بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ
INVESTIGATION OF CONCURRENT ENGINEERING IMPLEMENTATION READINESS IN GENERAL ENGINEERING DIVISION OF PT. PAL INDONESIA (PERSERO)

By:
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2511100108

SUPERVISOR:
PUTU DANA KARNINGSIH
INTRODUCTION
BACKGROUND

Construction Industry

Heavy and Civil engineering

General Construction

Construction Project

13% Total world GDP in 2013

15% Total world GDP in 2020

7.8% GDP 2008

Market %GDP

(Schilling, 2013)
External conditions (26.79%)
Change of drawing document (21.43%)
Condition of the field (19.64%)
Change of technical specifications (16.07%)
Other factors (16.07%)
BACKGROUND

NAVAL SHIP BUILDING

MERCHAND OR COMMERCE SHIP BUILDING

HARKAN SERVICE PRODUCT

GENERAL ENGINEERING

INDONESIA
BACKGROUND

GENERAL ENGINEERING

Edi Widiarto

DO "RECOVER"

By:

- Increase speed
- Increase manpower
- Increase engineering support
- Increase labor hour

Increase Production Cost 10%-20%

New sector focus
Powerplant (KPMG, 2013)

Problem

Late material delivery

Inadequate expert

High Frequency of Design Change

Low coordination between project stakeholders

Impact

BACKGROUND

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Impact
Evboumwan and Anumba (1998) defined Concurrent Engineering (CE) as an “...attempt to optimise the design of the project and its construction process to achieve reduced lead times, and improved quality and cost by the integration of design, fabrication, construction and erection activities and by maximising concurrency and collaboration in working practices”.

**BACKGROUND**

**GENERAL ENGINEERING**

**PROBLEM**

**SOLVE**

Original Schedule

Pipeline Design

Information Requirements

Pump Selection

Electrical Design

Structural Design

Overlapped Schedule

Pipeline Design

Pump Selection

Dependence Removed

Electrical Design

Structural Design

Time Savings
2. Assessment

Assessment Readiness

(Pawar, et al., 1996)
how to minimize engineering design change that often occurred in General Engineering Division by implementing CE, and to measure the readiness level of CE implementation in General Engineering Division PT. PAL Indonesia (Persero) with BEACON Model
Research Objective

To know readiness level of CE implementation in General Engineering division PT. PAL Indonesia (Persero).

To provide recommendation for lowest factor of readiness level to implement CE in General Engineering Division PT. PAL Indonesia (Persero).
Research benefit

know the readiness level of CE implementation.

get improvement recommendation
LIMITATION
• This research is done until improvement suggestion and not until improvement implementation.
• This research is conducted in General Engineering Division PT PAL Indonesia (Persero)

ASSUMPTION
• There are no company policy changing that influence significantly to the research.
• The improvement suggestion can be done by the company
• Financial problem is not influence the project implementation

Research scope
LITERATURE REVIEW
Literature Review

- Concurrent Engineering
- Concurrent Engineering in Construction
- Readiness Assessment of Concurrent Engineering
- Summary of Previous Research
Winner (1998) defined CE as ‘integrated, concurrent design of products and their related processes, including manufacture and support’ with the ultimate goal of customer satisfaction through the reduction of cost and time-to-market, and the improvement of product quality.’

<table>
<thead>
<tr>
<th>Company</th>
<th>The Benefits</th>
</tr>
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<tbody>
<tr>
<td>Boeing’s Ballistic System Division</td>
<td>engineering changes reduced from 15-20 to 1-2 drafts per drawing</td>
</tr>
<tr>
<td></td>
<td>materials shortage reduced from 12% to 1%</td>
</tr>
<tr>
<td></td>
<td>inspection costs cut by a factor of 3</td>
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<tr>
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<td>reduction in parts and assembly line</td>
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<tr>
<td></td>
<td>65% fewer suppliers</td>
</tr>
<tr>
<td></td>
<td>100% fewer screws or fasteners</td>
</tr>
<tr>
<td></td>
<td>100% fewer assembly tools</td>
</tr>
<tr>
<td></td>
<td>44% improvement in manufacturing cost</td>
</tr>
<tr>
<td></td>
<td>a trouble-free product introduction</td>
</tr>
<tr>
<td>NCR</td>
<td>reduce the lead time to develop a new aircraft engine by 30%</td>
</tr>
<tr>
<td>Rolls-Royce</td>
<td>Reduce production costs by 40%</td>
</tr>
<tr>
<td>McDonnell Douglas</td>
<td>reduced design cycle time by 33%</td>
</tr>
<tr>
<td>ITT (waste treatment and water service)</td>
<td></td>
</tr>
<tr>
<td>Need for change in construction</td>
<td>Goals and principle of CE</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>The need for change in construction is brought about by the uncompetitive nature of the industry and the inability to fully satisfy its clients with respect to costs, time, and value</td>
<td>The goals and objectives of CE include customer satisfaction, competitive business, reduction of product development time and cost, improvement of quality and value</td>
</tr>
<tr>
<td>Integration of the construction process is seen as one of most important strategies to improve the notoriously fragmented construction industry</td>
<td>The use of CE facilitates the integration of the member of the product development team, and the manufacturing process, thereby improving the product development process</td>
</tr>
<tr>
<td>Emerging strategies for improving the construction process are inadequate; they only address one aspect of problem, resulting in 'islands of automation' as in the case of computer-integrated construction strategies</td>
<td>As an amalgam of other methodologies, tools and techniques, CE provides a framework for not only integrating the construction process, but also the various tools and technologies that are used in the process</td>
</tr>
</tbody>
</table>

Source: (Khalfan, Anumba, & Patricia, 2007)
READINESS ASSESSMENT

- More effective and better in implementing CE in construction industry.
- Make the industry can evaluate and benchmark its project operation process.
- Develop appropriate tools to implement CE in the industry
- Make the industry can identify which area that need an improvement or changes
- Make the industry realized the needs of implement CE for bring improvement in whole project operation process.

BENEFIT

BEACON MODEL

(Khalifan dan Anumba, 2000)
SUMMARY OF PREVIOUS RESEARCH

- *Khalfan et al. (2000)*
  An investigation of the readiness of the construction industry for concurrent engineering

- *Khalfan et al. (2001)*
  Concurrent engineering readiness assessment of sub-contractors within the UK construction industry

- *Cheria, S (2014)*
  Investigation Of Concurrent Engineering Implementation Readiness In General Engineering Division of PT. Pal Indonesia (Persero)

- *Marconi, F.A (2015)*
  Preparing concurrent engineering implementation for VRLA battery in PT. X
METHODOLOGY
METHODOLOGY

Problem Formulation
Research Objective Determination
Literature Review
Data Collection
CE Team Forming

Problem Identification and Formulation Phase
Readiness Assessment Phase
**Problem Identification and Formulation Phase**

- Problem Formulation
- Research Objective Determination
- Literature Review
- Data Collection
- CE Team Development

**Readiness Assessment Phase**

- Field Study

**METHODOLOGY**
METHODOLOGY

Field Study

In Depth Interview

Focus Group Discussion
METHODOLOGY

Field Study

In Depth Interview

Focus Group Discussion

Data Collection

Engineering design

QC/QA

Procurement

CE Team

Forming

Marketing

Fabrication & installation

Finance
**BEACON Questionnaire Filling**

**Measuring Readiness level of CE Implementation**

**Gap Analysis**

**Improvement**

**Conclusion and Suggestion**

**Assessment of CE Readiness Phase**

**Analysis and Improvement Phase**

**END**

**METHODOLOGY**
METHODOLOGY

BEACON Questionnaire Filling

Fill by Expert

4 ALWAYS
2 OFTEN
1 SOMETIMES
0 NEVER

Measuring Readiness level of CE Implementation of CE

Score of questionnaire measure by summarize all of score from each question divided by number of question and times 4.
Assessment of CE Readiness Phase

Analysis and Improvement Phase

BEACON Questionnaire Filling

Measuring Readiness level of CE Implementation

Gap Analysis

Improvement

Conclusion and Suggestion

END

METHODOLOGY
CE READINESS ASSESSMENT
CE READINESS ASSESSMENT

Existing new project development

CE implementation planning

CE readiness assessment

Improvement
CE Implementation Plan

New Project of GE Division

EPCI of Madura BD Field

Topside 75 meters x 25 meters x 19 meters

Jacket 100 Meters x 75 Meters

Pile 100 Meters x 20 Meters
CE Implementation Plan

- **Engineering department**
  In charged in coordinating of all of members during design phase of project implementation.

- **Procurement department**
  In charged of purchasing materials that is needed to fabricate the component after design phase.

- **Fabrication & installation department**
  In charged in fabricating component after design and material arrived.

- **PPC department**
  In charged in planning all activities from beginning of the project until the end of the project.

- **QA/QC department**
  In charged of product or component's quality. The quality of components that have been fabricated has to meet customer requirement and quality regulation.

- **Finance & Tax department**
  In charged of managing budget in project development process.

- **Marketing department**
  In charged in getting order from client. Marketing member is also in charged to inform clear information about requirement of customer to all member of team.
CE Readiness Assessment

Questionnaire Verification

Assessment

EXPERT JUDGEMENT

Mr. Agus Budiyanto
As General Manager of General Engineering Division
Assessment

Existing Condition Assessment

Desired Condition Assessment

Existing Condition and Gap Analysis
Filed by Mr. Bambang Setyawan
As Deputy project manager

Existing Condition
Assessment

<table>
<thead>
<tr>
<th>Element</th>
<th>Part of element</th>
<th>Score</th>
<th>Total Score</th>
<th>Percentage</th>
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<td>28</td>
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<td>70%</td>
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<td>32</td>
<td>40</td>
<td>80%</td>
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<tr>
<td>People</td>
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<td>26</td>
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<td></td>
<td>Discipline</td>
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<td>69%</td>
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<tr>
<td>Project</td>
<td>Customer focus</td>
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<td>Quality assurance</td>
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<td>Project design</td>
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<td>Integration support</td>
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<td>Project</td>
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Q
Plot the result in Spider Diagram
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**Element average score**

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</table>
Plot the result in Spider Diagram
### Existing Condition Analysis

#### Management System

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<td>81%</td>
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</tbody>
</table>

**WHY??**
Existing Condition Analysis

- TEAM IN ORGANIZATION
- INTEGRATION SUPPORT

EXISTING CONDITION
- Individual reward
- Team reward

IT System
Gap Analysis

Technology Element
- Task Support
- Integration Support
- Information Sharing
- Coordination Support
- Communication Support

Process Element
- Management System
- Process Focus
- Organizational Framework
- Strategy Deployment
- Agility

People Element
- Team in Organization
- Team Leadership and Management

Client Focus
- Communication Support
- Coordination Support
- Information Sharing
- Integration Support
- Task Support

Process Focus
- AD HOC
- REPEATABLE
- CHARACTERIZED
- OPTIMIZING

Project Element
- Project Design
- Team Formation and Development
- Discipline

Quality Assurance
- Team in Organization
- Team Leadership and Management

Coordination Support
- Client Focus
- Communication Support
- Coordination Support
- Information Sharing
- Integration Support
- Task Support
IMPROVEMENT

RECOMMENDATION
FOR
IT SYSTEM

alternatives

IMPROVEMENT

RECOMMENDATION
FOR
REWARD SYSTEM

Potential Extra Benefit

Implementation plan

Benefit analysis

Discussion
IMPROVEMENT ALTERNATIVES

Reward System

Stajkovic & Luthans, (1997)

Team Member of the month

Personal Recognition

Thank You Card

- 1 thank you card = a voucher for car wash
- 5 thank you card = a voucher for dinner in a restaurant
- 10 thank you card = a voucher for shopping in a department
an integrated cross-functional software that re-engineering the manufacturing process, distribution, finance, human resource and other business process in a company to increase the efficiency, agility, and profitability (O’Brien, 2005)

MORSE marine construction company

content of messages exchanged between an LDAP client and an LDAP server.
IMPLEMENTATION PLAN

Reward System

GUIDELINES
(Nelson, 1994)

WHO  (outstanding employee/group in term of performance)
WHAT  (cash prizes, merchandize, etc)
HOW  (the nomination procedures, committee, point system, etc)

WHY  an effort to increase motivation of team member.
So, it can increase the readiness level of Concurrent Engineering Implementation

WHO  Employee in each team
WHAT  The alternatives: thank you card, team member of the month, manager congratulates directly
HOW  The reward will give in every project milestone
IMPLEMENTATION PLAN

IT System

Assumption

• The top management of PT PAL Indonesia (Persero) is commit to implement the improvement alternatives
• PT PAL Indonesia (Persero) has good financial ability to implement the improvement alternatives
• Understand why company want to implementer so they support the improvement alternatives implementation
• All employee support the implementation process
IMPLEMENTATION PLAN

Average Time: 12 Months (Fleisch et al., 2004)

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<td>6</td>
<td>Training</td>
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<td>TOTAL</td>
<td>$1,750,000.00</td>
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Implementation plan

IT System

Invest yearly

LDAP
Lightweight Directory Access Protocol

Total investment in year 1 = 10 x $220 = $2,200
Total investment in year 2 = 10 x $85 = $850
Total investment in year 3 = 10 x $85 = $850
And etc
BENEFIT ANALYSIS

Reward System

Expected benefits
- Motivation of all members of the team will increase
- Build a better work environment
- Savings $200,000 in a year.

Savings = Expected cost reduction \times \text{total cost of production} \times \text{number of project}
= 5\% \times \$2,000,000 \times 2
= \$200,000

Assumption
- In a year there are two milestones
- There are two teams for two projects in a year
- Team of the month cost Rp 200,000 once or equal to $15.9 or $127.22 in a year
- Thank you card reward cost thank you card reward is assumed Rp 1,000,000 once or equal to $79.51 or $636.08 in a year
- Manager congratulates directly reward is assumed Rp 50,000 once or equal to $3.98 or $31.81 in a year
BENEFIT ANALYSIS

Team Member of the month

Benefit Cost Ratio

Thank You Card

BCR = savings/total cost

= $200,000 / $127.22

= 1.572,125

BCR = savings/total cost

= $200,000 / $636.08

= 314.43

BCR = savings/total cost

= $200,000 / $31.81

= 6.288,5
**BENEFIT ANALYSIS**

**Expected benefits**
- Administrative costs of fax and telephone is going down
- Order processing will be simpler
- Support more integration between departments
- Savings $200,000 in a year.

**SAP R/3**

**Assumption**
- There are two teams for two projects in a year
- Planning horizon is 10 years

**Savings**
\[ \text{Savings} = \text{Expected cost reduction} \times \text{total cost of production} \times \text{number of project} \]
\[ = 5\% \times 2,000,000 \times 2 \]
\[ = 200,000 \]
• **Calculate the outflow Net Present Value (NPV)**
  The outflow NPV is $1,790,000. It because in the next years there are no outflow.

• **Calculate the inflow NPV**
  The interest rate (i) that used to calculate the NPV is 3%. The calculation of inflow NPV is explained below.

\[
\text{NPV} = \frac{FV}{(1+i)^1} + \frac{FV}{(1+i)^2} + \cdots + \frac{FV}{(1+i)^{10}}
\]

\[
= \frac{200,000}{(1+0.03)^1} + \cdots + \frac{200,000}{(1+0.03)^{10}}
\]

\[
= $618,307.90
\]

• **Calculate the ratio by dividing inflow NPV with outflow NPV**
  \[
  \text{BCR} = \frac{\text{inflow NPV}}{\text{outflow NPV}}
  \]

\[
= \frac{618,307.90}{1,790,000.00}
\]

\[
= 0.35
\]
**Expected benefits**

• Support good integration between department
• Data is more safe and secure
• Administrative costs of fax and telephone is going down
• Savings $200,000 in a year.

**Assumption**

• There are two teams for two projects in a year
• Planning horizon is 10 years

Savings = Expected cost reduction x total cost of production x number of project

= 5% x $2,000,000 x 2
= $200,000
• **Calculate the outflow Net Present Value (NPV)**
  The interest rate (i) that used to calculate the NPV is 3%. The calculation of outflow NPV is explained below.
  \[ \text{NPV} = \frac{FV}{(1+i)^0} + \cdots + \frac{FV}{(1+i)^{10}} \]
  \[ = \frac{2,200}{(1+0.03)^0} + \frac{850}{(1+0.03)^1} + \cdots + \frac{850}{(1+0.03)^{10}} \]
  \[ = 9,450.67 \]

• **Calculate the inflow NPV**
  The interest rate (i) that used to calculate the NPV is 3%. The calculation of inflow NPV is explained below.
  \[ \text{NPV} = \frac{FV}{(1+i)^1} + \cdots + \frac{FV}{(1+i)^{10}} \]
  \[ = \frac{200,000}{(1+0.03)^1} + \cdots + \frac{200,000}{(1+0.03)^{10}} \]
  \[ = 618,307.90 \]

• **Calculate the ratio by dividing inflow NPV with outflow NPV**
  \[ \text{BCR} = \frac{\text{inflow NPV}}{\text{outflow NPV}} \]
  \[ = \frac{618,307.90}{9,450.67} \]
  \[ = 65.43 \]
### DISCUSSION

**Benefit Cost Ratio**

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Less cost</td>
<td>1. Potentially affect jealousy between employee</td>
</tr>
<tr>
<td>2. Easy to implement</td>
<td></td>
</tr>
<tr>
<td>3. Effect to personal recognition is high</td>
<td></td>
</tr>
</tbody>
</table>

**Opportunity**

| 1. Manager can be familiar with the employee who did job well | |

**Threat**

| 1. The reward is potentially become not prestigious in the future | |

---

**SWOT analysis**

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. easy to implement</td>
<td>1. it cost highest than other alternatives</td>
</tr>
<tr>
<td>2. effect to personal recognition is moderate</td>
<td></td>
</tr>
<tr>
<td>3. potentially can motivate employee better than other alternatives</td>
<td></td>
</tr>
</tbody>
</table>

**Opportunity**

| 1. Variation of reward is high | |
| 2. This reward potentially still prestigious in the future | |

**Threat**

| 1. Employee not interested with the price | |

---

**Reward System**

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Less cost</td>
<td>1. Effect to personal recognition is low</td>
</tr>
<tr>
<td>2. Easy to implement</td>
<td></td>
</tr>
</tbody>
</table>

**Opportunity**

| 1. Potentially make better relationship between manager and employee | |

**Threat**

| 1. The reward is potentially become not prestigious in the future | |
## DISCUSSION

### Benefit Cost Ratio

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Support good integration</td>
<td>1. The investment cost is high</td>
</tr>
<tr>
<td>2. Decrease number of error or redundant data entry</td>
<td>2. The time needed to implement is long</td>
</tr>
<tr>
<td>3. Data can be access fast even the number of data is high and complex</td>
<td>3. Need expert employee to operate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Threat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It can produce more savings when it used in larger scale</td>
<td>1. Repairs cost when software or hardware breakdown is high</td>
</tr>
</tbody>
</table>

### SWOT analysis

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Less cost of investment</td>
<td>1. Not flexible</td>
</tr>
<tr>
<td>2. Easy to implement</td>
<td>2. Takes longer in data processing</td>
</tr>
<tr>
<td>3. Support moderate integration</td>
<td>3. The directory need to be update if a company need additional process in future</td>
</tr>
<tr>
<td>4. Time to implement is short</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Threat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Potentially make better relationship to IT Sub-Contractor company</td>
<td>1. Problem with IT sub-contractor effect to the performance of LDAP implementation</td>
</tr>
</tbody>
</table>
DISCUSSION

IMPROVEMENT ALTERNATIVES

1. Thank You Card
2. Team Member of the month
3. LDAP Lightweight Directory Access Protocol

LDAP Lightweight Directory Access Protocol
POTENTIAL EXTRA BENEFIT

Potential extra benefit for other part from the improvement

<table>
<thead>
<tr>
<th>Element</th>
<th>Part of element</th>
<th>Existing Percentage</th>
<th>Expected Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>Management system</td>
<td>87%</td>
<td>87%</td>
</tr>
<tr>
<td></td>
<td>Process focus</td>
<td>94%</td>
<td>94%</td>
</tr>
<tr>
<td></td>
<td>Organizational framework</td>
<td>73%</td>
<td>73%</td>
</tr>
<tr>
<td></td>
<td>Strategy deployment</td>
<td>68%</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>Agility</td>
<td>70%</td>
<td>70%</td>
</tr>
<tr>
<td>People</td>
<td>Team formation and development</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Team leadership and management</td>
<td>81%</td>
<td>81%</td>
</tr>
<tr>
<td></td>
<td>Discipline</td>
<td>69%</td>
<td>77%</td>
</tr>
<tr>
<td></td>
<td>Teams in organization</td>
<td>58%</td>
<td>60%</td>
</tr>
<tr>
<td>Project</td>
<td>Customer focus</td>
<td>64%</td>
<td>64%</td>
</tr>
<tr>
<td></td>
<td>Quality assurance</td>
<td>94%</td>
<td>94%</td>
</tr>
<tr>
<td></td>
<td>Project design</td>
<td>72%</td>
<td>72%</td>
</tr>
<tr>
<td>Technology</td>
<td>Communication support</td>
<td>78%</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Coordination support</td>
<td>72%</td>
<td>74%</td>
</tr>
<tr>
<td></td>
<td>Information sharing</td>
<td>75%</td>
<td>77%</td>
</tr>
<tr>
<td></td>
<td>Integration on support</td>
<td>53%</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>Task support</td>
<td>81%</td>
<td>83%</td>
</tr>
<tr>
<td></td>
<td>AVERAGE</td>
<td>74.6%</td>
<td>75.7%</td>
</tr>
</tbody>
</table>
CONCLUSION AND SUGGESTION
1. Based on the questionnaire result, General Engineering Division PT. PAL Indonesia (Persero) reached managed level and has total average score 74.65%. The average score for each element are 78% for process element, 72% for people element, 77% for project element and 72% for technology element. The parts that need to be improved is team in organization part in people element (58%) and integration support part in technology element (53%) which means both of them categorized to characterized level.

2. There are three alternatives to improve the readiness level of General Engineering division on team in organization part in people element. The first is implementing team member of the month. The second is implementing thank you card. The third is implementing a method that allow a top management or team leader congratulating directly to the team member who has best performance. To improve the readiness level of General Engineering division on integration support part in technology element, the alternatives are implement SAP R/3 and Lightweight Directory Access Protocol (LDAP).
1. **Suggestion for PT PAL Indonesia (Persero)**
   - Top Management keep increasing the understanding about Concurrent Engineering
   - Before implement CE, top management of General Engineering Division PT PAL Indonesia (Persero) has to increase the commitment to solve the part with lowest value from the result of BEACON Model by implementing the improvement recommendation before implementing Concurrent Engineering.
   - Top management also gives better understanding to the all employees about Concurrent Engineering.

2. **Suggestion for Next Research**
   - Focus Group Discussion (FGD) with CE team is an important activity to do. It better conduct FGD more than one time if it possible in order to make better understanding about CE in CE team member.
   - Besides assess the company, it needs to assess the whole company supply chain.
REFERENCES
References


Smith, Preston G. and Reinertsen, Donald G. Developing Products in Half the Time New York: Van Nostrand Reinhold, 1995

