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Supply Chain Management in Terms of Vendor Selection for New Technology Startup: A Case Study of Sini Company Mobile Apps Development

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Abstract:
SINI is one of the start-ups in the Internet of Things (IoT) industries in Indonesia. Until today, SINI still do not have all of the resources to develop a product with a technology only by this start-up. To develop a product, SINI need to outsource and being partnered with another party. SINI developing SINI Device Tracker and it consists of device tracker as hardware and mobile apps to control and support tracking function. SINI faced a problem in the android mobile apps development where the previous vendor cannot fulfil the requirement of mobile apps that they developed because there is still a bug that cannot be solved.
This research aims to find the alternatives solution that can be applied to solve SINI problem for mobile apps development, find the criteria that should be consider by SINI to choose a new vendor, and to study the strategy of vendor selection that fit with SINI company. To reach the aims of this study, sufficient literature studies are needed and validated with field research in the form of interview, consulting, and FGD with related parties such as IT consultant, programmer, SINI previous vendor, and the internal of SINI company. This study uses problem solving format by using quantitative and qualitative approaches, and also implements Multi-Criteria Decision Making (MCDM) by using Analytic Hierarchical Process (AHP) in the process of vendor selection for the development process of SINI mobile apps.

Keywords: *New technology startup, vendor selection, mobile apps development, multi-criteria decision making, analytic hierarchical process*

1. Introduction

Internet has drastically changed the way we live, moving people-to-people interactions on a practical level in several contexts ranging from professional to social relations. (Atzori, et al., 2010) Increasing numbers of physical objects connect to the Internet at an unprecedented rate realizing the Internet of Things (IoT) idea. (Al-Fuqaha, et al., 2015) IoT can add a new dimension to this process by enabling communication with and between smart objects, thus leading to the vision of communications in anything. (Atzori, et al., 2010) Over time, the IoT expects to have significant applications for the home and business, contribute to the quality of life of humans in this world, and grow the world economy. (Al-Fuqaha, et al., 2015) Radio Frequency Identification (RFID) is one of the IoT applications in industry, and it helps to track the moving objects that travel from supplier to customer. (Baruah & Dhal, 2019)

At present, there are very many criminal cases that occur in Indonesia, one of the criminal cases that often occur in Indonesia are theft cases. Over the years, statistics show that theft in Indonesia is still relatively common. (Statistik, 2019) Because the cases of loss of goods and theft are common in Indonesia, SINI sees an opportunity to create a business that can solve this problem, especially in Indonesia. Because IoT can be applied for tracking and also improves the quality of human life, SINI got the idea to create a tracking system in the form of device tracker that completed with tracking mobile apps that can be downloaded easily, and that can help people protect their valuable belongings and documents from cases of loss and theft.

SINI is one of the start-ups in the Internet of Things (IoT) industries in Indonesia. SINI was founded by four students of Bachelor of Entrepreneurship ITB in 2019, and this startup is a business that was built as a forum to implement the knowledge that was gained by the four founders during their studies at SBM ITB. The value of SINI is to solve the problem of losing important goods that are often experienced by many people.

1.1. Problem Statement

In the case of SINI, this start up is new technology start-up and still do not have all of the resources to develop a product with a technology only by this start-up. To develop a product, SINI need to outsource and being partnered with

another party by selecting vendors to fulfill SINI needs in term of product technology development. SINI was doing this step in the middle of 2019 for SINI Device Tracker development, and found the vendor, and the development of SINI Device Tracker planned to be completed by the end of 2019, but SINI Devive Tracker development completed in February 2020.

However, SINI team found that there were still problems in apps where the apps could not be used for more than 30 minutes, and if the user will continue their action to use this product, SINI users should reconnect the apps on the smartphone with the SINI device tracker first. SINI has confirmed this problem to the vendor, and the vendor has tried to resolve this problem. However, at the end of February 2020 the vendor said that they could not resolve this problem and stated that the development of Apps for SINI had been completed.

This is the core problem that raised in this research, where vendors cannot complete their work properly, but in the other hand SINI still needs the task of vendors to improve and continue the apps development to support the functions of SINI device tracker. But because SINI last vendor said that the development has been completed for them and cannot solve the bugs, SINI needs a new vendor. For this reason, SINI requires a strategy and planning for supply chain management in terms of vendor selection in product and software development.

1.2. Research Question

- What is the alternatives solution that can be choose regarding to SINI current condition in terms of apps development?
- What are the criteria that should be considered by SINI to selecting a vendor for SINI new product development?
- How is the strategy that should be implemented to select the best vendor that match with field of operation needs for apps development in SINI?

2. Literature Review

2.1. Supplier Selection Process

Many experts will agree that there is no one efficient method for assessing and selecting vendors, so businesses use various methods, and in terms of the supply chain, the degree of engagement applied to the selection is proportional to the quality of the product or service required. (Monczka, et al., 2009) The selection of suppliers based on criteria and supplier evaluation is one of the keys in terms of supply chain management, and supplier selection refers to the process by which a supplier is identified, analyzed and contracted. (Kowang, et al., 2017)

2.2. Supplier Selection Criteria

Business as a customer typically tests their prospective suppliers with allocated weights across several categories using their own selection criteria. (Monczka, et al., 2009, p. 248) The criteria for selecting suppliers at each company must be different, and it identified 23 supplier selection evaluation criteria, but there are criteria that weighted more than other that often used in choosing suppliers such as quality, performance history, delivery, warranty, and price (Dickson, 1966)Supplier selection can be started by looking for possible suppliers, and the selection criteria for suppliers can also be based on key performance indicators for the supplier. Some of the main criteria for supplier selection based on key performance indicators are on-time delivery, on-budget, quality, and client satisfaction level (Fekete &Hancu, 2010)

2.3. Multi Criteria Decision Making

One of the most important branches of decision-making theory is multi-criteria decision making. Multi criteria decision making is divided into two, continuous and discrete. In MCDM problem, in order to select the best alternative(s), a number of alternatives are evaluated with respect to a number of criteria. (Razei, 2014) To conduct the supplier selection process, Multi-Criteria Decision Making is an appropriate tool to use, because to select suppliers, there are several criteria to be used as a reference. Multi-criteria decision-making methods (MCDM) are usually used to rate possible outsourced component suppliers. These criteria play a crucial role in evaluating the suppliers' output and then determining the appropriate purchasing amounts for the desirable ones. (Kasirian, et al., 2010)

2.4. Analytic Hierarchy Process

Analytic Hierarchy Method (AHP) is one of the most common methods to use when choosing suppliers. AHP makes trade-offs in pair-wise comparative matrices between quantitative and qualitative factors, developed by decision-makers, and rates potential suppliers. (Kasirian, et al., 2010) AHP could be used to systematically combine various evaluators' assessments and collect the weights of qualitative parameters. (Yang & Chen, 2006)

3. Conceptual Framework

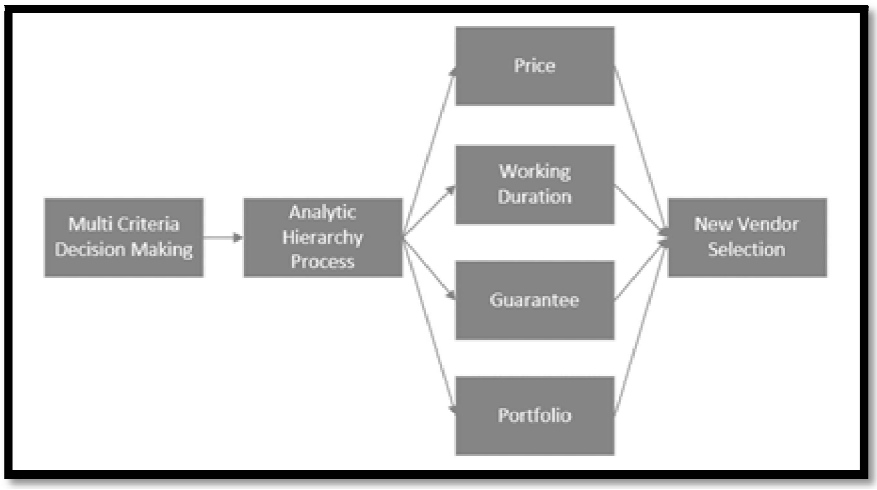

Figure 1: Conceptual Framework of SINI Company Supplier Selection
Source: Researcher Analysis

Figure 1 describes the conceptual framework of SINI supplier selection. In the conceptual framework of supplier selection at SINI Company, the main problem is the errors in the selection process of previous suppliers. The goal of this study is to choose the right new supplier to continue developing apps supporting SINI Device Tracker that are being developed by SINI Company. The supplier selection process is carried out using one of the Multi-Criteria Decision-Making (MCDM) process analytic methods, the Analytic Hierarchy Process (AHP). MCDM and AHP are used because there is more than one criterion taken into consideration in selecting suppliers for SINI Company, there are Price, Working Duration, Guarantee, and Portfolio. These criteria are the main criteria in determining suppliers' choice to be processed using AHP to choose the right supplier.

4. Methodology

This research uses problem solving format by using qualitative approaches and, and also using Analytic Hierarchical Process (AHP) in the process of vendor selection for the development process of SINI mobile apps. In this research, the qualitative approaches that being used are study literature, interview, consultation and a focus group discussion (FGD). The quantitative data for AHP comes from the result of the interview between researcher and new vendors that will be assessed for the vendor selection of SINI by using AHP.

For the interview, researcher using purposeful sampling technique. Purposeful sampling means researchers actively choose participants who understand the core phenomenon or the main idea being studied, and it related to the research conducted by the researcher. For data collection, researcher conduct an interview to IT Expert, SINI pervious mobile apps vendor, new vendor, and internal team of SINI.

The number of IT expert that interviewed by researcher are five experts. The purpose of holding interviews with IT expert is to consult and find out how the expert did the development of mobile apps until the success stages. This interview also helps the researcher to find out several things, such as:

- The strategies are used by experts in developing mobile apps.
- The alternatives solution that might be available for SINI mobile apps development problem
- The criteria that should be considered to select the best alternatives solution

The purpose of holding interviews with SINI last mobile apps developer is to determine how is the real problem that they faced in the development process of SINI apps. This interview also helps the researcher to find out several things, such as:

- The root cause of the bugs in SINI mobile apps development
- The point of view of SINI last apps developer regarding SINI apps development
- To know that the last apps developer can or cannot continue the apps developer

For vendor selection process, researcher interviewing four software house that will be assessed by using AHP to selecting new vendor for SINI mobile apps development. The criteria of vendor selection that determined by SINI are Price, Working Duration, Guarantee, and Portfolio. The purpose of holding interviews with new software house is to determine how the software house can solve the problem of apps development and if the software house match with SINI needs. This interview also helps the researcher to find out several things, such as:

- The portfolio of Software House
- The pricing of software house in terms of mobile apps development
- Ideal working time to develop a mobile app
- The availability of guarantee that offers by software house

5. Analysis and Result

5.1. Root Cause Analysis

The tool used to find the root cause of this problem is the Current Reality Tree (CRT). In the process of making Current Reality Tree, researcher creating a focus group discussion forum with the CEO and staff of SINI company to find out the problems of android mobile apps in SINI company. To analyze what is the root cause, researcher also held an interview with SINI last apps developer.

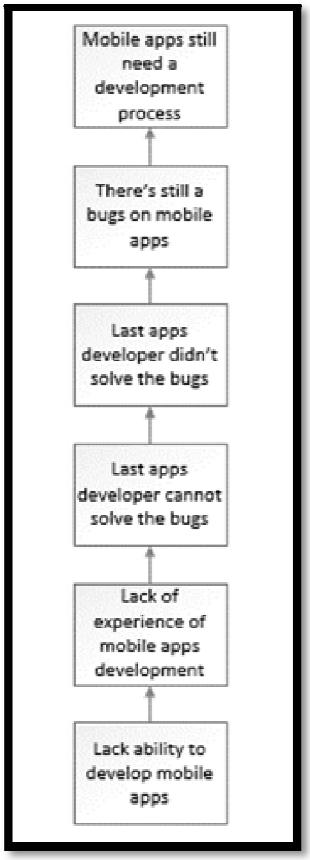

Figure 2: Current Reality Tree of SINI Mobile Apps Development Problem
Source: Researcher Analysis Based on Interview Result with Previous Vendor

Figure 2 describes current reality tree of SINI mobile apps development problem. This mobile apps still needs a development process to solve the bugs of the connection between mobile apps and the device tracker, but SINI previous developer cannot continue the development of SINI mobile apps. Based on the interview with SINI previous mobile apps, researcher found that the vendors still lack of ability to develop a mobile apps for tracking device. This conclusion is supported by several facts that researchers found during the interview process. First, this vendor just established a software house in August 2019 and received a project from SINI in September 2019. SINI device tracker project is the second project developed by this vendor. After being traced, this vendor is under an agricultural company and focuses on developing applications to optimize agricultural systems, so it can be concluded that this vendor is not experienced in developing mobile apps and device trackers. For this vendor's systems, they are still outsourcing the human resources to other teams to develop mobile apps, and this other team being their partner in working on every project they receive.

5.2. Business Solution Alternatives

To determine the alternative solution, researcher held an interview and consultation with five experts in mobile apps development. Based on the interview, the researcher found three alternatives that can be used as the solution for the problem of mobile apps development in SINI company, there are:

- Returning to SINI previous mobile apps developer, continuing mobile apps development.
- Find new mobile apps developer, continuing SINI mobile apps development by bringing SINI last mobile apps to the new vendor.
- Find new mobile apps developer and creating new SINI mobile apps.

5.3. Analysis of Alternatives

- Returning to SINI previous mobile apps developer, continuing mobile apps development.
- This alternative cannot be chosen because the SINI last apps developers still lack experience and knowledge in making mobile apps that support SINI Device Tracker, besides that they are also still outsourcing to other parties to develop mobile apps that their clients request.
- Find new mobile apps developer, continuing SINI mobile apps development by bringing SINI last mobile apps to the new vendor.

In this alternative, several mobile apps developer options are needed and it requires careful preparation, starting from determining vendor criteria in accordance with SINI needs obtained from focus group discussions with the internal SINI team.

It takes a decision-making process from these criteria in selecting a new developer, the multi-criteria decision-making methodology used in this case is the Analytic Hierarchy Process (AHP). After selecting the best mobile apps developer to become a vendor for SINI, the next step is to transfer the SINI last mobile apps source-code that have been developed by previous apps to new developer apps. This step is possible, but it is not certain that all mobile apps developed by previous developers can be continue to be developed by new developers. This possibility occurs because of the different logic in coding, differences in the programming language used, and various other obstacles.

In addition, this alternative also takes longer time of development, because new developer apps need an additional 2 weeks to 1 month of time to check the source code and also mobile apps that have been developed by previous mobile app developers. If from this examination the new apps developer states that they can continue the development of the previous SINI mobile apps, then the development can continue, and if not, then a new mobile apps development is needed to support the SINI device tracker function. After that the contract and agreement between the new mobile apps with SINI should be made.

5.3.1. Find New Mobile Apps Developer and Creating New SINI Mobile Apps

This alternative has a similarity of the procedure to the alternative to continue the development of SINI mobile apps with a new vendor. Still, the difference is that in this alternative, SINI has agreed to create new mobile apps with new developers as well. If this alternative is chosen, the chances of success will be very high because mobile apps are made from scratch and adapted to the SINI device tracker hardware so that all functions can be carried out properly, there is also a new agreement between SINI and a new app developer, there is a guarantee that new developers are experienced in developing mobile apps, and the process will be faster when it compared to the second alternative. However, if this alternative is chosen, the costs that should be paid by SINI will be higher because the development of the mobile app starts from scratch

5.4. New Vendor Selection

5.4.1. Criteria of New Vendor Selection

Based on the focus group discussion between the researcher and the internal SINI company, four criteria were obtained to select a new vendor to continue the development process of SINI android mobile apps. The four criteria are:

- Price
- Working Duration
- Guarantee
- Portfolio

5.4.2. Hierarchy Model

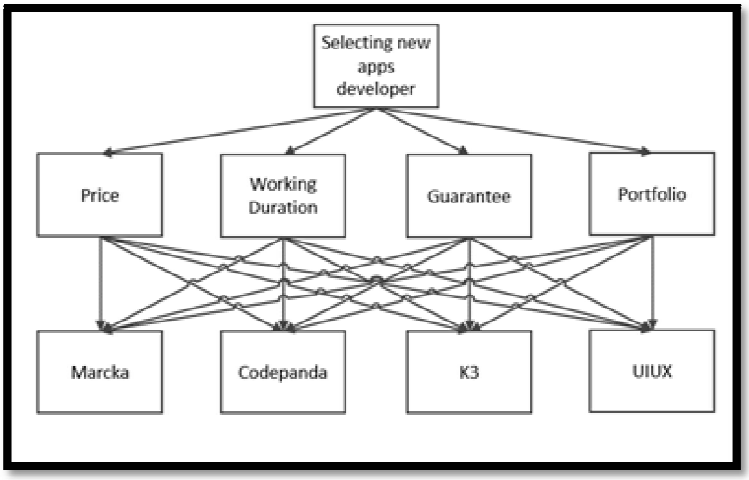

Figure 3: Hierarchy Model of SINI New Vendor Selection Process
Source: Researcher Analysis

Figure 3 describes hierarchy model of SINI vendor selection process. Based on this hierarchy model, from the top until the bottom, the first level contains the goals, the second level containing the criteria, and the third level contains the alternatives option. The goals of this Analytic Hierarchy Process are to selecting new apps developers. The criteria used in this hierarchy model are price, working duration, guarantee, and portfolio. The vendors that are the alternatives to be chosen as the new developer of the SINI mobile apps are Marcka, Codepanda, K3, and UIUX.

5.4.3. Vendor Comparison

Vendor	Price (Rp)	Working Duration	Guarantee	Portfolio (IT Project)
Marcka	Rp20,000,000	2 - 6 Month	<1 Month	3
Codepanda	Rp5,000,000 - Rp10,000,000	3 Month	2 - 3 Month	31
K3	Rp5,000,000	2- 3 Month	2 Month	6
UIUX	Rp3,000,000 - Rp5,000,000	1- 3 Month	<1 Month	10

Table 1: New Vendor Comparison
Source: Researcher's Interview Result with New Vendors

Table 1shows the comparison between four vendors based on the criteria of vendor selection for SINI mobile apps development, there are price, working duration, guarantee, and portfolio of IT project for each vendor.

5.4.4. Analytic Hierarchy Process

5.4.4.1. For Criteria

Criteria	Price	Working Duration	Guarantee	Portofolio
Price	1.00	0.20	0.14	0.33
Working Duration	5.00	1.00	0.33	3.00
Guarantee	7.00	3.00	1.00	5.00
Portofolio	3.00	0.33	0.20	1.00
Total	16.00	4.53	1.68	9.33

Table 2: Paired Comparison Matrix for Criteria of Vendor Selection

Table 2 show the paired comparison matrix for the criteria of new vendor selection in SINI. The comparison value of each paired criteria comes from the interview result held by the researcher with internal of SINI. The goals of the interview are to determine the priority of SINI to selecting vendor based on the criteria that being used. The comparison value is determining the priority of each criteria to other criteria.

Criteria	Price	Working Duration	Guarantee	Portofolio	Total	Average
Price	0.06	0.04	0.09	0.04	0.23	0.06
Working Duration	0.31	0.22	0.20	0.32	1.05	0.26
Guarantee	0.44	0.66	0.60	0.54	2.23	0.56
Portofolio	0.19	0.07	0.12	0.11	0.49	0.12

Table 3: Eigen Value for Criteria of Vendor Selection

Table 3 shows the eigen value for the criteria that being used for new vendor in SINI, and this is the result of synthesis of priority criteria. The average of eigen value comes from the total of eigen value per rows divided by the number of criteria. The average of eigen value describes the priority between one criterion to another, and the result is Guarantee have the highest priority than another criterion.

CI = (λmax-n)/(n-1)		
	λmax	4.177
	CI	0.059
	CR = CI/RI	
	CR	0.065

Table 4: Consistency Index and Consistency Ratio for Criteria of Vendor Selection

Table 4shows the consistency index and consistency ratio for Criteria of new vendor selection in SINI. Because the consistency ratio is below 0.1, so the data and judgement are correct because it has a good consistency.

5.4.4.2. For Price

Price	Marcka	Codepanda	K3	UIUX
Marcka	1.00	0.20	0.14	0.11
Codepanda	5.00	1.00	0.50	0.33
K3	7.00	2.00	1.00	0.33
UIUX	9.00	3.00	3.00	1.00
Total	22.00	6.20	4.64	1.78

Table 5: Paired Comparison Matrix for Price

Table 5shows paired comparison matrix for price criteria from the four option of new vendor for SINI. The comparison value of each paired vendor comes from the interview result held by the researcher with the vendor. The result this interview extracted into a table of vendor comparison (*Table 1. Vendor Comparison*). The comparison value is determining the priority of each vendor to other vendors in terms of price that offers by each vendor regarding to their services for mobile apps development.

Price	Marcka	Codepanda	K3	UIUX	Total	Average
Marcka	0.05	0.03	0.03	0.06	0.17	0.04
Codepanda	0.23	0.16	0.11	0.19	0.68	0.17
K3	0.32	0.32	0.22	0.19	1.04	0.26
UIUX	0.41	0.48	0.65	0.56	2.10	0.53

Table 6: Eigen Value for Price

Table 6 shows the eigen value for the price criteria of new vendor selection for SINI. The average of eigen value comes from the total of eigen value per rows divided by the number of vendors. The average of eigen value describes the priority between one vendor to another, and the result is UIUX have the highest priority than another vendor in terms of price criteria.

CI = (λmax-n)/(n-1)		
	λmax	4.146
	CI	0.049
	CR = CI/RI	
	CR	0.054

Table 7: Consistency Index and Consistency Ratio for Price

Table 7 shows the consistency index and consistency ratio for price criteria of new vendor selection in SINI. Because the consistency ratio is below 0.1, so the data and judgement are correct because it has a good consistency

5.4.4.3. Working Duration

Working Duration	Marcka	Codepanda	K3	UIUX
Marcka	1.00	0.20	0.17	0.11
Codepanda	5.00	1.00	0.33	0.25
K3	6.00	3.00	1.00	0.33
UIUX	9.00	4.00	3.00	1.00
Total	21.00	8.20	4.50	1.69

Table 8: Paired Comparison for Working Duration

Table 8shows paired comparison matrix for working duration criteria from the four option of new vendor for SINI. The comparison value of each paired vendor comes from the interview result held by the researcher with the vendor. The result this interview extracted into a table of vendor comparison (*Table 1. Vendor Comparison*). The comparison value is determining the priority of each vendor to other vendors in terms of working duration that offers by each vendor regarding to their services for mobile apps development.

Working Duration	Marcka	Codepanda	K3	UIUX	Total	Average
Marcka	0.05	0.02	0.04	0.07	0.17	0.04
Codepanda	0.24	0.12	0.07	0.15	0.58	0.15
K3	0.29	0.37	0.22	0.20	1.07	0.27
UIUX	0.43	0.49	0.67	0.59	2.17	0.54

Table 9: Eigen Value for Working Duration

Table 9shows the eigen value for the working duration criteria of new vendor selection for SINI. The average of eigen value comes from the total of eigen value per rows divided by the number of vendors. The average of eigen value describes the priority between one vendor to another, and the result is UIUX have the highest priority than another vendor in terms of working duration criteria.

CI = (λmax-n)/(n-1)		
	λmax	4.234
	CI	0.078
	CR = CI/RI	
	CR	0.087

Table 10: Consistency Index and Consistency Ratio for Working Duration

Table 10shows the consistency index and consistency ratio for working duration of new vendor selection in SINI. Because the consistency ratio is below 0.1, so the data and judgement are correct because it has a good consistency.

5.4.4.4. For Guarantee

Guarantee	Marcka	Codepanda	K3	UIUX
Marcka	1.00	0.14	0.20	1.00
Codepanda	7.00	1.00	3.00	7.00
K3	5.00	0.33	1.00	5.00
UIUX	1.00	0.14	0.20	1.00
Total	14.00	1.62	4.40	14.00

Table 11: Paired Comparison for Guarantee

Table 11 shows paired comparison matrix for guarantee criteria from the four option of new vendor for SINI. The comparison value of each paired vendor comes from the interview result held by the researcher with the vendor. The

result this interview extracted into a table of vendor comparison (*Table 1. Vendor Comparison*). The comparison value is determining the priority of each vendor to other vendors in terms of guarantee that offers by each vendor regarding to their services for mobile apps development.

Guarantee	Marcka	Codepanda	K3	UIUX	Total	Average
Marcka	0.07	0.09	0.05	0.07	0.28	0.07
Codepanda	0.50	0.62	0.68	0.50	2.30	0.57
K3	0.36	0.21	0.23	0.36	1.15	0.29
UIUX	0.07	0.09	0.05	0.07	0.28	0.07

Table 12: Eigen Value for Guarantee

Table 12shows the eigen value for the guarantee criteria of new vendor selection for SINI. The average of eigen value comes from the total of eigen value per rows divided by the number of vendors. The average of eigen value describes the priority between one vendor to another, and the result is Codepanda have the highest priority than another vendor in terms of guarantee criteria.

CI = (λmax-n)/(n-1)	
λmax	4.129
CI	0.043
CR = CI/RI	
CR	0.048

Table 13: Consistency Index and Consistency Ratio for Guarantee

Table 13shows the consistency index and consistency ratio for guarantee that offered by each new vendor for vendor selection in SINI. Because the consistency ratio is below 0.1, so the data and judgement are correct because it has a good consistency.

5.4.4.5. For Portfolio

Portfolio	Marcka	Codepanda	K3	UIUX
Marcka	1.00	0.11	0.33	0.25
Codepanda	9.00	1.00	7.00	5.00
K3	3.00	0.14	1.00	0.50
UIUX	4.00	0.20	2.00	1.00
Total	17.00	1.45	10.33	6.75

Table 14: Paired Comparison for Portfolio

Table 14shows paired comparison matrix for portfolio criteria from the four option of new vendor for SINI. The comparison value of each paired vendor comes from the interview result held by the researcher with the vendor. The result this interview extracted into a table of vendor comparison (*Table 1. Vendor Comparison*). The comparison value is determining the priority of each vendor to other vendors in terms of portfolio.

Portfolio	Marcka	Codepanda	K3	UIUX	Total	Average
Marcka	0.06	0.08	0.03	0.04	0.20	0.05
Codepanda	0.53	0.69	0.68	0.74	2.64	0.66
K3	0.18	0.10	0.10	0.07	0.45	0.11
UIUX	0.24	0.14	0.19	0.15	0.71	0.18

Table 15: Eigen Value for Portfolio

Table 15 shows the eigen value for the portfolio criteria of new vendor option for SINI. The average of eigen value comes from the total of eigen value per rows divided by the number of vendors. The average of eigen value describes the

priority between one vendor to another in terms of portfolio, and the result is Codepanda have the highest priority than another vendor in terms of portfolio.

CI = (λmax-n)/(n-1)		
	λmax	4.18407
	CI	0.06136
	CR = CI/RI	
	CR	0.06817

Table 16: Consistency Index and Consistency Ratio for Portfolio

Table 16shows the consistency index and consistency ratio for portfolio of new vendor option for SINI. Because the consistency ratio is below 0.1, so the data and judgement are correct because it has a good consistency.

5.5. Result

Final Result		Ranking
Marcka	0.06	4
Codepanda	0.45	1
K3	0.26	2
UIUX	0.23	3

Table 17: Final Result of Analytic Hierarchy Process of New Vendor Selection

Table 17shows the final result of analytic hierarchy process of new vendor selection for SINI mobile apps development. On the analytic process, researcher using four criteria such as Price, Working Duration, Guarantee, and Portfolio. Each vendor analyzed by using these four criteria. The result of AHP shows that Codepanda is the best vendor that fit with SINI needs of new vendor to continue SINI mobile apps development. The highest score on the final results reflects that Codepanda more feasible than another vendor to choose because it meets four criteria of selecting vendor for SINI company.

6. Conclusion and Recommendation

There are three alternative solutions that could be implemented by SINI to continue the development of mobile apps. The first solution is to return to the previous vendor to continue developing mobile apps, the second solution is to find a new vendor who can continue the development of the mobile apps, and the last solution is to find a new vendor to create new mobile apps to support the function of the SINI device tracker. However, the first solution could not be implemented, so the option that available is to select a new vendor by using AHP. SINI would consider four criteria in choosing a new vendor, such as the aspects of price, length of work, guarantee, and the portfolio of the new vendor. There are four new vendor choices for developing mobile apps SINI, and there are Marcka, Codepanda, K3, and UIUX. To assess the vendors based on the four criteria, the researcher conducted personal interviews with the four vendors. Researcher collect the data that needed to carry out the Analytic Hierarchy Process related to vendor selection from the results of the interview to each vendor. Based on the result of paired comparison, the guarantee has an average eigenvalue higher than the other criteria, so the guarantee value occupies the greatest weight in the vendor selection assessment. Based on the results of the AHP conducted to select vendors, the researcher found that Codepanda is the vendor that ranks first to be chosen by SINI because it has the highest score on vendor assessments using AHP. The highest score reflects that Codepanda is a more feasible vendor to choose because it meets the four SIN criteria in selecting vendor. This research can be used as a reference by SINI in choosing the right vendor for each project that will be undertaken if you need external resources such as IT developers. The vendor is an important aspect of the company's supply chain that determines its success. For future research, it will be needs to analyze the strategy of having a good partnership between vendors and new technology startup and the strategy of creating a requirement and contract with new vendor to supporting the vendor selection activities in new technology startup.

7. References

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