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MEASURING THE TECHNOLOGICAL INNOVATIVENESS IN PT DIRGANTARA INDONESIA, CASE : THE DEVELOPMENT OF AIRCRAFT N219

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Many management experts who claim that innovation is one of the guarantees for the company or organization in improving its competitiveness. But how to respond to and anticipate the pace through innovation is not simple and easy to do. In the word Economic Forum, there are many companies in Indonesia which is seen as less innovative, although Indonesia was ranked 38th in general and ranking 33 of 148 countries in the innovation pillar. Since 2006, PT Dirgantara Indonesia aircraft N219 develop capacity of 19 people to replace existing aircraft pioneer. Indonesian manufacturing companies need to improve their innovation and thus they require some measurement framework to help them achieve it. As background the importance of innovation for companies in Indonesia, researchers provide a theoretical review of measurement innovation activities based on technological innovation and management innovation itself. This final project is to identify activities of innovation and management of innovation at PT Dirgantara Indonesia for the development of aircraft N219. Measurement of innovation categorized into CLAS-Category (Category Creative, Lucky Category, Automatic Category and Superb Category). In collecting the data, the sample used is 50 people by distributing questionnaires to employees and interview people in the top management ranks in PT Dirgantara Indonesia. The results of this study are PT Dirgantara Indonesia has conducted several activities have supported innovation and management innovation for the development of several aircraft N219, but it still needs to be improved and enhanced return. In the measurement of innovation, PT Dirgantara Indonesia fall into the superb category of innovation though not yet reached the highest point. That is, PT Dirgantara Indonesia is a company that enjoys and benefits from the employee's ability to perform the required activities of the company during the process of innovation and good for the environment as well as the impact of the innovation practices of good management in the areas of strategy, resources, and operations.

Keywords: The activities of innovation, The management of innovation, and Innovation measurement.

Introduction

Many management experts who claim that innovation is one of the guarantees for the company or organization in improving its competitiveness. The statement was widely supported by the results of research or empirical evidence. Various indicators show that the innovation or other factors which may cause the relevant circumstances relatively backward economic development and welfare of its people. But how to respond to and anticipate the pace through innovation is not simple and easy to do. Thus, many companies competing to create and develop innovative because they think innovation is an important source can make companies compete and excel in the good name of the company to be good in the eyes of customers (Aldianto, 2014). Furthermore, encourage technological innovation and national competitiveness, therefore, countries encourage companies to develop and improve the management of innovation and performance (Chiesa, Coughlan, and Voss, 1996 in Aldianto, 2014).

In the world economy, various indicators suggest that Indonesia still lags behind other countries that have led to the era of information and globalization. It can be seen from the indicators of the Global Competitiveness Index, ICT Development Index, E-Readiness, Network Readiness Index and Human Development Index is an indicator that is often used to measure the extent to which a country's position in the competitive environment and innovation. There are many companies in Indonesia which is seen as less innovative, although Indonesia was ranked 38th in general and ranked 33 of 148 countries in the innovation pillar (World Economic Forum, 2013 in Aldianto, 2014). In the list of most innovative companies, there are 15 companies from Asia but Indonesia is not one company that entered into the list of the most innovative companies (Arndt and Einhorn, 2010).

Therefore, since 2006, PT Dirgantara Indoneisa develops aircraft N219 capacity of 19 people to replace existing aircraft pioneer. Currently, the aircraft aerodynamic test has been completed. Company competence in the field of design and production of aircraft must be maintained and developed in order to work as an aerospace industry that is whole and complete through vehicle development program and production of new aircraft.Indonesian manufacturing firms need to improve their innovation and thus they require some measurement framework to help them achieve it. In this study, innovation refers to technological innovation, which is defined as: the tendency of companies to make technological innovations, which include the development of new products or services and provide a new process for creating a product or service. As a background the importance of innovation for companies in Indonesia, researchers provide a theoretical review of the measurement of innovation activities based on technological innovation and management innovation itself.

Literature Review

Definition and Understanding of Innovation

Innovation is one of the corporate choice to face market competition and sustainable management. (Fagerberg, Srholec, and Verspagen, 2010) considers innovation as the efforts of the company through the use of technology and information to develop, produce and market new products for the industry. In other words, innovation is the modification or invention ideas for continuous improvement and development to meet customer needs.

(Pervaiz and Shepherd, 2010) innovation companies can generate R & D (Research and Development), production and marketing approach and ultimately lead to the commercialization of these innovations. In other words, innovation is the process of realizing a new idea, which is different from the first, by means of production or to make it come true, where innovations including the generation of evaluation, and implementation of new concepts. Where the use of new and different methods and technologies to improve the quality or lower cost, to meet or exceed the company target.

(Schumpeter, 1949) states that innovation consists of five elements, namely:
1. Introducing a new product or a qualitative change in an existing product.
2. Introducing the new process to the industry.
3. Opening new markets.
4. Developing new sources of supply of raw materials or other inputs.
5. Changes in industrial organization.

Seen that there are some fundamental similarities of the concept of innovation, which is something new, either in the form of ideas, goods, processes, or services. But things that still shows the differences are how to scope and to measure the innovation. Measurement is done by evaluating

the innovation inputs, processes and outputs of innovation. This study focuses on the measurement of the innovation process because it can lead the company to perform innovation.

Innovation Process

Three innovation phases: initiation-phse, development-phase, and diffusion-phase (Hansen and Birkinshaw, 2007). Data are analyzed and activities (together with the related management actions) are collected in specific groups, which have led to the variables of the measurement model (illustrated in Figure 1) as follow:

In the Initiation Phase

Initiation phase is the beginning of the project. In this phase, the idea for the project is explored and elaborated. The goal of this phase is to examine the feasibility of the project. In addition, decisions are made concerning who is to carry out the project, which party (or parties) will be involved and whether the project has an adequate base of support among those who are involved (Wijnen, 2004 and Kor, 2002). In this phase is divided into two parts : Conceiving ideas and Acquiring information and transforming it into knowledge (Aldianto, 2014).

1. Conceiving ideas

This phase, in which people generate ideas, is one of the important steps in innovation. Activities at this stage as to cooperate and collaborate with other companies, build relationships and work with customers and key opinion leaders, follow the developments in technology and products, learn new technologies, and working closely with sister companies within the group of companies (Aldianto, 2104).

2. Acquiring information and transforming it into knowledge

This phase is important because here the idea is to work to be opportunity to work together with other companies for specific purposes, for example, become a distributor or do co-marketing, reverse engineer, conducting joint research with universities or other research institutions, and conduct research with other research institutions (Aldianto, 2014).

In the Development Phase

During the development phase, everything that will be needed to implement the project is arranged. Potential suppliers or subcontractors are brought in, a schedule is made, materials and tools are ordered, instructions are given to the personnel and so forth. The development phase is complete when implementation is ready to start. All matters must be clear for the parties that will carry out the implementation (Wijnen, 2004 and Kor, 2002). In this phase is divided into two parts : Implementing and validating knowledge and Checking the appropriateness of the selected product regarding several aspects in marketing, operation, and finance (Aldianto, 2014).

3. Implementing and validating knowledge

In this phase, the company has mastered several technologies (knowledge) and they need proof that they can make something of it. Such, the company began to build trust with various stakeholders, working on small projects to build experience and follow product development projects in one or more phases, such as design, production, testing and sales (Aldianto, 2014).

4. Checking the appropriateness of the selected product regarding several aspects in marketing, operation, and finance

Companies need to think in a broader view than just the product. In order to increase the likelihood that the innovation will happen they need to ensure that candidates are selected according innovation by such actions, conduct market research to develop a product, evaluate the readiness of technology companies, including necessary equipment and human knowledge and skills, build

capabilities according to the standard production industry, and do a quick interim results to demonstrate the advantages of the product developed (Aldianto, 2014).

In the Diffusion Phase

This phase involves the construction of the actual project result. The diffusion phase is the doing phase, and it is important to maintain the momentum (Wijnen, 2004 and Kor, 2002). In this phase is divided into two parts : Commercializing phase 1: Getting customers or users and acquiring their feedback and Commercializing phase 2: Go and scaling up the project (Aldianto, 2014).

5. Commercializing phase 1: Getting customers or users and acquiring their feedback
The first step in this phase requires companies to get first customers so they get money and information for improving the product: making further prototype and exploring variety of features and applications, cooperate with other companies, focusing on low risk low profit projects for building trust and getting quick approval, and working on improvement based on customers feedback (Aldianto, 2014).

6. Commercializing phase 2: Go and scaling up the project
In this last phase companies have to exploit the product further with some activities like: Offering products/services widely through spin-off companies or sister companies, collaborating and benchmarking with best companies, and building better supply and distribution channel (Aldianto, 2014).

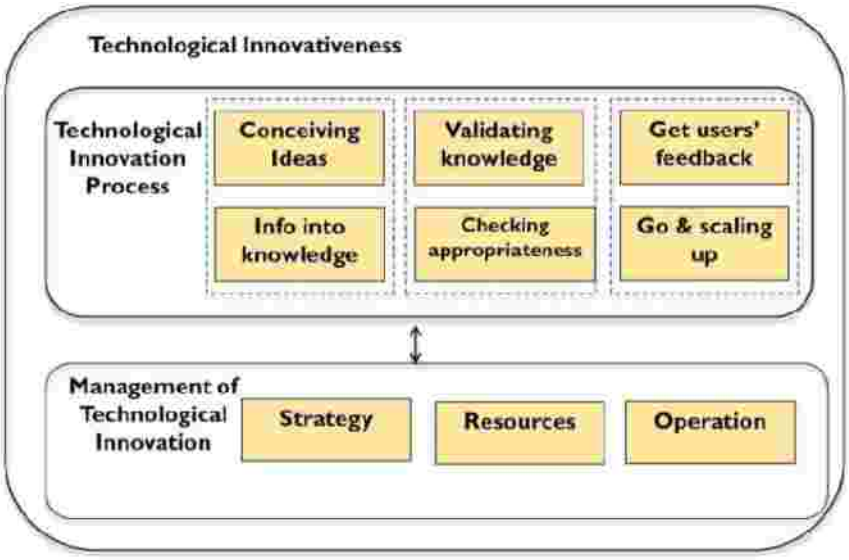

Figure 1. The innovativeness measurement model (Aldianto, 2014).

In the area of the management of innovation, companies have disclosed their practices and concerns in the issues related to (can be seen Figure 1) : required competences and the tools & facilities, human-related (such as leadership, reward, and training), governance, external factors, and the timing of the innovation (Aldianto, 2014). They are then categorized in the following group:

1. Some management practices in area that is related with strategy such as a willingness to work on additional small innovations and open to learn about the latest developments, and willingness to incorporate collaborative projects with more advanced companies, has particular competence and continue to develop it. (Aldianto, 2014).

2. Some management practices in area that is related with resources such as provide the necessary tools and facilities, are willing to hire experienced experts or consultants as champion, establishing and developing the entrepreneurial behavior, giving project for employees to exercise and build their competence further by setting up training (Aldianto, 2014).

3. Some management practices in area that is related with operation such as clear instructions from the top management to all companies in the group, the decision-making process clearly and quickly, using a dedicated team for product development, and the use of standard procedures (Aldianto, 2014).

Innovation Measurement

To determine a company's innovativeness position in a four-box category, named CLAS-Category (Aldianto, 2014), which is described below:

Creative Category: Innovativeness of companies making creative innovation
This innovation category indicates that the actions of employees in companies doing creative activities required during the process of innovation. However, the company does not fully support them with the necessary management practices in the areas of strategy, resources, and operations to create a good environment for creating innovation. Innovation is the tendency of companies in this category innovation driven by the innovations that came out of the capabilities, competence, and creativity of employees. They create innovative, even with little support from management (Aldianto, 2014).

Lucky Category: Innovativeness of companies making accidental innovation
Innovation category is characterized by only a few actions the company's employees in performing the activities required during the process of innovation and the company does not provide a good environment in which management practices required in the areas of strategy, resources, and operations to support innovation. The company in this category is calculated as a company with a low innovation, which deliberately makes regular innovation and think only luck (Aldianto, 2014).

Automatic Category: Innovativeness of companies making rational innovation
Innovation category is characterized by companies that prepare good environment for innovation by management practices needed in the areas of strategy, resources, and operations. However, employees do not often perform activities necessary for the innovation process. It is rationally expected employees to innovate in these companies well managed when the management adding new tools, gain new procedures, or new hire experts. So, this innovation category is the tendency of companies to conduct innovation driven by management actions but limited in areas that do not require a lot of innovation activities out of the employee's ability, competence, and creativity (Aldianto, 2014).

Superb Category: Innovativeness of companies making comprehensive innovation
Innovation category is characterized by companies that enjoy and benefit from the ability of employees to perform well company activities required during the process of innovation and also a good environment for innovation as the effect of good management practices in the areas of strategy, resources, and operations. It is expected that the company is able to make the innovation category comprehensive technological innovation that requires competence and good support from the employees in the company (Aldianto, 2014).

METHODOLOGY

This research using quantitative method. This study were obtained through interviews and spreading questionnaire given to the employees of PT Dirgantara Indonesia. In likert scale,

respondent specify their level of agreement to a statement. Likert scale is a psychometric scale commonly used in questionnaires in doing survey research. 4 variables used are :

1. Never : We never do/ have this activity.
2. Rarely : We rarely do/ have this activity
3. Often : We often do/ have this activity
4. Always : We always do/ have this activity

Following is the example of Likert Scale from questionnaire :

SECTION 1 : The actvities in the innovation process					
INITIATION PHASE					
No	Statement	Never	Rarely	Often	Always
1	We have reguler meeting with our customers and key opinion leaders to discuss problems and ideas.	1	2	3	4

After getting the results of the questionnaire respondents, to calculate the results of the questionnaire the researcher using a predetermined weighting factors in Table 1 below. So that would be obtained from the questionnaire analysis.

Table 1. Weight Factor (Aldianto,2014)

Criteria	Weight factor sub-criteria	Weight factor criteria
Activities		.333
Conceiving ideas	.225	
Acquiring information	.098	
Implementing & validating	.098	
Checking the appropriateness	.177	
Commercializing Phase I	.225	
Commercializing Phase II	.177	
Management of innovation		.667
Strategy related	.500	
Resources related	.250	
Operation related	.250	

Sampling method is by convenience sampling method with non-probability sampling approach, which is when respondent were sampled at the study site. Determination of the number of respondent is determined by the slovin's formula.

$$n = \frac{N}{1+N.e^2}$$

Where,
n = Number of minimum sample,
N = Number of population
e = Error level that desired

Total employees at PT Dirgantara Indonesia is 4070 people. Researchers take the population size (N) refers to the total employees in the division of management programs under the Directorate of Technology and Development at 111 people. Because the researchers focused on process-related innovation aircraft N219 which only employees in the division of management programs. Based on Slovin method above, the amount of sample with population size (N) equal to 111 people and the error standard of 10%. So that researchers can calculate the sample size using Slovin formula, as follows:

$$n = \frac{111}{1+111.0,1^2} = 52,61 \approx 53 \text{ Sample}$$

Result of Measuring Innovation in PT Dirgantara Indonesia

Average results of each phase activities in the innovation and a related group of management of technological innovation at aircraft N219 obtained from the results of the quetionnaires are as follow Table 2 :

Table 2. The Average Results

Criteria		Average
Activities		
Initiation Phase	Conceiving Ideas	2,933
	Acquiring Information	2,769
Development Phase	Implementing & Validating	2,558
	Checking the Appropriateness	2,780
Diffusion Phase	Commercializing Phase I	3,132
	Commercializing Phase II	3,005
Management of Innovation		
Strategy Related		2,709
Resources Related		2,740
Operation Related		2,488

Can see in Table 2, the average of the highest in the innovation process is the diffusion phase which is commercializing Phase I in the amount of 3,132 and commercializing Phase II in the amount of 3,005. This means that PT Dirgantara Indonesia in the process of innovation in aircraft N219 tended to be more frequent activity for technological innovation rather than support the activities of the management practices as we see in Figure 2.

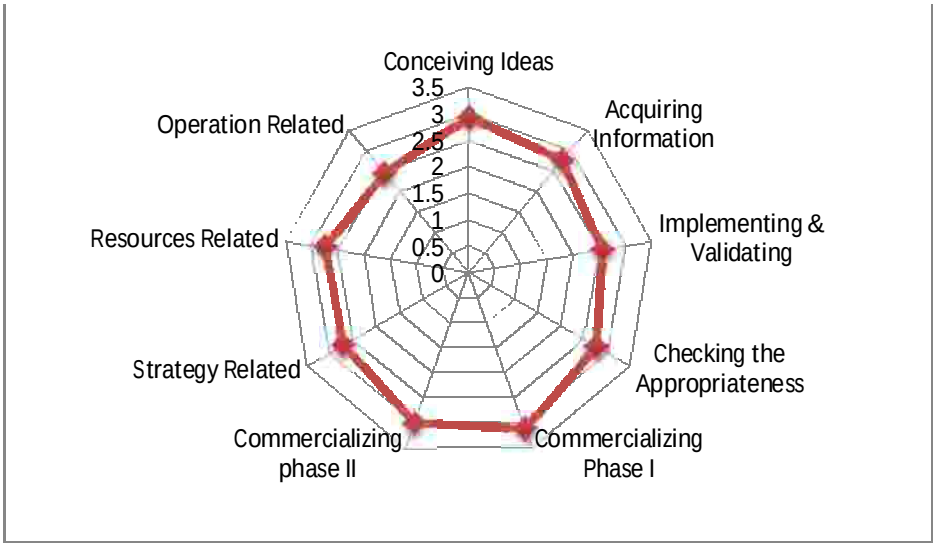

Figure 2 The innovativeness variables in PT Dirgantara Indonesia of aircraft N219

Table 3. Innovation Measurement Results

Criteria	Weight Factor Sub-criteria	Weight Factor Criteria	Average	The Result of Multiplaying	(Total The Result of Multiplaying x Weight Factor Criteria)
Activities of Innovation		0,333			0,969
Conceiving Ideas	0,225		2,933	0,660	
Acquiring information	0,098		2,769	0,271	
Implementing & Validating	0,098		2,558	0,251	
Checking the Appropriateness	0,177		2,780	0,492	
Commercializing Phase I	0,225		3,132	0,705	
Commercializing Phase II	0,177		3,005	0,532	
Total		0,333	17,176	2,910	0,969
Management of Innovation		0,667			1,775
Strategy Related	0,500		2,709	1,355	
Resources Related	0,250		2,740	0,685	
Operation Related	0,250		2,488	0,622	
Total		0,667	7,937	2,662	1,775

In the activities of innovation, the results point to determine the quadrant in measuring innovation aircraft N219 is 0.969 (can be seen in Table 3) . This figure is obtained from the calculation of the multiplication of the total weight factor Sub-factor with Average is 2.910. After that, multiplied by the Weight Factor Criteria is 0.333, the result obtained is 0.969. On the management of innovation, the results obtained from the total multiplication is 2.662 multiplied by the Weight Factor Criteria is 0.667, then the result is 1.775. So the point to define innovation in aircraft N219 PT Dirgantara Indonesia is the point at 0.969 on the activities of innovation and 1.775 on management of innovation.

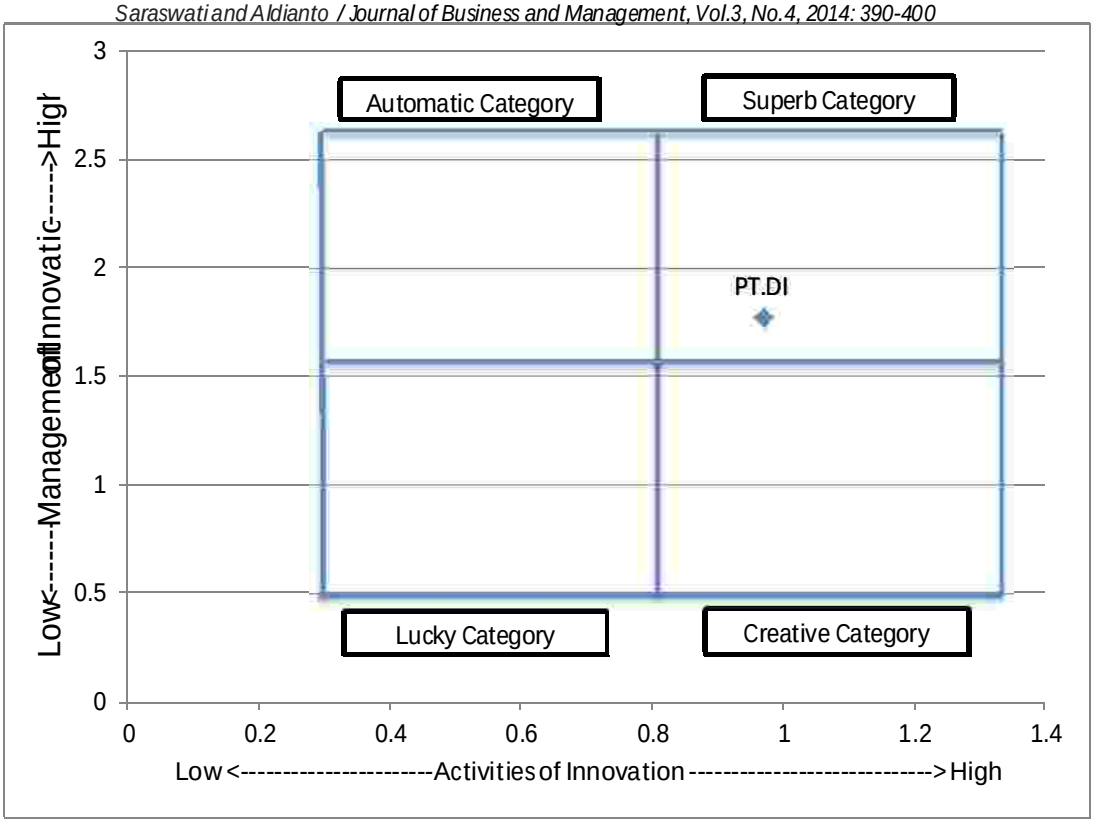

Figure 3. Innovativeness category at aircraft N219 in PT Dirgantara Indonesia

This is shown in Figure 4.5 that for technological innovation aircraft N219 sufficient support activities of innovation, but more often in variable the Get users' feedback and Go & scaling up. While the conduct of management of innovation in PT Dirgantara Indonesia unfavorable. Therefore, PT Dirgantara Indonesia fall into the category Superb, because PT Dirgantara Indonesia in activities of innovation are still many who have not done as, in cooperation with the company known as an innovator, developing new features and new variations, and following training. In addition, PT Dirgantara Indonesia also does not yet support multiple management of innovation such as, developing entrepreneurial behavior, appreciate innovative ideas from employees, and celebrate the success of innovation to motivate employees. This innovativeness category is characterized by companies that enjoy and benefit from the ability of employees to perform well the required activities during innovation process from start initiation phase, development phase to diffusion phase but at aircraft N219 in PT Dirgantara Indonesia still not stable. There is also good environment for innovation as a result of good management practices in areas of strategy, resources, and operation but for PT Dirgantara Indonesia is still lacking in management of innovation.

Conclusion

Activities of innovation that has been done by PT Dirgantara Indonesia related technological innovation aircraft at N219 more frequently in Getting customers or users and acquiring their feedback and Go and scaling up the project seperti they made a prototype to test and prototype broken for flight test aircraft, improve the product based on the needs and feedback from customers, work closely with other companies to distribute this product, building supplier and distribution lines are better than ever, discussions with experts to make policy, they intensified marketing efforts, especially branding. For other activities of innovation that is more rarely done by PT Dirgantara Indonesia. While in the management of innovation, PT Dirgantara Indonesia not support it so it is still low due strategy, resources and operation.

In CLAS category, PT Dirgantara Indonesia has entered the Superb category. If seen the point of innovation is still far from perfection. Thus, in aircraft technology innovation N219 is still fairly unstable and inconsistent. Because PT Dirgantara Indonesia in activities of innovation are still many who have not done as, in cooperation with the company known as an innovator, developing new features and new variations, and following training. In addition, PT Dirgantara Indonesia also does not yet support multiple management of innovation such as, developing entrepreneurial behavior, appreciate innovative ideas from employees, and celebrate the success of innovation to motivate employees.

Recommendation

From this research, these are several recommendation from the researcher that might help PT Dirgantara Indonesia improve the innovation technology :

- PT Dirgantara Indonesia must improve activities of innovation and management of innovation of the technological innovations so as to achieve the perfect superb category, such as reducing inventories to a level that is planned, using existing capacity as much as possible, do the planning together with all existing chain, and function distribution, all of which can be achieved through collaboration with business partners in a business network, see everything with thinking out of the box to alleviate any bottlenecks and production issues that have defined, always exploring the eccentric ideas and concepts that sounded absurd, as well as in teams to discuss their ideas and concepts can be transformed be a solution or a reasonable practice, and never lose persistency company to a successful issue resolved.
- To increase the respondents recommended further research and developed a questionnaire to all be valid.
- For further research can be examined in another division at PT Dirgantara Indonesia.
- It is recommended for further research to confirm that as well as examining the similarities and differences with other companies in the manufacturing sector, since this study only found differences in the content details of the activities and the management of innovation.
- Further study is also recommended to analyze whether the size of a company influences the innovativeness of that company.
- For further research may add other variables and innovation measurement results can be attributed to the commitment or performance of employees.

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