46,667	10	8	-20
3	UD. Mardi Jaya	1	1	2	1,6	-20	8	8	0

Table 5.2 DMU projection of input improvement in Knowledge Acquisition Process (cont'd)

				O1		
No.	DMU	Score	Rank	Data	Projection	Diff.(%)
1	CV.Sinar Mas	1	1	5	5	0
2	CV. Wijaya Mebel	0,8	3	2	2	0
3	UD. Mardi Jaya	1	1	2	2	0

5.4.2 Knowledge Integration Process Efficiency Analysis

In Knowledge Integration Process, the projection of input improvement in Knowledge Integration Process can be seen in the table 5.3 below. The DMU that still not efficient is CV. Wijaya Mebel and UD. Mardi Jaya. The projection for the CV. Wijaya Mebel is 20 % amount of reduction in the input of I1 (amount of discussion/meeting in each month) from the actual input of I1. It means that from the 3 times discussions/meetings in each month, it should be reduced to 2, 4 or rounded down to 2 from the actual input of 3 discussions/meetings for amount of discussions/meetings in each month. The projection for the UD. Mardi Jaya is 20 % amount of reduction in I1 from the actual input of I1. It means that from 2 discussion/meetings in each month, it should be reduced to 1, 6 or rounded down to 1 for amount of discussions/meetings in each month.

Table 5.3 DMU projection of input improvement in Knowledge Integration Process

				I1			O3		
No.	DMU	Score	Rank	Data	Projection	Diff. (%)	Data	Projection	Diff.(%)
1	CV.Sinar Mas	1	1	4	4	0	10	10	0
2	CV. Wijaya Mebel	0,8	2	3	2,4	-20	6	6	0
3	UD. Mardi Jaya	0,8	2	2	1,6	-20	4	4	0

5.4.3 Knowledge Innovation Process Efficiency Analysis

For the Knowledge Innovation Process, the projection of input improvement is shown in the table 5.4. In this process, the DMU has the same score of 1, so that there is no projection of input improvement in each DMU because it already has

score of 1 which means that it already efficient. It is because the DMU can manage their innovation process in terms of training activities that have been followed by producing the new design or products that wanted by the customer and it also creating an environment to share their knowledge intensely.

Table 5.4 DMU projection of input improvement in Knowledge Innovation Process

				I3		
No.	DMU	Score	Rank	Data	Projection	Diff.(%)
1	CV.Sinar Mas	1	1	20	20	0
2	CV. Wijaya Mebel	1	1	10	10	0
3	UD. Mardi Jaya	1	1	8	8	0

Table 5.4 DMU projection of input improvement in Knowledge Innovation Process (cont'd)

				O1			O3		
No.	DMU	Score	Rank	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
1	CV.Sinar Mas	1	1	5	5	0	10	10	0
2	CV. Wijaya Mebel	1	1	2	2	0	6	6	0
3	UD. Mardi Jaya	1	1	2	2	0	4	4	0

5.4.4 Knowledge Protection Process Efficiency Analysis

In the Knowledge Protection Process, the projection of input improvement in Knowledge Protection Process can be seen in the table 5.5 below. The DMU that still not efficient is CV. Wijaya Mebel and UD. Mardi Jaya. The projection for the CV. Wijaya Mebel is 84 % amount of input reduction for I2 (average interval of document creation (in weeks)) from the actual input of I2. It means that from the 10 weeks of average interval of document creation, it should be reduced to 1, 6 weeks or rounded up to 2 weeks. The projection for the UD. Mardi Jaya is 77, 78 % amount of input reduction for I2 from the actual input of I2. It means that from the 9 weeks average interval in document creation, it should be reduced to 2 weeks.

Table 5.5 DMU projection of input improvement in Knowledge Protection Process

				I2			O2		
No.	DMU	Score	Rank	Data	Projection	Diff.(%)	Data	Projection	Diff.(%)
1	CV.Sinar Mas	1	1	4	4	0	20	20	0
2	CV. Wijaya Mebel	0,16	3	10	1,6	-84	8	8	0
3	UD. Mardi Jaya	0,222	2	9	2	-77,778	10	10	0

5.4.5 Knowledge Dissemination Process Efficiency Analysis

For the Knowledge Dissemination Process, the projection of input improvement is shown in the table 5.6 below. The DMU that still not efficient is CV. Wijaya Mebel and UD. Mardi Jaya. The projection for the CV. Wijaya Mebel is 84 % amount of reduction in I2 (average interval of document creation (in weeks)) from the actual input of I2. It means that from the 10 weeks of average interval of document creation, it should be reduced to 1, 6 weeks or rounded up to 2 weeks. The projection for the UD. Mardi Jaya is 77, 78 % amount of input reduction for I2 from the actual input of I2. It means that from the 9 weeks average interval in document creation, it should be reduced to 2 weeks.

Table 5.6 DMU projection of input improvement in Knowledge Dissemination Process

				I2		
No.	DMU	Score	Rank	Data	Projection	Diff.(%)
1	CV.Sinar Mas	1	1	4	4	0
2	CV. Wijaya Mebel	0,16	3	10	1,6	-84
3	UD. Mardi Jaya	0,2222	2	9	2	-77,778

Table 5.6 DMU projection of input improvement in Knowledge Dissemination Process (cont'd)

				O1			O2		
No.	DMU	Score	Rank	Data	Projection	Diff.(%)	Data	Projection	Diff.(%)
1	CV.Sinar Mas	1	1	5	5	0	20	20	0
2	CV. Wijaya Mebel	0,16	3	2	2	0	8	8	0
3	UD. Mardi Jaya	0,2222	2	2	2,5	25	10	10	0

5.4.6 Knowledge Officer Infrastructure Efficiency Analysis

In Knowledge Officer Infrastructure, the projection of the input improvement can be seen in the table 5.7 below. The DMU that still not efficient is CV. Wijaya Mebel. The projection for input improvement is 46, 67 % amount of reduction in the I1 (amount of discussion/meetings in each month) from the actual input of I1. It means that the Knowledge Officer of the SMEs need to reduce the amount of discussions in the SME from 3 discussions/meetings to 1, 6 or rounded up to 2 discussions/meetings in each month. For the I3, the projection of input improvement is 36 % amount of reduction in the I3 (amount of training, seminar and other activities that followed each year (in hour)) from the actual input of I3. It means that the Knowledge Officer need to reduce the amount of training, seminar and other activities from 10 hours of training to 6, 4 or rounded down to 6 hours of training. If the Knowledge Officer has done their role well and managing the Knowledge management well, they could increase the output of the Knowledge Management process.

Table 5.7 DMU projection of input improvement in Knowledge Officer Infrastructure

				I1			I3		
No.	DMU	Score	Rank	Data	Projection	Diff.(%)	Data	Projection	Diff.(%)
1	CV. Sinar Mas	1	1	4	4	0	20	20	0
2	CV. Wjaya Mebel	0,64	3	3	1,6	-46,667	10	6,4	-36

				I1			I3		
No.	DMU	Score	Rank	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
3	UD. Mardi Jaya	1	1	2	2	0	8	8	0

Table 5.7 DMU projection of input improvement in Knowledge Officer Infrastructure(cont'd)

				O2		
No.	DMU	Score	Rank	Data	Projection	Diff.(%)
1	CV. Sinar Mas	1	1	20	20	0
2	CV. Wjaya Mebel	0,64	3	8	8	0
3	UD. Mardi Jaya	1	1	10	10	0

CHAPTER 6
SUGGESTION AND CONCLUSION

In this chapter will be informed conclusions from the results of research that has been done, then it will be informed the suggestions for improvement to the company or to further researchers.

6.1 Conclusion

After collecting and processing data, it can be concluded from this research that is as follows:

1. The Knowledge Management Framework using Knowledge Value Chain is done by using the Knowledge identification tools such questionnaire, creating Knowledge Database and Properties, and assigning the critical knowledge in the Knowledge Acquisition Process. In the Knowledge Integration Process, it is creating integration trajectories that refer to the core first type in the production and finishing work unit. For the Knowledge Innovation process, it is creating the gap analysis in the SMEs for training needs. For the Knowledge Protection Process, it is using Knowledge Documentation and registration for the Geographical Indication Intellectual Property Rights (GI IPR), for the Knowledge Dissemination Process, it is creating the Communities of Practice (COP) in the SMEs and for the Knowledge Management Infrastructure, it is done by creating Knowledge Officer roles and objectives for the SMEs
2. There are six Key Knowledge in the furniture SMEs that consist from production unit and finishing unit. The key knowledge is obtained from the weighting between the criteria (knowledge) and cluster (work unit). First is Log Specification knowledge (PU-K-01) with the score of 0, 1579. Second is, Coloring and Coating Operation knowledge (FU-K-06) with the score of 0, 1539. Third is Sanding Tools knowledge (FU-K-03) with the score of 0, 1492. Then, Sanding Operation knowledge (FU-K-01) with the score of 0, 1395. Next is Coloring and Coating Tools knowledge (FU-K-07) with the

score of 0, 1257. Last is Staining Operation knowledge (FU-K-04) with the score of 0, 0861

3. The result of assessment of the Knowledge Management that using Knowledge Value Chain Framework for 3 SMES that observed is consist of 5 processes and 1 infrastructure. First, in Knowledge Acquisition Process, CV. Sinar Mas has score of 1, CV. Wijaya Mebel has score of 0, 8 and UD. Mardi Jaya has score of 1. Then, in Knowledge Integration Process, CV. Wijaya Mebel has score of 1, CV. Wijaya Mebel and UD. Mardi Jaya has score of 0, 8. For Knowledge Innovation Process, CV. Sinar Mas, CV. Wijaya Mebel and UD. Mardi Jaya has the same score of 1. In Knowledge Protection Process, CV. Sinar Mas has the score of 1, CV. Wijaya Mebel has the score of 0, 16 and UD. Mardi Jaya has score of 0, 222. In Knowledge Dissemination Process, CV. Sinar Mas has score of 1, CV. Wijaya Mebel has score of 0, 16 and UD. Mardi Jaya has score of 0, 222. For the Knowledge Officer Infrastructure, CV. Sinar Mas and UD. Mardi Jaya has score of 1 and CV. Wijaya Mebel has score of 0, 64
4. For the knowledge acquisition process measurement result, the projection of input improvement for CV. Wijaya Mebel is 46, 67 % amount of reduction in input of I1 from the actual input and for the I3, the projection for CV. Wijaya Mebel is 20 % amount of reduction. The projection for UD. Mardi Jaya is 20 % amount of reduction in input I1 from the actual input of I1. For knowledge integration, the projection for the CV. Wijaya Mebel is 20 % amount of reduction in the input of I1 from the actual input of I1. The projection for the UD. Mardi Jaya is 20 % amount of reduction in I1 from the actual input of I1. For knowledge innovation, there is no projection of input improvement in each DMU because it already has score of 1 which means that it already efficient. For knowledge protection, the projection for the CV. Wijaya Mebel is 84 % amount of input reduction for I2 from the actual input of I2 the projection for the UD. Mardi Jaya is 77, 78 % amount of input reduction for I2 from the actual input of I2. For knowledge dissemination, the projection for the CV. Wijaya Mebel is 84 % amount of reduction in I2 from the actual input of I2 .The projection for the UD. Mardi Jaya is 77, 78 % amount of

input reduction for I2 from the actual input of I2 for knowledge officer infrastructure measurement result, The projection for input improvement in CV. Wijaya Mebel is 46, 67 % amount of reduction in the I1 from the actual input of I1 For the I3, the projection of input improvement is 36 % amount of reduction in the I3 from the actual input of I3

6.2 Suggestion

Suggestions that could be given both for the company as the object research and also for the further research.

A. For Company:

1. In periodically or continuously, enterprises do the assessment of the Knowledge Management Framework, so the enterprises has a periodic report of its Knowledge Management performance.
2. From these knowledge management framework assessment, enterprise might use it as the report to overview and evaluate the knowledge management framework regarding to the current condition to make the knowledge management framework more compatible and advance.

B. For Further Research

1. In the next research, a topic that can be developed that related to this topic is about Knowledge Loss Risk Assessment with the purpose of providing recommendations to companies about risk mitigation activities on knowledge and key knowledge that owned by the enterprises.

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APPENDIX

Appendix 1

A. Knowledge Audit Questionnaire

Alwi Badrudin
087853670795

Kuisioner *Knowledge Management*
di UKM Mebel Kota Pasuruan

Kepada Bapak/Ibu yang saya hormati, perkenalkan saya Alwi Badrudin, mahasiswa semester 8 Jurusan Teknik Industri Institut Teknologi Sepuluh Nopember (ITS) Surabaya yang sedang melakukan penelitian Tugas Akhir yang berjudul '*Designing and Assessing the Knowledge Management using Knowledge Value Chain framework and Data Envelopment Analysis (DEA) in SMES furniture in Pasuruan city*.

Kuisioner berikut merupakan kuisioner yang berhubungan dengan *Knowledge* apa saja yang dibutuhkan untuk melakukan suatu aktivitas dalam proses bisnis untuk mencapai target bisnis perusahaan.

Nama: KHOIRUL **Pekerjaan:** Finishing

Bagian: (Lingkari yang sesuai) **No. Telp:** 085 755 249 961

1. Pengadaan Kayu
2. Penggergajian
3. Pengeringan
4. Pembahanan Dasar
5. Konstruksi
6. Pengamplasan
7. Perakitan
8. Finishing
9. Pemasangan Perlengkapan

Jenjang Pendidikan: (Lingkari yang sesuai)

1. SD
2. SMP/Sederajat
3. SMA/Sederajat
4. SMK
5. Sarjana

Petunjuk pengisian: Berilah tanda (X) pada salah satu jawaban yang anda pilih.
Dipebolehkan untuk mengisi jawaban pilihan lebih dari satu.
Isi kolom kotak sesuai dengan jawaban anda.

1. Sesuai pada bagian pekerjaan yang dilakukan, informasi atau pengetahuan apa saja yang dibutuhkan dalam kegiatan tersebut:

1. KERTAS GOSOK
2. BLOWER TANGAN
3. KAIN POP

2. Selain anda, apakah pengetahuan tersebut dimiliki oleh orang lain?
   a. Ya b. Tidak, (jika tidak lanjut ke pertanyaan nomor 4)
3. Jika Ya, siapa pihak lain yang memiliki pengetahuan tersebut:
   a. Anggota satu bagian b. Anggota bagian lain c. Pimpinan
4. Dimana anda mendapatkan pengetahuan tersebut:
   a. Training b. Mempelajari sendiri c. Seminar d. Pengalaman bekerja
5. Dalam bentuk apa pengetahuan tersebut disimpan:
   a. Tertulis (dokumen, buku, memo, dll) b. Tidak tertulis (masih di miliki oleh pribadi/keahlian)
6. Apakah pengetahuan tersebut berguna untuk bagian lain?
   a. Ya b. Tidak, (jika tidak lanjut ke pertanyaan nomor 8)
7. Jika Ya, apa kegunaan pengetahuan/informasi tersebut untuk bagian lain?

8. Jika Tidak, mengapa pengetahuan/informasi tersebut tidak dapat digunakan oleh bagian lain?

9. Apakah pengetahuan pada pertanyaan nomor 1 tersebut diperbaharui secara berkala:
   a. Ya b. Tidak
10. Jika Ya, seberapa rutin pengetahuan tersebut diperbaharui:
   a. 3 bulan sekali b. 6 bulan sekali c. 1 tahun sekali d. lebih dari 1 tahun sekali
11. Bagaimana cara perbaruan pengetahuan tersebut (pertanyaan nomor 9) diperbarui:

12. Pengetahuan apa yang dibutuhkan untuk meningkatkan kemampuan serta kinerja:

Pelatihan

Appendix 2

B. Pairwise Comparison Questionnaire

Kuisioner Pembobotan *Knowledge* pada UKM Mebel Kota Pasuruan

Nama: **Bagian:**

Jabatan:

Kepada Bapak/Ibu yang saya hormati, perkenalkan saya Alwi Badrudin, mahasiswa semester 8 Jurusan Teknik Industri Institut Teknologi Sepuluh Nopember (ITS) Surabaya yang sedang melakukan penelitian Tugas Akhir yang berjudul '*Designing and Assessing the Knowledge Management using Knowledge Value Chain framework and Data Envelopment Analysis (DEA) in SMES furniture in Pasuruan city*.

Kuisioner berikut merupakan kuisioner metode *Analytic Network Process* (ANP) untuk menentukan nilai bobot *knowledge* yang telah teridentifikasi dari pengelolaan data penilitian sebelumnya. Kuisioner ini terdiri dari *pairwise comparison* (perbandingan berpasangan) antar kelompok unit dan kelompok sub unit didalamnya, serta pengetahuan yang telah teridentifikasi dalam sub unitnya. Kuisioner ini adalah media yang digunakan oleh peneliti kepada pihak ahli atau *expert* dalam hal penilaian untuk pemilihan *knowledge* yang dianggap sebagai *key knowledge*.

Sebelum memulai pengisian, diharapkan Bapak/ Ibu membaca petunjuk pengisian kuisioner yang telah tertera di bagian atas sebelum kuisioner. Kerahasiaan identitas Bapak/ Ibu akan terjaga dan hasil kuisioner hanya akan digunakan untuk kepentingan penelitian. Apabila terdapat kesulitan dalam mengisi kuisioner dapat menghubungi penulis (087853670795). Atas perhatian Bapak/Ibu saya ucapkan terima kasih.

Atas bantuan dan partisipasi Bapak/ Ibu, peneliti mengucapkan terimakasih.

Petunjuk Pengisian Kuesioner:

Beri tanda (✔) pada nilai perbandingan yang paling sesuai menurut anda. Pemberian nilai yang semakin besar ke kanan menandakan bahwa kriteria di bagian kanan lebih dipentingkan daripada kriteria di bagian kiri. Berikut adalah contoh tabel tingkat kepentingannya.

Knowldge 1	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	*Knowledge* 2

Berikut merupakan penjelasan dari skala perbandingan berpasangan pada ANP

Nilai	**Definisi**	**Keterangan**
1	Sama (*Equal*)	Kedua elemen memiliki kepentingan yang sama
2	Nilai antara sama dan sedang (*Equal-Moderate*)	Nilai antara dua penilaian yang berdekatan
3	Sedang (*Moderate*)	Satu elemen sedikit lebih penting dibandingkan dengan elemen pasangannya
4	Nilai antara sedang dan kuat (*Moderate-Strong*)	Nilai antara dua penilaian yang berdekatan
5	Kuat (*Strong*)	Satu elemen lebih penting dibandingkan dengan elemen pasangannya
6	Nilai antara kuat dan sangat kuat (*Strong-Very Strong*)	Nilai antara dua penilaian yang berdekatan
7	Sangat kuat (*Very Strong*)	Satu elemen sangat penting dibandingkan dengan elemen pasangannya
8	Nilai antara sangat kuat dan ekstrim (*Very Strong-Extreme*)	Nilai antara dua penilaian yang berdekatan
9	Ekstrim (*Extreme*)	Satu elemen memiliki sifat mutlak sangat penting dari elemen pasangannya

Contoh Pengisian Kuesioner:

Contoh, apabila dirasa *'Knowledge 1* **mutlak penting** daripada *Knowledge 2'* maka cara pengisian skala perbandingan berpasangannya adalah sebagai berikut :

Knowledge 1	**9**	**8**	**7**	✔ **6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	*Knowledge* 2

Pada penjelasan nilai skala perbandingan berpasangan diketahui nilai 9 merupakan **'satu elemen lebih mutlak penting daripada elemen lainnya'** sehingga nilai yang diberikan tanda (✔) merupakan nilai 9 yang berada di sebelah kiri atau dekat dengan *Knowledge* 1.

Kuesioner perbandingan berpasangan antar kriteria (*Knowledge*):

Perbandingan antar kriteria sehubungan dengan Proses Pengecatan dalam Unit Kerja Finishing																		
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan

Perbandingan antar kriteria sehubungan dengan Proses Pengecatan dalam Unit Kerja Finishing																		
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Proses Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Alat Pengecatan dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Alat Pengecatan dalam Unit Kerja Finishing																		
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Proses Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Proses Pengamplasan dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengecatan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Proses Pengamplasan dalam Unit Kerja Finishing																		
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Proses Pengamplasan dalam Unit Kerja Produksi																		
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengukiran
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikasi Kayu
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian
Alat Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikasi Kayu
Alat Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian

Spesifikasi Kayu	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian

Perbandingan antar kriteria sehubungan dengan Alat Pengamplasan dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengecatan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Alat Pengamplasan dalam Unit Kerja Produksi																		
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengukiran

Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikasi Kayu
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian
Alat Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikasi Kayu
Alat Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian
Spesifikasi Kayu	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian

Perbandingan antar kriteria sehubungan dengan Proses Pewarnaan Dasar dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengecatan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Proses Pewarnaan Dasar dalam Unit Kerja Finishing																		
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Alat Pewarnaan Dasar dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengecatan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan

Perbandingan antar kriteria sehubungan dengan Alat Pewarnaan Dasar dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Mesin Pengamplasan dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengecatan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan

Perbandingan antar kriteria sehubungan dengan Mesin Pengamplasan dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar

Perbandingan antar kriteria sehubungan dengan Mesin Pengamplasan dalam Unit Kerja Finishing																		
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar

Perbandingan antar kriteria sehubungan dengan Mesin Pengamplasan dalam Unit Kerja Produksi																		
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengukiran
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikasi Kayu
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian
Alat Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikasi Kayu

Perbandingan antar kriteria sehubungan dengan Mesin Pengamplasan dalam Unit Kerja Produksi																		
Alat Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian
Spesifikasi Kayu	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Penggergajian

Perbandingan antar kriteria sehubungan dengan Proses Perakitan dalam Unit Kerja Produksi																		
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengukiran
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengelemban
Proses Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengelemban
Alat Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengelemban
Alat Pengukiran	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengelemban
Proses Pengelemban	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengelemban

Perbandingan antar kriteria sehubungan dengan Proses Pengukiran dalam Unit Kerja Produksi																		
Proses Perakitan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengukiran

Perbandingan antar kriteria sehubungan dengan Proses Pengukiran dalam Unit Kerja Finishing																		
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan

Perbandingan antar kriteria sehubungan dengan Alat Pengukiran dalam Unit Kerja Produksi																		
Proses Perakitan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengukiran

Perbandingan antar kriteria sehubungan dengan Alat Pengukiran dalam Unit Kerja Finishing																		
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan

Perbandingan antar kriteria sehubungan dengan Proses Pengeleman dalam Unit Kerja Produksi																		
Proses Perakitan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengeleman
Proses Perakitan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikasi Kayu

Perbandingan antar kriteria sehubungan dengan Proses Pengeleman dalam Unit Kerja Produksi																		
Alat Pengelem an	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikas i Kayu

Perbandingan antar kriteria sehubungan dengan Alat Pengeleman dalam Unit Kerja Produksi																		
Proses Perakitan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengelem an
Proses Perakitan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikas i Kayu
Proses Pengelem an	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Spesifikas i Kayu

Perbandingan antar kriteria sehubungan dengan Spesifikasi Kayu dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengecatan
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengampla san
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengampla san
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar

Perbandingan antar kriteria sehubungan dengan Spesifikasi Kayu dalam Unit Kerja Finishing																		
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pengecatan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar

Perbandingan antar kriteria sehubungan dengan Spesifikasi Kayu dalam Unit Kerja Finishing																		
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Proses Pewarnaan Dasar
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Proses Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pewarnaan Dasar
Proses Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pewarnaan Dasar	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

Perbandingan antar kriteria sehubungan dengan Proses Penggergajian dalam Unit Kerja Finishing

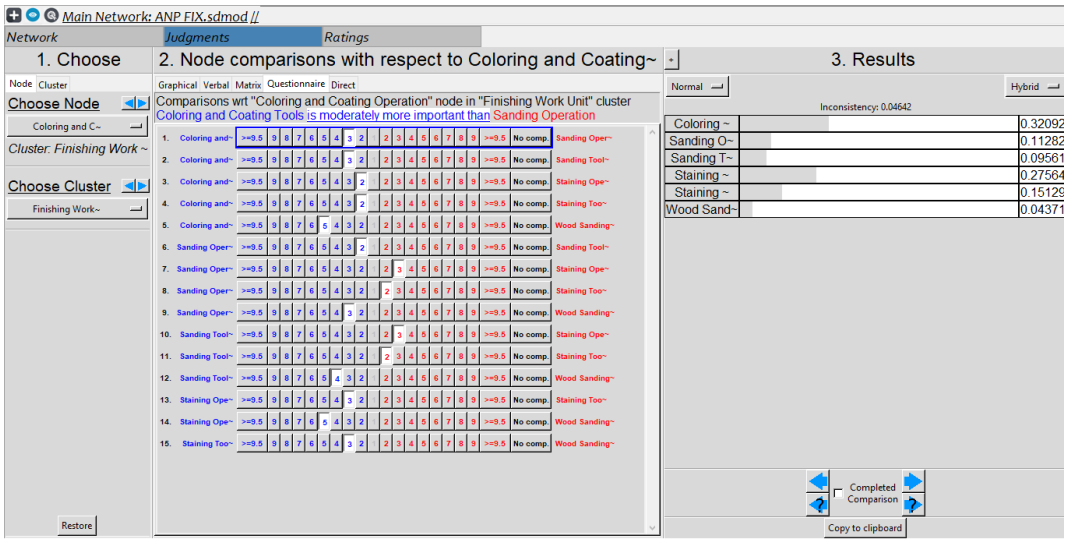
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Alat Pengamplasan
Proses Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan
Alat Pengamplasan	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Mesin Pengamplasan

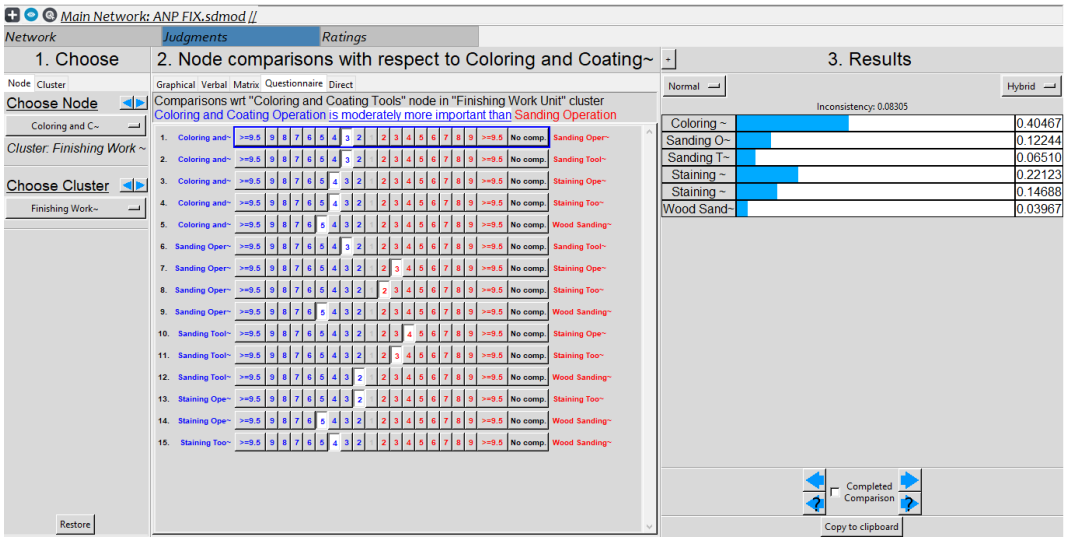
Perbandingan antar klaster sehubungan dengan Unit Kerja Finishing																		
Unit Kerja Finishing	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Unit Kerja Produksi

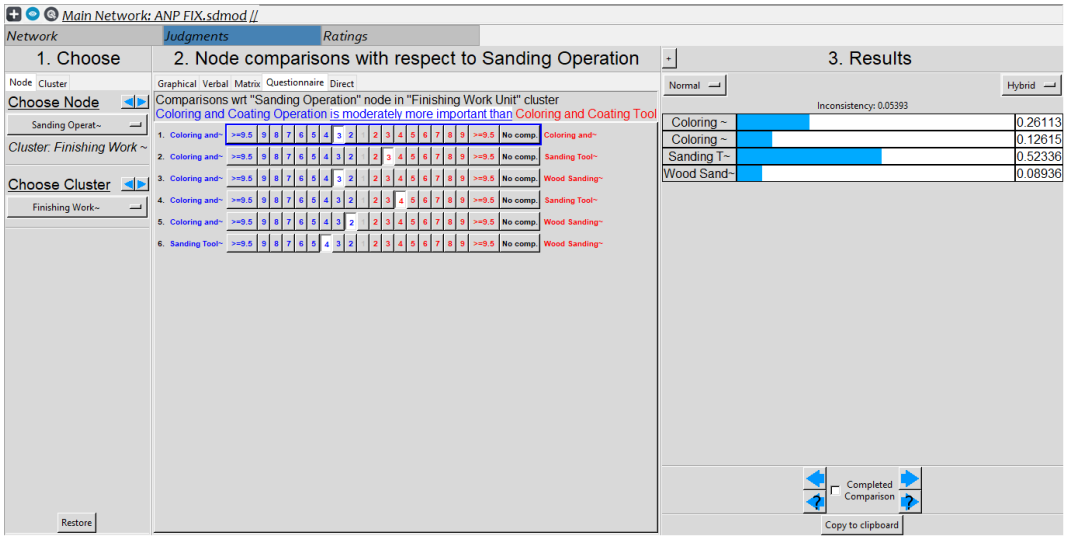
Perbandingan antar klaster sehubungan dengan Unit Kerja Produksi																		
Unit Kerja Finishing	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Unit Kerja Produksi

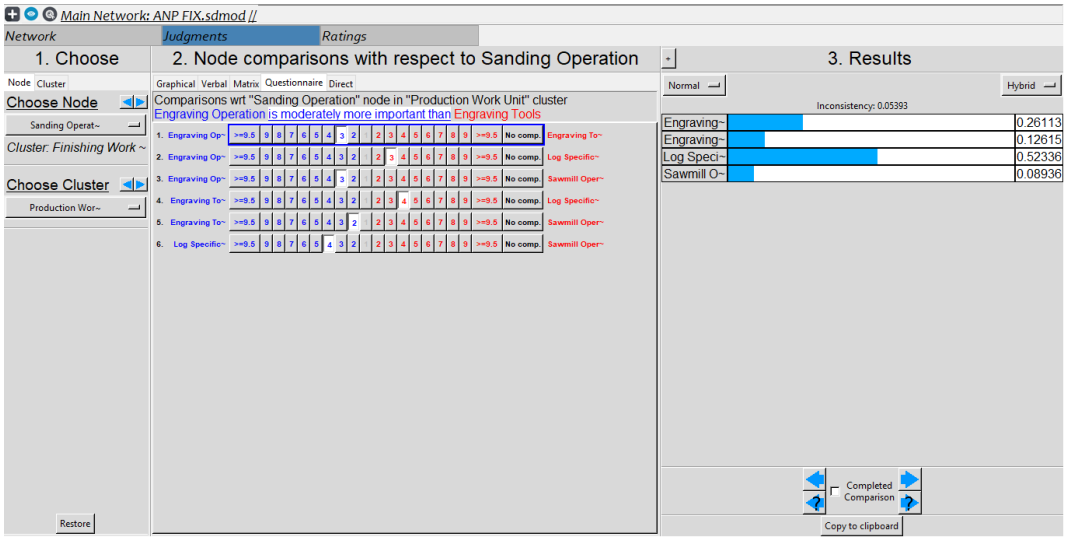
Appendix 3

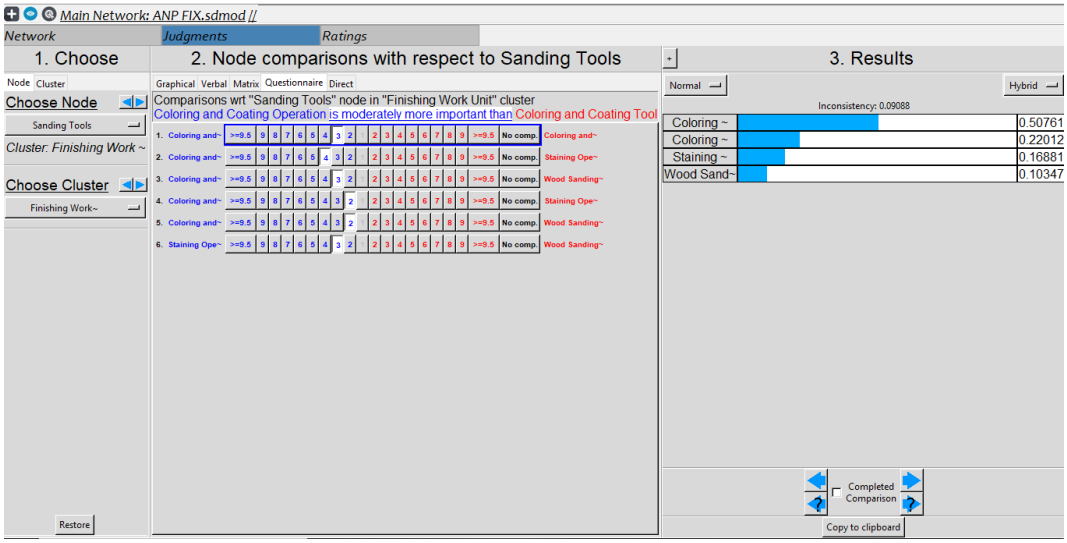
C. Pairwise Comparison result in Super Decisions Software

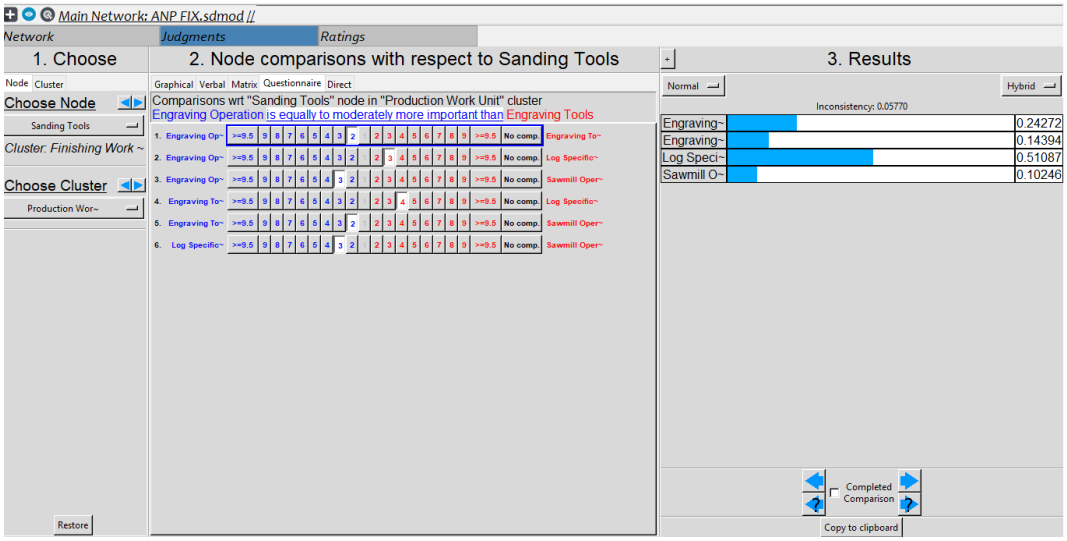


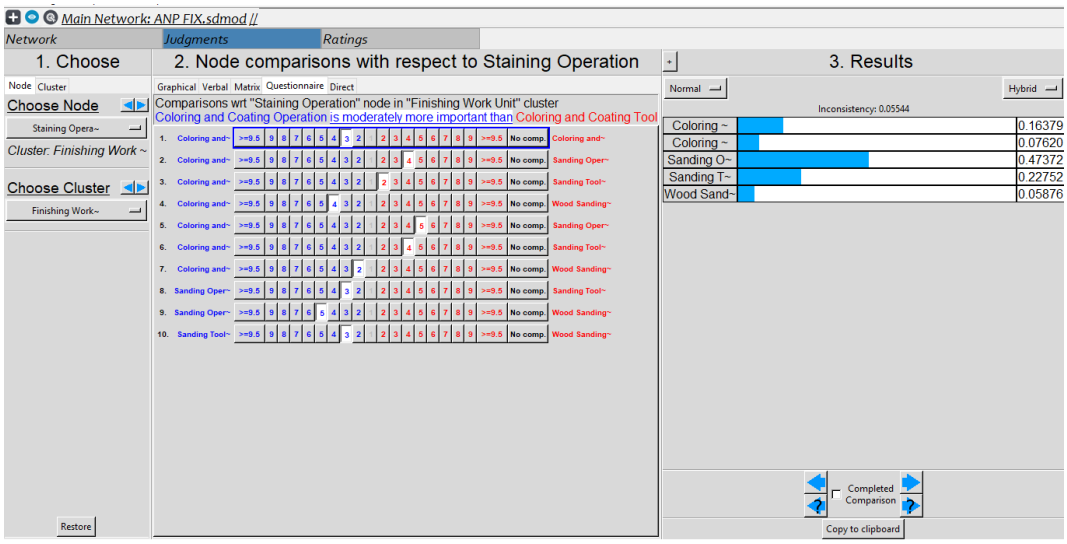


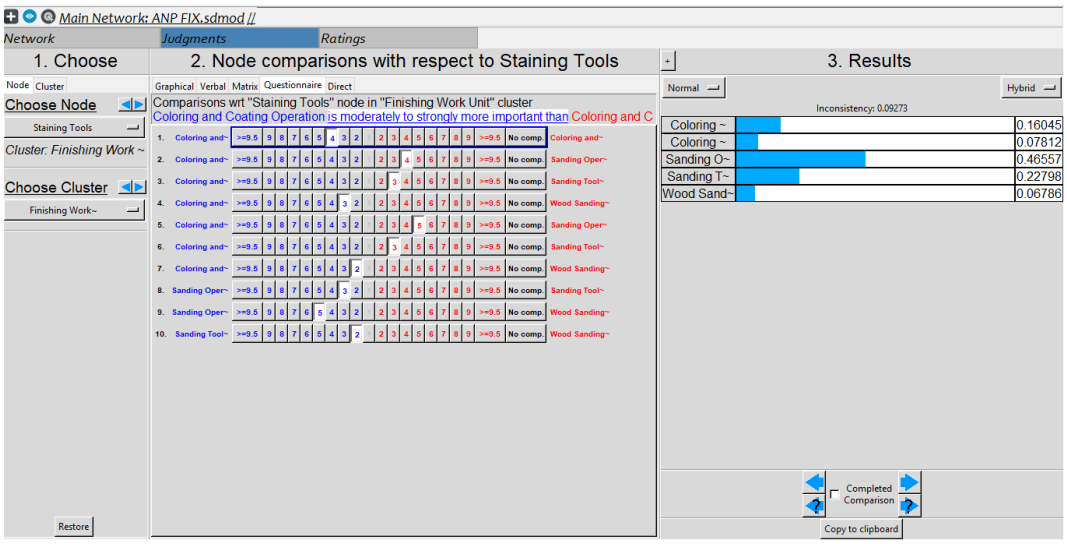

Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Sanding Operation
3. Results
Choose Node
Sanding Operat~
Cluster: Finishing Work ~
Choose Cluster
Finishing Work~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Sanding Operation" node in "Finishing Work Unit" cluster
Coloring and Coating Operation is moderately more important than Coloring and Coating Tool
Normal
Hybrid
Inconsistency: 0.05393
Coloring ~ 0.26113
Coloring ~ 0.12615
Sanding T~ 0.52336
Wood Sand~ 0.08936
Completed Comparison
Copy to clipboard

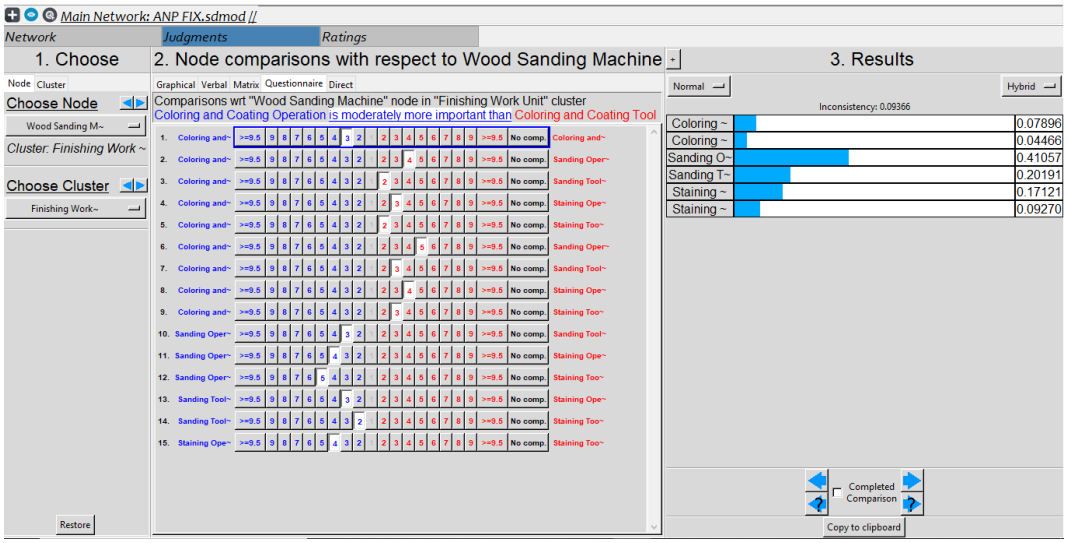

Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Sanding Operation
3. Results
Choose Node
Sanding Operat~
Cluster: Finishing Work ~
Choose Cluster
Production Wor~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Sanding Operation" node in "Production Work Unit" cluster
Engraving Operation is moderately more important than Engraving Tools
Normal
Hybrid
Inconsistency: 0.05393
Engraving~ 0.26113
Engraving~ 0.12615
Log Speci~ 0.52336
Sawmill O~ 0.08936
Completed Comparison
Copy to clipboard

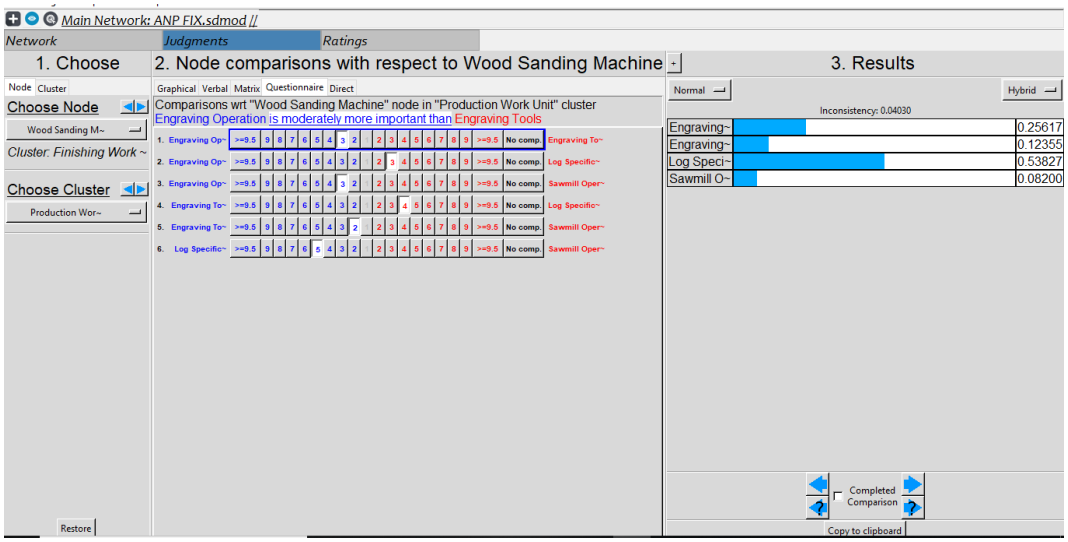

Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Sanding Tools
3. Results
Choose Node
Sanding Tools
Cluster: Finishing Work ~
Choose Cluster
Finishing Work~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Sanding Tools" node in "Finishing Work Unit" cluster
Coloring and Coating Operation is moderately more important than Coloring and Coating Tool
Normal
Hybrid
Inconsistency: 0.09088
Coloring ~ 0.50761
Coloring ~ 0.22012
Staining ~ 0.16881
Wood Sand~ 0.10347
Completed Comparison
Copy to clipboard

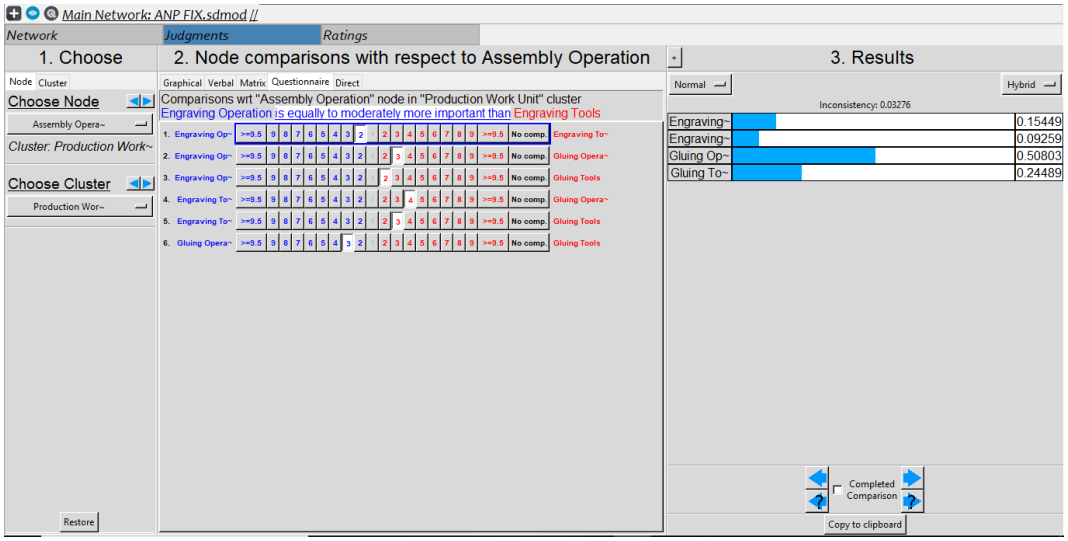

Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Sanding Tools
3. Results
Choose Node
Sanding Tools
Cluster: Finishing Work ~
Choose Cluster
Production Wor~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Sanding Tools" node in "Production Work Unit" cluster
Engraving Operation is equally to moderately more important than Engraving Tools
Normal
Hybrid
Inconsistency: 0.05770
Engraving~ 0.24272
Engraving~ 0.14394
Log Speci~ 0.51087
Sawmill O~ 0.10246
Completed Comparison
Copy to clipboard

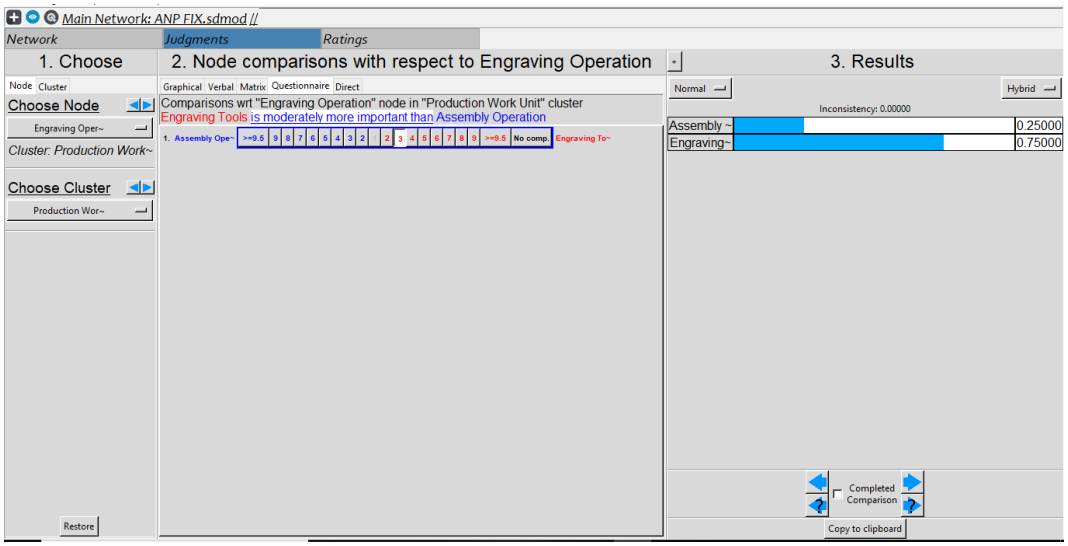

Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Staining Operation
3. Results
Choose Node
Staining Opera~
Cluster: Finishing Work ~
Choose Cluster
Finishing Work~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Staining Operation" node in "Finishing Work Unit" cluster
Coloring and Coating Operation is moderately more important than Coloring and Coating Tool
Normal
Hybrid
Inconsistency: 0.05544
Coloring ~ 0.16379
Coloring ~ 0.07620
Sanding O~ 0.47372
Sanding T~ 0.22752
Wood Sand~ 0.05876
Completed Comparison
Copy to clipboard

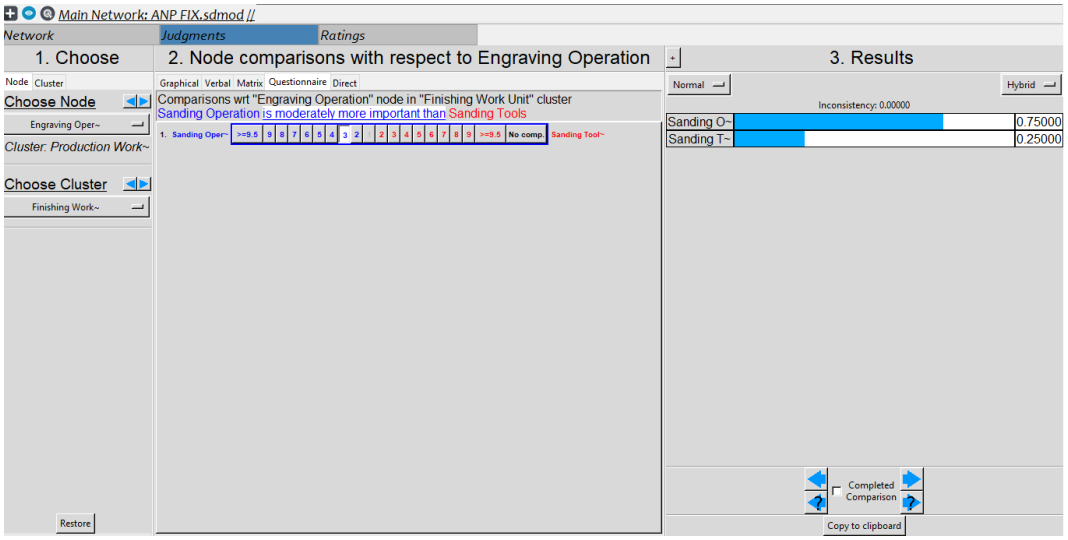

Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Staining Tools
3. Results
Choose Node
Staining Tools
Cluster: Finishing Work ~
Choose Cluster
Finishing Work~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Staining Tools" node in "Finishing Work Unit" cluster
Coloring and Coating Operation is moderately to strongly more important than Coloring and C
Normal
Hybrid
Inconsistency: 0.09273
Coloring ~ 0.16045
Coloring ~ 0.07812
Sanding O~ 0.46557
Sanding T~ 0.22798
Wood Sand~ 0.06786
Completed Comparison
Copy to clipboard

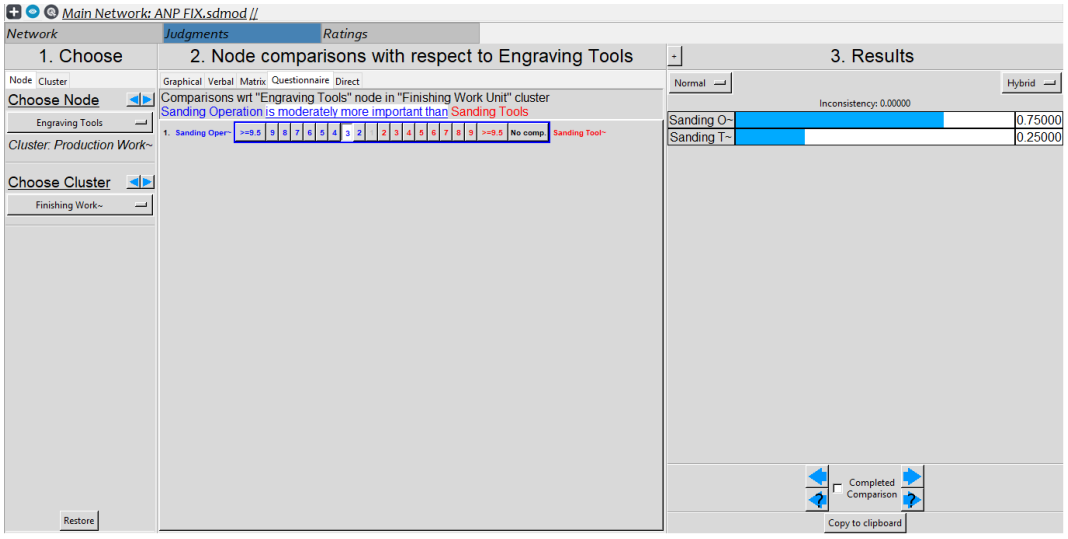

Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Wood Sanding Machine
3. Results
Choose Node
Wood Sanding M~
Cluster: Finishing Work ~
Choose Cluster
Finishing Work~
Restore
Comparisons wrt "Wood Sanding Machine" node in "Finishing Work Unit" cluster
Coloring and Coating Operation is moderately more important than Coloring and Coating Tool
Normal
Hybrid
Inconsistency: 0.09366
Coloring ~ 0.07896
Coloring ~ 0.04466
Sanding O~ 0.41057
Sanding T~ 0.20191
Staining ~ 0.17121
Staining ~ 0.09270
Completed Comparison
Copy to clipboard


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Wood Sanding Machine
3. Results
Choose Node
Wood Sanding M~
Cluster: Finishing Work ~
Choose Cluster
Production Wor~
Restore
Comparisons wrt "Wood Sanding Machine" node in "Production Work Unit" cluster
Engraving Operation is moderately more important than Engraving Tools
Normal
Hybrid
Inconsistency: 0.04030
Engraving~ 0.25617
Engraving~ 0.12355
Log Speci~ 0.53827
Sawmill O~ 0.08200
Completed Comparison
Copy to clipboard


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Assembly Operation
3. Results
Choose Node
Assembly Opera~
Cluster: Production Work~
Choose Cluster
Production Wor~
Restore
Comparisons wrt "Assembly Operation" node in "Production Work Unit" cluster
Engraving Operation is equally to moderately more important than Engraving Tools
Normal
Hybrid
Inconsistency: 0.03276
Engraving~ 0.15449
Engraving~ 0.09259
Gluing Op~ 0.50803
Gluing To~ 0.24489
Completed Comparison
Copy to clipboard


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Engraving Operation
3. Results
Node
Cluster
Choose Node
Engraving Oper~
Cluster: Production Work~
Choose Cluster
Production Wor~
Graphical
Verbal
Matrix
Questionnaire
Direct
Comparisons wrt "Engraving Operation" node in "Production Work Unit" cluster
Engraving Tools is moderately more important than Assembly Operation
1. Assembly Ope~
>=9.5
No comp.
Engraving To~
Normal
Hybrid
Inconsistency: 0.00000
Assembly ~
0.25000
Engraving~
0.75000
Completed Comparison
Copy to clipboard
Restore


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Engraving Operation
3. Results
Node
Cluster
Choose Node
Engraving Oper~
Cluster: Production Work~
Choose Cluster
Finishing Work~
Graphical
Verbal
Matrix
Questionnaire
Direct
Comparisons wrt "Engraving Operation" node in "Finishing Work Unit" cluster
Sanding Operation is moderately more important than Sanding Tools
1. Sanding Oper~
>=9.5
No comp.
Sanding Tool~
Normal
Hybrid
Inconsistency: 0.00000
Sanding O~
0.75000
Sanding T~
0.25000
Completed Comparison
Copy to clipboard
Restore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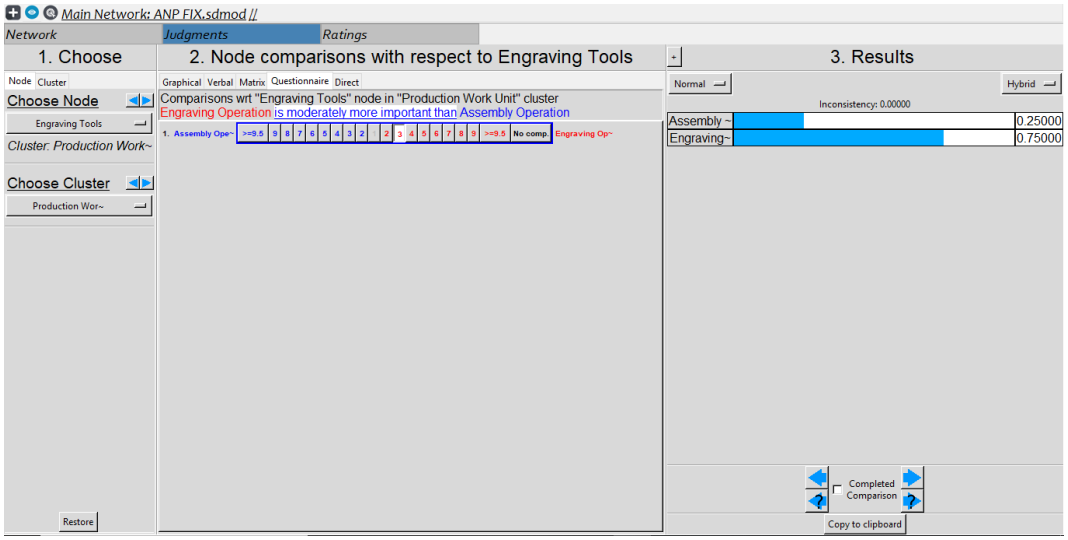
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Engraving Tools
3. Results
Node
Cluster
Choose Node
Engraving Tools
Cluster: Production Work~
Choose Cluster
Finishing Work~
Graphical
Verbal
Matrix
Questionnaire
Direct
Comparisons wrt "Engraving Tools" node in "Finishing Work Unit" cluster
Sanding Operation is moderately more important than Sanding Tools
1. Sanding Oper~
>=9.5
No comp.
Sanding Tool~
Normal
Hybrid
Inconsistency: 0.00000
Sanding O~
0.75000
Sanding T~
0.25000
Completed Comparison
Copy to clipboard
Restore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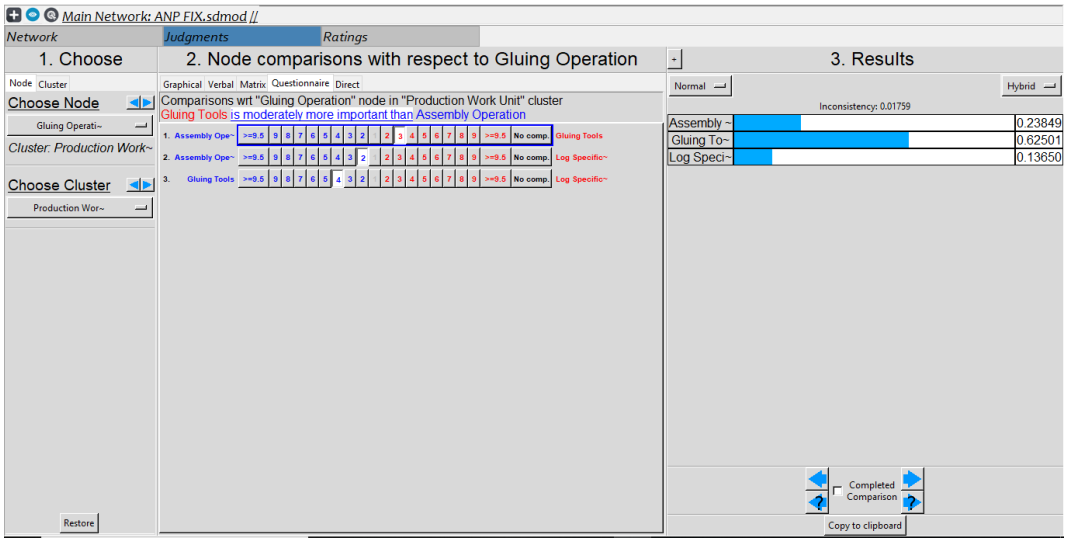
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Engraving Tools
3. Results
Node
Cluster
Choose Node
Engraving Tools
Cluster: Production Work~
Choose Cluster
Production Wor~
Restore
Graphical
Verbal
Matrix
Questionnaire
Direct
Comparisons wrt "Engraving Tools" node in "Production Work Unit" cluster
Engraving Operation is moderately more important than Assembly Operation
1. Assembly Ope~
No comp.
Engraving Op~
Normal
Hybrid
Inconsistency: 0.00000
Assembly ~
0.25000
Engraving~
0.75000
Completed Comparison
Copy to clipboard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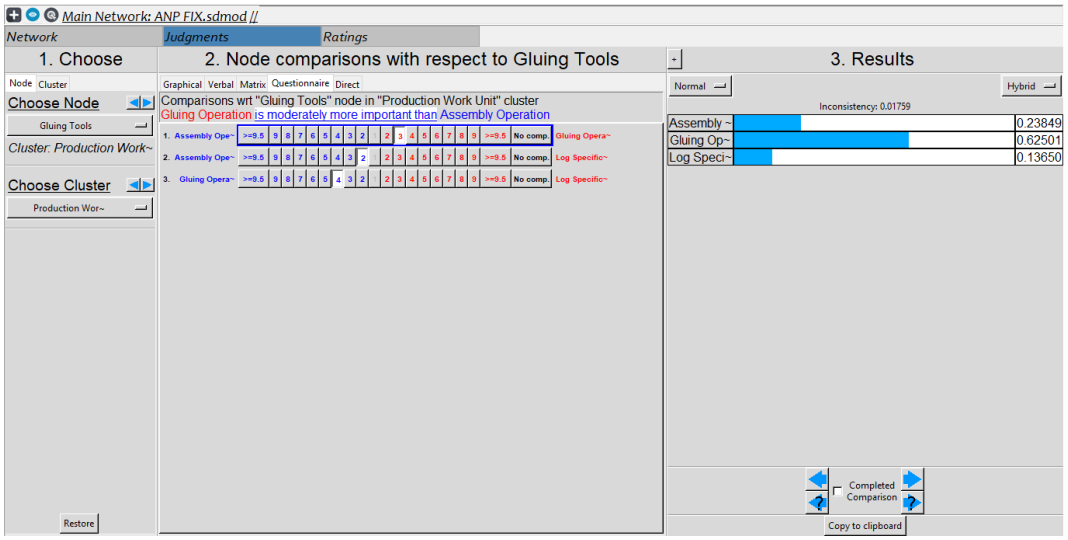
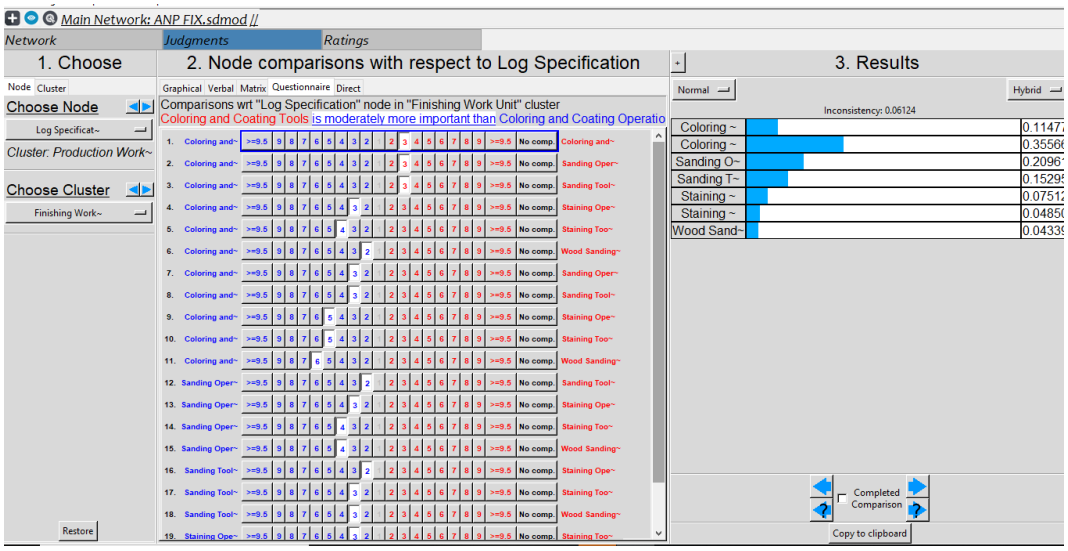
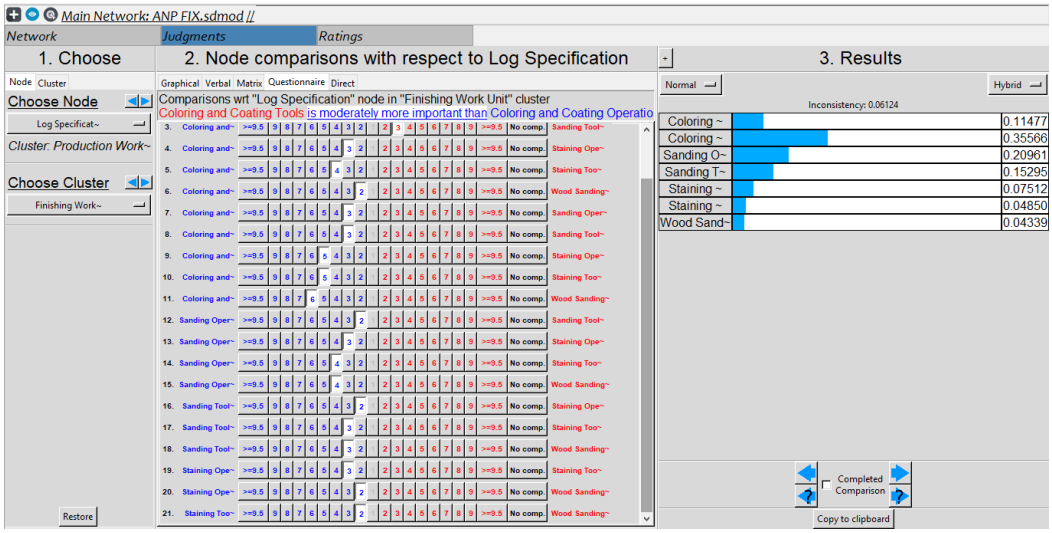
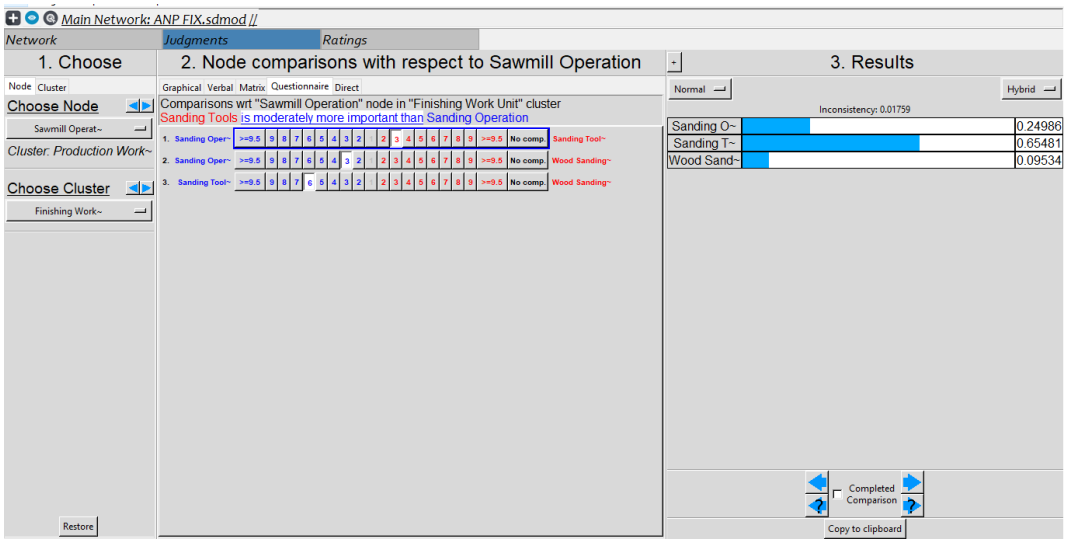
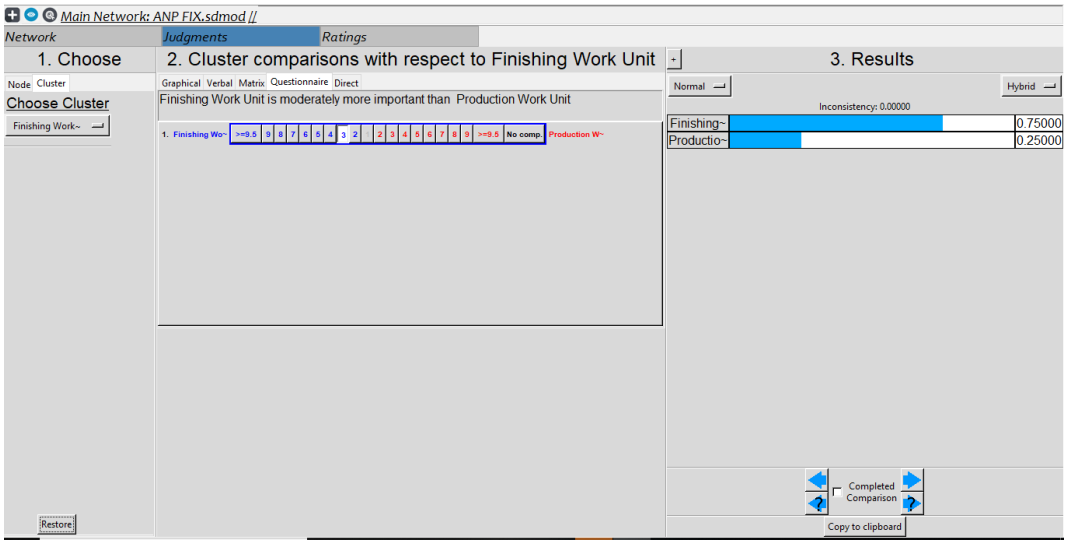
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Gluing Operation
3. Results
Node
Cluster
Choose Node
Gluing Operati~
Cluster: Production Work~
Choose Cluster
Production Wor~
Restore
Graphical
Verbal
Matrix
Questionnaire
Direct
Comparisons wrt "Gluing Operation" node in "Production Work Unit" cluster
Gluing Tools is moderately more important than Assembly Operation
1. Assembly Ope~
Gluing Tools
2. Assembly Ope~
Log Specific~
3. Gluing Tools
Log Specific~
No comp.
Normal
Hybrid
Inconsistency: 0.01759
Assembly ~
0.23849
Gluing To~
0.62501
Log Speci~
0.13650
Completed Comparison
Copy to clipboard

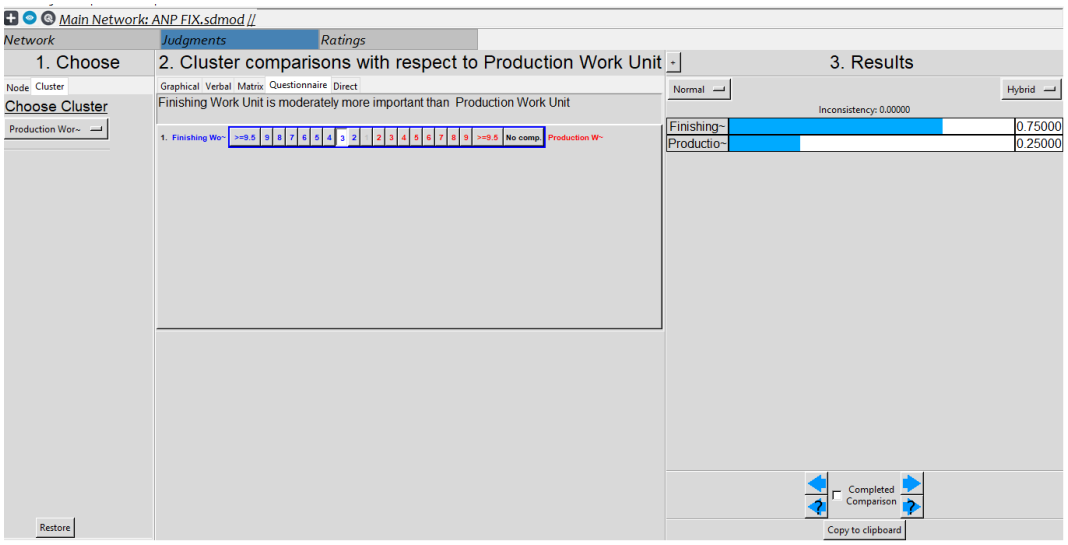

Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Gluing Tools
3. Results
Node
Cluster
Choose Node
Gluing Tools
Cluster: Production Work~
Choose Cluster
Production Wor~
Restore
Graphical
Verbal
Matrix
Questionnaire
Direct
Comparisons wrt "Gluing Tools" node in "Production Work Unit" cluster
Gluing Operation is moderately more important than Assembly Operation
1. Assembly Ope~
Gluing Opera~
2. Assembly Ope~
Log Specific~
3. Gluing Opera~
Log Specific~
No comp.
Normal
Hybrid
Inconsistency: 0.01759
Assembly ~
0.23849
Gluing Op~
0.62501
Log Speci~
0.13650
Completed Comparison
Copy to clipboard


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Log Specification
3. Results
Choose Node
Log Specificat~
Cluster: Production Work~
Choose Cluster
Finishing Work~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Log Specification" node in "Finishing Work Unit" cluster
Coloring and Coating Tools is moderately more important than Coloring and Coating Operatio
Normal
Hybrid
Inconsistency: 0.06124
Coloring ~ 0.1147
Coloring ~ 0.3556
Sanding O~ 0.2096
Sanding T~ 0.1529
Staining ~ 0.0751
Staining ~ 0.0485
Wood Sand~ 0.0433
Completed Comparison
Copy to clipboard


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Log Specification
3. Results
Choose Node
Log Specificat~
Cluster: Production Work~
Choose Cluster
Finishing Work~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Log Specification" node in "Finishing Work Unit" cluster
Coloring and Coating Tools is moderately more important than Coloring and Coating Operatio
Normal
Hybrid
Inconsistency: 0.06124
Coloring ~ 0.11477
Coloring ~ 0.35566
Sanding O~ 0.20961
Sanding T~ 0.15295
Staining ~ 0.07512
Staining ~ 0.04850
Wood Sand~ 0.04339
Completed Comparison
Copy to clipboard


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to Sawmill Operation
3. Results
Choose Node
Sawmill Operat~
Cluster: Production Work~
Choose Cluster
Finishing Work~
Restore
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "Sawmill Operation" node in "Finishing Work Unit" cluster
Sanding Tools is moderately more important than Sanding Operation
Normal
Hybrid
Inconsistency: 0.01759
Sanding O~ 0.24986
Sanding T~ 0.65481
Wood Sand~ 0.09534
Completed Comparison
Copy to clipboard


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Cluster comparisons with respect to Finishing Work Unit
3. Results
Node
Cluster
Choose Cluster
Finishing Work~
Graphical
Verbal
Matrix
Questionnaire
Direct
Finishing Work Unit is moderately more important than Production Work Unit
1. Finishing Wo~
>=9.5
9
8
7
6
5
4
3
2
2
3
4
5
6
7
8
9
>=9.5
No comp.
Production W~
Normal
Hybrid
Inconsistency: 0.00000
Finishing~
Productio~
0.75000
0.25000
Completed Comparison
Copy to clipboard
Restore


Main Network: ANP FIX.sdmod //
Network
Judgments
Ratings
1. Choose
2. Cluster comparisons with respect to Production Work Unit
3. Results
Node
Cluster
Choose Cluster
Production Wor~
Graphical
Verbal
Matrix
Questionnaire
Direct
Finishing Work Unit is moderately more important than Production Work Unit
1. Finishing Wo~
>=9.5
9
8
7
6
5
4
3
2
2
3
4
5
6
7
8
9
>=9.5
No comp.
Production W~
Normal
Hybrid
Inconsistency: 0.00000
Finishing~
Productio~
0.75000
0.25000
Completed Comparison
Copy to clipboard
Restore

BIOGRAPHY

Alwi Badrudin was born in Bogor, April 18th, 1996. He is the second child from in his family. He was graduated from TK Islam Karya Mukti in 2002, SD Islam Karya Mukti 2008, SMPN 1 Bogor in 2011, and SMAN 1 Bogor in 2014. After that, he attends one of the state university in Indonesia, Institut Teknologi Sepuluh Nopember in majoring Industrial Engineering Department.

Beside on developing hard skills, he also active in developing for soft skills, in his college, he was active on joining in Himpunan Mahasiswa Teknik Industri on 2015 as staff of entrepreneurship (KWU) department and 2016 as head of entrepreneurship (KWU) department.

He got lot of experiences both of hard and soft skill during her study. He attended some of soft skill training such as LKMM PRA TD that held by BEM FTI ITS in 2014, LKMM TD that held by HMTI ITS in 2015, and P3MTI that held by HMTI ITS in 2016. For hard skills, he attended the subject courses, which are Knowledge Management, Management of Industrial Environment, Supply Chain Management, Performance Management and Sustainable Manufacturing. His hobbies are futsal, photography and explore new things. He likes to gather and meet new people. He can be found through email contact alwibadrudin20@gmail.com.