

Organizational Design for Automation and Digitalization Initiative using Analytical Hierarchy Process: A Case Study of an Aerospace Manufacturer in Indonesia

Dian Ekawati* and Gatot Yudoko

School of Business and Management, Institut Teknologi Bandung, Indonesia

Abstract. Industry 4.0 become popular when it launched first time in 2011. This revolution refers to interconnection of manufacturing system, which known as Internet of Things. As Indonesia embrace the challenge in 2018, PT SKY, an Indonesia aerospace manufacturing company start the initiative at 2020, by configure digital council. This is to facilitate automation and digitalization initiative within the organization. The team member is part timer from cross function department, who passionate and occupy by self-develop skill on it. Recent challenge of growth of customer demand, and some constraint face by digital council, management view an opportunity to be cost competitive organization company, by develop more focus on automation and digitalization. However, a challenge for company in low-cost country, require proper strategy approach. Based on organization design theory, strategy, and organization structure, have correlation. This study explores the propose organizational design for the company. A decision-making analysis performed thru AHP (Analytic Hierarchy Process) approach to select highest ranking of three alternatives of organization structure, with three criteria. Result analysis show hybrid as highest-ranking score 0.464, then follow by semi structured interview, thematic data analysis, to collect the insight from the team. Based on research execution, the study able to recommends hybrid organization structure with three important actions, to bridge from current digital council ad hoc organization.

Keywords: Organization design, manufacturing, AHP, Industry 4.0

1. Introduction

Indonesia Ministry of Industry launch “Making Indonesia 4.0” program, in 2018. Inside the report (Ministry of Industry, 2018), signed by formerly president Joko Widodo, it mentions manufacturing contribution thru the initiative. It expects 5%-10% manufacturing sector’s contribution to gross domestic income. Five sectors manufacturing priority are F&B, textile & apparel, automotive, chemicals and electronics.

PT SKY is a manufacturing company located in Bandung, which is part of an American multinational aerospace and defense conglomerate headquartered in Arlington, Virginia corporate company. PT SKY Bandung was established in 1997 as a small

machining company with 28 total employees. After several step of company acquisition, including a period to be joint venture with government company, finally at 2014, the company fully acquired by current corporate company. The company having 400+ employees with 200+ active part numbers, which are mainly use for actuate aircraft movement horizontal, vertical, and slower movement during landing, mainly for Airbus A320 series. By considering industry 4.0 concept introduction in Indonesia, PT SKY start to approach the implementation within the organization. The initiative was triggered by business unit policy deployment flow down in 2020 and benchmark to sister company at a Singapore site, also benchmark result to an Indonesia automotive industry.

*Corresponding author. Email: dian_ekawati@sbm-itb.ac.id

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According to business unit vision, which flow down annually, digitalization became one of the expectations to be start in operation. This expectation aligns with industry 4.0 in manufacturing sector, which expected to create a cost competitive organization. As the first stepping stone and to have better alignment, coordination on various initiative, in 2020, PT SKY General Manager initiate

Digital Council, which consists of 3 Senior Leadership as steering committee and part time organizing committee for the execution activity. This team had regular meeting to study digitalization concept and understand current state of industry 4.0 application within the site. The structure show in figure 1.



Figure 1
PT SKY Digital Council Organization
Source: PT SKY

There are two categories of activity within digital council, which calls as digitalization and automation. The digitalization mostly initiates to simplify the process of working on task and resulted faster and accurate working result. Since the initiative comes and execute separately by each process owner, it creates many varieties of digital application platform, which are difficult to combine with other process's application and hard to maintain the continuity, especially when the creator leaves organization or change role.

The objective of automation project drives to improve quality performance, especially on manual process. The automation will help to provide more consistent result and robust process.

Since 2020 implementation of digital council, both automation and digitalization, maintenance of the digital face the challenge. Since there is no function maintain it, due the competency is not well existed within organization. With the ad hoc organization form, it creates confusion of which function should maintain all the application and automation.

This study aims to define suitable organization structure design in correlation with automation and digitalization initiative execution and face the challenge of industry 4.0. The study has objective to propose suitable organization structure, aligned to company growth and challenge towards industry 4.0 implementation.

The research's limitation of this study identifies as only few of benchmark to similar aerospace industry in Indonesia to enable learn from others. However, a review of organization design and innovation thru literature, performed to add reference of the execution.

To achieve the objective of this study, a decision-making solution approach explored. According to (Németh et al., 2019), MCDM (Multi Criteria Decision Making) is the collective name of formal approaches, to evaluate decision making, by consider multiple criteria in transparent way. The theory collects seven methods of decision-making comparison, to explore the trade-off. Summary comparison shows in figure 2.

Based on the table, AHP (Analytic Hierarchy Process) is easy to use, not necessarily require software, and provide lowest chance of bias

among other similar methods without software requirements.

Method name	Resource requirement	Software requirement	Chance of bias	General complexity
Direct weighting	Low	No	High	Very low
SMART combined with swing weighting	Low	No	Moderate-high	Low
AHP	Moderate	Not necessarily	Moderate	Moderate
MACBETH	Moderate	Yes	Moderate-low	Moderate
DCE	High	Yes	Low	High
PAPRIKA	High	Yes	Low	High
CA	High	Yes	Low	High

AHP: Analytic hierarchy process; CA: Conjoint analysis; DCE: Discrete choice experiments; MACBETH: Measuring attractiveness by a categorical-based evaluation technique; PAPRIKA: Potentially all pairwise rankings of all possible alternatives; SMART: Simple multiattribute rating technique.

Figure 2

Decision Making Comparison

Source : (Németh et al., 2019)

In the study of (Farooque & Akhtar, 2021), the authors used AHP for technology selection with consideration, that AHP can help to provide better prioritisation, capture subjective and objective aspects. The same method also utilized by (Bhadu et al., 2023) to provide decision of potential technologies applies in modernization and automation to decide the rank of identified technologies and consistency check. AHP method also used by (Sajjad et al., 2022a) for industry 4.0 transformation development model. With background reason of AHP capability to integrate decision maker's knowledge and experience instinctively thru numbers indication and the support of the MCDM theory, this study decided to use AHP methodology approach, for organization structure proposal. Exploring prior studies, AHP may utilized for decision-making in operational or tactical levels (e.g., industry 4.0 technology selection, equipment investment). This study extends the application of AHP to organization structure, which is more at a strategic level side. Novelty of the approach provides systematic approach to complex design of organization, align to current and future industry 4.0 challenge, in rare ecosystem industry in Indonesia, such as aerospace sectors.

2. Literature Review and Hypotheses Development

Industry 4.0

(Stankovic et al., 2017) mentioned industry 4.0 became popular in 2011, after introduce by Germany government, thru the launch of "Plattform Industrie 4.0". The core of Industry 4.0 is Internet of things which allows connection of machines, products, systems and people. According to (Erol et al., 2016), there are four concepts of Fourth Industrial Revolution, which are known as Internet of Things, Industrial Internet, Cloud-based Manufacturing, and Smart Manufacturing. Looking back to the history of industrial revolution, it was started in 1760, when steam engine invented and implemented in farming sector. Following industry 1.0, the second phase happened with the invention of combustion machine by used oil as power. In this era, key goal of industry was the mass production. In 1960, the 3rd industrial revolution happened thru the implementation of information technology, electronic devices and automation in production line. (Rahman et al., 2023). Illustration of industrial revolution, show in Figure 3.

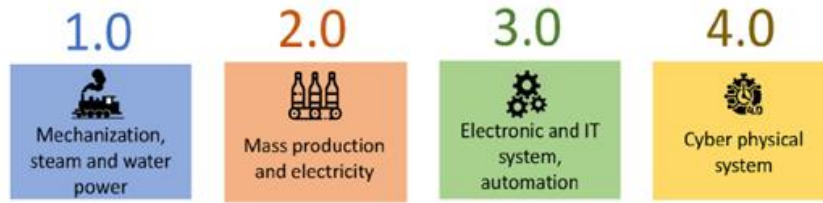


Figure 3
Revolution Industry History
Source : (Rahman et al., 2023)

In 2018, Indonesia Ministry of Industry launched “Making Indonesia 4.0” program. This initiative aims to achieve Indonesia aspiration to be global top 10 economy by 2030. The expected impact of this program has 2 direct impacts (revive production sector

and regain net exporter position), and 4 indirect impacts (improve country financial strength, enhance government spending, enhance investment, build robust economy). Illustration shows in figure 4.

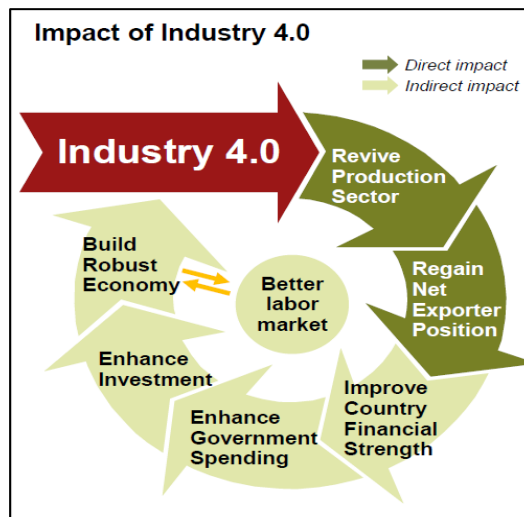


Figure 4
Impact of Industry 4.0
Source : (Ministry of Industry, 2018)

There are five pioneer sectors of priorities execution in Indonesia, they are food and beverage, textile and apparel, automotive, chemical industry, and electronics. These sectors are contributor of 60% manufacturing GDP, 65% of manufacturing export and 60% of manufacturing workers. (Ministry of Industry, 2018). Indonesia government expects, the five pioneer sectors will become the backbone of implementation, to be ASEAN market's leader.

Organization Structure Theory

Organization structure refers as formalized pattern that manage interaction between task, technologies, and people within the organization. Structure design has aims to

ensure effective utilization of resource to achieve organization objective (Dess, Gregory G, McNamara, Gerry, Eisner, 2016).

There are three key components in the definition of organization structure: (Daft, 2010)

1. Organization structure designates formal reporting relationships, including the number of levels in the hierarchy and the span of control of managers and supervisors.
2. Organization structure identifies the grouping together of individuals into departments and of departments into the total organization.

3. Organization structure includes the design of systems to ensure effective communication, coordination, and integration of efforts across departments.

According to (Daft, 2010), there are three indicators as consideration, when we want to design organization structure – required work activities, reporting relationship, and departmental groupings. There should be strategically important task, for department creation consideration. Following required work activities for the department, the next task is designing organizational hierarchy

which show chain of commands or reporting relationship. Then, follow the last indicator is departmental groupings. The activities then have to be coordinated (M.Burton, Richard, Obel & B, 2004), to ensure collective goals will be achieved.

There are five types of department grouping. Overall show in Figure 5. The last options, which is not included in the figure, known as hybrid structure which combine more than one options.

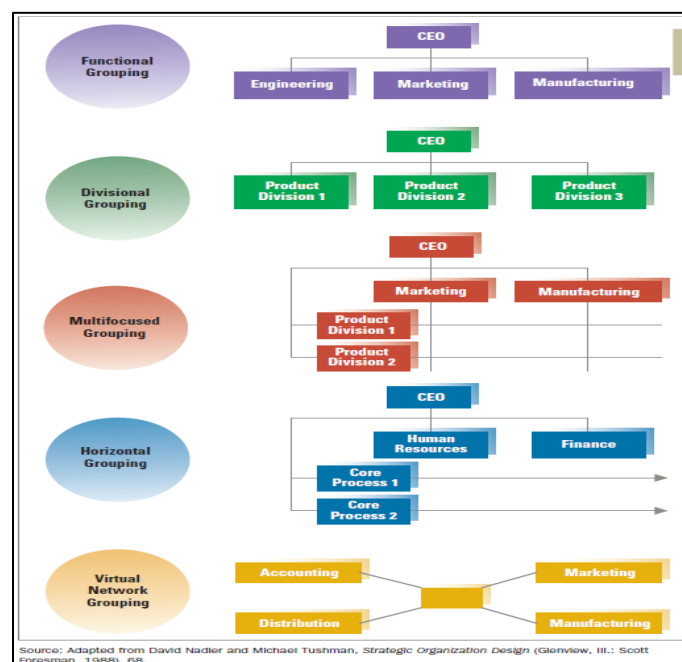


Figure 5
Department Grouping Option
Source : (Daft, 2010)

In **Functional structure**, activities grouped by common function. This type effectively works in organization, in which in-depth expertise is important. Term of **Divisional structure** used to reflect product structure or strategic business unit. In this type, the organization organized based on product, service, major program or profit centre. **Multi focused grouping or known as matrix structure** use when both technical expertise and product innovations are important to the organization. The matrix is very strong in horizontal linkage. The recent approach of

horizontal structure, organize employee around core process. This type focus on collaboration and teamwork to achieve success. The **virtual network** also called modular structure. In this type, organization will do outsourcing and coordinates the activities thru small headquarter, on some work.

Organization Management for Innovation

As we transition into Industry 4.0, many industry experts see this change in a favourable aspect. According recent reports from BCG and PwC, industry 4.0 expected to boost efficiency by 15–20% and contribute to over 20% of revenue growth in the next five years. Some research papers point out that digitalization acts as a driver and enabler of service (Parida, Vinit, Sjödin, David & Reim, 2019). Overall, digital service mostly shows characteristic of closer supplier-customer relationships. Some aspects such as co-creation, long-term engagement, and greater investment in the relationship are consequences which identify have intra- and inter-organizational effects (Kamalaldin et al., 2020).

The choices regarding structure and coordination are interconnected. Once a structure is established, the options for coordination become restricted, to ensure a good fit. Coordination required more information processing compared to determining the structure. Furthermore, within the context of structure and coordination, organizational design defines roles and responsibilities, including task allocation, resource distribution, and the coordination of smaller units and tasks (M.Burton, Richard, Obel, 2018).

According to (O'Reilly III, Charles A., L.Tushman, 2004) study, it shows that 90% of ambidextrous organization achieve their goal, to mix the innovation with existing way of managing the process. There are 35 attempts to launch breakthrough innovations. Companies under study, use total four ways of approach managing the innovations. Seven were carried out within existing *functional designs*, integrated into the regular organizational. Nine were set up as *cross-functional teams*, groups operating within the established organization, outside the existing management hierarchy. Four took the form of *unsupported teams*, independent units set up outside the established organization and management hierarchy. And 15 were pursued within *ambidextrous organizations*, where the

breakthrough efforts were organized as structurally independent units, each having its own processes, structures, and cultures but integrated into the existing senior management hierarchy.

AHP

There are several methodologies in decision making. In their study, (Németh et al., 2019) explained MCDM namely as formal approaches, to evaluate decision making, by consider multiple criteria in transparent way. The study compares seven methods of decision making, to explore the trade-off. Following this study, AHP is easy to use, not necessary require software, with lowest chance of bias among three other methods without software requirements. The AHP study being used on industry 4.0 fields, for decision making, by refer to study conducts by (Farooque & Akhtar, 2021) and (Bhadu et al., 2023).

AHP method able to combine both physical and psychological aspect on decision making. Physical means, tangible measurement that can be touched by individuals. Psychological aspect mostly intangible, have correlation with one's belief, ideas about the person and his environmental. AHP approach can be measure both aspect, to consider during decision making process. (R. W. Saaty, 1987) Saaty prepare a decomposed decision in following 4 steps. (T. L. Saaty, 2008).

1. Problem definition and determine knowledge on it. Create decision hierarchy from top, include decision's goal. Then follow by intermediate levels to lowest one.
2. Constrict pairwise comparison matrix. This step should compare upper level to immediate lower level of it.
3. Utilize priorities from the comparison to weigh with immediate lower level. This activity performs for each element, then obtain the value compare to global priority. This step continues up to most bottom level. Illustrative example shows in Figure 6.

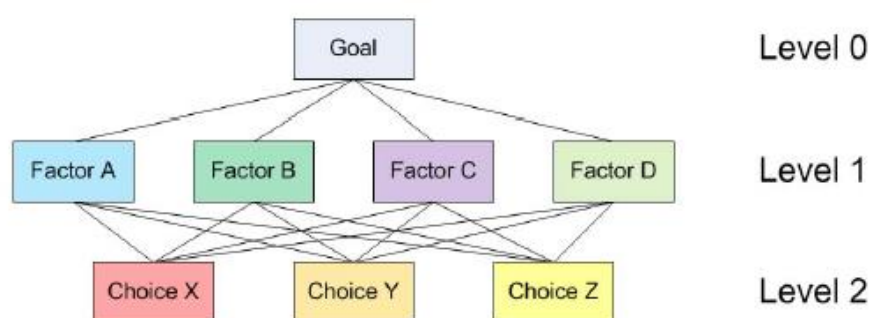


Figure 6
Two level AHP Illustration Example
Source : (Braunschweig, 2001)

Journal Literature Exploration

Novelty of this study, explore through the search and comparison of several type of study which utilize AHP and or organization design. Based on the exploration in google scholar on 2020 above published journal, there are 16,200 study related to industry 4.0 in manufacturing industry, 63,700 topics on

organization design, 17,300 journal related to analytic hierarchy process (AHP).

However, combine two or three of the approaches use in this study not an easy search. Below are several studies exploring with industry 4.0, organization design combines with AHP approach.

Table 1
Literature Study Overview
Source: Author

No	Journal Title	Reference	Content Overview
1.	Decision Making Process Development for Industry 4.0 Transformation	(Sajjad et al., 2022b)	AHP approach to select suitable industry 4.0 transformation model
2.	Industry 4.0 and Indian Manufacturing: An AHP Approach	(Farooque & Akhtar, 2021)	AHP technique approach to identify and prioritize industry 4.0 technology in Indian manufacturing firms.
3.	Digital Transformation and Organization Design – A Complex Relationship	(Kretschmer & Khashabi, 2020)	Provide an integrated overview on correlation of digital transformation affects to organization design by classifying and analysing the effect on the process of output creation in firms
4.	Transitioning from a hierarchical product organization to an open platform organization: a Chinese case study	(Luo et al., 2018)	Case study examines the challenges experienced by large multinational firms to transform the organization
5.	A method for selecting processes for automation with AHP and TOPSIS	(Costa et al., 2023)	Selection of automation process by AHP and TOPSIS approach

Table 1. Continued

No	Journal Title	Reference	Content Overview
6.	Agile Shopfloor Organization Design for Industry 4.0 Manufacturing	(Bader et al., 2019)	Present an approach of work organization design for automotive industry 4.0 manufacturing
7.	Implications of Industry 4.0 on industrial employment: A comparative survey from Brazilian, Chinese, and German practitioners	(Beier et al., 2022)	Provide analysis of how Industry 4.0 effect to industrial employment by comparing practitioners' perceptions from Brazil, China, and Germany

Based on above study comparison, there is limited study combine organization design, industry 4.0 and AHP. Besides, less study provides the perspective from aerospace component manufacturing industry.

Following the literature review, this study utilizes framework of analysis, which shows in Figure 7. There are three major steps, and six detail activities perform on structure design decision making proposal analysis.

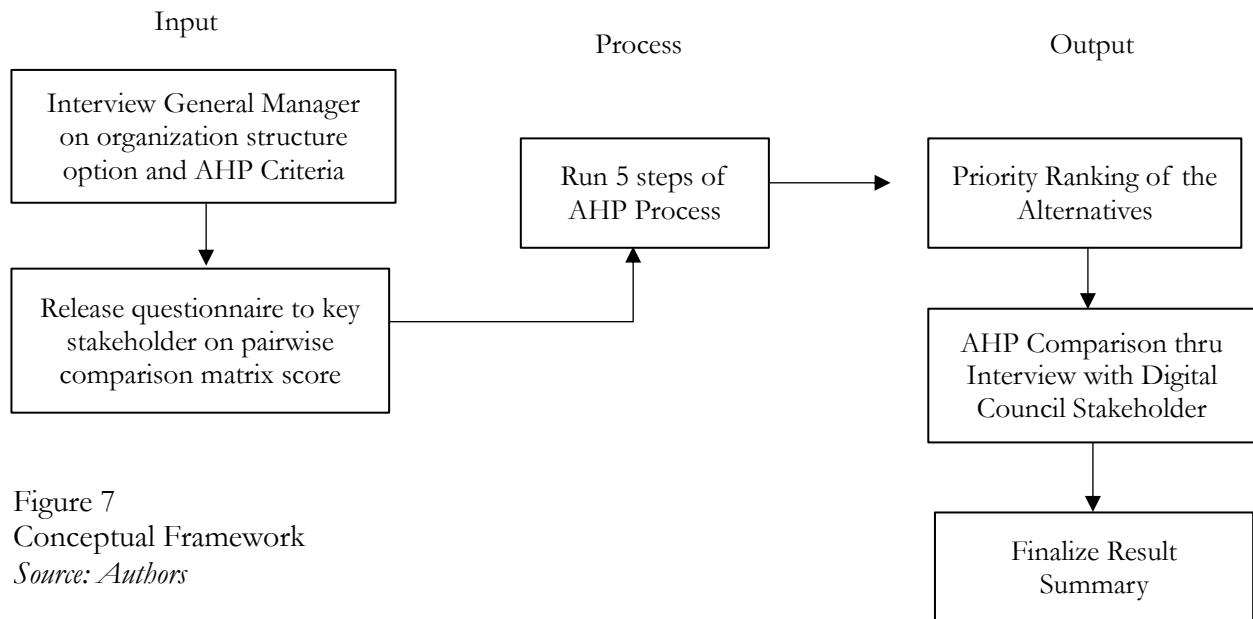


Figure 7
Conceptual Framework
Source: Authors

3. Methodology

There are known 3 types of research, which are quantitative, qualitative, and mixed method. This study uses mixed method, which combine quantitative and qualitative approach.

Quantitative

Quantitative approach basically measure numeric data, analyse with statistical and graphic technic to examine variable's relationship (Saunders et al., 2019). AHP approach collect and analyse choice and factor by using numeric data. The steps of AHP decision making, consists of 5 major steps. Detail will be explained below:

1. Develop hierarchy structure.
The construction of hierarchy consists of goal, criteria, and alternatives.
2. Define Pair Wise Comparison Matrix.
Create pairwise comparisons, by rate the relative importance between each pair of decision alternatives and criteria. The assessment performs together with decision maker person. Figure 8 shows numerical rating 1-9 use in AHP.

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong Importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another, its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of highest possible order of affirmation

Figure 8

Numeric Scale Numbers of AHP

Source : (Saaty, T. L. & Vargas, 2012)

3. Synthesizing Procedures
In this step, calculate priority vector for each matrix created in step 2. There are three steps involve mathematics matrix calculation.
 4. Perform consistency test
As mentioned above, AHP put focus on consistency, which check in this step. Calculate consistency index and consistency ratio (CR). Follow consistency criteria below.
 - If $CR < 0.1$, pairwise comparison matrix consistent.
 - If $CR > 0.1$, pairwise comparison matrix inconsistent.
 5. Calculate ranking of criteria, to decide strongest proposed choice.
- Prior to quantitative approach with AHP, an interview performed with General Manager as the highest hierarchy stakeholder within organization, to define factor and choice direction, based on his vision. Following the interview, it defines three factors and three choices of organization structure.
- An approach of utilize questionnaire, distributed to digital council steering committee (4 respondents decision maker General Manager, Engineering Manager, Operation Manager, Continuous Improvement Manager), to gather agreed numeric scale based on reference of (Ardhana, 2022). Table 2 to table 5, show questionnaire distribute to get numeric scale.

Table 2

Numeric Scale Questionnaire Compare Criterias

Source: Authors

Question 1

Which one of the following criteria do you think is more important for selection of digitalization & automation organization structure?

Criteria		<-- Pairwise Numerical Rating -->																		Criteria	
Scope of Work	of	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chain of Command	of	
Scope of Work	of	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Decision Making Clarity	Decision	
Chain of Command	of	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Decision Making Clarity	Decision	

Table 3

Numeric Scale Questionnaire Compare Alternatives to Scope of Work

Source: Authors

Question 2

Based on criteria "Scope of Work", which one of the following alternative solutions do you think is more suitable in the creation of digitalization & automation organization structure?

Alternative	<-- Pairwise Numerical Rating -->																		Alternative
Current Digital Council	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Matrix Structure	
Current Digital Council	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hybrid	
Matrix Structure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hybrid	

Table 4

Numeric Scale Questionnaire Compare Alternatives to Chain of Command

Source: Authors

Question 3

Based on criteria “Chain of Command”, which one of the following alternative solutions do you think is more suitable in the creation of digitalization & automation organization structure?

Alternative	<-- Pairwise Numerical Rating -->																	Alternative
Current																		Matrix
Digital	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Structure
Council																		
Current																		
Digital	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hybrid
Council																		
Matrix	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hybrid
Structure																		

Table 5

Numeric Scale Questionnaire Compare Alternatives to Decision Making Clarity

Source: Authors

Question 4

Based on criteria “Decision Making Clarity”, which one of the following alternative solutions do you think is more suitable in the creation of digitalization & automation organization structure ?

Alternative	<-- Pairwise Numerical Rating -->																	Alternative
Current																		Matrix
Digital	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Structure
Council																		
Current																		
Digital	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hybrid
Council																		
Matrix	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hybrid
Structure																		

Qualitative (After AHP Analysis)

Following AHP analysis, which resulted priority ranking decision, a semi structured interview performed with stakeholder to find the insight against AHP result. The semi structure interview selected, to enable arrive

with prepared question, and at same time explore the detail with respondent. Listed of respondents for the interview, show in table 5. List of question to be confirm with stakeholder, will focus on three aspects. The detail show in table 6.

Table 6
Interview Respondent List Selection
Source: Authors

No	Job Title	Years of Service in Organisation	Role in Digital Council
1	General Manager	6 years	Advisor
2	Engineering Manager	6 years	Steering Committee
3	Operation Manager	13 years	Steering Committee
4	Maintenance Head	25 years	Organizing Committee
5	Continuous Improvement Senior Staff	8 years	Organizing Committee
6	Maintenance Supervisor	10 years	Organizing Committee
7	Shipping Supervisor	10 years	Organizing Committee
8	QMS Supervisor	10 years	Organizing Committee

Table 7
Interview Question
Source: Authors

No	Variable	Question	Source
1	Understanding the Need	What is your understanding on why we need automation and digitalization?	(Jaspert & Ebel, 2022)
2		What changes required, in your opinion for the organization structure of automation and digitalization?	
3	Align Organization Design Goal	What should be the goal of automation and digitalization organization?	(Bals & Turkulainen, 2017)
4	Understanding current role and future expectation	Do you understand yourself and your team role in current automation and digitalization structure?	(Fecher et al., 2018)
5		What is your expectation on future role of automation and digitalization?	

4. Findings and Discussion

AHP (Analytic Hierarchy Process)

First step of AHP start by develop hierarchy which shows in figure 9. There are three criteria and alternatives identified thru interview with general manager, who is the highest hierarchy in the organization.

Step two of AHP is creating Pairwise Comparison Matrix (PCM) based on average number data collection with interview with decision maker from Digital Council Steering Committee. The result of average data collection shows in table 7.

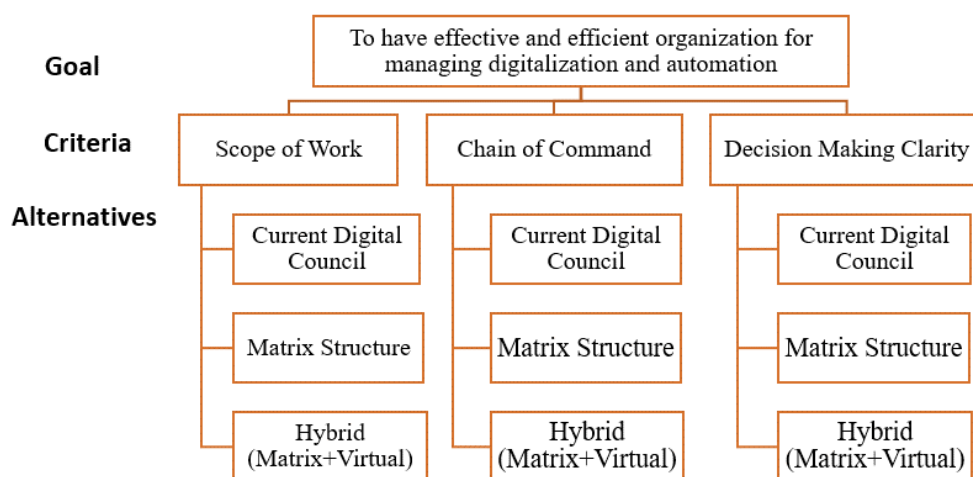


Figure 9
AHP Hierarchy
Source: Authors

Table 8
Pairwise Comparison Matrix
Source: Author

Scope of Work	Current Digital Council	Matrix Structure	Hybrid	Chain of Command	Current Digital Council	Matrix Structure	Hybrid
Current Digital Council	1	0.33	0.50	Current Digital Council	1	0.20	0.33
Matrix Structure	3	1	1	Matrix Structure	5	1	2
Hybrid	2	1	1	Hybrid	3	0.50	1

Decision Making	Current Digital Council	Matrix Structure	Hybrid		Scope of Work	Chain of Command	Decision Making	
Current Digital Council	1	0.25	0.20		Scope of Work	1	3	1
Matrix Structure	4	1	0.33		Chain of Command	0.33	1	0.50
Hybrid	5	3	1		Decision Making	1	2	1

In the step three, the data is synthesizing, follow three steps analysis as detail follow, sum column of PCM, divide number in column with its total sum of the column. Then

final step is calculating the average of each row. Final result of data synthesizes called eigen vector, which shows in table 8.

Table 9

Eigen Vector of Alternatives and Criteria

Source: Authors

Eigen Vector of Alternatives

Alternatives Criteria	Current Digital	Matrix Structure	Hybrid
Scope of Work	0.170	0.443	0.387
Chain of Command	0.110	0.581	0.309
Decision Making Clarity	0.096	0.284	0.619

Eigen Vector of Criteria

Scope of Work	0.443
Chain of Command	0.170
Decision Making Clarity	0.387

Prior getting the rank of alternatives, a consistency test should perform to check consistency degree of each paired assessment. Analysed number calls Consistency Ratio

(CR). There are five steps of perform consistency ratio, CI and CR, formula stated in figure 10, while result explain table 9 and table 10.

Table 10

Consistency Ratio Analysis Result for Alternatives

Source: Authors

Criteria	Alternatives	Weighted Sum / Priority Vector of Alternatives	λ_{max}	CI	CR
Scope of Work	Current Digital Council	3.009	3.018	0.009	0.016
	Matrix Structure	3.025			
	Hybrid	3.020			
Chain of Command	Current Digital Council	3.001192843	3.004	0.002	0.003
	Matrix Structure	3.006371814			
	Hybrid	3.003523608			
Decision Making Clarity	Current Digital Council	3.021662246	3.087	0.430	0.075
	Matrix Structure	3.083283343			
	Hybrid	3.155127323			

Table 11

Consistency Ratio Analysis Result for Criteria

Source: Authors

Criteria	Weighted Sum / Priority Vector of Alternatives	$\lambda_{\max}$	CI	CR
Scope of Work	3.025	3.018	0.009	0.016
Chain of Command	3.009			
Decision Making Clarity	3.020			

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

$$CR = \frac{CI}{RI}$$

Figure 10

CI and CR Formula

Source : : (Saaty, T. L. & Vargas, 2012)

Based on analysis show in table 9 and table 10, the consistency ratio shows < 0.1 , both alternatives and criteria. It's proven that the pairwise comparison matrix is consistent and can continue to the ranking calculation.

The result of ranking analysis, express in table 11. Based on this, hybrid structure is the highest rank among the three alternatives.

Table 12

Ranking Calculation Result

Source: Authors

Alternatives	Ranking Calculation	
Current Digital Council	0.131	Rank III
Matrix Structure	0.405	Rank II
Hybrid	0.464	Rank I

Qualitative Analysis – Stakeholder Review

A semi structure interview with digital council conducted to understand respondent's insight. The interview was voice recorded, then transcript to text, with original language, Indonesia, and English, prior perform the analysis. There are five questions being ask to respondent. Qualitative analysis with thematic

analysis conduct at this section. Four steps are followed in this study, as per (Saunders et al., 2019). The result of interview analysis, will be use to compare with AHP result, to strengthen the proposed organization structure. Summary qualitative analysis refine themes of five questions, shows in table 13.

Table 13

Qualitative Analysis Refine Themes Summary

Source: Authors

No	Question	Refine Themes Result
1	What is your understanding on why we need automation and digitalization?	Automation & Digitalization initiate with the background of ensure good industry competitiveness, by: 1. Improve performance to achieve better company result 2. Make the process easier, better, faster, cheaper 3. Increase company competitiveness, adaptive to meet customer demand
2	What changes required, in your opinion for the organization structure of automation and digitalization?	There are three changes identify by respondent: 1. Organization Change, 43% respondent consider council is sufficient with current load, focus and business 2. Refine vision-mission of automation and digitalization, align to company ones 3. Enhance the way of working
3	What should be the goal of automation and digitalization organization, in your opinion?	Automation and Digitalization Organization should have objective: 1. To be enabler function, to contribute to company performance and accelerate existing process 2. Bring value to company There are nearly equal population of respondent stated clear and not clear.
4	Do you understand your role in current automation and digitalization structure?	1. For clear role statement, opportunities are existed for develop coordinator role and to be one gate activity 2. To ensure clearer role, suggestion from respondent are : - Clarify load/time segregation, for part timer - Clarify decision and leader directive authority - Clarify maintain activity owner - Establish mutual goal and role/procedure - Clarity of organization/function, and leader role
5	What is your expectation on role of automation and digitalization in future?	There are three action required for future organization. 1. With current load, council is good, an enhancement required such as establish leader and structure with part time team member from necessary department, align goal 2. Conduct review to finalize vision align to site one prior decide to move for future structure and goal 3. Expected future organization : - Clear scope, authority and budget - Clear Chain of Command - Clear Scope & Authority - Frequent process maturity evaluation - Cover all site activity - Act as support function with small size - Metric established - Synergy with all function

5. Conclusion

AHP approach and qualitative analysis thru interview with digital council member, able to create the organization structure design proposal for the company. The qualitative analysis with five questions able to cover the objective of digitalization and automation activity. Summary result details as follow.

- Based on AHP (Analytic Hierarchy Process) approach by consider three categories and three alternatives, showed that **hybrid structure** is the most selected by the respondent, thru pair wise comparison matrix feedback.
- From the thematic analysis approach, preference of organization structure show three actions to be execute. 1) Consider current work load, continue existing digital council organization is best option, with some enhancement action required. 2) Refine automation and digitalization vision-mission. 3) In the condition that a required to create new organization

become priorities, there are eight expectations on the new organization.

Following type of organization structure, with qualitative analysis, the option to use **hybrid structure, which combine matrix and virtual network**, is the most option match to the expectation. In the hybrid structure, a new function called smart factory will manage two sections, automation and digitalization. These two sections manage the activity thru network structure, involving third party and business unit function.

The proposed organization structure, following eight expectations of future structure, expressed in interview summary of question number five in table 13. Besides, a linkage with business unit function also important, to ensure continuous alignment with corporate function will help the implementation. Initiative structure, is shown in figure 11.

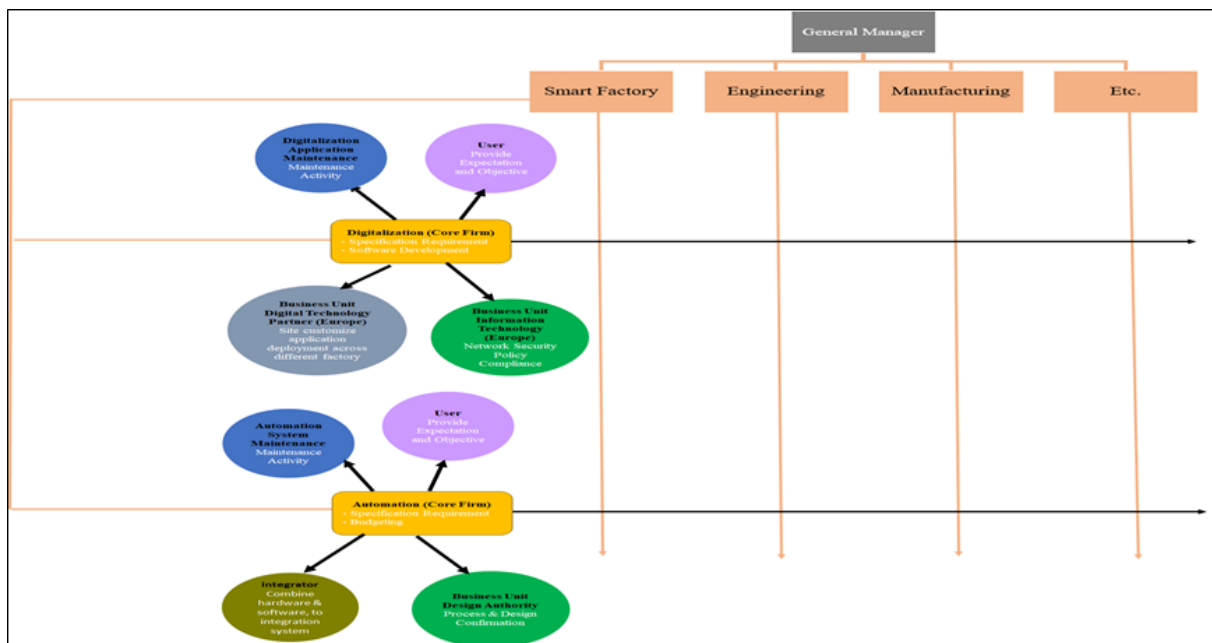


Figure 11
Recommended Hybrid Organization Structure
Source: Authors

The organization selection for PT SKY, based on the qualitative and quantitative analysis, show similarity to ambidextrous organization explain at the literature. Similarity of separately structure, with connection to existing management hierarchy connect the hybrid option to ambidextrous shape. Looking at the successful implementation of ambidextrous organization in the study of (O'Reilly III, Charles A., L.Tushman, 2004), raise an optimistic that PT SKY will be successfully transform the digitalization initiative to achieve the organization objective.

According to the study of (Keček et al., 2023) that was performed 205 respondents from with 40.5% came from corporation company which pursue organization change, it stated that, the theory highlights the critical role of management, particularly through leadership, as well as other functions such as planning, organizing, human resource management, and control, are confirmed. A key focus in the process of organizational change management is developing a change and communication strategy design, to minimize the impact of changes on both the business and the employees affected. Organizational changes significantly influence people and organizational culture, which can often create major challenges to the implementation. This drives the importance of effectively managing organizational change, placing additional pressure on management.

The lesson learnt of (Keček et al., 2023) study, as explains in above paragraph, is key actions to be considered during PT SKY organization change implementation, to ensure major impact on employee's morale and culture can be avoided and resulted successful transformation for automation and digital initiative in the company.

A recommendation for future research is to explore the organization design of other industries or aerospace manufacturing sectors in Indonesia to embrace Industry 4.0 through automation and digitalization. This kind of

studies will broaden the perspective on industry preparedness, to support the implementation of the "Making Indonesia 4.0" initiative by the Ministry of Industry.

Declarations

Author contribution

All authors contributed equally as the main contributors of this paper. All authors read and approved the final paper.

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Competing interest

The authors declare that they have no conflicts of interest to report regarding the present study.

References

- Ardhana, Y. (2022). *Kepner-Tregoe Problem Analysis and Analytic Hierarchy Process to Select Best Solution for Nitrogen Supply Shortage at Refinery Unit VI Balongan*. Bandung Institute of Technology.
- Bader, S., Barth, T., Krohn, P., Ruchser, R., Storch, L., Wagner, L., Findeisen, S., Pokorni, B., Braun, A., Ohlhausen, P., & Palm, D. (2019). Agile shopfloor organization design for industry 4.0 manufacturing. *Procedia Manufacturing*, 39, 756–764. doi: 10.1016/j.promfg.2020.01.434
- Bals, L., & Turkulainen, V. (2017). Journal of Purchasing and Supply Management Achieving efficiency and effectiveness in Purchasing and Supply Management: Organization design and outsourcing. 23(June), 256–267. doi: 10.1016/j.pursup.2017.06.003
- Beier, G., Matthess, M., Shuttleworth, L., Guan, T., de Oliveira Pereira Grudzien, D. I., Xue, B., Pinheiro de Lima, E., & Chen, L. (2022). Implications of Industry 4.0 on industrial employment: A comparative survey from Brazilian, Chinese, and German practitioners. *Technology in Society*, 70(April), 102028. doi: 10.1016/j.techsoc.2022.102028

- Bhadu, J., Bhamu, J., & Saraswat, P. (2023). An Analytic Hierarchy Process (AHP) Approach for Prioritizing the Industries 4.0 Technologies (I4.0T). *Evergreen*, 10(2), 667–675. doi: 10.5109/6792813
- Braunschweig, T. (2001). Analytic hierarchy process. *Planning Agricultural Research: A Sourcebook*, 231–241. doi: 10.1079/9780851994017.0231
- Costa, D. S., Mamede, H. S., & da Silva, M. M. (2023). A method for selecting processes for automation with AHP and TOPSIS. *Heliyon*, 9(3), e13683. doi: 10.1016/j.heliyon.2023.e13683
- Daft, R. L. (2010). *Organization Theory and Design, Tenth Edition (Tenth Edit)*. South-Western Cengage Learning.
- Dess, Gregory G, McNamara, Gerry, Eisner, A. B. (2016). *Strategic Management, Text & Cases (Eight Edit)*. McGraw-Hill Education.
- Erol, S., Jäger, A., Hold, P., Ott, K., & Sihn, W. (2016). Tangible Industry 4.0: A Scenario-Based Approach to Learning for the Future of Production. *Procedia CIRP*, 54, 13–18. doi: 10.1016/j.procir.2016.03.162
- Farooque, H., & Akhtar, A. (2021). *Industry 4.0 and Indian Manufacturing: An AHP Approach*. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 0(2018), 509–517. doi: 10.46254/in01.20210139
- Fecher, F., Winding, J., Hutter, K., & Füller, J. (2018). Innovation labs from a participants ' perspective. *Journal of Business Research*, May, 0–1. doi: 10.1016/j.jbusres.2018.05.039
- Jaspert, D., & Ebel, M. (2022). Settings of Organizational Adjustments due to Digital Servitization. 1278–1287.
- Kamalaldin, A., Linde, L., Sjödin, D., & Parida, V. (2020). *Transforming provider-customer relationships in digital servitization: A relational view on digitalization*. *Industrial Marketing Management*, 89(December 2018), 306–325. doi: 10.1016/j.indmarman.2020.02.004
- Keček, D., Vuković, D., & Balić, D. (2023). Implementation Of Organizational Changes According To The Mckinsey 7S Model. *Journal of Pharmaceutical Negative Results*, 14(04), 524–529. doi: 10.47750/pnr.2023.14.04.64
- Kretschmer, T., & Khashabi, P. (2020). Digital Transformation and Organization Design: An Integrated Approach. *California Management Review*, 62(4), 86–104. doi: 10.1177/0008125620940296
- Luo, J., Van de Ven, A. H., Jing, R., & Jiang, Y. (2018). *Chinese Company study case on organization shifted.pdf*. *Journal of Organization Design*, 7(1).
- M.Burton, Richard, Obel, B. (2018). The science of organizational design: fit between structure and coordination. *Journal of Organization Design*.
- M.Burton, Richard, Obel, B., & B. O. (2004). *Strategic Organizational Diagnosis and Design: developing theory for application (2nd Editio)*. Kluwer Academic Publisher.
- Ministry of Industry. (2018). Revolusi Industri 4.0 di Indonesia. *In Interciencia* (Vol. 30, Issue 8).
- Németh, B., Molnár, A., Bozóki, S., Wijaya, K., Inotai, A., Campbell, J. D., & Kaló, Z. (2019). Comparison of weighting methods used in multicriteria decision analysis frameworks in healthcare with focus on low-and middle-income countries. *Journal of Comparative Effectiveness Research*, 8(4), 195–204. doi: 10.2217/cer-2018-0102
- O'Reilly III, Charles A., L.Tushman, M. (2004). The Ambidextrous Organization. *Harvard Business Review*, April, 1–276. doi: 10.1057/9781137488145
- Parida, Vinit, Sjödin, David, & Reim, W. (2019). Reviewing Literature on Digitalization, Business Model Innovation, and Sustainable Industry: Past Achievements and Future Promises. *Sustainability (Switzerland)*. doi: 10.3390/su11020391

- Rahman, S., Ghosh, T., Ferdous, N., Kaiser, M. S., Anannya, M., & Hosen, A. S. M. S. (2023). Measurement: Sensors Machine learning and internet of things in industry 4.0: A review. *Measurement: Sensors*, 28(January), 100822. doi: 10.1016/j.measen.2023.100822
- Saaty, R. W. (1987). The analytic hierarchy process-what it is and how it is used. *Mathematical Modelling*, 9(3–5), 161–176. doi: 10.1016/0270-0255(87)90473-8
- Saaty, T. L. (2008). Decision making with the Analytic Hierarchy Process. *International Journal of Services Sciences*, 9(3), 215–229. doi: 10.1504/ijssci.2008.017590
- Saaty, T. L., & Vargas, L. (2012). *Models, Methods, Concepts & Applications of the Analytic Hierarchy Process 2nd edition*. Springer Science.
- Sajjad, A., Ahmad, W., & Hussain, S. (2022a). Decision Making Process Development for Industry 4.0 Transformation. *Advances in Science and Technology Research Journal*, 16(3), 1–11. doi: 10.12913/22998624/147237
- Sajjad, A., Ahmad, W., & Hussain, S. (2022b). Decision Making Process Development for Industry 4.0 Transformation. 9(3), 356–363.
- Saunders, M. N. K., Adrian, T., & Lewis, P. (2019). *Research Methods for Business Students*. In Pearson Education International.
- Stankovic, M., Gupta, R., & Figueroa, J. (2017). *Industry 4.0 - Opportunities behind the challenge*. UNIDO Background paper. United Nations Industrial Development Organization, 1–56. https://www.unido.org/sites/default/files/files/2017-11/UNIDO_Background_Paper_on_Industry_4.0_27112017.pdf