Implementation Analytical Hierarchy Process in Decision Making System of Information Technology Governance Based On COBIT 5 Framework Case Study: PT. Perkebunan Nusantara XI

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Abstract- **PT. Perkebunan Nusantara XI is one of State-own Enterprise that engaged to produce sugar cane in Indonesia. PT. Perkebunan Nusantara XI have 16 units of sugar mills and 1 subsidiary that focuses on Healthy Services with 7 hospitals. In order to make their business being optimal so that they implement Information Technology. In 2017, PT. Perkebunan Nusantara XI implement Enterprises Resources Planning (ERP) SAP for give them more efficiency and optimized in business process. Based on those situation, to make their investment being optimized and also increase their productivity, They need to make Information Technology (IT) governance.**

This research was conducted to choosing an IT goals using analytical hierarchical process and make analysis about the condition of IT governance in PTPN XI and next steps to fix the gap using COBIT 5. COBIT 5 is one of the best framework that focuses on IT governance field. COBIT 5 equip with a capability assessment models of IT process on a company and some attributes which concerned with each ability level of IT process. An expert had made decision about criteria needed in analytical hierarchical process and chosen IT goals in this research is IT Agility.

The results of this research show that maturity level system in PTPN XI is in level 1 as a performed process in the largely achieve. Top of management PTPN XI should be targeting in 5 years maturity level system in PTPN XI would be in level 5 as largely achieve

Index Terms- **ERP SAP, COBIT 5, Analytical Hierarchy Process.**

I. INTRODUCTION

Information is a key resource for all enterprises. Information is retrieved from all of data transactions give knowledge-based of Board of Directors and Executive Management to make any necessary decision in enterprises. Technology plays a key role in these actions. There are so many proven cases that technology gives full supports in every single platform of enterprise to help them get data and retrieve information rapidly. Technology is becoming pervasive n all aspect of business process. Enterprises and their executive strive about maintain quality of information to support their business decisions. They need to generate business value from IT-enable investments like achieve strategic goals, and realize business benefits through effective and innovative use of IT. Besides that, enterprises should to manage and maintain IT-related risk at an acceptable level and ensure optimizing the cost of IT services and technology in line with their business process. Board of Directors (BoD) and top management in enterprises have to embrace IT like any other significant part of their business. IT conduct the enterprises needed, being a part of good corporate governance (GCG) in optimize of investment in IT and it is mentioned in Law Ministry of State-Own Enterprises No. PER-01/MBU/2013.

COBIT 5 provides a comprehensive framework that assists enterprises to achieve their goals and deliver value through effective governance and management of enterprise IT. COBIT 5 helps enterprises get optimal value from IT by maintaining a balance between realizing benefits and optimizing risk level and resource use. COBIT 5 enables information and related technology to be governed and managed in a holistic manner for the entire enterprise, taking in the full end-to-end business and functional areas of responsibility, considering the IT-related interests of internal and external stakeholders.

There are so many domains in COBIT 5 and to optimize this research, the researchers use Analytical

Hierarchical Process (AHP) for choosing what is the first domain module that is implemented in PTPN XI. It is one of the multi-criteria decision making technique and is used to solve complex problem in various areas like political science, sociology and management process to evaluate multiple types of project in complex technical-economics issues.

PT. Perkebunan Nusantara XI (PTPN XI) is one of the state own company that produce sugar cane and molasses in Indonesia. PTPN XI have 16 units that produce sugarcane and molasses and 1 subsidiary company that have business in hospital management. Since last 2016 top management of PTPN XI decided to implement Enterprise Resource Planning (ERP) SAP to support their business process in order to increase production and optimize their business process as a part of improvement Good Corporate Governance (GCG) of PTPN XI. PTPN XI implements all of modules in SAP that consists of finance module, controlling module, material management module, plan production module, plan maintenance module, project system module, front end module, business plan consolidation module and Business Intelligent and Business Object (BIBO) module. For optimizing IT-enable investment in PTPN XI, COBIT 5 framework is used to conduct IT governance and AHP in choosing IT domain of COBIT 5.

II. BACKGROUND

A. Analytical Hierarchy Process

The AHP method is general theory of measurement (R.W.Saaty, 1987). One of the advantage of AHP is pairwise comparisons of selected elements and attributing them into a scale. Each preference matches a proper number T.L Saaty's fundamental scale shown in Table 1. Assigning preferences to the selected elements is subjective and assessed by an expert, which increase the substantive correctness of the result (Alijca, 2016) Pairwise comparisons of selected elements allow simultaneous ordering them in term of quality and quantity, depends of which one criterion lead over and more important than others. Comparison of criteria in the AHP method consists of two step:

1. Arranging the factors in hierarchic structure descending from on overall goal to criteria and sub criteria in successive levels.

2. Giving fundamental scale of use in making in the comparison of criteria and sub criteria, then calculating the relative dominance of factors. Choosing the most criterion having the greatest impact on the achievement of the overall goal.

Making pair comparison of the selected criterions it is essential to put them in the diagonal matrix(n x n). The comparison is made by identifying the impact of element on the left side of the matrix to the elements at the top of matrix.

Table 1. Table of Saaty's Fundamental Scale

Intensity of Importance on an absolute scale	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and judgement strongly favour one activity over another
5	Essential of strong importance	Experience and judgement strongly favour one activity over another
7	Very strong importance	An activity is strongly favoured and its dominance demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the highest order possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgements	When compromise is needed
Reciprocals ($1/3, ..., 1/9$	If activity i has one of the above numbers assigned to it when compared with activity j, then j has the reciprocal values when compared with i

Below the main diagonal there are the inverse of the pairwise comparisons, the formula of matrix A:

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ 1/a_{1n} & 1/a_{2n} & ... & 1 \end{bmatrix} \qquad (1)$$

Due to the inverse of the pairwise comparisons, the i-th row is the inverse oh the i-th column, so there is a relation:

$$Aw = nw \qquad (2)$$

where:

w is vectors of weights $w_1, w_2, \ldots, w_n$

Elements of the vector of weights w are priorities vector the various criteria because of the overall goal:

$$w = \sum_{j=1}^{n} w_j a_{ij} \qquad (3)$$

One of the most important sizes designated in the method of AHP is the largest eigenvalue of matrix, and is one measure of the compliance of comparisons reflecting the proportionality of the preferences:

$$\lambda_{max} = \frac{1}{w_1} \sum_{j=1}^{n} a_{ij w_j} \qquad (4)$$

A is consistent if and only if $\lambda_{max} = n$[3].

The second factor necessary to obtain the AHP method is calculating the value of Consistency Index (CI). It is the negative average of other roots of the characteristic polynomial of A:

$$CI = \frac{\lambda_{max} - n}{n-1} \qquad (5)$$

The last factor is Consistency Ratio (CR). If the ratio of CI significantly small, the estimated of w can be accepted. CR is determined by the formula:

$$CR = \frac{CI}{Ri} \qquad (6)$$

where:

RI – Random Index [4], [5].

B. COBIT 5 Framework

Information Technology is a key of resource for all enterprises and from the time that information is created to the moment that it is destroyed, technology plays a significant role (ISACA, 2012) (ISACA, Process Assesment Model (PAM): Using COBIT 5, 2012). Information technology is increasingly advanced and has become pervasive enterprise and in social, public and business environments.

COBIT 5 provides a comprehensive framework that assists enterprises in achieving their objectives for the governance and management of enterprise IT. Simply stated, it helps enterprises create optimal value from IT by maintaining a balance between realising benefits and optimising risk levels and resource use. COBIT 5 enables IT functional areas of responsibility, considering the IT-related interests of internal and external stakeholders. COBIT 5 is generic and useful for enterprises of all sizes, whether commercial, not-for-profit or in the public sector.

There is five key principles for governance of enterprise IT:

- Meeting stakeholder needs.
- Covering the enterprise end to end.
- Applying a single, integrated framework.
- Enabling a holistic approach.
- Separating governance from management

These five principles enable of the enterprise to build an effective governance and management framework that optimises information and technology investment and use for the benefit of stakeholders. Meeting stakeholder is needed for create value for their stakeholders by maintaining a balance between the realisation of benefits and optimisation of risk and use of resources. COBIT 5 provides all of the required process and enablers to support business value creation through to use of IT. COBIT 5 covering the enterprise end to end means that COBIT 5 integrates governance of enterprise IT into enterprise governance.

Applying a single integrated framework in COBIT 5 because COBIT 5 align with other relevant standards and good practice, each providing guidance on a subset of IT activities. Enabling holistic approach of COBIT 5 because COBIT 5 defines a set of enablers to support the implementation of a comprehensive governance and management system for enterprise IT. And the last principle of COBIT 5 is separating governance from management. COBIT 5 framework makes clear distinction between governance and management. These two disciplines encompass different types of activities, required different organisational structures and serve different purposes.

The COBIT 5 process reference model subdivides the processes of the enterprise IT into two main areas of activity, governance and management [7]. In the governance area there is Evaluate, Direct and Monitor (EDM) domain that deals with the stakeholder governance object like value delivery, risk optimisation, and resource optimisation. In the management area there are four domains that are in line with the responsibility areas of plan, build, run and monitor (PBRM) and they provide end-to-end coverage IT. The domains are Align, Plan and Organise (APO), Build, Acquire and Implement (BAI), Deliver, Service and Support (DSS) and the last is Monitor, Evaluate and Asses (MEA).

C. IT Governance in PT.Perkebunan Nusantara XI

In 2017, PTPN XI adopted ERP SAP to their business process. ERP SAP is one of the common technology that is used to manage enterprise resources. It also help stakeholder to control their business activity continuously because ERP SAP make all of part the business being integrated. This implementation refers to decree of holding company PT. Perkebunan Nusantara (Secretary, 2016). All modules that is used by PTPN XI provided in Table 2. Implementation of ERP SAP in PT Perkebunan Nusantara XI was designed by top management that is consisted by Board of Directors, Head of Divisions and IT manager, following director decision and according to regulation designed by holding company and third party as consultant.

Before adopting ERP SAP, PTPN XI has performed IT to their business process that is produced by IT division. But all of their applications ran partially and it was not established being integrated each other. ERP SAP make all modules being integrated each other and every division in PTPN take responsibility for their module in order to optimize their work. In every single transaction of ERP SAP will affect in any transaction.

Table 2. ERP SAP Modules In PTPN XI

Modules of SAP	Department
Finance	Accounting
Controlling	Planning and Budgeting
Material Management	Procurement
Plan Production	Processing & Quality Control
Plan Maintenance	
Project System	Technique
Human Capital Management	Planting
	Human Resource Development
Front End	
Business Plan & Consolidation	Processing & Quality Control
Business Intelligent & Business Object	Planning and Budgeting
	Corporate Secretary

Table 3. Criteria of Determining AHP

Code	Criteria
K1	Complexity of Implementation
K2	Cost of Implementation
K3	Goals of Enterprise
K4	Time of Implementation
K5	Priority Goal of IT related with Enterprise Goals

IT management in PTPN XI is located at IT department and lead by a manager. IT department has tasks to manage all of everything about IT services and all needs from any division was deserved by IT department. Before PTPN XI adopted ERP SAP, IT department has made improvement for business activity. There are so many applications and standard of operational procedures about IT management. Some of applications still used despite of PTPN XI has implemented ERP SAP like company profile website, Account Receivable System Management (ARSM) and email application system.

It was not easy to align between IT goals and business goals. It requires holistically approached in the business parties to be involved in the company. Focus management, great effort and great management also required to realize the alignment of IT system in company. Those factors needed to run business professionally in order to achieve optimum result (David S.Kerr, 2013).

III. METHOD

A. Determine Criteria Selection for IT Process

In order to compare the evaluation criteria of priority IT goals that will be conducted in this research, there are main criteria further subdivide into the sub criteria and shown by Table 3. These criteria is generated from learning by the some references and interview an expert in PTPN XI. Corporate secretary is chosen because in the structure of PTPN XI, IT department is sub division in the Corporate Secretariat Division.

B. Determine Domain IT Goal of COBIT 5

Determining domain IT goal is based on stakeholder's need then mapping them into COBIT 5 goal cascade until achieve the corresponding IT Process and analyse company business document to identify which IT process that become in the high priority key by Chief Executive Officer decision document which the number is 3.19/MoU/2016. Based on the those method, the priority of IT process chosen a Business Goal Optimization of Business Process Functionality with IT goals that shown at Table 4.

In the chosen IT Goals, there are subdomains that must be achieved by enterprise to make their maturity levels should be upgraded. IT goal Alignment of

Business Process Strategy has domains that is shown in Table 5. IT goal Delivery of IT Services in line with Business Requirement is shown in Table 6. IT goal Adequate Use of Application, Information & Technology is shown in Table 7, IT goal IT Agility is shown in Table 8 and IT goal Enablement and Support of Business Processes by Integrating Applications and Technology into Business Processes is shown in Table 9.

Table 4. IT Goals List of Chosen IT Process

IT Goals	Code Name
Alignment of Business Process Strategy	N1
Delivery of IT Services In Line With Business Requirement	N2
Adequate Use of Application, Information & Technology	N3
IT Agility	N4
Enablement and Support of Business Processes by Integrating Applications and Technology into Business Processes	N5

Table 5. IT Process in the IT Goal Alignment of Business Process Strategy

IT Process	Description
EDM1	Ensure Governance Framework Setting And Maintenance
EDM2	Ensure Benefit Delivery
APO1	Manage the IT Management Framework
APO2	Manage Strategy
APO3	Manage Enterprise Architecture
APO5	Manage Portfolio
APO7	Manage Human Resources
APO8	Manage Relationships
BAI1	Manage Program and Projects
BAI2	Manage Requirement Define

Table 6. IT Process in the Delivery of IT Services in line with Business Requirement

IT Process	Description
EDM1	Ensure Governance Framework Setting And Maintenance
EDM2	Ensure Benefit Delivery
EDM5	Ensure Stakeholder Transparency
APO2	Manage Strategy
APO8	Manage Relationships

APO9	Manage Service Agreements
APO10	Manage Suppliers
APO11	Manage Quality
BAI1	Manage Program and Projects
BAI2	Manage Requirement Define
BAI3	Manage Solution and Identification and Build
BAI4	Manage Availability and Capability
BAI6	Manage Change
DSS1	Manage Operation
DSS2	Manage Services Requests and Incidents
DSS4	Manage Continuity
DSS6	Manage Business Process Controls
MEA1	Monitor, Evaluate and Asses Performance and Conformance

Table 7. IT Process in the Adequate Use of Application Information and Technology

IT Process	Description
APO4	Manage Innovation
BAI5	Manage Organizational Change Enablement
BAI7	Manage Change Acceptance & Transitioning

Table 8. IT Process in the IT Agility

IT Process	Description
EDM4	Ensure Resources Optimisation
APO1	Manage the IT Management Framework
APO3	Manage Enterprise Architecture
APO10	Manage Suppliers
BAI8	Manage Knowledge

Table 9. IT Process in the IT Goal Enablement and Support of Business Process by Integrating Applications and Technology

IT Process	Description
APO8	Manage Relationships
BAI2	Manage Requirement Define
BAI7	Manage Change Acceptance & Transitioning

C. Hierarchy Structure Data

Modelling Hierarchy structure data is started from weighting in every alternative solution from chosen criteria. There are five alternative solutions which is shown in Table 4. The model of hierarchy structure is shown in Figure 1.

D. Participant Ratings of IT Process

Participants in this research are a top level management in PTPN XI. They are Chief Executive Officer, Corporate Secretary, Head of Controlling and Budgeting Division of PTPN XI, IT manager of PTPN XI and Senior IT Staff of PTPN XI. Participants were asked for questionnaire about IT governance of PTPN XI right now based on the chosen IT process. The scale was labelled as 0 if it is not implemented, 1 if it is partially implemented, 2 if it is partially implemented, 3 if it is largely implemented and 4 if it is fully implemented.
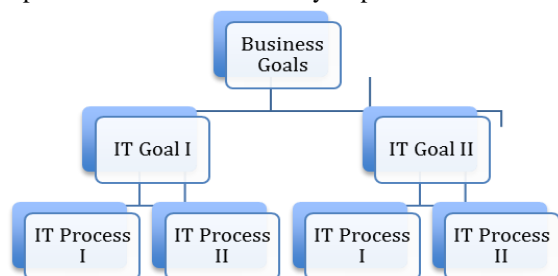

Figure 1. Hierarchy Structure Data

IV. RESULT

A. Weighting Criteria and Alternatives

There are two kinds of weighting in this research. The first weighting is done by given in every chosen criteria. This process is shown by Table 10. K1 is meant as complexity of implementation, K2 is cost of implementation, K3 is goals of enterprise, K4 time of implementation and K5 is priority goal of IT related with enterprise goals.

Next step is weighting every alternative solution. Given table 11 is presented the weighting table of Alternative solution of Alignment of Business Process Strategy. Table 12 is presented the weighting table of Alternative solution of Delivery of IT Services in line with Business Requirement. Table 13 is presented the weighting table of Adequate Use of Application, Information and Technology. Table 14 is presented the weighting table IT Agility. Table 15 is presented the weighting table Enablement and

Support of Business Processes by Integrating Applications and Technology into Business Processes. In every alternatives table there are code name that represented as N1,N2,N3,N4 and N5. N1 is meant as Alignment of business strategy, N2 is Delivery of IT Services in line with Business Requirement, N3 is Adequate Use of Application, Information and Technology, N4 is IT Agility and the last N5 is Enablement and Support of Business Processes by Integrating Applications and Technology into Business Processes.

Next step is calculating the Normalize every weighting table. In every table we need to confirm what is the priority of IT process that one to serve. After getting the normalize table we need to calculate about Consistency Ratio (CR) and Consistency Index (CI) of every alternative solution. CR value need to be under 0.1 in order that weighting ratio is true. And We need to choose the alternative solution which the highest value as priority. In this research IT agility is one of the most priority alternative solution with CR is 0.036 and CI is 0.328.

B. Reliability and Validity Test

Reliability test is using for measurement about data from participants. The result of reliability test is shown in Table 16. The value of Cronchbach's Alpha is 0,9058, that is should be aligned with reliability criteria.

Validity test is using for measurement validity of data from participants. Significant level in this research is 5% and the r value is 0.687, and r value from questionnaire is bigger than r table so data is valid.

C. Gap Analysis

After the capability level is obtained by questionnaire, then maturity level system in every IT process domain is known (as is condition). Top management also gave the target for every IT process must be achieved in five years. Gap analyse between as is condition and level that one to achieved is shown in Table 17.

D. Improvement Step of IT Governance

After knowing about as is condition and what will achieve in the future, we need make some improvements on the our IT governance based on COBIT 5. There are some many steps on the

improvement level in every IT process depends on what is the condition.

The average of as is condition of IT process in PTPN XI at the level 1. Improving is needed in order to should be achieve to the level 2. Because of that, IT processes in the level 1 need to be largely or fully achieve. If IT process achieved in largely or fully achieved in the level 2 attributes (performance management and product management), then it would be continued at level 3. If IT process achieved in largely or fully achieved in the level 3 attributes (process definition and process deployment), then it would be continued at level 4. If IT process achieved in largely or fully achieved in the level 4 attributes (process measurement and process control), then it would be continued at level 3 (process innovation and optimisation).

Table 10. Weighting Table of Criteria

Criteria	K1	K2	K3	K4	K5
K1	1.00	2.00	2.00	0.50	3.00
K2	0.50	1.00	2.00	0.33	2.00
K3	0.50	0.50	1.00	0.25	2.00
K4	2.00	3.00	4.00	1.00	5.00
K5	0.33	0.50	0.50	0.20	1.00
Total	4.33	7.00	9.50	2.28	13.00

Table 11. Weighting Table Alignment of Business Process Strategy

Alternative	N1	N2	N3	N4	N5
N1	1.00	2.00	2.00	0.50	3.00
N2	0.50	1.00	2.00	0.33	2.00
N3	0.50	0.50	1.00	0.25	2.00
N4	2.00	3.00	4.00	1.00	5.00
N5	0.33	0.50	0.50	0.20	1.00
Total	4.33	7.00	9.50	2.28	13.00

Table 12.Weighting Table Delivery of IT Services in line With Business Requirement

Alternative	N1	N2	N3	N4	N5
N1	1.00	0.33	0.20	0.33	0.20
N2	3.00	1.00	0.20	0.20	0.20
N3	5.00	1.00	1.00	2.00	1.00
N4	3.00	5.00	0.50	1.00	0.33
N5	5.00	5.00	1.00	3.00	1.00
Total	17.00	12.33	2.90	6.53	2.73

Table 13. Weighting Table Adequate of Application, Information & Technology

Alternative	N1	N2	N3	N4	N5
N1	1.00	2.00	2.00	0.50	3.00
N2	0.50	1.00	2.00	0.33	2.00
N3	0.50	0.50	1.00	0.25	2.00
N4	2.00	3.00	4.00	1.00	5.00
N5	0.33	0.50	0.50	0.20	1.00
Total	4.33	7.00	9.50	2.28	13.00

Table 14. Weighting Table IT Agility

Alternative	N1	N2	N3	N4	N5
N1	1.00	0.50	0.33	0.25	2.00
N2	2.00	1.00	0.33	0.50	3.00
N3	2.00	3.00	1.00	0.33	4.00
N4	4.00	3.00	2.00	1.00	5.00
N5	0.50	0.33	0.25	0.20	1.00
Total	9.50	7.83	3.92	2.28	15.00

Table 15. Weighting Table Enablement and Support of Business Process by Integrating Applications and Technology into Business Process

Alternative	N1	N2	N3	N4	N5
N1	1.00	3.00	5.00	3.00	3.00
N2	0.33	1.00	3.00	3.00	3.00
N3	0.20	0.33	1.00	0.33	0.33
N4	0.33	0.33	3.00	1.00	0.33
N5	0.33	0.33	3.00	3.00	1.00
Total	2.20	5.00	15.00	10.33	7.67

Table 16. Reliability Measurement Table

Variable	Data	Mean	StDev
EDM4	5	1,4	0,894
APO1	5	1,4	0,894
APO3	5	1,2	0,867
APO10	5	1,2	0,867

BAI8	5	1,4	0,894
TOTAL	5	6,6	4,416

Table 17. Gap Analysis of IT Process

IT Process	As Is Condition	Achieved Condition	Gap
EDM04	1	5	4
APO1	1	5	4
APO3	1	5	4
APO10	1	5	4
BAI8	1	5	4

V. CONCLUSIONS AND RECOMMENDATION

A. Conclusion

1. Determining of IT goals using AHP obtained IT Agility as priority of IT Process that want to be fully implementation in PTPN XI.
2. The average of IT process in PTPN XI was on level 1 and their target should be level 5 in five years.

B. Recommendation

1. Relatively, this research was examined 24 numbers of IT processes in the company, while this paper examined 8 number of IT processes. Further study need to take larger scope of IT process analysis that haven't done yet.
2. This research needs to involved any related framework in order to make it optimally.

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