



communications

Electronic Systems



**How we do it here –
Selecting Alternatives**

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Updated Feb 2010

**Every decision,
whether it is at home or at the
workplace,
is simply
a choice between options.**



Retaining Wall Example

- Agree on basic requirements
 - Length; height; shape
- Consider alternative solutions
 - Exposed aggregate; concrete timber; stone; interlocking blocks
- Which is most important
 - Price or appearance; can you do it yourself or do you have to hire someone



**We tend to make decisions in our head or on the fly
based on experience or knowledge.**

If we didn't, we would never survive!



**However, there are several issues associated
with making decisions on the fly:**

- 1. People forget, people leave, data is lost, traceability is lost**
- 2. Would you have come to the same conclusion if you had performed a detailed Options Analysis?**

Both have consequence to our projects and business.

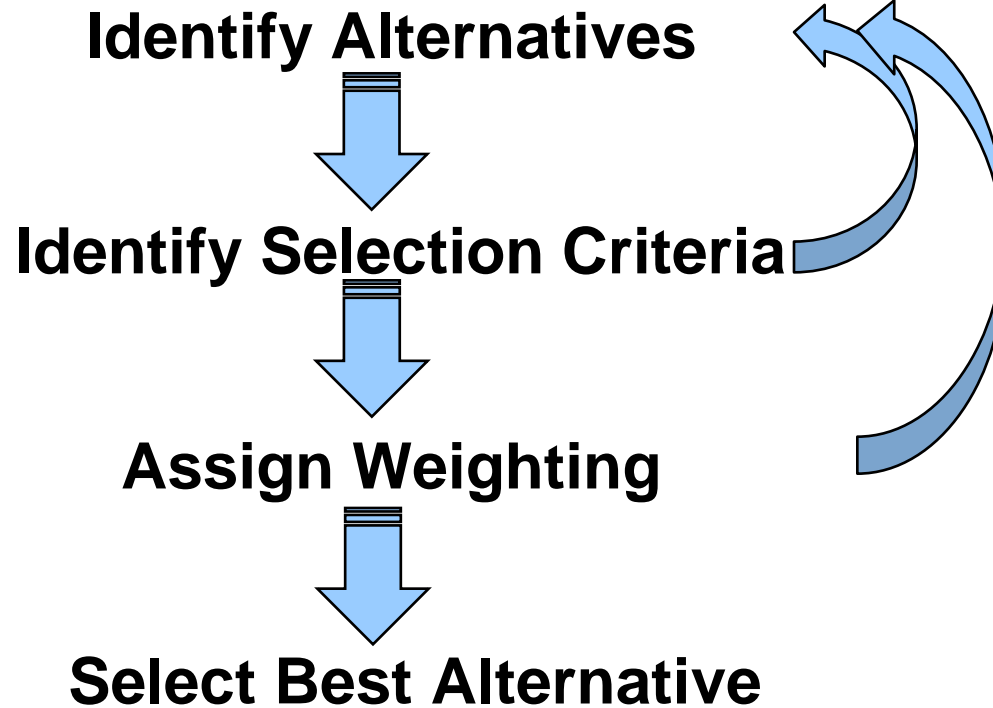


CMMI Quote

“Formal evaluation processes reduce the subjective nature of decisions and have a higher probability of selecting a solution that meets multiple demands”



Way Ahead



Do we need to document every decision?



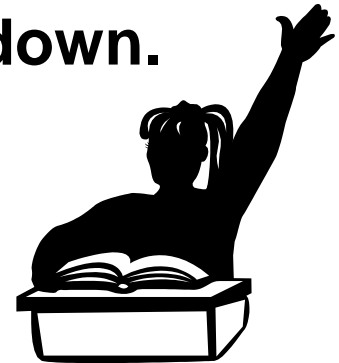
Answer: EP206 Provides Guidelines:

- Are alternatives considered to be of medium or high risk?
- Are alternatives related to changing work products under Configuration Management?
- Could the selection of an alternative impact agreed upon schedules?
-impact agreed upon budgets?
-impact agreed upon project objectives?
- Is the cost of conducting a formal evaluation reasonable compared to potential impacts?



2nd Answer: “Baby Steps”

If we make good core decisions at the lower level, then the high level design will be stable and work the first time, keeping rework costs down.



**I/O Card
Selection**

**Fiberglass
vs
Aluminum**

**Bus
Technology**

**Make vs
Buy**



**Chassis
Style**

**Served or
local
application**



Engineering Procedure EP206

Selecting Alternatives

Note: The data provided on the following slides is fictitious and is provided only as an example.



Selecting Alternatives – EP206

Create an Excel Workbook with Six Tabs:

Introduction: defines the problem, the stakeholders, timelines, and other logistics.

Evaluation Criteria: defines the criteria for an optimal solution.

Criteria Weighting: defines the most important criteria and uses this weighting to ensure the most effective alternative is selected.

Matrix: provides a matrix of alternatives versus the agreed upon criteria.

Conclusion: documents the findings of the comparison.

Recommendation: documents the recommendation based on the agreed upon weighted criteria.



Selecting Alternatives – EP206

Introduction Tab

Project	Ground Facilities Upgrade
Topic	Ethernet Card Selection
Engineer	John Smith
Date	26 Feb 2007, updated 23 Mar 07
Purpose	To select a PCI Gigabit Ethernet card for the GSE Computer so that EOIR data can be downloaded
Stakeholders	99 Wing (users), John Doe (Engineering Manager), Jane Doe (LCMM)



Selecting Alternatives – EP206

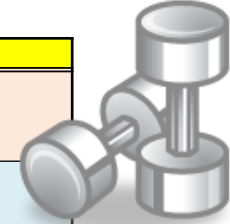
Evaluation Criteria Tab

Item	Evaluation Criteria	Source/Rationale
1	Cost	Best Value
2	Operating Temperature	GSE Requirements Spec (Low temperature operation to -15 degrees C)
3	Conformal Coating Available	Conformal coating protects card from moisture, fungus, dust and corrosion
4	MIL specs / ruggedization	As per Requirements Spec, #####. -Shock requirements of MIL-STD-810F, Method 516.5. -Random vibration requirements of MIL-STD-810F, Method 514.5. -Sinusoidal vibration requirements of MIL-STD-810F, Method 514.2.
5	Number of Ports	Number varies from 1 to 4
6	Warranty	Warranty typically varies from lifetime to 1-2 years
7	Ease of Installation	External adapters and PCMCIA cards are easier to install than an internal PCI card.
8	Hot Swappable	External adapters and PCMCIA cards tend to be hot swappable. PCI cards are not.
9	Delivery Time / lead time	Anything more than 6 weeks will impact schedule
10	Approved Vendor List	vendors should be on L-3 Approved Vendor List to ensure quality and reliability



Selecting Alternatives – EP206

Criteria Weighting Tab



Evaluation Criteria	Weighting	Scores	Justification
Cost	10%	10 = \$10-100 6 = \$100-1000 3 = \$1000+	
Operating Temperature	15%	15 = 70 degree range 12 = 60 degree 10 = 50 degree 5 = 40 degree	
Conformal Coating Available	15%	15 = yes 0 = no	
MIL specs / ruggedization	15%	15 = yes 0 = no	
Number of Ports	5%	5 = 4 or more ports 3 = 1-4 ports 1 = 1 port	Number of ports may affect cost
Warranty	10%	10 = lifetime 6 = 1 or more years 2 = less than 1 year	
Ease of Installation	0%	5 = installed outside chassis 3 = installed inside chassis	after subsequent analysis, ease of installation is no longer a factor
Hot Swappable	0%	5 = hot swappable 0 = not hot swappable	after subsequent analysis, hot swappable is no longer a factor
Delivery Time / lead time	15%	15 = 1-2 business day 10 = 1-2 weeks 5 = more than 2 weeks -10 = more than 6 weeks	delivery time may affect schedule
Approved Vendor List	15%	15 = yes 5 = no	approved vendors are preferable, but additional vendors can be added to list as required
Total (Should equal 100)	100%		



Selecting Alternatives – EP206

MatrixTab

jklItem	Criteria	Weighting	Solution 1		Solution 2		Solution 3		Solution 4	
			Item #1 from company abc		Item #2 from company def		Item #3 from company ghi		Item #4 from company jkl	
			Parameter	Score	Parameter	Score	Parameter	Score	Parameter	Score
1	Cost	0.1	\$29.99 CAD	10	\$32.50 CAD	10	\$125.00 CAD	6	\$380 USD	6
2	Operating Temperature	0.15	0 to 44 deg C	5	0 to 40 deg C	5	0 to 50 deg C	10	0 to 60 deg C	12
3	Conformal Coating Available	0.15	No	0					Yes	15
4	MIL specs / ruggedization	0.15	No	0	No	0	No	0	No	0
5	Number of Ports	0.05	1	1	1	1	1	1	2	3
6	Warranty	0.1	1 Year	6	2 year	6	2 Year	6	3 year	6
7	Ease of Installation	0	Inside chassis	0	Inside chassis	0	Inside chassis	0	Inside chassis	0
8	Hot Swappable	0	No	0	No	0	No	0	No	0
9	Delivery Time / lead time	0.15	1-2 day	15		10	10	10	4-5 weeks	5
10	Approved Vendor List	0.15	No	5	No	5	5	5	No	5
Total		100	42		37		38		52	

Summary

PCI Solutions	Final Score
Item #4	52
Item #2	37
Item #1	42
Item #3	38

NOTE: The Item #4 card is way ahead due to weighting of 15 for conformal coating



Selecting Alternatives – EP206

Conclusion Tab

1	All solutions met the minimum port functional requirement of criterion 5.
2	Solution 4 scored highest due to how it can be provided with conformal coating.



Recommendation Tab

1	<p>Given that the card will be installed in a rugged computer chassis, conformal coating is deemed unnecessary. When the conformal coating criterion is discounted, Solution 1 scores higher than Solution 4.</p> <p>Solution 1 is therefore recommended, based primarily on its substantial advantages with regard to delivery and price.</p>
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Selecting Alternatives – EP206

Application Notes:

- *Iterate as required (eg. select technology USB or PCI, then select I/O card)*
- may also be effectively used for management issues such as course selection or prioritization of projects.
- Add extra worksheets to store telecons, OEM data, sub evaluations, or stakeholders' comments.
- Whenever possible, Evaluation Criteria should be traceable to a source.
 - customer requirements, derived requirements, operational scenarios, technical limitations, environmental constraints, identified risks, business case assumptions, or business objectives.
- Use working groups or peer reviews to agree on selection criteria for critical items
- Workbooks may be logged as a Design File Memo (DFM), Ref EP202
- Workbooks do not negate the requirement for a full Design Description Document (DDD) or associated Design Reviews (PDR/CDR). They are intended to augment or reinforce that process.

Keep it Simple, but keep it real



Responsibilities

The Project Leader is responsible to:

- ensure that designs activities are conducted and documented to the degree warranted by the complexity of the project and the decision itself.
- ensure team members understand and are committed to documenting decisions
- ensure that the EPP identifies the tools/evaluation methods, such as EP206
- ensure that the progress of planned and unplanned design analysis is progressing
- ensure that the progress is reported to the Engineering Manager
- ensure the proper use of DFMs
- ensure records are configured/managed as per CMPs or under local project Control

The Engineering Manager is responsible to:

- ensure that the Project Leader is doing the above items



Cost Impact

Workbooks should not impact the cost of your project.



Workbooks are simply a vehicle to document your thought process.



Memo from the Eng Manager

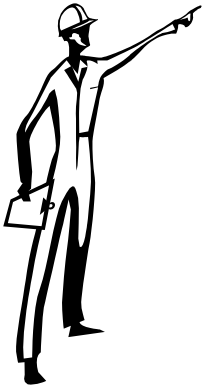
Decisions Analysis Records

I would like to take this opportunity to formally remind staff of the important requirement to record decisions made during design projects. Project history should include why a particular component was selected for a particular function. The analysis that was performed needs to be documented.

EP206, Selecting Alternatives, describes a formal evaluation process through which multiple alternatives may be analyzed and an optimum alternative identified. This process uses an Excel workbook with multiple worksheets to record the analysis, conclusion, and recommendation.

Project Leads need to ensure that the project team captures all major decisions, so that any future work on that particular end item deliverable or similar design project does not have to repeat the process, arriving at the different conclusion and hence introducing risk for success on that project/end item.

John Doe
Engineering Manager



Conclusion

- Always identify alternatives!
- Select best solution based on criteria and weighting
- Not feasible to analyze every decision, keep it simple, review the core options
- Workbooks provide a good compromise for a full options analysis
- Workbooks are expected to be used on most projects
- Capture workbooks as Design File Memos (DFMs) as required

Keep it simple, but keep it real...

even poor documentation may be better than no documentation





The
End

