"LEAN/FLOW DESIGN EVENT"

A MANUFACTURING COST REDUCTION CASE STUDY

By

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A Research Paper

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ABSTRACT

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American manufactures continue to receive fierce competition from abroad. Due to this competition, manufacturers continue to look for ways to cut costs while maintaining high levels of product quality and availability.

This is a field problem case study involving a major commercial HVAC company with multiple facilities in the Midwest. Due to the extremely competitive manufacturing environment, the company has requested they remain anonymous, henceforth to be referred to as the "XYZ" Company. The primary objective of the field project is to reduce their costs on a specific product line by $250,000 annually. The secondary objective of the field project is to create a design evaluation process that can be replicated by the company in future for further cost reduction initiatives.

The methodology to be used in this field project has roots in Value Engineering but it deviates and adds to that existing body of knowledge. The problem solving procedure to be used is a highbred between Value Analysis, Lean Design and a Kaizen Event. The procedure not only utilizes a critical thinking process but also a creative thinking process. The process focuses on identifying improvement opportunities in both the design and production processes of the product. Specific steps in this problem solving methodology are:

- Selection – a systematic approach in choosing a potentially high return-on-investment project.
- Information – a scientific approach in analyzing the product functional design for potential areas of design and/or process improvement.
- Creativity – a creative brainstorming approach to identifying alternative designs/processes that will enhance the competitive advantage of the company.
- Analysis – a systematic approach to comparing the design/process alternatives to identify the high impact, low cost, options.
- Development – a financial analysis of the alternative designs/processes and formal presentation to management for the approval of the design/process changes.

Acknowledgements

God,

Family,

Work.

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Chapter 1

Statement of the Problem

Introduction

American manufactures continue to be challenged by foreign competition. In the 70's it was Japan, in the 90's it was Mexico, now it's China. We are in a global economy; there will always be a new competitor to challenge the status quo (Costanza, 1990, p.1-2). This broad, all encompassing statement is used today with a cold aura of detachment. But for those workers that are displaced by foreign competition, this is a personal and emotional issue.

American manufactures must be able to compete worldwide in cost, quality, reliability and availability. Companies throughout the U.S. are mapping their value streams, seeking, locating and eliminating waste (Womack, 1996, p.19). One of the most significant challenges today is in the area of cost. This is a case study of one company's approach to cutting wasteful costs to be more competitive in the world market.

Purpose of the Study

From a broad perspective, the purpose of this study is to provide an example of how a traditional American manufacturing company can reduce costs to be more competitive in the world market. The specific purpose of this study is to define, and execute a problem solving process targeting the design of products at this company to cut manufacturing costs without having an adverse effect on their product reliability, quality or availability.

Goal of the Study

There are two goals in this study, one; develop a process to evaluate the design of a product and it's corresponding processes in order to reduce the product's cost, which can be replicated by the company on future improvement projects; and two; facilitate them though this process the first time to realize their objectives and goals. The company's specific cost reduction target for this project is $250,000 per year.

Scope and Limitations

Even though this company has multiple international locations and product lines, this project is limited to one product line produced in the Midwest. The planning portion of this project has been limited in time to the equivalent of a Kaizen event; one week. If possible, the company would also like to limit project capital investments to what can be recovered in a twelve-month period.

Chapter 2

Literature Review

Historical Perspective

The methodology developed in this project is proprietary and somewhat tailored to this specific company but has its roots in previously proven methodologies. The methodology used in this project is called a Lean/Flow Design Event and is constructed on the foundations of Value Engineering, Design for Manufacturing, Lean Design and Kaizen Events.

Kaizen Event

The term Kaizen Event should not be confused with the term Kaizen. In Japanese, Kaizen means continuous, incremental improvement. Kaizen became popular, and has been widely used in the automotive industry (Park, 1999, p.39). A Kaizen event, on the contrary, is an intense group problem solving process usually one week in duration. Kaizen events are often used as a tool in a company's initiative to move towards Lean Manufacturing. Kaizen events however, are typically not used to evaluate the design of a product (Park, 1999, p.18-19).

Value Engineering

Value Engineering methodology has its roots deep in Industrial Engineering disciplines. It was very popular in the defense industry in the 1970's and 1980's. It is a very systematic and analytical process for evaluating the functions of a design in order to seek out cost improvement opportunities. Much focus has been placed on the analytical and systematic process used in Value Engineering, but its true value is its ability to open the mind to new ideas by "breaking down constraints to visualization" (Park, 1999, p.5). However, due to its complexity, it can be a very time consuming and cumbersome process. Value Engineering still exists, but it has gradually evolved into what is known today as Design for Manufacturing or Design for Assembly (Anderson, 1990, p.93).

Design for Manufacturability (DFM)

DFM methodology of product/process improvement is an evolutionary enhancement of Value Engineering (Anderson, 1990, p.10). DFM is sometimes also referred to as Lean Design. There is little difference between Value Engineering and Lean Design, but the name creates a bond with the currently popular manufacturing methodology of Lean Manufacturing (Womack, 1996). DFM is a less cumbersome method of design analysis than Value Engineering but it to searches for waste in the product design and production processes. It is the practice of taking manufacturing into consideration when designing products. Some considerations of DFM are (Anderson, 1990, p.9):

- Design in the least time, with the least development cost.
- Make the quickest and smoothest transition into production.
- Assembly and test with a minimum amount of time and cost.
- Appropriate levels of quality and reliability.
- Satisfy customer needs and compete well in the marketplace.

Chapter 3

Research Methodology

The methodology used in this field project has roots in Value Engineering/Analysis but it also deviates from that existing body of knowledge. The problem solving procedure used is a highbred between Value Analysis, Design for Manufacturing and a Kaizen Event. The procedure not only utilized a critical thinking process but also a creative thinking process. The process focused on identifying improvement opportunities in both the design and production processes of the product. There are seven steps in this design/process improvement process; selection, information, creativity, analysis, development, implementation and verification. This field project details the company's progress through the first five steps of the methodology but does not track their progress through the implementation and verification phases of the process. In addition to the project methodology, two other key ingredients were necessary for a successful project. First, management personnel were briefed on the methodology and the commitment that would be needed to conduct a successful project. Second, company personnel were provided on-site training as a prerequisite to the project (Appendix A).

Selection Phase: This phase utilizes a process for investigation potential business areas for opportunities of design or process improvements.

Candidates are sought that:

- Need profit improvements

- Are in production but have years of product life remaining
- Sales forecasts are somewhat predictable
- Sales volume justifies investigation
- Documentation and cost data is available

The process begins by seeking candidates and ends with a list of candidates along with specific product and process information.

Information Phase: This phase utilizes a scientific approach in analyzing the product functional design for potential areas of design and/or process improvement.

This phase uses a technique and form called a FAT (Functional Analysis Technique) chart. This is a process created by the researcher; it is a distilled version of a “FAST” chart used in Value Analysis (Park, 1999). The following detail is compiled for each of the candidates from the previous stage:

- Objectives of the design in relation to the customer expectations
- Limitations of the design functions
- Primary and secondary functions of the design characteristics
- Physical characteristics associated with the design functions
- Associated cost detail and summary of the above

This phase begins with product information for each of the candidates identified in the selection phase and ends with a FAT chart for each of the candidates.

Creativity Phase: This phase uses a creative team brainstorming approach to identifying alternative product designs/processes that will enhance the competitive advantage of the company.

In this phase, the process abruptly changes from analytical to creative. The objective of this phase is to break down each participant's existing paradigms of the product's design and processes. Some of the challenges presented to the team are:

- Can the process or part be eliminated?
- Can the specification be loosened or eliminated?
- Can a standard part be substituted?
- Can the parts be modified for quicker fabrication or assembly?
- Can an inexpensive material be substituted?
- Can parts be combined?
- Can fasteners be reduced or eliminated?

This phase begins with the FAT charts developed from the previous phase and ends with a list of unabridged design and process alternatives addressing the design and process characteristics of the product under analysis.

Analysis Phase: This phase uses a systematic approach to compare the design and process alternatives to highlight the high impact, low cost options. This phase filters the ideas from the creativity phase to yield feasible design and process alternatives, steps in this process include:

- Refine and combine ideas

- Rate ideas for potential savings
- Rate ideas for potential implementation costs
- Sort the ideas with high savings and low costs in Pareto order
- Test the top candidates for common sense and select the top ideas for final analysis

This phase begins with a comprehensive list of product design and process alternatives and ends with an abbreviated list in rank order of feasibility and profitability.

Development Phase: This phase yields a financial analysis of the alternative designs and processes for a formal presentation to management for approval of the design and process changes. This phase develops detailed cost/benefit analysis for each of the product design/process alternatives developed in the previous phases. The following are details outlined in each of the proposed improvement recommendations:

- What design/process changes are required
- How and when can they be implemented
- What are the costs and the risk of the changes
- What are the expected results of the changes

These changes are evaluated individually and compositely for both written and oral presentation to management for approval. This phase begins with the list of improvement finalists and ends with detailed cost/benefit analyses for each of the ideas as well as a comprehensive report both written and verbal. The final presentation to management concludes this project methodology.

Implementation Phase: This phase implements the recommendations developed from the previous phases.

This phase is not in the scope of this research project.

Verification Phase: The final step of this methodology is to verify the results of the project against the plan.

This phase is not in the scope of this research project.

Chapter 4

The Project

Management Meeting:

A meeting was held prior to any project activity to clearly define the expectations of the project between the researcher and the management team. Project goals, timelines and responsibilities were topics of discussion. The following were project details defined in that meeting.

Product: The management team had gone thorough a preliminary selection process prior to the official start of the project identifying products that had potentially significant opportunity for improvement. These candidates were reviewed and approved at the project kickoff meeting. Due to the size and complexity of the product the management team had chosen, there was some concern by everyone as to the feasibility of completing the project within the suggested timeline. It was agreed that if the project seemed too large after the onset, the project scope would be reconsidered.

Because the selected product was large and complex, consensus was reached limit the project to the evaluation final assembly of the product. Cost improvement opportunities identified in parts and subassemblies would be captured but evaluated at a future date.

Financial Goals: The financial goal of the project was to save $250,000 each year in product or process costs for the specified product line. The company also hoped to accomplish these savings with minimal capital investments. They did anticipate accruing some project costs, but requested the team target a twelve to eighteen month cost recovery period for the product and process changes they recommended.

Project Timeline: The first five steps of this process are structured to be completed in a similar timeframe as a Kaizen Event; five days. Due to capacity constraints, the timeframe was compressed to three days. In order to achieve this compression, management agreed to allow some data gathering after the formal meetings adjourned.

Management also asked that the recommended changes be capable of being implemented within one year.

Team Participants: The project team consisted of eight cross-functional company personnel including both management and shop floor personnel. The financial department was unable to participate and their presence was notably missed during the project.

The researcher was approved as the facilitator of the project team and a company employee was assigned as the champion of the project. The champion not only had responsibilities during the planning phases of the project but was also the individual who would have responsibilities for the eventual implementation of the recommendations.

The management meeting concluded with clear expectations of roles, responsibilities and outcomes.

On-site Training:

A PowerPoint presentation (see attachment A) was created to provide the team participants an overview of the Lean/Flow Design Event process. The training consisted of about one hour of instruction at each phase of the project. The overall theme of the training was; “Challenge Everything!”

Selection Phase:

Much of this phase had been completed by the management team prior to the start of the project. The team was briefed on what had been selected and the reasons why it was selected. As was the case with the Management Team, the implementation team also had concerns as to whether or not there was adequate time to evaluate the selected product line. The production assembly process for this product has six stations. The team was split into two and each sub-team was assigned three product assembly stations to investigate. A brief information form was completed for each of the product assembly stations (Appendix B); this completed the selection phase of the project.

Information Phase:

The information phase was the most complex and time-consuming portion of the project. Even though the project was broken up by assembly stations, the analysis was focused not on the process, but on the design of the product at each of the stations. The teams were given examples of the tasks at each stage of the information phase before analyzing their portion of the product.

The first task was to define the objectives of the design. There were often multiple design objectives as well as multiple sub-objectives. A time limit was given for completing each task of each phase. These time limits were flexible but necessary to keep the teams on task. Once the objectives were identified, the team documented them on the FAT chart. The project had a full time recorder to convert the hand written documentation, flip-chart information and digital pictures into cohesive information at each phase of the process.

The second task of the information phase was to define the scope, or the limitations, of the potential design alternative e.g. the design must comply with the laws of physics, etc. The team participants had some difficulties during this phase breaking through their current paradigms e.g. “we’ve always done it that way”, “no welding has worked in the past”, etc.

The third task in this phase was the identification of functions for each of the design objectives. Production personnel often didn’t realize the reasons for some of the design characteristics; this phase exposed them to the reasons for the current design. The functions were sometimes split into smaller, more detailed, sub-functions.

The fourth task was to identify the configuration of parts associated with each of the functions. The objectives and limitations tasks of this phase could be completed independently from one another. The remaining tasks in this phase were completed concurrently. Rather than listing individual parts, the team often listed subassemblies but this deviation posed no problem in the analysis.

The fifth task was to cost the design configuration. This was somewhat difficult because no one on the teams had access to pertinent financial information. For lack of a better method, the teams assigned a subjective estimate of material and labor cost each of the design characteristics rather than a specific financial value. Even though this was not optimal, it was adequate to proceed with the remainder of the phase.

The sixth task was to investigate issues or problems with the current configuration. Team participants interviewed numerous office and shop floor personnel to solicited information concerning product failures or assembly problems. Numerous issues associated with the assembly and fabrication of the product were identified and recorded on the FAT charts.

This phase of the project was the most time consuming portion of the project. One of the major difficulties during this phase was the team’s desire to jump into solutions.

Creativity Phase:

Prior phases of the project emphasized an analytical approach; this phase required a complete switch in the participants thinking process. This phase required a creative, freethinking process to be successful. The objective of this phase was to create an unabridged list of beneficial alternative product designs and processes. Old design and process paradigms were obstacles to new and innovative alternatives. The challenge of this phase was to get the participants to “Challenge Everything!” Multiple brainstorming techniques were used in this full day of activity. Individual anonymous suggestion ballets, group brainstorming and affinity analyses were used to solicit over 100 design and process improvement suggestions.

Analysis Phase:

The creative phase generated a nonjudgmental, unabridged list of product design and process improvement alternatives for each of the six product subassembly stations. This phase condensed and filtered those lists to identify the best alternatives. The first step was to combine and refine the ideas; then the remaining ideas were rated for potential cost savings. Next, each idea was rated for difficulty and cost of implementation. The rankings were subjective because each participant’s ranking was based on their personal opinion. They used a one to ten rating scale where 10 is the highest score and 1 is the lowest. Again, without a representative from the company’s financial department, cost and benefit ranking was done using the best estimates from the participants. Most of the ideas had a narrow range of ranking; ideas that had a significant numeric spread were discussed in some detail and reevaluated. The numeric cost ranking was then subtracted from its benefit ranking to calculate a delta between the two rankings. The ideas were then sorted with the high savings, low cost ideas at the top of the list. Then, with less than a day remaining in the project, the participants reviewed all six of the prioritized lists to select the improvement finalists to carry into the next and final phase. The improvement opportunities that were not selected were saved for future analysis. The best ideas from the lists were carried over for evaluation in the development phase of this project.

Development Phase:

Each idea that was selected then required a detailed cost benefit analysis be completed by the team participants. Each improvement idea now needed further detail as to; what changes were require, how and when they were to be implemented, what the costs and risks would be and what were the expect results. The facilitator discouraged subjective benefits such as improved morale and easier assembly. The teams were encouraged to document tangible, quantitative benefits for each of the suggested design or process improvements. A digital picture of the product or process and a detailed cost/benefit analysis was developed for each improvement idea (Appendix B). The individual improvement recommendations were compiled on a spreadsheet to calculate the total projected savings.

Results:

On the last day of the project, the project teams gave a two-hour presentation to senior company management on the project and its outcomes. The team participants took turns in presenting the tasks, the reasons, and the results of each of the steps they took in the event. They briefly reviewed each of their recommended improvement projects. In the three-day event, the teams had identified over twenty-four improvement projects with a projected annual savings of over $390,000 exceeding their goal of $250,000. Management was very pleased with the results of the project and assured the implementation team they would support their recommendations.

Chapter 5

Conclusions and Recommendations

Even though this was a very successful project, it is not an easy process. One of the major difficulties in facilitating this process is transitioning the participants from an analytical thinking process to a creative thinking process, then back to an analytical thinking process. This mental leapfrogging is difficult for both the participants and the facilitator. The overall success of this style of project is contingent on the team's ability to make this transition. A seasoned facilitator is highly recommended for this type of improvement project.

This was the company's first Lean/Flow Design Event so it was difficult for the participants to understand the process, or the reasons for the analytical complexity at the beginning of the process. The training conducted beforehand helped provide the participants some insight into the process, but it's highly recommended that future Lean/Flow Design Events include participants from previous events. They could assist the team in visualizing the direction and expected outcomes of the process.

Six months after the conclusion of the project, the company had successfully implemented many of the proposed process and product improvements. Some of the suggested improvements were found to be unfeasible but most were implemented yielding results greater than the original estimates.

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Womack, James P. & Jones, Daniel T. (1996). Lean Thinking. New York, New York: Simon & Schuster Inc.

Appendix A

Lean/Flow Design Event PowerPoint Presentation

Lean/Flow Design

Lean/Flow Design Event

Presented by:
Lloyd Peterson & Lynn Berry

Sponsored by:
Saint Paul College
Jeet Do Manufacturing, LLC
Stout Advanced Manufacturing Assistance

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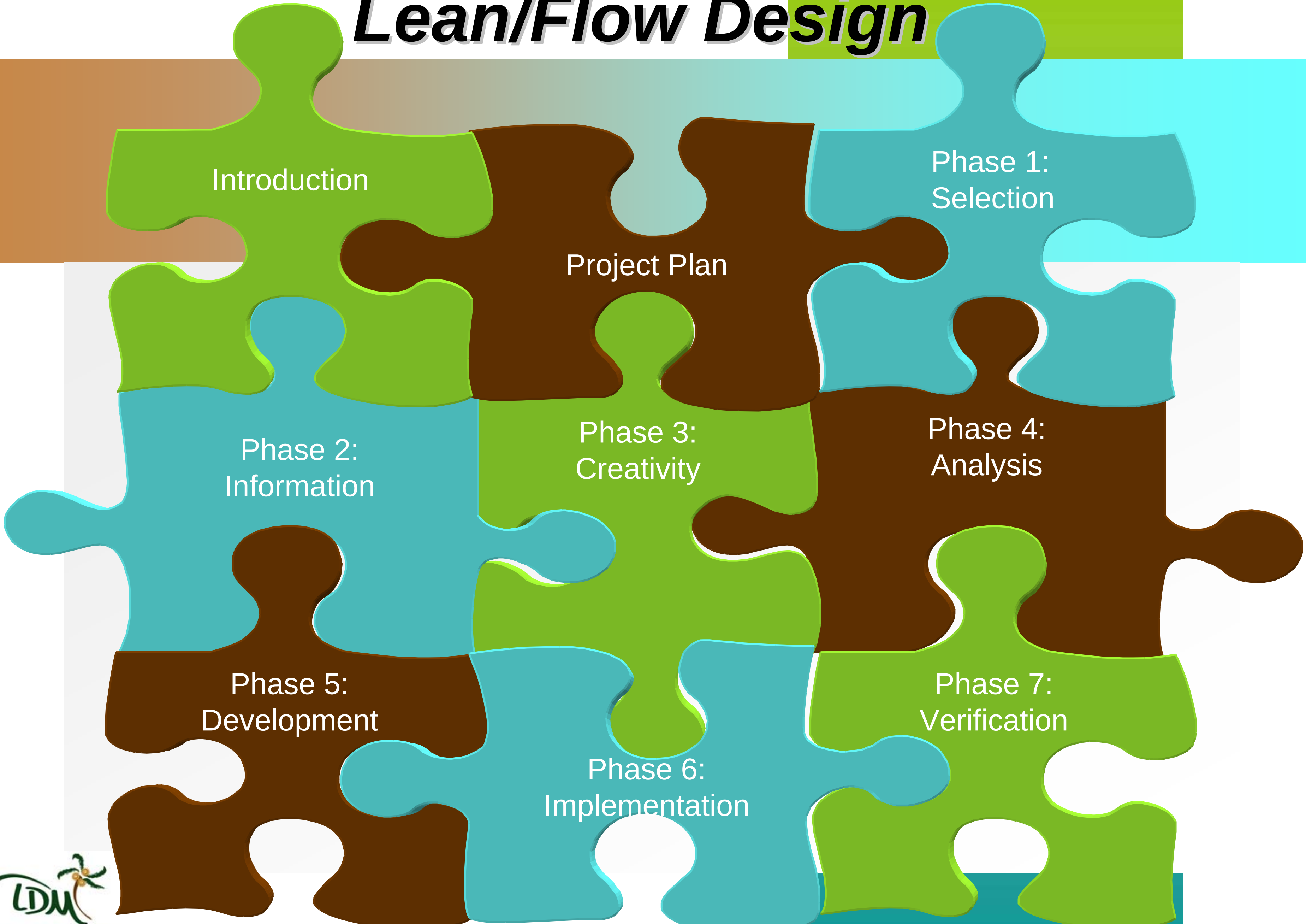
Lean/Flow Design



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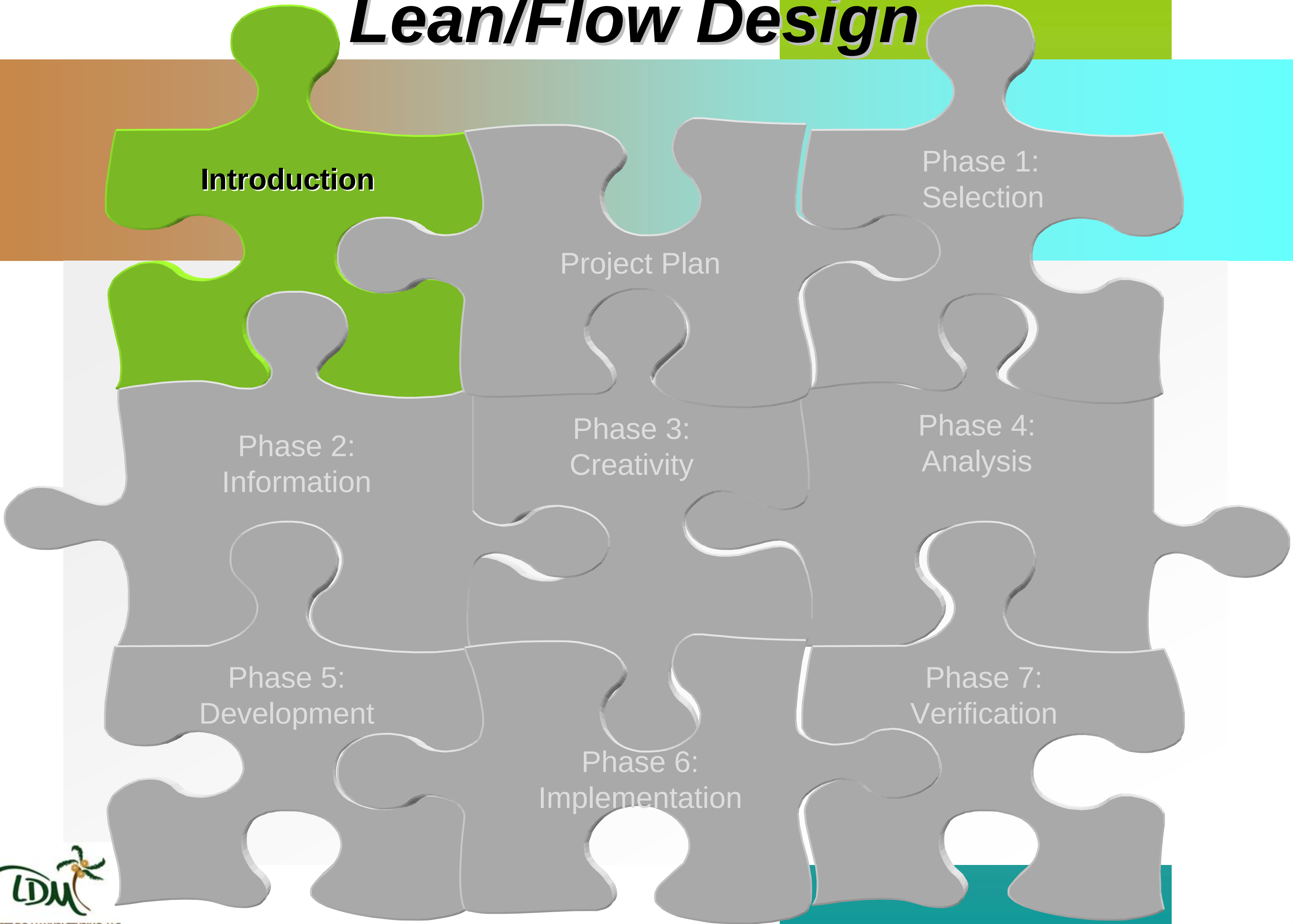

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Lean/Flow Design

Challenge Everything!

Lean/Flow Design

- Uses a cross-functional team
- Follows a systematic project plan
- Identifies and evaluates design functions & costs
- Develops new and innovative alternatives
- Determines the best and lowest life-cycle cost options
- Develops financially supported recommendations
- Reports to management within one week

Project Selection Criteria

- Product needs profit improvement
- Product is in production and has remaining years of active life
- Sales forecasts are somewhat predictable
- Sales volume of product justifies investigation
- Documentation and cost data is available

Team Selection

- Teams of 6 – 8 members, 1 – 2 teams per event.
- Team could include: Shop Floor Employee, Supervisor, Design Engineer, Production Engineer, Quality Engineer, Accountant, Buyer, Industrial Engineer, Sales, Marketing.
- Team must be free to work away from their jobs for the Workshop period without recall or interruption.
- Team members must be experienced in technical disciplines required by the project.
- Prior project experience desirable for 1 - 2 team members.

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Team Responsibilities

Facilitator:

- Keep team on track and on schedule

Champion:

- Assign action items
- Arrange resources
- Coordinate oral reports

Recorder:

- Record all information
- Coordinate written reports

Team Members:

- Explore, create, develop, recommend, report

Management Responsibility

- Keep an open-mind
- Actively support the project
- Define the scope & boundaries of the project
- Act on the team's recommendations
- Keep an open-mind

Reasons why a product may not represent the best possible value:

- Lack of information & time during design
- Decisions based on wrong assumptions
- No systematic design process
- Reluctance to seek advice
- Changing technology
- Poor teamwork
- Poor specifications
- Habitual thinking

80% of product costs are fixed at design stage!

What's in a GOOD design:

- Cross-functional input
- Minimum amount of parts
- Few or no fasteners
- Parts only go together one-way
- Parts align easily
- Set-ups are minimized
- Standard parts are used

"No amount of process improvement can compensate for a poor design!"

$$\text{Value} = \frac{\text{Function} + \text{Performance} + \text{Quality} + \text{Availability}}{\text{Cost}}$$

Value is a price established by someone else

Worth is personal -- it’s what you would pay for a product or service

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Value Management

Value Analysis

Applied to products in production -- sometimes years after product introduction

Value Engineering

Usually applied in the concept/design phase. Sometimes applied during design and prototype preproduction areas and referred to as ***Concurrent Engineering***

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Lean/Flow Design

A Philosophy focused on eliminating everything which induces cost but does not contribute value

A System for analyzing products and processes for the purpose of eliminating those that do not add value.

A Technique to identify product functions, and to create and evaluate design/process alternatives.

Lean/Flow Design

Goal:

- Improve Quality
- Improve Performance
- Improve Profitability
- Reduce Lead Time

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Lean/Flow Design

Lean/Flow Design Analysis

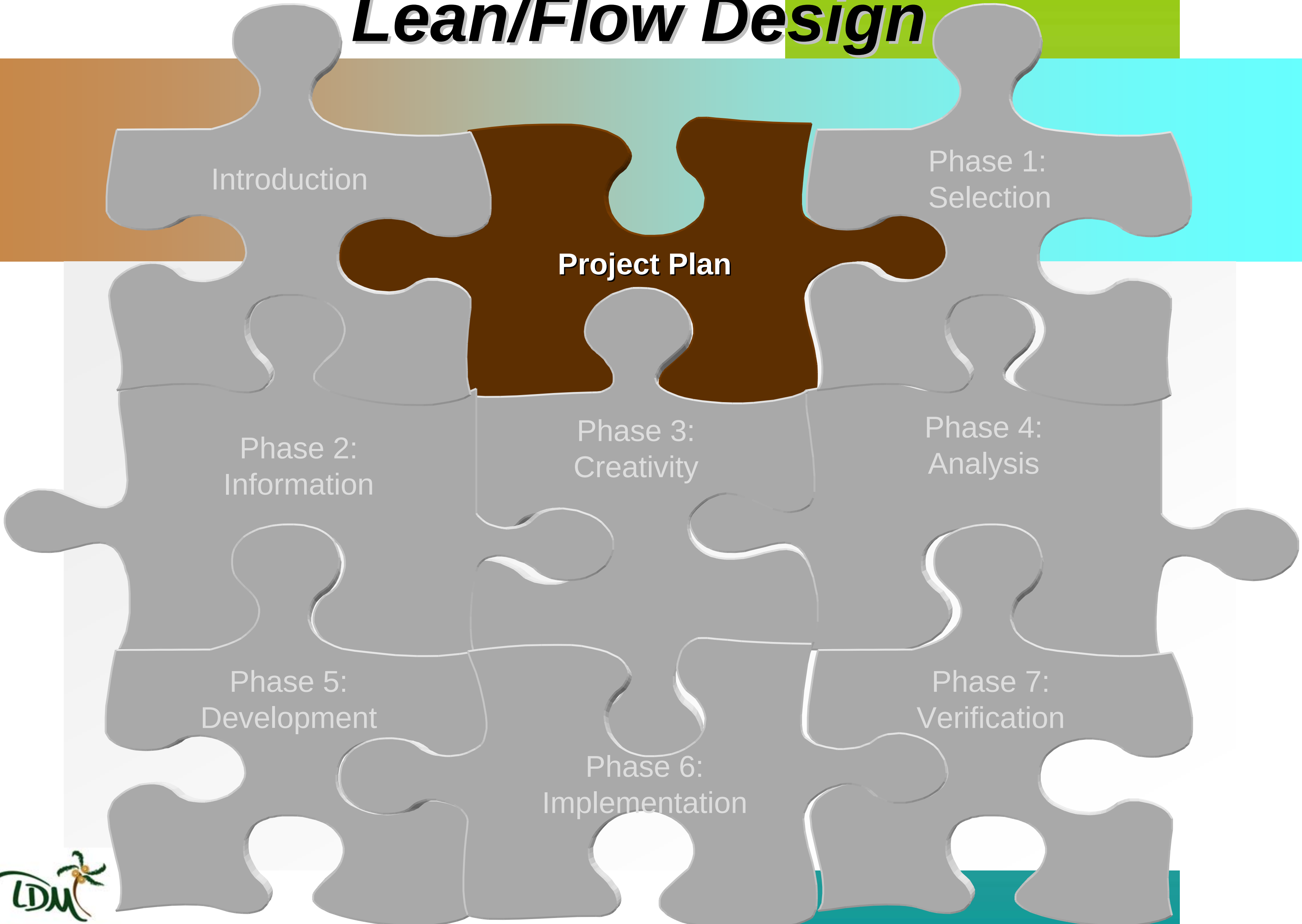
- Design for manufacturability/assembly
- Simple concepts/processes
- Common parts & materials
- Similar assembly systems
- Lowers quality costs

- **Product Standardization**
  - Simplify supply management
  - Lowers material overhead cost
  - Build to order
- **Process Standardization**
  - Lean/flow production
  - Setup reductions
  - Inventory control

Value Search

- What is it?
- What does it do?
- What should it do?
- What else can it do?
- What do they cost?
- What is best at lowest cost?

Lean/Flow Design



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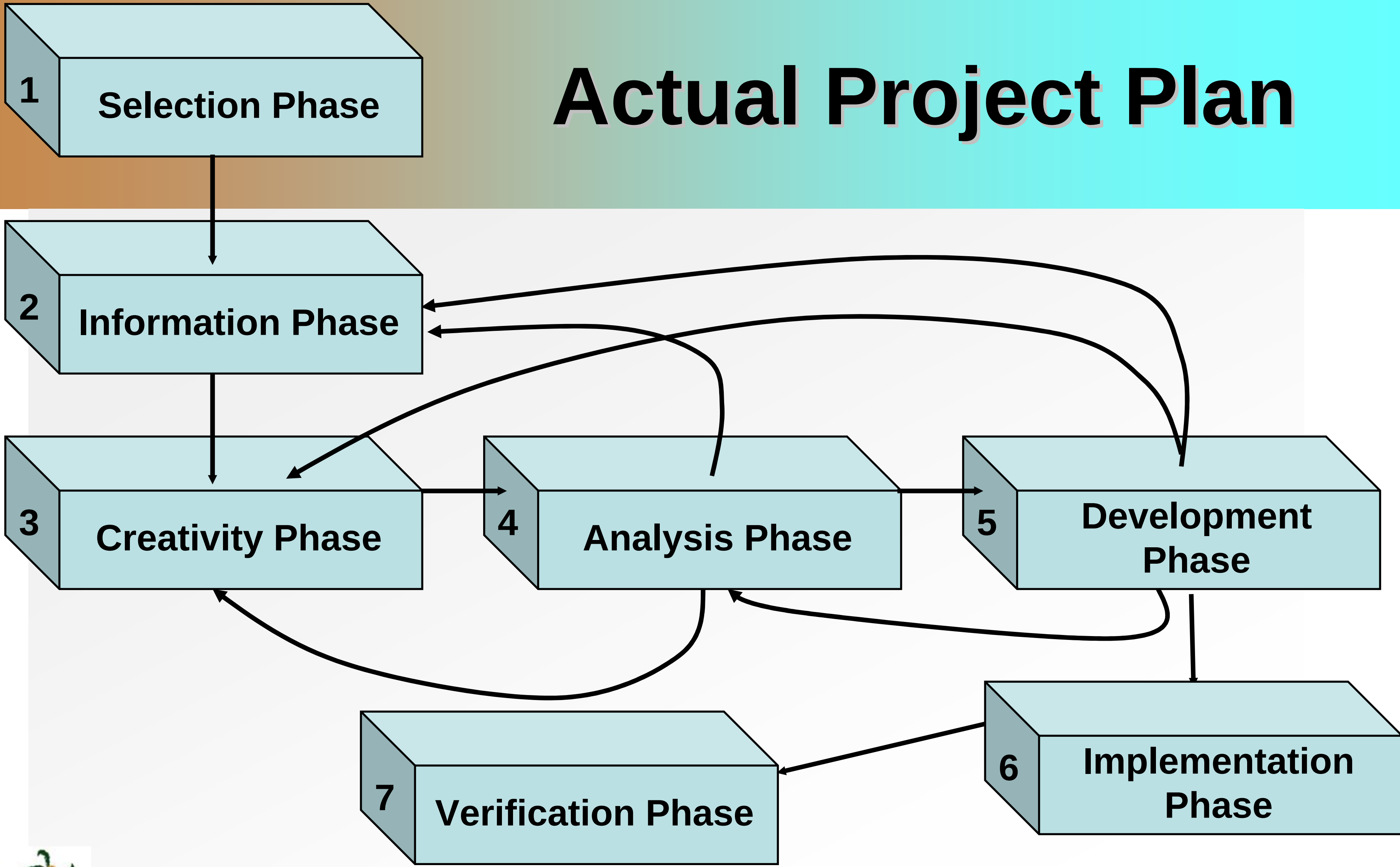
Lean/Flow Design

Challenge Everything!

Actual Project Plan



Lean/Flow Design

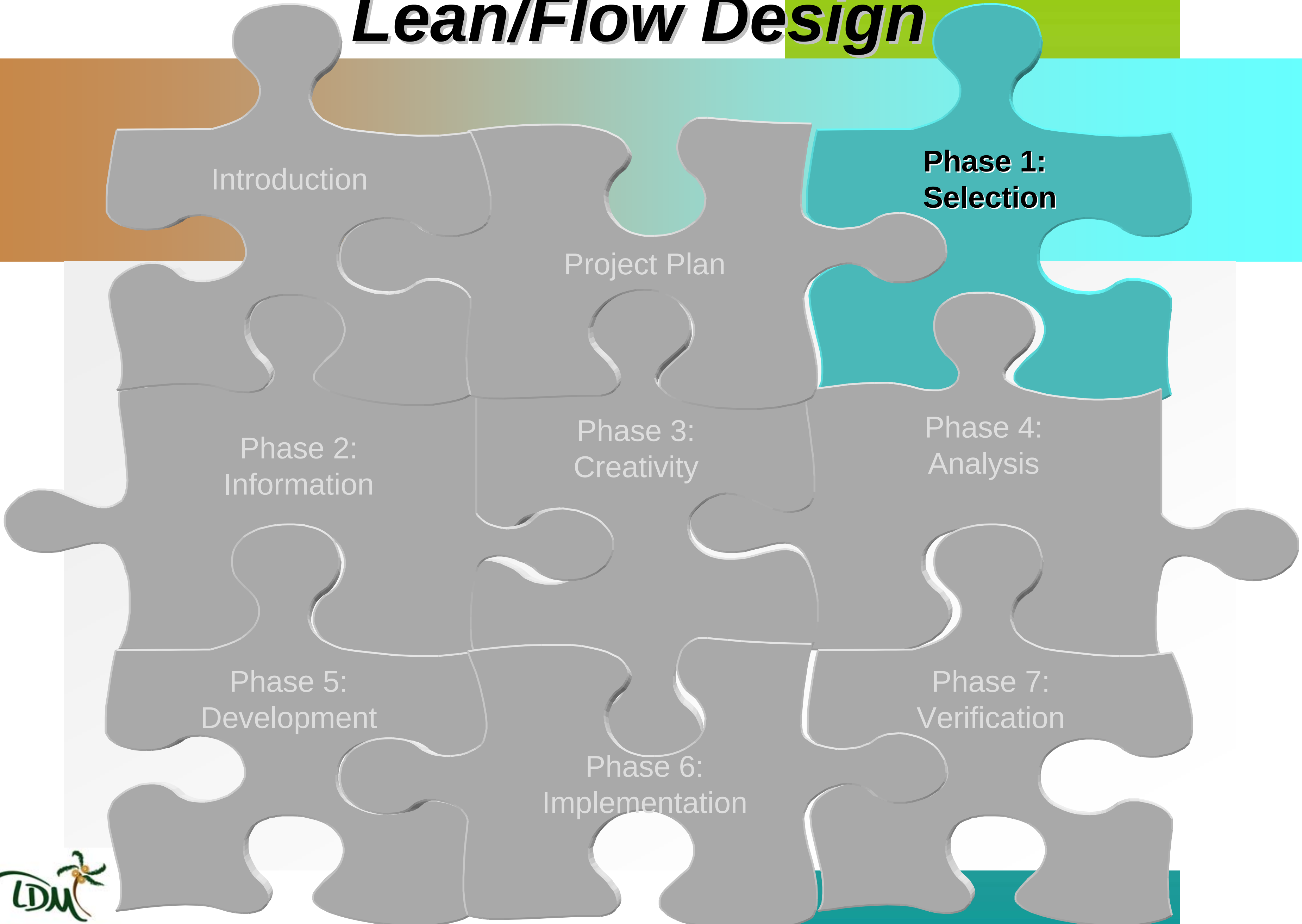
Function

Analysis

Technique

Trim away the FAT – Get Lean

Lean/Flow Design



Lean/Flow Design

Challenge Everything!

Project Selection Phase

1. Seek Candidates
2. Get Basic Information
3. Rank Candidates
4. Choose Finalists
5. Get Product Information on Final Candidates

Project Selection Criteria

- Product needs profit improvement
- Product is in production and has remaining years of active life
- Sales forecasts are somewhat predictable
- Sales volume of product justifies investigation
- Documentation and cost data is available

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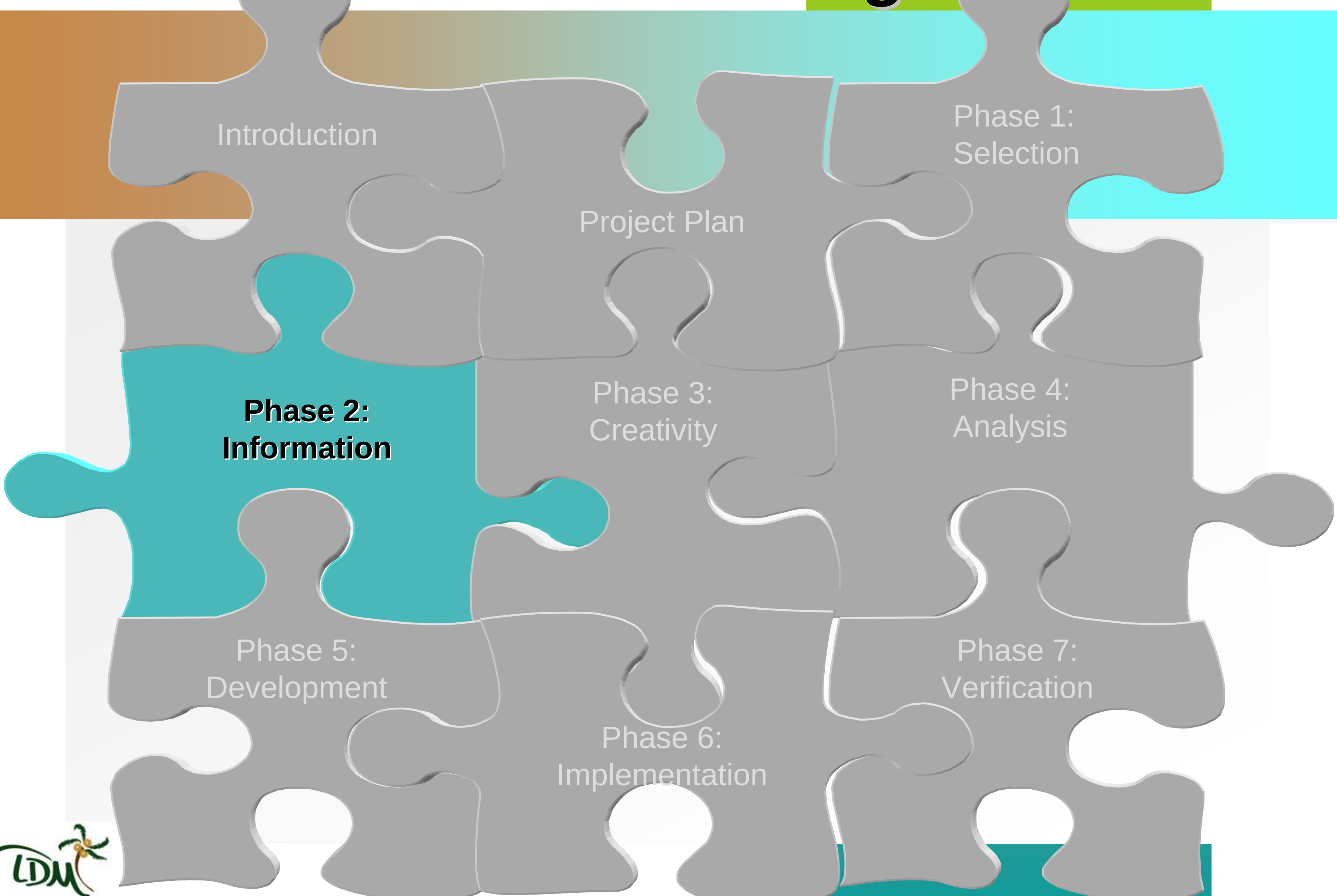
Product Information Checklist

1. Project: Name and Brief Description
2. Status: Full Production (History) -- Pre-Production -- Design
3. Customer Data: Who, Where, What Special Interests?
4. Problems and Factors (i.e., Safety, Reliability, Responsibility, etc.)
5. Production Data: Total Qty., Annual Qty, Rate/Mo, Production Mgr., Group, Location, Phone No.
6. Cost Data: Unit cost now $______, Cost Breakdown Avail., Status of Cost, Cost Estimator, Cost Target
7. Technical Data: Specs, Drawings, Parts Lists, Tooling, Layouts, Hardware Samples, Other (List)
8. Information Sources: Design Supv., Design Engr, Service Engr, Mfg, Procurement, Quality, Specialists

Lean/Flow Design

Your Selected Projects?

Lean/Flow Design



Lean/Flow Design

Challenge Everything!

Information Phase

Product Information

Product Objectives

Scope Limitations

Function Identification

Design/Process Analysis

Cost Analysis

FAT Chart

Information Phase

- What is it?
- What does it do?
- What must it do?
- What does it cost?

Light Fixture Example

Ceramic

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Classification of Functions

Classification of Functions		Example
1. OBJECTIVE	The reason a basic function exists	Provide low cost incandescent light fixture
2. BASIC FUNCTIONS	Functions which, if eliminated, will destroy the objective	Energize bulb; hold bulb; cover box
3. SECONDARY [Lower Order] FUNCTIONS	Functions which exist because a particular means was chosen to meet the basic function	Attach conductors; conduct current

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FAT DIAGRAM

CERAMIC LIGHT FIXTURE EXAMPLE

WHAT	WHY	why	HOW	what	how	How Much
Objective	**Basic Function**	**Lower Function**	**Design**	**Material**	**Process**	**Cost**
Low-cost incandescent light fixture	Attach to Box	•Conform to box •Provide fastener •Provide base holes	Screws	Steel	Purchase	.014
Satisfy Customer	Provide Decor	•Choose material •Provide shape •Provide size				
Protect Customer	Attach Shade	Provide groove	Design Base	Porcelain	Mold	.312
Meet U. L. Requirements	Meet Specs & Environment (Means to) Energize Bulb	•Cover box •Insulate conductors •Identify polarity •Color terminals •Connect source •Provide terminals •Conduct current •Provide conductors	Screws Bus Bars	Brass Brass	Purchase Cut/Tap	.038 .010
	Hold Bulb	•Contact bulb elec. •Conform to bulb •Maintain contact	Thd. Shell Spring Contact	Alum.	Form	.010
	Provide Convenience	•Assemble parts •Rivet assy. •Package the assy •Box parts	Rivets Holes Box	Brass Brass Paper	Form Purchase Purchase	.006 .062 .022

Scope Limits (between Objective and Basic Function)

FAT Cost Summary

Part Name	Cost	%	Cum %
Base	.312	64.5	64.5
Labor	.062	12.8	77.3
Contact Shell	.038	07.8	85.1
Mounting Screws	.014	02.9	88.0
Hot Terminal	.012	02.5	90.5
Hot Screw	.012	02.5	93.0
Center Contact	.010	02.1	95.1
Ground Terminal	.010	02.1	97.2
Ground Screw	.008	01.6	98.8
Rivets	.006	01.2	100.

Light Fixture Example

Plastic

Lean/Flow Design

- Functional Analysis of your product

Objective Example

- **Low cost**
- **Incandescent light fixture**
- **Meet U.L. requirements**
- **Safe**

Light Fixture

Lean/Flow Design

Your Objectives?

SCOPE Example

Screw type mounting: Within the scope -- must be compatible with standard fixture receptacle. The fixture is **outside** of the scope.

Power Source: Outside the scope -- cannot be changed. The bulb, if redesigned, must remain compatible with the current power source.

Shape of the bulb: Within, except for the limiting conditions of the bulb usage or functions.

Internal parts: Within the scope. Specification may limit the use of certain materials, however. This should be investigated, but specifications may be challenged.

Electrical contact points: Within the scope, but must be adaptable to standard fixtures in which the bulb will be used.

Lean/Flow Design

Your Scope?

Function Example

- Reproduce sound – the speaker in the ear piece converts electrical impulses into sound.
- Inform user – a bell or buzzer informs the user of an incoming call.
- Transmission index – the numbers identify the transmission codes for that particular button/hole.
- Conduct electrical current/signals – the wire acts as a electrical transmission conduit.
- Store hand piece – the cradle at the top of the body acts as a storage place.

Phone

Function analysis is the heart of Lean/Flow Design

To define functions, use an **Action Verb** and a **Descriptive Noun**, for example:

Verb	+ Noun	= Function
Generate	Heat	Generate Heat
Expand	Gas	Expand Gas
Move	Piston	Move Piston
Apply	Torque	Apply Torque
Record	Data	Record Data

Lean/Flow Design

Your Functions?

Lower Functions Example

- Pleasing to look at.
- Durable material.
- Non-toxic.
- Encase working components.
- Light weight
- Mobile (within limits)

Phone

Lean/Flow Design

Your Lower Functions?

Design/Process Analysis Example

Parts List	Basic Function	Secondary Functions	Cost
(2) Screws	Attach (to) box	Provide Box Fastener .... Type	.014
(1) Combine cover and base	Provide décor Hold shade Meet environment Provide elec. Protection Identify maker Show U.L. conformance	Include attractiveness .... Config. .... Color Provide attachment .... Config. Drain condensate .... Holes Cover Box .... Config. Insulate Box .... Mat'l Separate conductors .... Config. Provide lettering .... Kind	.312
(1) Contact Shell	Hold Bulb Energize Bulb	Conform to bulb .... Config. Conduct Current .... Mat'l Contact electrode	.038
(1) Spring Contact	Energize Bulb	Contact electrode .... Position Maintain contact .... Config. Conduct current .... Mat'l	.010
(2) Bus Bar	Energize Bulb	Conduct current .... Mat'l Connect source .... Config.	.022
(2) Terminal	Energize Bulb	Connect source.................................. Config.	.020
(3) Rivets	Complete Assembly	Hold parts .... Config.	.006
		Labor	.062
		Total	.484

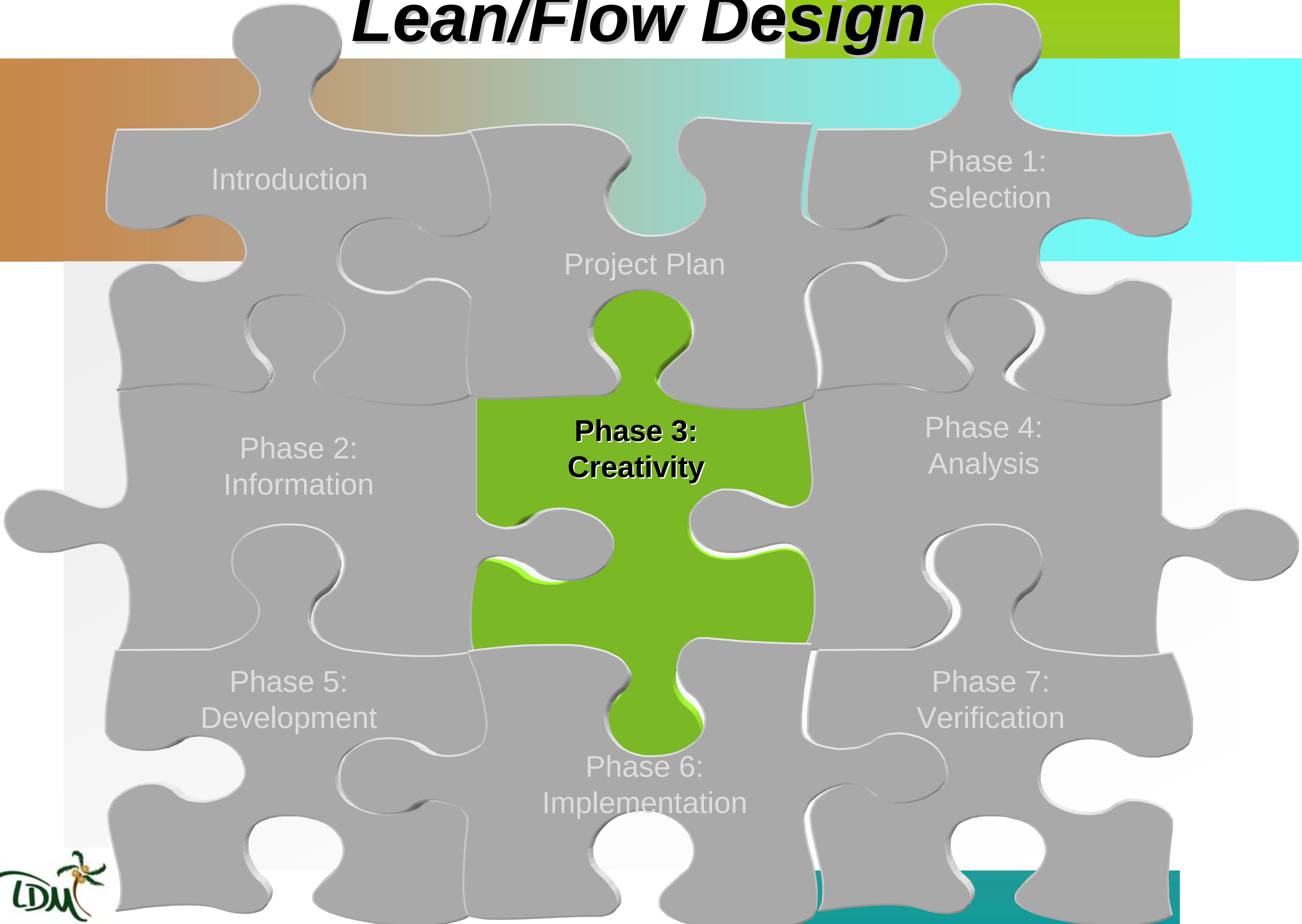
Lean/Flow Design

Your Design/Process Analysis?

Lean/Flow Design

Your Cost Detail?

Lean/Flow Design



Lean/Flow Design

Challenge Everything!

Creativity Phase

1. FAT Charts
2. Brainstorm Functions
3. List Alternatives
4. Break & Meditate
5. Refine Ideas
6. List of Alternatives

Idea Killers

- We can't do that
- We tried that before
- We've always done it that way
- It isn't in the budget
- We're not ready for that
- Our business is different
- We did all right without it
- The boss would never go for it
- We don't have enough time

Rules for Brainstorming

Defer Judgment:

Critique comes afterward.

Welcome Freewheeling:

The wilder the idea, the better.

Solicit Quantity:

The greater the number of ideas, the greater the likelihood of good ones.

Encourage Hitchhiking

Adding to or combining ideas may produce better ideas.

Creativity Techniques

1. Pick a costly basic function
2. Brainstorm each function 10-20 mins.
3. List all ideas
4. Move to a lower order function as necessary
5. Continue through function lists
6. Break and let the subconscious ideate
7. Reconvene and brainstorm some more
8. Refine ideas
9. List design/process alternatives

JEET DO MANUFACTURING, LLC

Identify New Ways

check list

- Can the item or process be eliminated?
- Oversimplify but meet basic requirements
- Can the specification requirements be eliminated or loosened?
- Can standard parts or processes be used?
- Can the present configuration be purchased at lower cost?
- Would an altered standard part or process be more economical?
- Is the current design/process really necessarily?
- Is the current design the result of custom, tradition, or opinion?
- Can parts be modified or assemble easier/quicker?
- What would be a radical alternative?

Identify New Ways

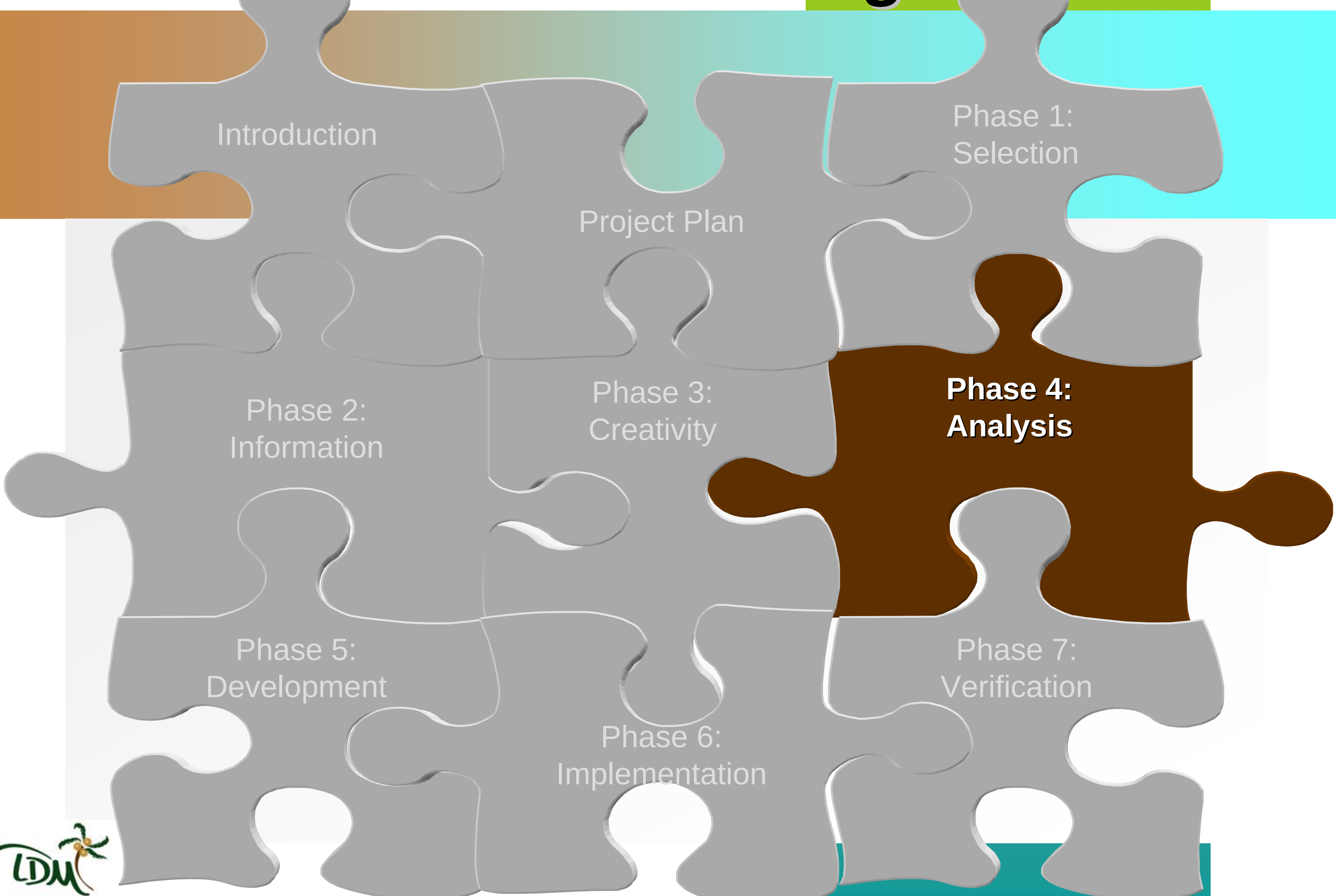
check list

- Are features that improve appearance justified?
- Is there a less costly item that will satisfy the function?
- Can a less expensive material be used?
- Can the design be modularized?
- Can a lighter gage material be used?
- Can other materials or processes be used?
- Analyze surface coatings
- Review all fasteners
- Would stainless steel cost less than plating?
- Consider different processing methods
- Can parts be combined?

Lean/Flow Design

Your List of Design/Process Alternatives?

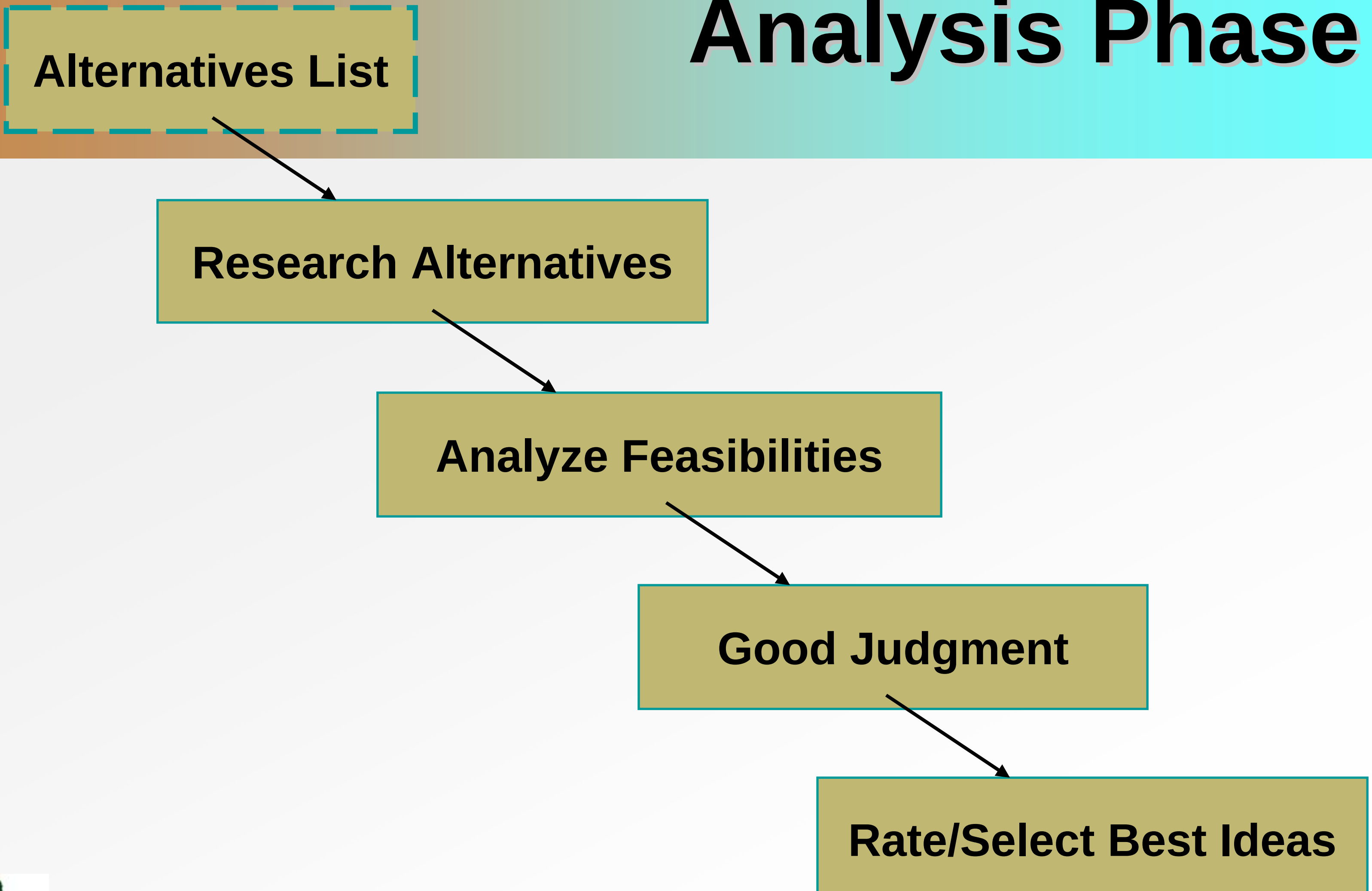
Lean/Flow Design



Lean/Flow Design

Challenge Everything!

Analysis Phase



Analysis Phase

- Refine & combine ideas
- Rate (high, medium, low) each idea for potential savings.
- Rate (high, medium, low) each idea for implementation costs.
- Sort & rank ideas (high savings/low cost versus low savings/high cost).
- Test & select the top ideas.

Analysis Phase Test

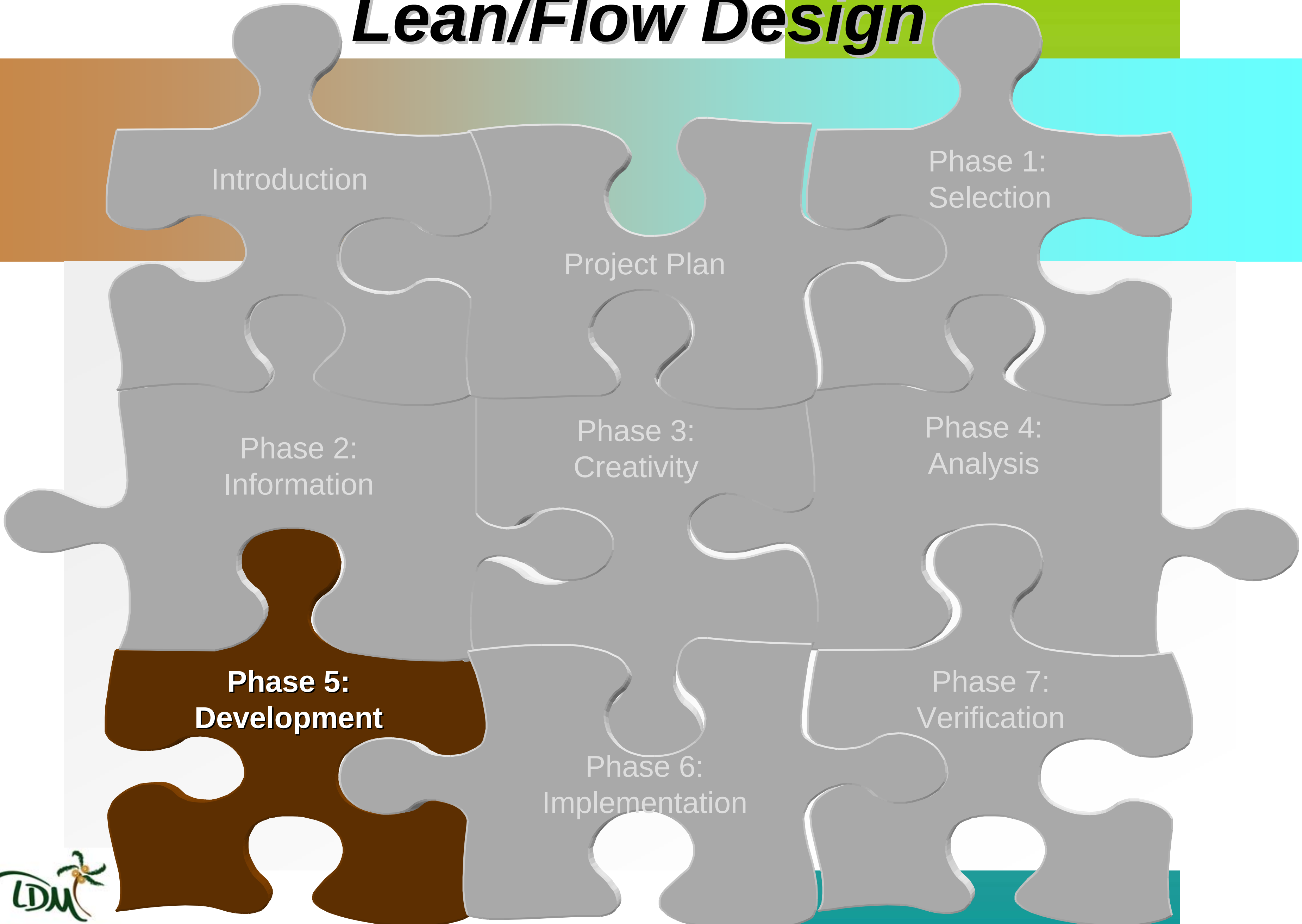
Will the idea:

- Meet all the necessary functions?
- Meet the customers expectations?
- Be an improvement over the current design?
- Meet your project targets?
- Meet with resistance (who)?
- Pass a “common sense” test?

Lean/Flow Design

Your List of finalists?

Lean/Flow Design



Lean/Flow Design

Challenge Everything!

Development Phase

Selected Best Ideas

Compile Detailed ROI Data

Develop Reports

Oral Report

Written Report

Approve/Reject Recommendations

Development Phase

Four things need to be detailed and clearly communicated:

- What changes are required?
- How and when can they be implemented?
- What is the cost and the risk?
- What are the expected results?

Development / Implementation Cost

Cost Examples

Engineering	40 Hrs
Eng. Rate	20 $/Hr
Tooling (in-house)	$2000
Tooling (out-house)	$2000
Design	20 Hrs
Design rate	30 $/Hr
Material acquisition	5%
General & administration	15%

Calculations:

$2000 tooling (out-house) x 1.05 (material acq.) =	$2100
$2000 tooling (in-house)	+2000
40 (Hrs Engr) x 20 ($/Hr rate)	+ 800
20 (Hrs design) x 20 ($/Hr rate)	+ 600
subtotal	5500
General & administrative	x 1.15
Total dev/imp cost	**$6325**

Cost Examples

Material Cost

Purchase price	$3.58 each
Usage	3 per device
Material scrap	10%
Material acquisition	5%
General & administrative	15%

Calculations:

$3.58 x 3 (usage) + .90 (material scrap) x 1.05 (material acquisition) x 1.15 (general & administrative = $14.41 total cost per device

Labor Cost

Standard hours	100 Hrs/1000 (M) Devices
Rate	8.50 $/Hr
Efficiency	90%
Salvage	10%
Scrap	10%
Burden	110%
General & administrative	15%

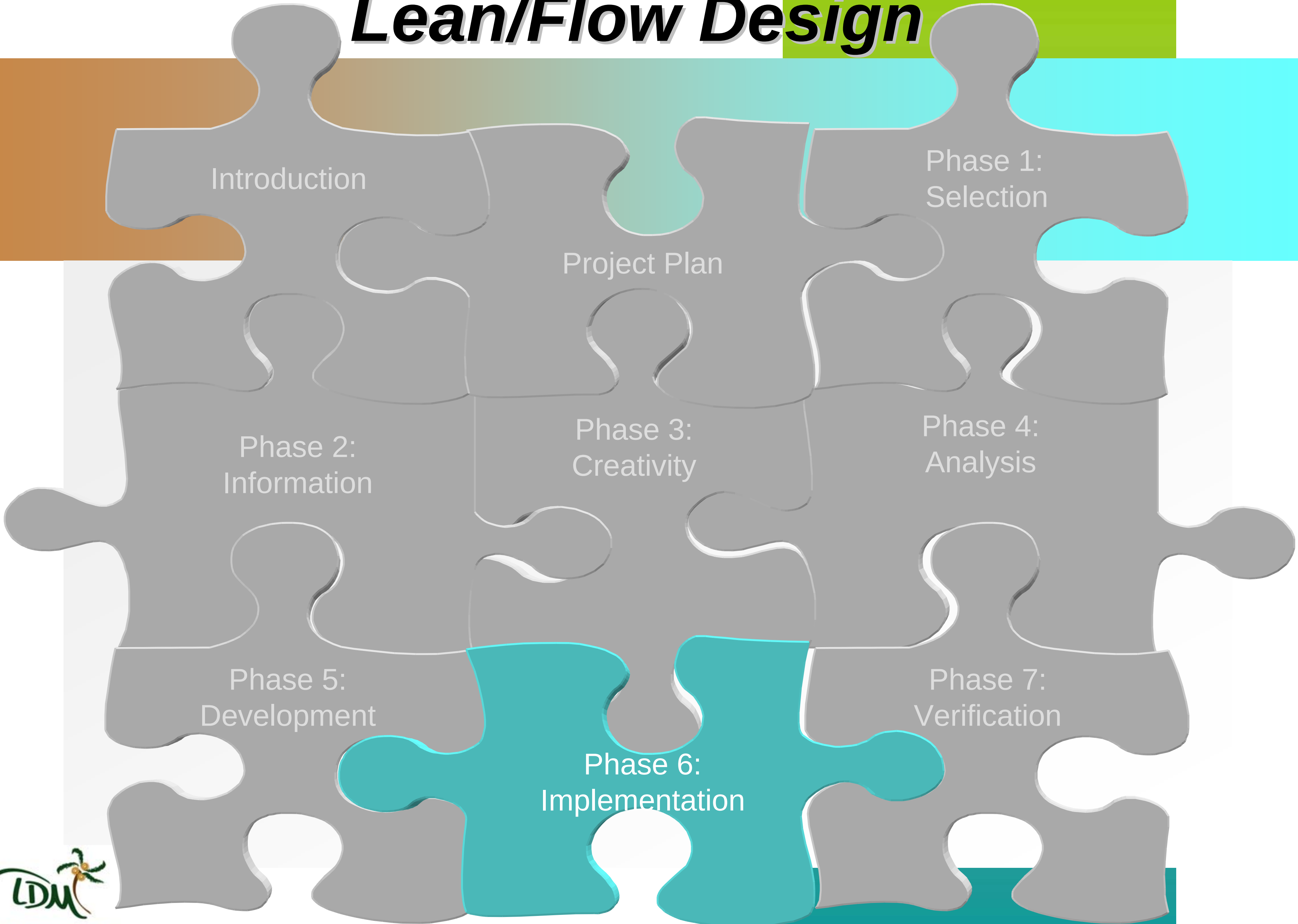
Calculations:

100 (Hr/M) x 8.50 ($/Hr) ÷ .90 (efficiency) x 1.10 (salvage) - .90 (scrap) x 2.10 (burden) x 1.15 (general administration) = $2787.68 total $/M cost or $2.79 per device

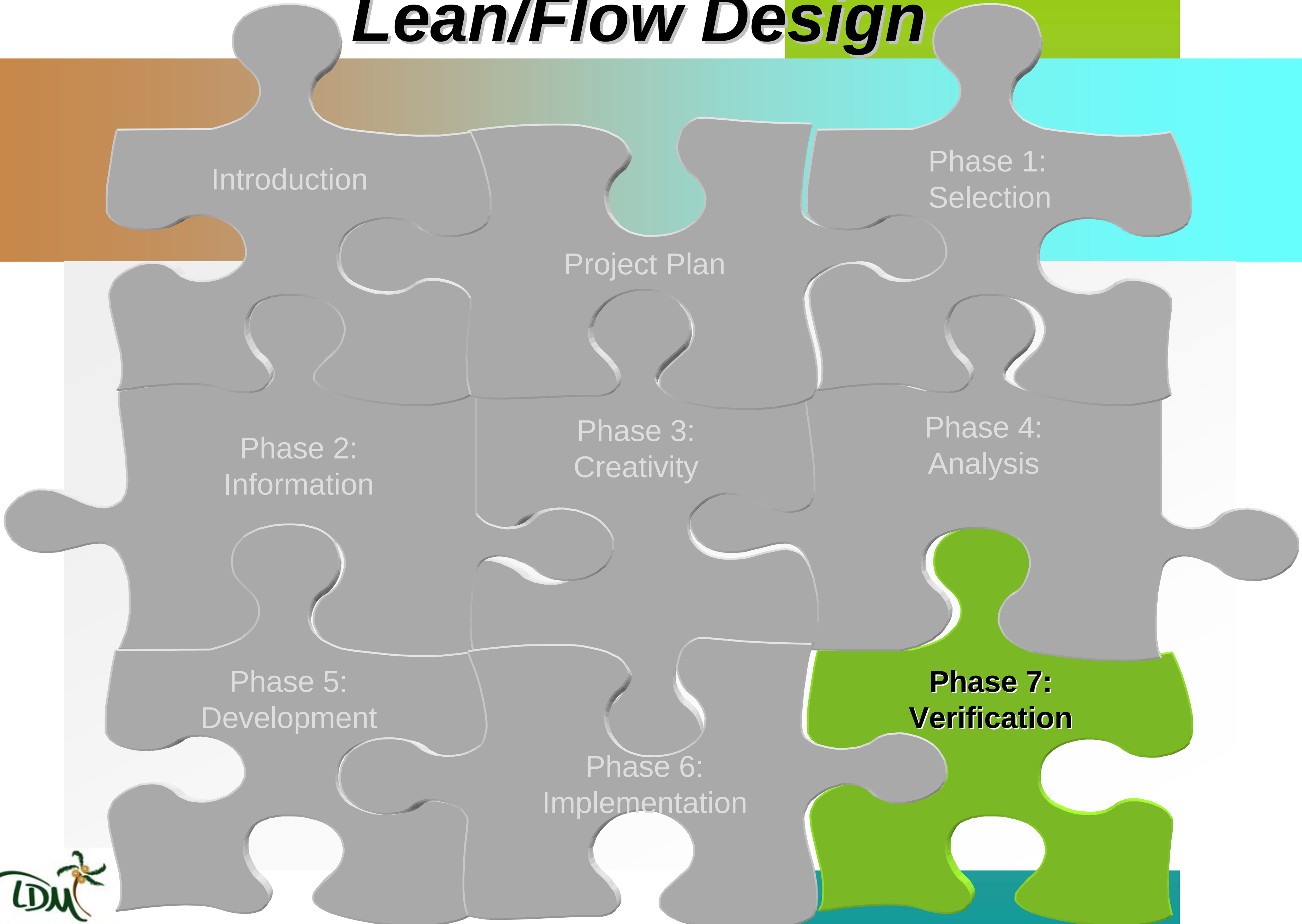
Labor & Material Cost

Labor	$2.79 per device (calculated)
Material	$14.41 per device (calculated
Total	$17.20 cost per device

Lean/Flow Design



Lean/Flow Design



The End

Lean/Flow Design

FORMS

Appendix B

XYZ Company Project Report

Lean/Flow Design Event
XYZ Company, Midwest, USA
11/2003

Final Report

Introduction

Lean/Flow Design is the philosophy of eliminating anything that contributes to cost but not to worth or function. The XYZ Company Lean/Flow Design Event was an intensive, 3-day organized analysis of product and process requirements for the purpose of achieving only the necessary functions and performance at the lowest overall cost. During the Design Event a structured 7-phase project plan was used to identify necessary functions and creatively generate less costly alternatives for accomplishing them. The seven phases of the plan are described below.

The Seven Phases

1. Selection:
   This initial phase includes ***selection of appropriate products or processes to address*** during the workshop and ***selection of cross-functional teams*** to review and analyze chosen products or processes.
2. Information:
   The Information Phase is dedicated to examining and defining the issues related to the selected product or process. It uses information gathering techniques and forms to identify **basic functions** and to answer:
   a. What is it?
   b. What does it do?
   c. What must it do?
   d. What does it cost?
3. Creativity:
   Brainstorming and problem solving techniques are applied to develop alternative ways to achieve the necessary **functions** identified in the Information Phase.
4. Analysis:
   Decisions are made on which of the ideas generated through brainstorming and problem solving are feasible and cost effective.
5. Development:
   Proposals are developed to support implementation of selected ideas. The Workshop concludes with the presentation of proposals to management.
6. Implementation:
   Proposals approved by management are implemented outside of the scheduled workshop.
7. Verification:
   Verification of implemented projects is required to assure they have met expected objectives.

Results and Recommendations

The XYZ Company Lean/Flow Design Workshop's cost reduction or improvement goal was to identify opportunities for annual savings of at least $250,000. Results and recommendations resulting from each phase of the Workshop follow.

Results and Recommendations

Phase 1: Selection

1. Selection

Process/Product Selection:

Prior to the workshop, XYZ management met to identify and rank issues and concerns. Issues were rated high, medium or low for cost, number of components, and risk and ranked by priority (Tables 1 & 2). Five high priority issues were identified (Table 3); however due to time constraints, the highest ranked issue, number eight (8), was divided into 4 sub-issues or projects which could be addressed during the 3-day workshop.

Table 1. Project Selection (8/15/03)

Issue #	Cost	Unit	Comp.	Risk	Selected Projects
1.	H	Gasket	H	H	
2.	M	OAH base (too many parts)	M	L	3
3.	L	Roof/Floor PPT to Galv	L	L	
4.	M	Doors cross broke/roller	H	H	
5.	H	Foam panels	H	H	
6.	H	Fan sleds (small) redesign	M	M	2
7.	H	Common fans across product lines	M	M	
8.	H	Design for Flow Line Mfg (fasteners; part fit up	M	L	1
9.	M	Vestibule design	L	L	5
10.	H	Pallet elimination -- $500K	M	H	
11.	L	Digital control standards	L	L	
12.	M	Plastic usage Ω_△_	M	M	
13.	H	Splice channels	M	M	
14.	L	Drain pan coating	L	M	
15.	H	Eliminate floor turning (top down assembly)	M	H	
16.	M	Down draft blower—attach discharge ext. to unit	M	L	
17.	M	Corner clip toxing	M	H	
18.	M	Smaller panels L.T. 10ft	M-L	M	
		Duct collar fan discharge redesign (see 16)			
19.	M+	Filter frames (Plastic T seal)	M	M	4
20.	L	Door bulb gasket – door windows	H	H	
21.	M	Roof design to eliminate roof panels – OAH	H	H	
22.	H	Damper design	M	M-H	
23.	M	F/B damper assembly	M	M-H	
24.	H	Intermediate design	M	H	
25.	H	Frame channel design—roll form	H	H	
26.	L	Door hanging	M	M	
27.	L	Pipe support –eliminate large blowers	L	L	
28.	M	Caulking outdoor construction	M	H	
29.	M	MZ damper	M	H	

Legend: L = <20K; M = 20K – 100K; H = >100K

Table 2. Issues Sorted by Cost and Savings				
$ Savings	H		6, 7, 8, 10, 13, 15, 22, 24	1, 5, 25
	M	9	2, 12, 16, 17, 18, 19, 23, 28, 29	4, 21
	L	3, 11, 14, 27	26	20
		L	M	H
			Implementation Cost	

Table 3. Five Priority Issues

Issue #	Ranking	Issue
8	**1**	**Design for Flow Line Mfg (fasteners; part fit up):** **- Station 1: FAI Bases** **- Station 2: FA2 Internal Sheetmetal** **- Stations 3 & 4: Main Components** **- Station 5: Paneling**
6	2	Fan sleds (small) redesign
2	3	OAH base (too many parts)
19	4	Filter frames (Plastic T seal)
9	5	Vestibule design

<u>Team Selection:</u>

Two teams were comprised from among XYZ Engineering, Management, and Shop Floor employees to address the four projects related to issue number 8. Team members and projects are shown below:

Table 4. Teams and Projects

Team A: Stations 1 and 2	Team B: Stations 3, 4, and 5
Participant 1 Participant 2 Participant 3 Participant 4	Participant 5 Participant 6 Participant 7 Participant 8

The teams' initial tasks were to complete Project Identification Checklist forms:
Checklists helped establish Objectives, Status, and Technical Data for each of the four Projects under study. Completed Project Identification Checklists are provided below.

Project Identification Checklist (Objectives, Status, and Technical Data)

Project Name: Station 1 , FAI Bases

1. Brief Project Description

Assemble base rails, FC, bottom panels, uprights, heavy duty floor, tread plate. Assemble curb bases.

Management and Project Objective; Results Desired

Reduce labor. Improve ergonomics.

2. Current Project Status

❑ Under Development ________________________ In Production_8_Yrs

3. Customer Data: Who are the customers or customer types?

FA2

What are the customersÕspecific requirements?

On the pallet correctly; layout correct; quality correct.

What sales problems have been encountered

Layout is wrong; floor panel dents.

Does the customer want functions we do not furnish?

Wants FC & INT to come with section.

Do we provide functions the customer does not need?

Build floor upside down & flip floor

4. Problems & Factors: Identify known production and quality problems

- **Pipe supports**
- **Flipping floor after assy**
- **Too many fasteners**
- **Floor dents**
- **Ergonomics**
- **Lining up holes thru HD floor and panels**

What changes are being made or planned now?

None

5. Production Data

Tooling Status: Hand tools ________________________
Mfg Location: OWT ____________________ Assembly Location: FA1 ____________________
Major Purchased Components: ________________________

____
Annual Production Quantity ____________Rate per Mo. ____________
Predicted Production Life ____________Yrs. @ ____________1st Yr; ____________2nd Yr; Etc.
Other: 7 people ________________________

6. Cost Data: Current Cost

Current Unit Cost	$	Selling Price	$
Estimated Market Share	%	Desired Market Share	%

Specific Cost Goal

Cost Reduction	$	Per Unit %	%
Per Unit $	$	Per Annum %	%
Per Annum Unit Cost Target	$	Other	

7. Technical Data

GA drawings
Sect prints
Fasteners
pictures

Project Identification Checklist (Objectives, Status, and Technical Data)

Project Name: Station 2, FA2 Internal Sheetmetal

1. Brief Project Description

Install filterracks, drainpans, blower rails, bulkheads, springs, seismic mounts

Management and Project Objective; Results Desired

Eliminate labor
Reduce cost
Increase throughput

2. Current Project Status

❑ Under Development ________________________ In Production_7_Yrs

3. Customer Data: Who are the customers or customer types?

FA3, 4, 5, 6

What are the customersÕspecific requirements?

Proper layout
Installation of S/M parts
Assembled correctly
On-time

What sales problems have been encountered

Empty Kanban in FA3
Rework

Does the customer want functions we do not furnish?

No

Do we provide functions the customer does not need?

Excessive grinding; USMS hammer; Ease uffit-up

4. Problems & Factors: Identify known production and quality problems

- Too many fasteners
- Fit-up of drainpan supports (changed style of panel screw)
- Drainpan quality (weld/paint)
- Coil support (too heavy Ğ thread fastener)
- Subassembly of FL rack
- Extrusion channel (# of fasteners)

What changes are being made or planned now?

None at present

5. Production Data

Tooling Status: hand tools
Mfg Location: OWT ________ Assembly Location: FA2 ________
Major Purchased Components: springs, fasteners, seismic mounts, silicone ________
Annual Production Quantity 24,000 ________ Rate per Mo. 2000 ________
Predicted Production Life 5 Yrs. @ 10% gain/yr
Other: Labor cost 7 people/10 hrs day ________

6. Cost Data: Current Cost

Current Unit Cost $ ________ Selling Price $ ________
Estimated Market Share ________ % Desired Market Share ________ %

Specific Cost Goal

Cost Reduction $ ________ Per Unit % ________ 10%
Per Unit $ $ ________ Per Annum % ________ %
Per Annum Unit Cost Target $ ________ Other ________

7. Technical Data

Attach/Obtain: Specs, drawings, parts lists, tooling, layouts, hardware samples, etc.

- GA dwgs
- Assy dwgs
- List of fasteners
- Check off sheets
- Picture of fastener rack
- Picture of tools
- Picture of FA2 layout

Project Identification Checklist (Objectives, Status, and Technical Data)

Project Name: Station 3 & 4, Main Components

1. Brief Project Description
Define major components. Coils, blowers, F+BP, IF&BP, Blenders, dampers, elec. Heat, Heat Wheels, Filters (HEPA)

Management and Project Objective; Results Desired
Sound Attenuators; Easier assembly; less fasteners

2. Current Project Status
❑ Under Development ________________________ In Production_8_Yrs

3. Customer Data: Who are the customers or customer types?
Assemblers

What are the customersÕspecific requirements?
Physically fits, meets specifications per order

What sales problems have been encountered
Lead time, incorrect product received.

Does the customer want functions we do not furnish?

Lifting points, lifting technique/handling

Do we provide functions the customer does not need?

4. Problems & Factors: Identify known production and quality problems

- **No receiving inspections.**
- **Adequate inspection drawings.**
- **Alignment procedures differ between OWT and FOBAdd lifting brackets to elec. HT. (Plan)**
- **Handling of large coils**
- **Baffles Xeter vs. Noveaire**

What changes are being made or planned now?

5. Production Data
Tooling Status ____
Mfg Location: OWT ____________________ Assembly Location: FAB ____________________
Major Purchased Components: ____
____
Annual Production Quantity ______________ Rate per Mo. ______________
Predicted Production Life ______________ Yrs. @ ______________ 1st Yr; ______________ 2nd Yr; Etc.
Other____

6. Cost Data: Current Cost
Current Unit Cost $ ________ Selling Price $ ________
Estimated Market Share ________ % Desired Market Share ________ %

Specific Cost Goal
Cost Reduction $ ________ Per Unit % ________ %
Per Unit $ $ ________ Per Annum % ________ %
Per Annum Unit Cost Target $ ________ Other ________

7. Technical Data
Attach/Obtain: Specs, drawings, parts lists, tooling, layouts, hardware samples, etc.

Project Identification Checklist (Objectives, Status, and Technical Data)

Project Name: Station 5, Paneling

1. Brief Project Description

Installation of panels, doors, light kits, filter gauges, door hardare, windows, strike plates, OAH roofs.

Management and Project Objective; Results Desired

Easier assembly

2. Current Project Status

❑ Under Development ________________________ In Production 8+ Yrs

3. Customer Data: Who are the customers or customer types?

Assemblers and end user

What are the customersÕspecific requirements?

1. panels that are fabricated within tolerance without defect.
2. receive product without defect.

What sales problems have been encountered

Door leaks, missing panels, rust on OAH roof channel.

Does the customer want functions we do not furnish?

S.S. cabinet and fasteners.

Do we provide functions the customer does not need?

4. Problems & Factors: Identify known production and quality problems

- **dents in liners and panels**

What changes are being made or planned now?

- 12Óc-c on plenum fan & positive pressure sections.
- Foam panels and doors

5. Production Data

Tooling Status: ____________________

Mfg Location: ____________________ Assembly Location: ____________________

Major Purchased Components: ____________________

____

Annual Production Quantity ____________ Rate per Mo. ____________

Predicted Production Life ____________ Yrs. @ ____________ 1st Yr; ____________ 2nd Yr; Etc.

Other: 7 people ____________________

6. Cost Data: Current Cost

Current Unit Cost $ ____________ Selling Price $ ____________

Estimated Market Share ____________ % Desired Market Share ____________ %

Specific Cost Goal

Cost Reduction $ ____________ Per Unit % ____________ %

Per Unit $ ____________ Per Annum % ____________ %

Per Annum Unit Cost Target $ ____________ Other ____________

7. Technical Data

attach/obtain specs, drawings, parts lists, tooling, layouts, hardware samples, etc.

Results and Recommendations

Phase 2: Information

Check List

- ❑ What is it?
- ❑ What does it do? – Determine the function
- ❑ What must it do? – Determine the function
- ❑ What does it cost?
- ❑ Determine the quantity affected
- ❑ Collect background history
- ❑ Obtain list of suppliers
- ❑ Check forecast usage
- ❑ Check for superfluous factors
- ❑ Search for costly specifications
- ❑ Review requirements
- ❑ Check status of design and development
  - Are major changes planned?
- ❑ Set target worth – build a cost model
- ❑ Select high-cost areas
- ❑ Search for multiple quantity usage
- ❑ Question effect on publication costs
- ❑ Review process sheets
- ❑ Review equipment and tooling
- ❑ Contact company specialists
- ❑ Contact specialty vendors

2. Information Phase

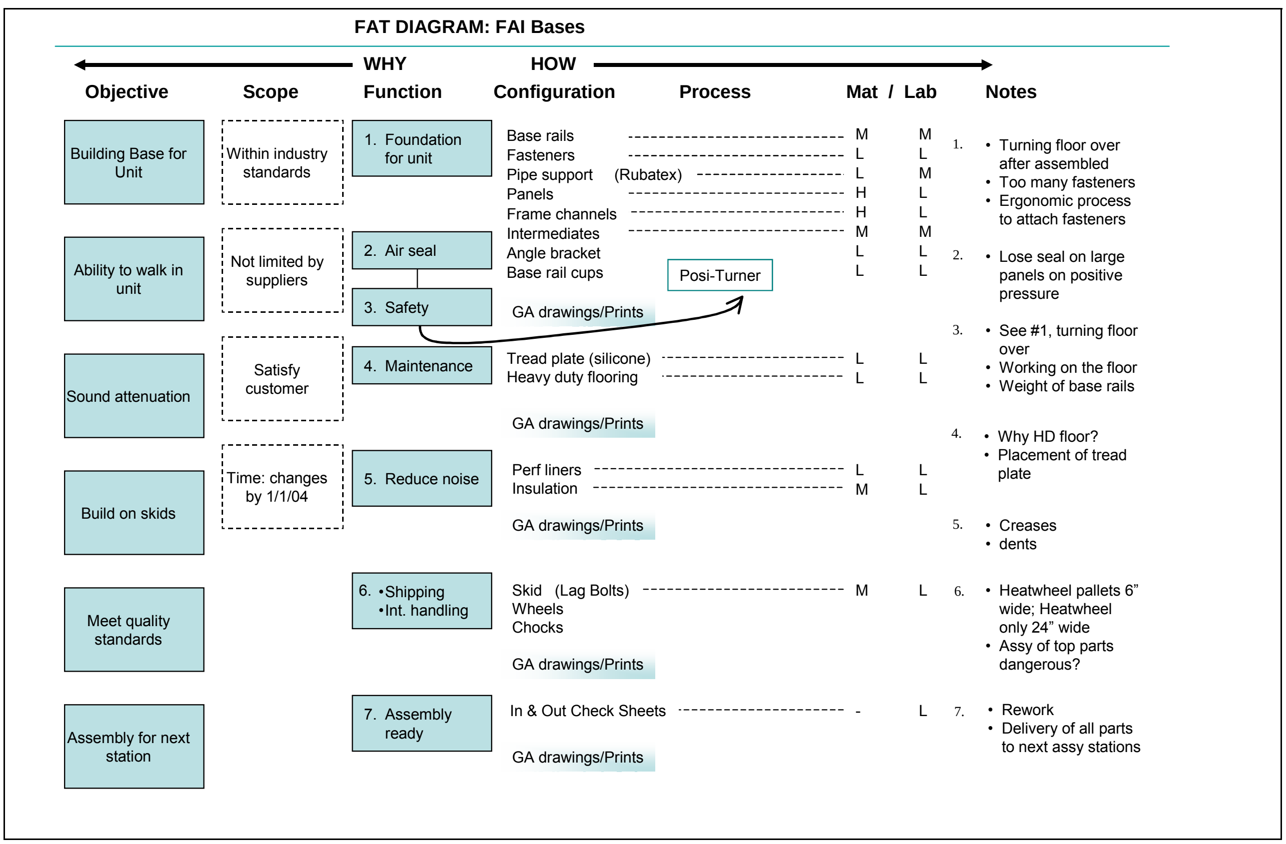
The Objective of the Information Phase was to collect and analyze as much data as necessary to gain a full understanding of the systems under study. The primary tool used by teams during this phase was the ***Functional Analysis Technique (FAT) Model:***

Teams developed FAT Models to identify project scopes and clarify basic and secondary functions of the systems under study. The cost of Labor and Materials for each function was estimated as High, Medium, or Low. As the final step in the FAT model process, teams interviewed shop-floor employees to identify problem areas.

FAT Models are presented below. After completing FAT models, teams had an understanding of each systems' basic and secondary functions, and a visual chart of their interdependency. The FAT Models provided a basis for challenge and creative speculation during the Creativity Phase which followed.

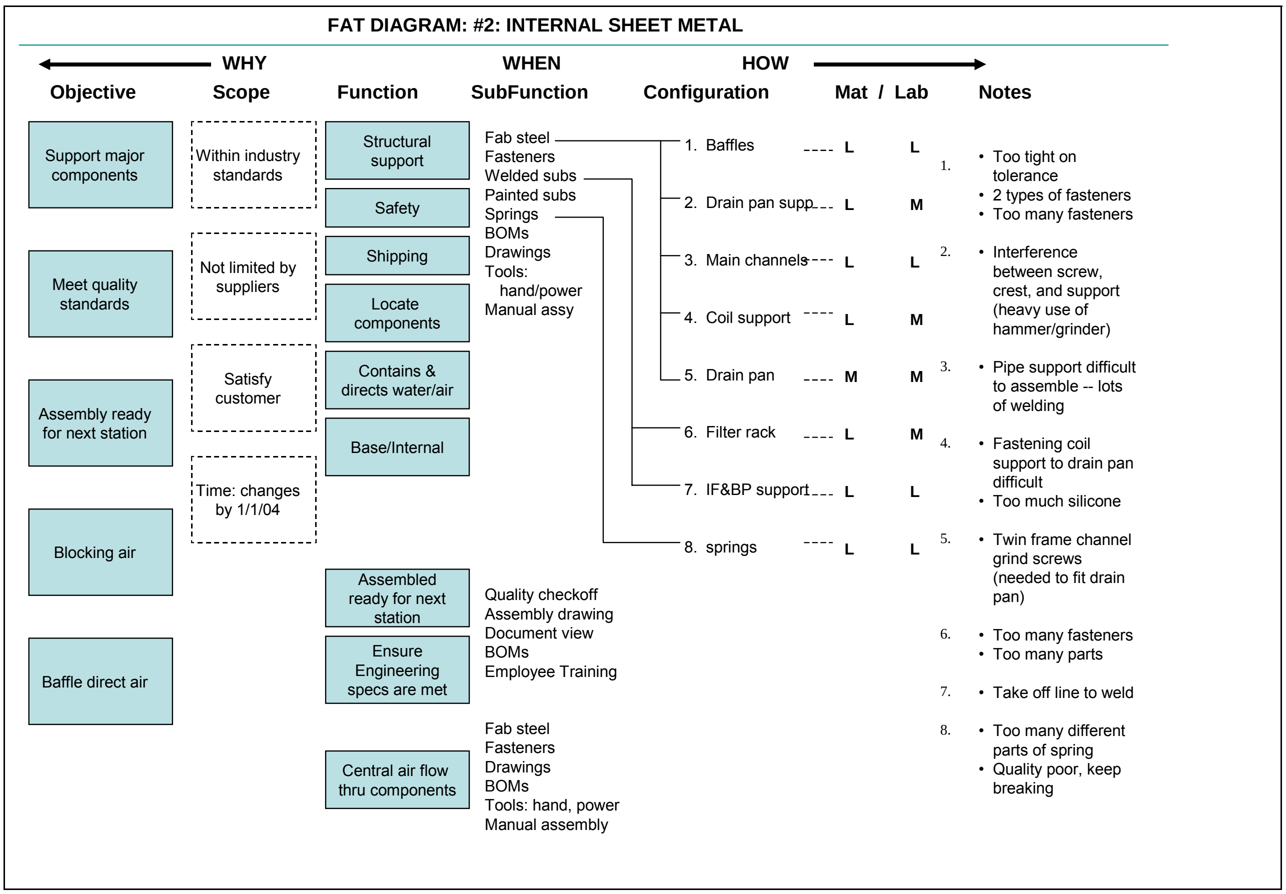
<u>Functional Analysis Summary, Station 1, FAI Basis</u>

This station assembles base rails, FC, bottom panels, uprights, heavy duty floors, and tread plates and curb bases. Primary objectives are to reduce labor and improve ergonomics. Customers (e.g., the next station) require correct layout on the pallet, and acceptable quality. They would like the FC and INT to come with the section. Production problems include incorrect layout and floor panel dents, and issues related to floor construction (floors are built upside down and then flipped). Other known production and quality problems include pipe supports, too many fasteners, ergonomic, and lining up holes through HD floor and panels.



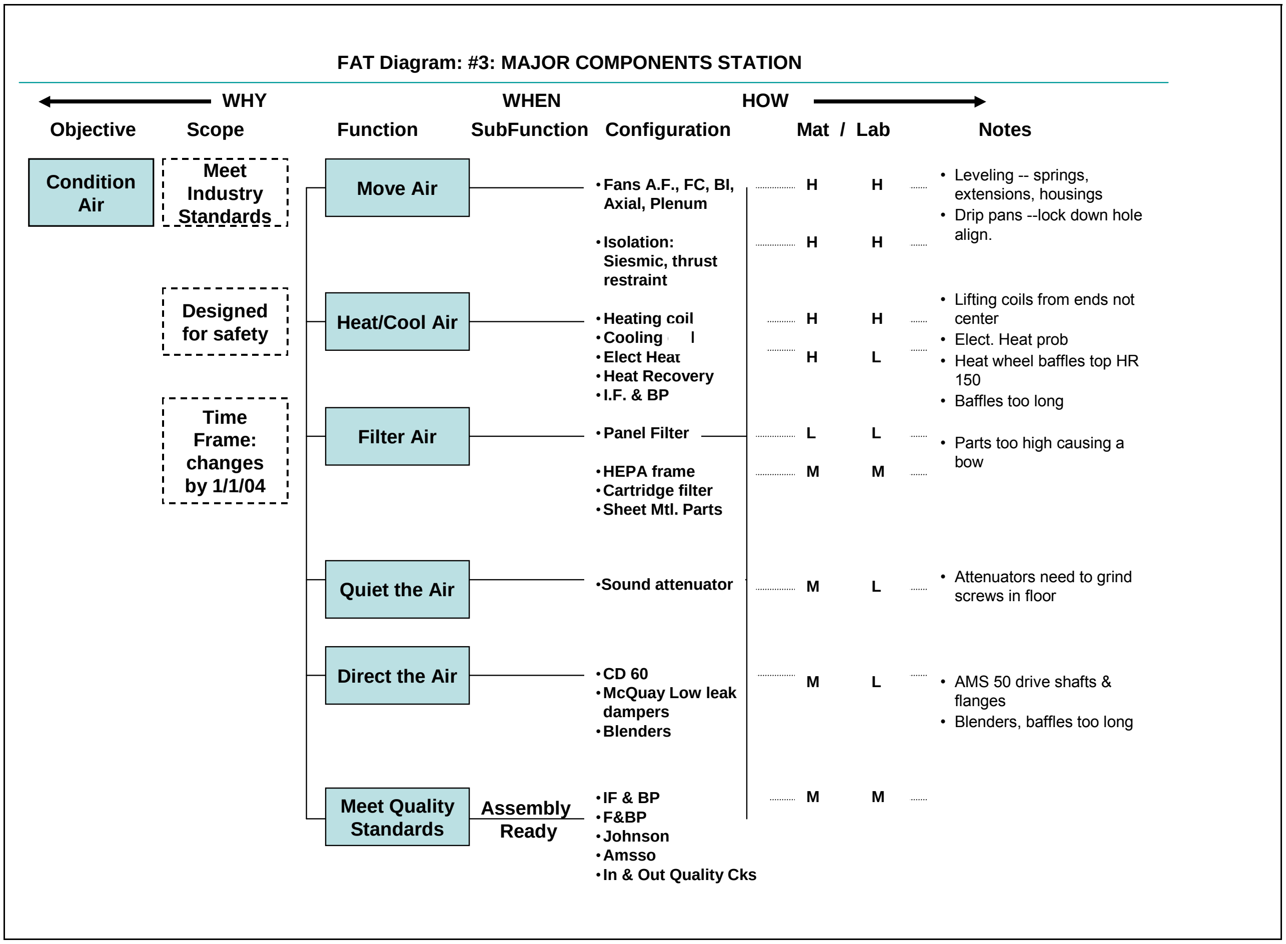
Functional Analysis Summary, Station 2, FA2 Internal Sheetmetal

Station 2 installs filter racks, drain pans, blower rails, bulkheads, springs, and seismic mounts. Management objectives include reduction of labor and costs and increased throughput. The next station requires proper layout, installation of S/M parts, and on-time delivery. Rework and empty Kanban (FA3) have been problems, and excessive grinding, use of hammer, and ease of fit-up are issues. Other production and quality problems include too many fasteners, fit-up of drain pan supports, drain pan quality (weld/paint) coil support (too heavy – thread fastener), subassembly of FL rack, and extrusion channel (number of fasteners). Customers would like XYZ Company to furnish S.S. cabinet and fasteners. Sales problems have included door leaks, missing panels, and rust on OAH roof channel.



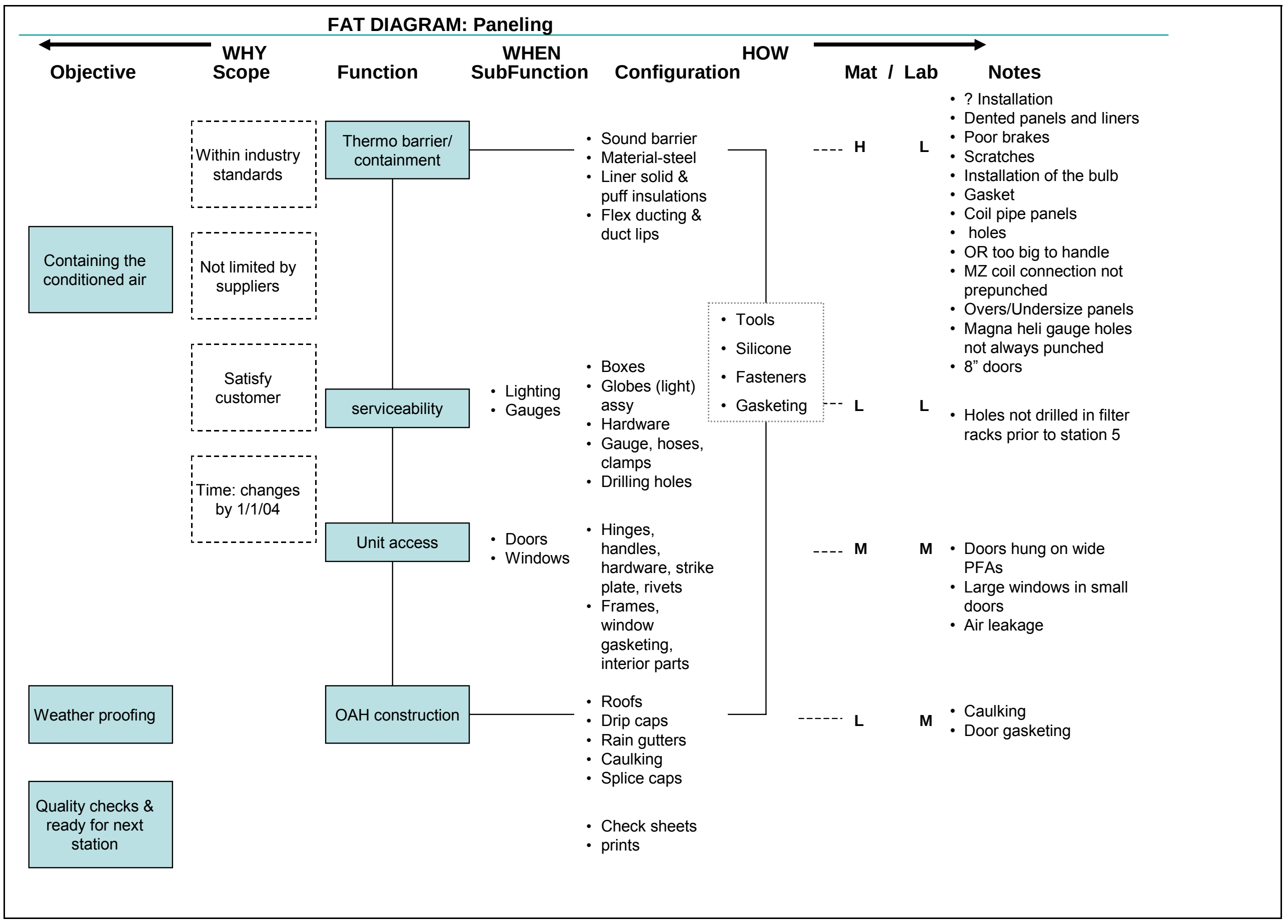
Functional Analysis Summary, Station 3 & 4, Main Components

This station assembles major components including coils, blowers, F+BP, IF&BP, blenders, dampers, electric heat, heat wheels, and filters (HEPA). Objectives include easier assembly, fewer fasteners, and sound attenuators. The customer requires elements to physically fit and meet specifications per order. Lifting and handling are challenges. Lead time and delivery of incorrect product have been problems. Production problems include no receiving inspections, inadequate inspection drawings, alignment procedures that differ between facilities, a need for lifting brackets on electric HT, handling of large coils, and baffles.



Functional Analysis Summary, Station 5, Paneling

Work at this station includes installation of panels, doors, light kits, filter gauges, door hardware, windows, strike plates, and OAH roofs. The product has been in production about 8 years. A primary objective is easier assembly. Production problems include dents in liners and panels. Customers' specifically require panels that are fabricated within tolerance and without defect. Customers would like the S.S. cabinet and fasteners to be furnished. Sales problems have included door leaks, missing panels, and rust on OAH roof channel.



Results and Recommendations

Phase 3: Creativity

3. Creativity Phase

During this phase, Teams A & B brainstormed for alternative ways to achieve the necessary functions identified in the Information Phase. Ideas for each project were recorded in a table (see Analysis Phase, below). Note that some ideas applied to *all* stations, and were recorded in a separate table.

Check List

- ❑ Can the item or step be eliminated?
- ❑ Oversimplify to determine basic requirements
- ❑ Create by eliminating specification requirements
- ❑ Brainstorm the problem – use creative thinking
- ❑ Can standard parts or elements be used?
- ❑ Can the present configuration be purchased at lower cost?
- ❑ Would an altered standard part or element be more economical?
- ❑ Check the necessity for present design or method
- ❑ Determine if the design method is the result of custom, tradition, or opinion
- ❑ Are features that improve appearance justified?
- ❑ Is there a less costly element that will satisfy the function?
- ❑ Can a less expensive material be used?
- ❑ Can a lighter gage material be used?
- ❑ Check the possibility of using newly developed material/systems/processes
- ❑ Analyze surface coatings
- ❑ Review all fasteners
- ❑ Would stainless steel cost less than plating
- ❑ Consider different operations methods

Results and Recommendations

Phase 4: Analysis

3. Analysis Phase

Ideas developed in Phase 3 were investigated, compared, and ranked according to implementation costs and potential benefits. The 3 to 6 best ideas per project (indicated in the *Rank* column in the following tables) were selected for proposal analysis in the Development Phase.

Project: Station 1, FAI Bases Function: Foundation for Unit; Shipping; Internal Handling				
Rank	**Idea**	**Cost** **Low ⇒ High** 1 - 2 - … … 9 - 1 0	**Benefit** **Low ⇒ High** 1 - 2 - … … 9 - 1 0	**Difference**
4	Base rail clips -- can we eliminate?	**0**	**4**	**4**
1	Base rails–too many fasteners–use threaded bolts – use push pins – use embossed tabs to eliminate 50% of base rail screws	**4**	**8**	**4**
3	Pallets – add to pallet for transporting FC/INT – design FC/INT to different stations	**2**	**6**	**4**
5	Panels – sort PFAs to FA1	**1**	**5**	**4**
2	Pipe supports – redesign w/less parts, no rubatex, no rubber washer	**5**	**9**	**4**
6	Lift table to improve ergonomics	**4**	**8**	**4**
	Blower main channel – eliminate hand marking of fastener position	**0**	**3**	**3**
	Fan main channel too long – damages gasket -- replace by .100”	**1**	**4**	**3**
	Add slots in base rail on narrow sections & eliminate skid	**4**	**7**	**3**
	Fasteners – lag bolt w/collar to eliminate washer – punch smaller hole in base rack to eliminate washer	**1**	**3**	**2**
	Wheels – use storage bin with collapsible side	**2**	**4**	**2**
	Wheels – use front load rack	**2**	**4**	**2**
	Shipping angle bracket – 3 screws per corner – eliminate 1 screw (4 screws per section)	**2**	**4**	**2**
	Wheels – redesign wheels w/4 casters & brake	**3**	**4**	**1**
	Shipping bracket – replace angled bracket & 3 screws w/flat bracket under baserail, 1 screw, use corner screw to hold other end of bracket	**3**	**4**	**1**
	Get rid of wood pallets	**8**	**9**	**1**
	Snap together floors	**7**	**8**	**1**
	Posturner – redesign for top down assy	**7**	**7**	**0**
	Internal bulk heads with trust restraint – no dimension on cabinet drawing to show position of L&R part (FA2)	**3**	**3**	**0**
	use unmodified engine lift to rotate hoses	**5**	**5**	**0**
	Baserail bolts – replace with slots and self-fixturing tabs, then weld	**7**	**7**	**0**
	Snap together frame channels	**8**	**8**	**0**
	~~rivet all structural supports rather than fasteners or spot weld~~			
	More notch/opening on frame channel ends.	**T B D**	**T B D**	
	~~Redesign panel and frame assy on bottom for a top-down approach~~			
	~~Lift table – for ergonomic correct height~~			
	~~Forklift knock out in base rails~~			

Project: Station 2, FA2 Internal Sheet metal Function: Structural Support; Locate Comps				
Rank	Idea	Cost Low ⇒ High 1 - 2 - … … 9 - 1 0	Benefit Low ⇒ High 1 - 2 - … … 9 - 1 0	Difference
2	Too many screws – reduce same size to 1 size fits all	3	8	5
1	Drainpan supports need slots instead of clearance holes	1	6	5
7	Punch clearance holes for all filter gauges and tubing	4	8	4
3	Redesign rubber mount so bolt doesn't back out when installing locknut	1	5	4
3	Coil supports need larger holes to fasten	1	5	4
3	Filter rack clearance holes need to be bigger for bottom screws	1	5	4
3	Coil baffle (HT152) eliminate. 2 screws	1	5	4
	More pre-assembly	3	7	4
	Filter rack tolerance needs to be loosened	3	6	3
	All 1-piece bulkheads on SAH	5	7	2
	Weld booth paints all welds	1	3	2
	Stainless steel D.P. – tack weld coil supports to drain pan – eliminate 8 fasteners & silicone operation or reduce # of screws	4	6	2
	Redesign bins for springs – front load "5S"	1	2	1
	Main channels – need to look at how attached to unit –use bigger screw to eliminate number of screws	4	5	1
	economizer baffle – too many screws (redesign) – tabs & slots	4	5	1
	Main channels – slot all clearance holes for bulkheads/splice channels	5	5	0
	fan bulkhead location – add text to labels for top, bottom, left, right	2	2	0
	Have scaffolding for assemblers to stand on	7	6	- 1
	Hang a counter balanced drill above assy position	5	3	- 2
	Replace springs with rubber bumpers	-	-	-
	Filter racks w/extrusion channels – clips instead of screws	-	-	-
	Springs for fans – reduce	-	-	-
	~~Breaks for pallet wheels~~			
	~~Finish f. channels and intermediates to move with section~~			
	~~Filter gage hole should be pre? for gage and lines~~			
	~~Damper blocked FFs – can we use tabs to eliminate screws?~~			
	~~1 & 2 row coil bot support (eliminate spot weld)~~			
	~~Weld or snap together filter racks~~			
	~~Pipe support assy redesign~~ ~~A. box support with shipping tie down incorporated~~ ~~B. solid rubber square~~			
	~~Air or rubber to replace springs~~			

Project: Station 3&4, Main Components		Function: Move air; Heat/Cool Air		
Rank	Idea	Cost Low ⇒ High 1 - 2 - … … 9 - 1 0	Benefit Low ⇒ High 1 - 2 - … … 9 - 1 0	Difference
1	Wheels of fan assemblies – too much labor to remove – keep quick release clamp	2	5	3
2	Replace "T" seals with extrusions	3	6	3
3	Leave frame channel off to install electric Heat.	1	3	2
	Square holes as guide holes	5	6	1
	Seismic mount need to be taped together to install them – more openings	5	6	1
	Cannot get at bolts under the fan for seismic mounts – more room	5	6	1
	Modify frame channels for easier install (last channel)	3	4	1
	Shipping tie-down – eliminate assy and bolt by using a longer bolt in spring and a weld nut	3	4	1
	Eliminate alum filter rack (replace with extrusion)	5	5	0
	Redesign belt guard	7	7	0
	Shorting baffles by 1/16" to 1/8"	7	5	- 2
	Coil self supported -- no extra supports in the box	6	4	- 2
	Buy fans	5	1	- 4
	H. coil baffles clip in no screws	7	3	- 4
	Coil support – replace screws and silicone with gasket and snap-tabs	8	3	- 5
	Buy coils	9	0	- 9
	Make blender long baffles into four or more pieces	T B D	T B D	
	Larger clearance holes in filter racks	T B D	T B D	
	~~Common fasteners~~			
	~~Shorter filter rack parts to frl(?) better~~			
	~~Quicker way to release wheels and connect ? to blower sub assembly~~			
	Delete whistle strips	T B D	T B D	
	~~Bulkhead flex connector gasket – replace all the screws by inserting parts from other side, adding end flanges to hold the previous flange, put one screw in last bracket~~			
	~~Blower frames to include mounting springs in its own frame~~			

Project: Station 5, Paneling	Function: Thermo Barrier/Containment; Unit Access			
Rank	Idea	Cost Low ⇒ High 1 - 2 - … … 9 - 1 0	Benefit Low ⇒ High 1 - 2 - … … 9 - 1 0	Difference
1	Eliminate amoflex from coil connections – foam panel	2	7	5
2	Flex duct replacement	4	8	4
	Better door jigs / door hanging process	1	4	3
	Knockouts in baffles for filter gauge tubing	3	5	2
	Remove 40% of screws on duct clips – redesign	7	9	2
3	Eliminate blower spring -- rails mount right to floor panels NOTE: this duplicates a proposal under consideration for Station 1	5	7	2
	Pre punch filter gauges	6	7	1
	Panel corner clip – eliminate	8	9	1
	Panel cell install all door windows	2	3	1
	Eliminate frame channel gasket – install gasket on doors & panels only	7	8	1
	Buy MZ dampers	5	5	0
	Vendor complete more of the assembly as door handles	2	2	0
	Panel & Frame channel tolerances (taper)	7	6	- 1
	Dx panels precut – stacked coils – need two panel tolerance to handle	7	6	- 1
	Pre punch light kits	9	7	- 2
	Foam inject fill panels	1 0	8	- 2
	Hinges that require no jigs to install & are moveable after installing = adjustable for leaks	8	5	- 3
	Replace windows	T B D	T B D	
	~~Eliminate labels from panels & F/C~~			
	Self sealing – no caulking coil to frame box	T B D	T B D	

Project: All Stations				
Rank	Idea	Cost Low ⇒ High 1 - 2 - … … 9 - 1 0	Benefit Low ⇒ High 1 - 2 - … … 9 - 1 0	Difference
5	measure and improve first pass quality (% of units going into offline)	4	9	5
3-4	Automatic screw guns	3	8	5
1	standardize fastener head types (Phillips, hex, star, etc.) Work with supplier	4	8	4
3-4	Drop and or raise floors/platforms (station #1)	2	6	4
2	Get holsters for drills so assemblers don't have to pick up/set down drills	1	5	4
	Lighter tools/counterweight tools	3	6	3
	have assemblers wear carpenter aprons to hold screws/fasteners magnetic holders	2	5	3
	Tools and supplies move right to needed area – reduce walking	2	5	3
	(Redesign flex connector) stamp form and standardize sizes rather than duct lips move to station #4	6	8	2
	Everything on line – no paper (except GA)	4	6	2
	FAB – consolidate labels/prepackage labels (station #6 – 26 LABELS)	3	5	2
	Move carts and sections – assist power carts	3	4	1
	Use robotics – to assemble and or spot weld (look at it in respect to feeder lines)	8	8	0
	Counterbalance drill from wrist to shoulder	3	3	0
	More detail on all prints (GA Drawings or section prints)	8	7	- 1
	standardize skids – width of forklift tongs – cut to length	7	6	- 1
	No wheels, track in floor to move parts	6	5	- 1
	All sect in enclosed trailers – no cardboard	7	4	- 3
	Have own shipping trucks	9	2	- 7
	Snap together parts	8	8	O
	Length of splice channels a touch smaller to fit in better (station #6)	T B D	T B D	
	~~Feed screw guns~~			
	~~50% gasket wasted~~			
	(frame channels remove labels) Put no labels on – no labels to take off	T B D	T B D	
	~~First pass quality~~			

4. Development Phase

Teams examined each idea for technical, cost, and implementation feasibility, and presented proposal summaries of value improvement, savings, and break-in points to management at the end of the workshop. Individual proposals are presented in detail in the following section. At the conclusion, Table 5 provides a summary of proposals and estimated values, including payback time.

XYZ Company Proposal Analysis

Proposal Name:	Drop and/or raise floors/platforms for ergonomic/safety improvement.	PA#	1	Station #	All

A. Proposal description:
Lift table or device. Ergonomically better, injury avoidance.

B. Implementation Cost Analysis

A		B	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$ 1,000.00
Pubs.	$	Capital equipment	$ 12,000.00
Maintenance	$ 1,000.00		$
Outside	$ 2,000.00		$
	$		$
		Total cost of implementation	$ 16,000.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$ 20,000.00
Safety (Cost Avoidance)	$	$
	$	$
Total unit cost	**$**	$20,000.00

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	7.5 mos	Annual Savings	$20,000.00 avoidance

XYZ Company Proposal Analysis

Proposal Name:	Paneling – flex duct replacement	**PA#**	2	**Station #**	5

A. Proposal description:

Fan section duct replacement, redesign to bulb style.

B. Implementation Cost Analysis

A		B	
Design	$ 6,400.00	Tool design & make	$
Drafting	$ 8,000.00	Rework	$
Models	$ 3,000.00	Route sheets	$
Testing	$ 500.00	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
		Total cost of implementation	$ 17,900.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$ 7,311.00	$
Labor & burden cost	$	$ 24,370.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
Total unit cost	**$**	**$ 31,681.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	7.5 mos	Annual Savings	$ TBD

XYZ Company Proposal Analysis

Proposal Name:	Internal Sheetmetal – Supports need slots instead of clearance holes.	**PA#**	3	**Station #**	2

A. Proposal description:

Bigger holes to eliminate use of hammer for installation

B. Implementation Cost Analysis

A		B	
Design	$ 80.00	Tool design & make	$
Drafting	$ 240.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
Manufacturing Ser.	$ 80.00		$
	$		$
	$		$
		Total cost of implementation	$ 400.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$ 13,366.00	$
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 13,366.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	0.3 Months	Annual Savings	$ 13,366.00

XYZ Company Proposal Analysis

Proposal Name:	Internal Sheetmetal – supports need larger holes to fasten.	**PA#**	4	**Station #**	2

A. Proposal description:
Stainless – bigger hole.

B. Implementation Cost Analysis

A		**B**	
Design	$	Tool design & make	$ 400.00
Drafting	$ 160.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
		Total cost of implementation	$ 560.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$ 3,341.00	$
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	2 months	Annual Savings	$ 3341.00

XYZ Company Proposal Analysis

Proposal Name:	Internal Sheetmetal — Rack clearance holes need to be bigger for bottom screws.	PA#	5	Station #	2

A. Proposal description:

Bigger hole to eliminate use of hammer for installation

B. Implementation Cost Analysis

A		B	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
	$		$
	$		$
		Total cost of implementation	$

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	0 months	Annual Savings	$ 4,411.00

XYZ Company Proposal Analysis

Proposal Name:	Paneling -- Eliminate from connections – foam panel	PA#	6	Station #	5

A. Proposal description:

Eliminate foam panel based on sections

B. Implementation Cost Analysis

A		B	
Design	$ 320.00	Tool design & make	$
Drafting	$ 1,600.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
CCSI	$ 5,000.00		$
		Total cost of implementation	$ 6,920.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$ 5,620.00
Labor & burden cost	$	$ 24,000.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	2.8 mos	Annual Savings	$ 29,620.00

Proposal Name:	Internal Sheetmetal – Eliminate 2 screws.	PA#	7	Station #	2

A. Proposal description:

Review design hole locations & # of fasteners – too many holes and fasteners due to old design carryover

B. Implementation Cost Analysis

A		B	
Design	$ 640.00	Tool design & make	$
Drafting	$ 1,280.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
Software	$ 400.00		$
	$		$
	$		$
		Total cost of implementation	$ 2,320.00

C. Production Cost/Benefit Analysis: based on per unit cost

Material & acquisition cost **[6 screws]**	$	$ 0.36
Labor & burden cost **[1.5 min]**	$	$ 0.30
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 0.66**

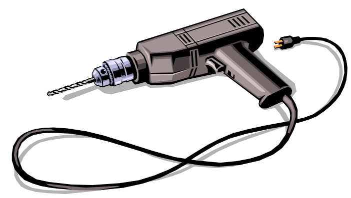
Potential Savings/Sect	$ .66	Sections/Yr	6,111 sections
Break Even Point	6.9 mos	Annual Savings	$ 4,033.00

XYZ Company Proposal Analysis

Proposal Name: Automatic screw guns **PA#** 8 **Station #** All

A. Proposal description:

Start with station #5, panel screws, and half of all screws



B. Implementation Cost Analysis

A		B	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$ 12,000.00
	$		$
		Total cost of implementation	$ 12,000.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 74,777.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
Total unit cost	**$**	**$ 74,777.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	1.9 mos	Annual Savings	$ 74,777.00

XYZ Company Proposal Analysis

Proposal Name:	Internal Sheetmetal – redesign rubber mount so bolt doesn't back out when installing locknut.	**PA#**	9	**Station #**	2

A. Proposal description:
Contact vendor and have purchased part design modified

B. Implementation Cost Analysis

A		B	
Design	$ 160.00	Tool design & make	$
Drafting	$ 80.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
		Total cost of implementation	$ 240.00

C. Production Cost/Benefit Analysis/Unit:

	cost	savings
Material & acquisition cost	$	$
Labor & burden cost	$	$ 1.67
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$ 1.67	Sections/Yr	629 sections
Break Even Point	2.7 mos	Annual Savings	$ 1,050.00

Proposal Name: Base - too many fasteners **PA#** 10 **Station #** 1

A. Proposal description:
Option #1 – Too many fasteners – use threaded bolts, use tabs to eliminate 50% of base screws, also eliminate lag screw washers.

B. Implementation Cost Analysis Option #1

A		B	
Design	$ 7,500.00	Tool design & make	$
Drafting	$ 2,000.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$ 2,000.00
Pubs.	$	Capital equipment	$
Software	$ 200.00		$
MFG Jerome	$ 500.00		$
	$		$
		Total cost of implementation	$ 12,200.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
Total unit cost	**$**	**$ 90,536.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	1.6 mos	Annual Savings	$ 90,536.00

Proposal Name:	Base - too many fasteners	**PA#**	10	**Station #**	1

A. Proposal description:
Option #2 – Too many fasteners – use TOX and eliminate all fasteners on base

B. Implementation Cost Analysis Option #2

A		B	
Design	$ 7,500.00	Tool design & make	$
Drafting	$ 2,000.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$ 2,000.00
Pubs.	$	Capital equipment	$ 30,000.00
Software	$ 200.00		$
MFG Jerome	$ 500.00		$
	$		$
		Total cost of implementation	$ 42,200.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 180,000.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	2.8 mos	Annual Savings	$ 180,000.00

Proposal Name:	All departments – Standardize fastener head types (Phillips, hex, star, etc.) Work with supplier.	PA#	11	Station #	All

A. Proposal description:
Standardize fastener drive type

B. Implementation Cost Analysis

A		B	
Design	$ 3,200.00	Tool design & make	$
Drafting	$ 8,000.00	Rework	$
Models	$	Route sheets	$
Testing	$ 240.00	Tryout	$
Pubs.	$	Capital equipment	$ 500.00
	$		$
		Total cost of implementation	$ 11,940.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 34,000.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	4.2 mos	Annual Savings	$ 34,000.00

Proposal Name:	Pipe supports – redesign w/fewer parts, no washer	**PA#**	12	**Station #**	1

A. Proposal description:
Redesign all pipe supports to box channel or other design

B. Implementation Cost Analysis

A		B	
Design	$ 3,200.00	Tool design & make	$
Drafting	$ 4,800.00	Rework	$
Models	$ 500.00	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
Software	$ 1,600.00		$
	$		$
	$		$
		Total cost of implementation	$ 10,100.00

C. Production Cost/Benefit Analysis / unit

	cost	**benefit**
Material & acquisition cost	$ 0.60	$ 8.40
Labor & burden cost	$	$ 4.80
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$ 12.60	Sections/Yr	997 sections
Break Even Point	9.6 mos	Annual Savings	$ 12,562.00

XYZ Company Proposal Analysis

Proposal Name:	Eliminate rail clips	**PA#**	13	**Station #**	1

A. Proposal description:

B. Implementation Cost Analysis

A		B	
Design	$ 160.00	Tool design & make	$
Drafting	$ 80.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
Software	$ 100.00		$
	$		$
	$		$
		Total cost of implementation	$ 340.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 22,893.50
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	.2 mos	Annual Savings	$ 22,893.50

Proposal Name:	Leave frame channel off to install electric heat	**PA#**	14	**Station #**	3&4

A. Proposal description:
Install electric heat with lifting brackets.

B. Implementation Cost Analysis

A		B	
Design	$	Tool design & make	$
Drafting (3)	$ 240.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
Safety (?)	$		$
	$		$
	$		$
		Total cost of implementation	$ 240.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 332.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	8.67 mos	Annual Savings	$ 332.00

XYZ Company Proposal Analysis

Proposal Name:	All stations – Get holsters for drills so assemblers don't have to pick up/set down drills	PA#	15	Station #	All

A. Proposal description:
Buy holsters and issue to each assembler

B. Implementation Cost Analysis

A		B	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$	Holsters	$ 400.00
	$		$
	$		$
		Total cost of implementation	$ 400.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 33,416.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$** 33,416.00

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	.01 mos	Annual Savings	$ 33,416.00

XYZ Company Proposal Analysis

Proposal Name:	Replace “T” seals with extrusions	**PA#**	16	**Station #**	3&4

A. Proposal description:

Improved quality, eliminates safety issue, easier replacement, eliminates gasket

B. Implementation Cost Analysis

A		B	
Design	$	Tool design & make	$
Drafting	$ 2,400.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
	$		$
	$		$
		Total cost of implementation	$ 2,400.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 13,500.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
Eliminate “D” Gasket	$	$ 2,250.00
	$	$
	$	$
Total unit cost	**$**	**$**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	12 mos	Annual Savings	$ 2,250.00

Proposal Name:	Sort Parts	PA#	17	Station #

A. Proposal description:

B. Implementation Cost Analysis

A		**B**	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
	$		$
	$		$
		Total cost of implementation	$

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$ 0**	**$ 1,000**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	0 mos	Annual Savings	$1000

XYZ Company Proposal Analysis

Proposal Name:	Wheels on assemblies – too much labor to remove – keep quick release clamp	PA#	21	Station #	3&4

A. Proposal description:

Replace bolt and nut with a quick release pin

B. Implementation Cost Analysis

A		B	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
Eng search	$ 500.00	Purchase pins	$ 400.00
	$	Retrofit assembly	$ 200.00
	$		$
		Total cost of implementation	$ 1,100.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 4,874.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 4,874.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	2.7 mos	Annual Savings	$ 4,874.00

XYZ Company Proposal Analysis

Proposal Name:	Pallets – add to pallet for transporting parts to different stations	**PA#**	22	**Station #**	1

A. Proposal description:

Add 12" to each pallet to transport parts through assembly. Add (2) boards to each pallet.

B. Implementation Cost Analysis

A		**B**	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
	$		$
	$		$
		Total cost of implementation	$ 0

C. Production Cost/Benefit Analysis:

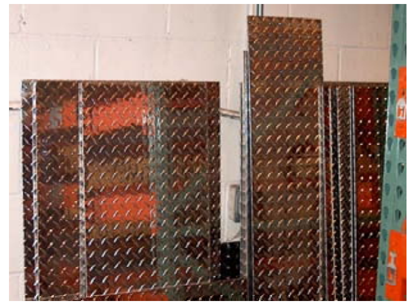
Material & acquisition cost	$	$
Labor & burden cost	$	$ 4,000.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 4,000.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	0 mos	Annual Savings	$ 4,000.00

XYZ Company Proposal Analysis

Proposal Name:	Tread plate installation	**PA#**	23	**Station #**	

A. Proposal description:
Eliminate caulking under tread plate



B. Implementation Cost Analysis

A		**B**	
Design	$ 40.00	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
	$		$
	$		$
		Total cost of implementation	$ 40.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$ 500.00
Labor & burden cost	$	$ 1000.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 1,500.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	0 mos	Annual Savings	$ 1,500

XYZ Company Proposal Analysis

Proposal Name:	Reduce length of channel to reduce gasket damage	**PA#**	24	**Station #**	

A. Proposal description:

B. Implementation Cost Analysis

A		**B**	
Design	$ 80.00	Tool design & make	$
Drafting	$ 80.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
Software	$ 200.00		$
Mfg. Ser.	$ 100.00		$
	$		$
		Total cost of implementation	$ 460.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 2,200.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 2,200.00**

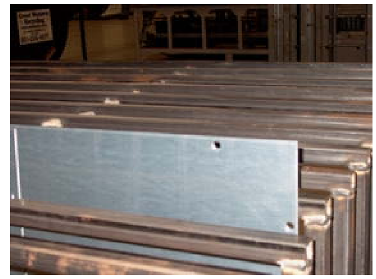
Potential Savings/Sect	$	Sections/Yr	
Break Even Point	2.4 mos	Annual Savings	$2200.00

XYZ Company Proposal Analysis

Proposal Name:	Eliminate wasted time installing heavy duty floor	**PA#**	25	**Station #**

A. Proposal description:

Need to punch larger clearance holes in floor



B. Implementation Cost Analysis

A		**B**	
Design	$	Tool design & make	$
Drafting	$ 80.00	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
MFG Serv.	$ 80.00		$
	$		$
	$		$
		Total cost of implementation	$ 160.00

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 3,341.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 3,341.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	.3 mos	Annual Savings	$ 3,341.00

Proposal Name:	Kanban parts	PA#	30	Station #	2

A. Proposal description:

Improve process – kanban between line and warehouse

B. Implementation Cost Analysis

A		B	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
	$		$
	$		$
		Total cost of implementation	$ 0

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 2,000.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 2,000.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	**Immediate**	Annual Savings	$ 2,000.00

XYZ Company Proposal Analysis

Proposal Name: Weld booth to paint all weld **PA#** 31 **Station #** 2

A. Proposal description:

Welding to paint all welds – reduce labor in assembly area

B. Implementation Cost Analysis

A		**B**	
Design	$	Tool design & make	$
Drafting	$	Rework	$
Models	$	Route sheets	$
Testing	$	Tryout	$
Pubs.	$	Capital equipment	$
	$		$
	$		$
	$		$
		Total cost of implementation	$ 0

C. Production Cost/Benefit Analysis:

Material & acquisition cost	$	$
Labor & burden cost	$	$ 500.00
Scrap & salvage factor	$	$
Inspection LBM	$	$
Packaging	$	$
	$	$
	$	$
	$	$
Total unit cost	**$**	**$ 500.00**

Potential Savings/Sect	$	Sections/Yr	
Break Even Point	0 mos	Annual Savings	$ 500.00

Summary of Proposals and Estimated Value

Cumulative totals	Implementation Costs	Annual Savings
	$94,720.00	$390,342.00

Proposal Description	PA #	Implementation Costs	Annual Savings	Payback (Months)
Pipe supports	PA12	$10,100.00	$12,562.00	9.6
Base fasten reduct Opt #1	PA10	$12,200.00	$90,536.00	1.6
- Base fast reduct Opt #2	PA10			
Reduce length of channel	PA24	$460.00	$2,200.00	2.6
Lift table	PA1	$15,000.00	$20,000.00	7.5
Eliminate amoflex	PA6	$6,920.00	$29,620.00	2.8
Eliminate clip	PA13	$340.00	$22,893.00	0.2
Add to pallet to hold parts	PA22	$0.00	$4,000.00	0
Holsters for assemblers	PA15	$400.00	$33,416.00	0.1
Welders paint welds	PA31	$0.00	$500.00	0
Sort Parts	PA17	$0.00	$1,000.00	0
Kanban springs	PA30	$0.00	$2,000.00	0
Increase hole size	PA25	$160.00	$3,341.00	0.3
Support slots	PA3	$400.00	$13,336.00	0.3
Supports need larger hole	PA4	$560.00	$3,341.00	2
Racks clearance hole	PA5	$0.00	$4,411.00	0
Hole elimination	PA7	$2,320.00	$4,033.00	6.9
Redesign rubber mount	PA9	$240.00	$1,050.00	2.7
Electric heat installation	PA14	$240.00	$332.00	8.67
Replace T seals	PA16	$2,400.00	$2,250.00	12
Flex duct replacement	PA2	$17,900.00	$24,370.00	7
Standardize fasteners	PA11	$11,940.00	$34,000.00	4.2
Elim caulking of treadplate	PA23	$40.00	$1,500.00	0
Quick release wheel	PA21	$1,100.00	$4,874.00	2.7
Automatic screw guns	PA8	$12,000.00	$74,777.00	1.9