Concept Generation

Nestle Purina Team 2

Daniel Andenmatten, Brandon Hoffman,
Nathan Kish, Chris Simpson, Pengfei Wu

NORTHERN ARIZONA UNIVERSITY

College of Engineering, Forestry & Natural Sciences

Nestlé PURINA

Overview of Presentation

- Problem Statement
- Concept Generation
- Concept Selection
- Updated Gant Chart
- Conclusion
- References

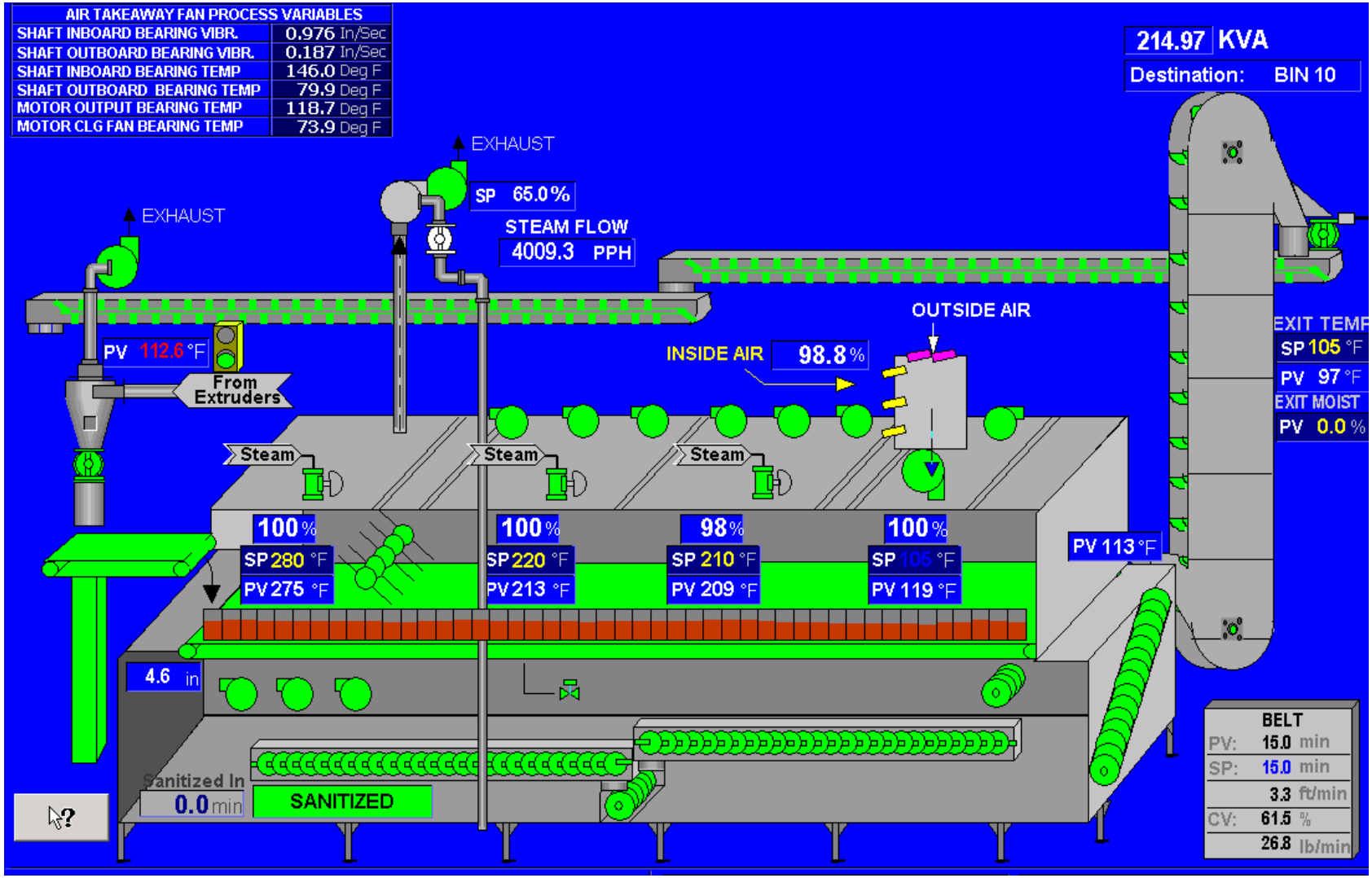
Problem Statement

- **Dryer 3 uses significantly more energy than the other four dryers to extract moisture from the product.**

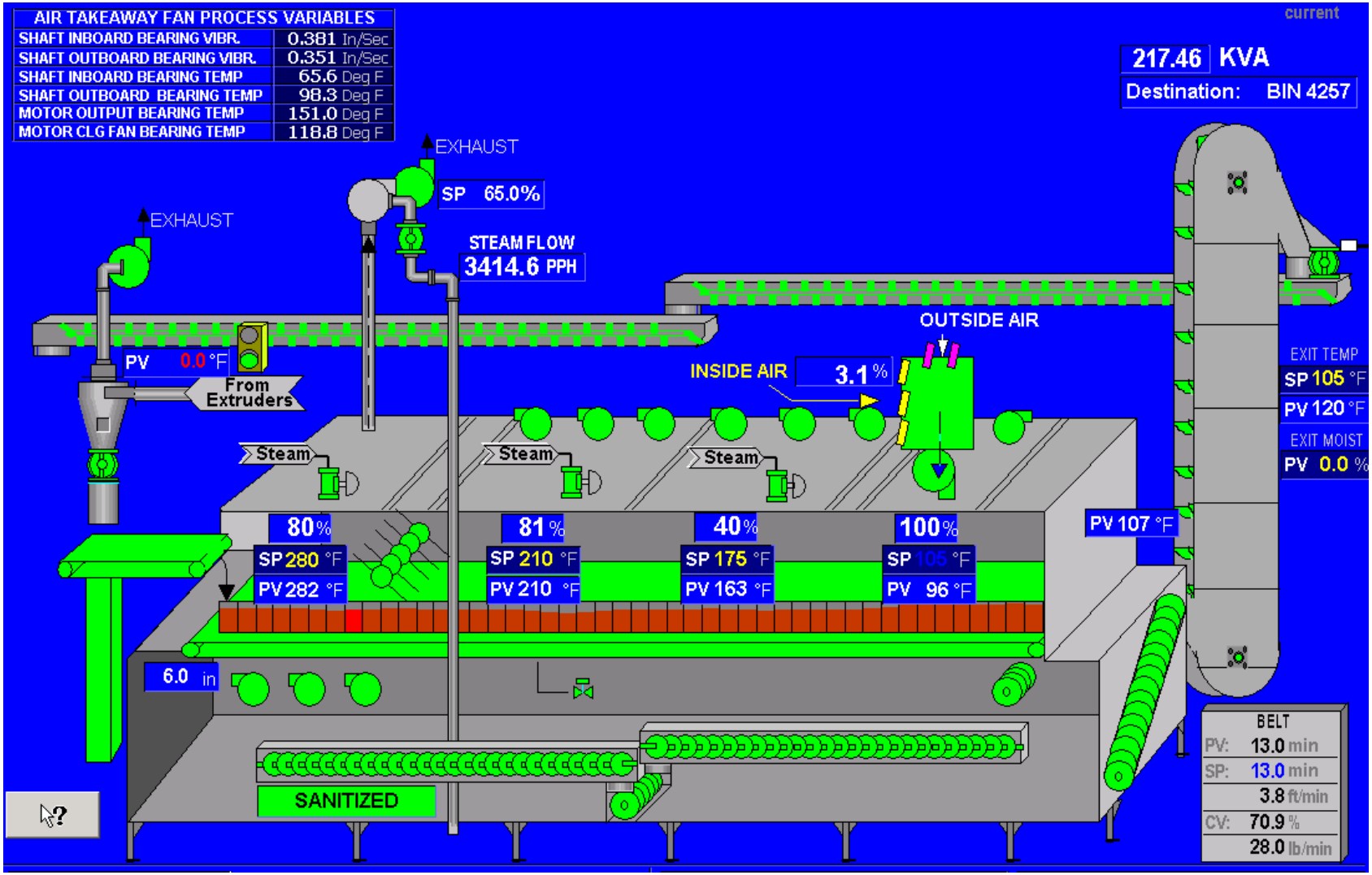
Concept Generation

- **Stages:**
  - **Concrete Problem Definition**
  - **System Definition**
  - **Initial Brainstorming**
  - **Osborn's Checklist**
  - **Refining of Ideas for Concept Selection**

System Definition – Dryer 3



Comparison To Dryer 1



Comparison Info

- **Dryer 3**
  - **4.6 inch bed depth**
  - **4009.3 pound per hour steam flow rate**
- **Dryer 1**
  - **6 inch bed depth**
  - **3414.6 pound per hour steam flow rate**
- **35% less efficient**

Dryer Efficiency Index = bed depth per steam flow rate

Index of Dryer 3 = $\frac{4.6}{4009.3}$ ***1000= 1.14733**

Index of Dryer 1 = $\frac{6}{3414.6}$ ***1000= 1.7516**

Percent Difference = 34.7%

Initial Brainstorming

1) Rebuild Steam Traps
2) Insulation
3) Boiler Changes
4) Fuel for Boiler
5) Steam properties
6) Dryer Fuel
7) Steam system
8) Product
9) Dryer Air Flow
10) Dryer size

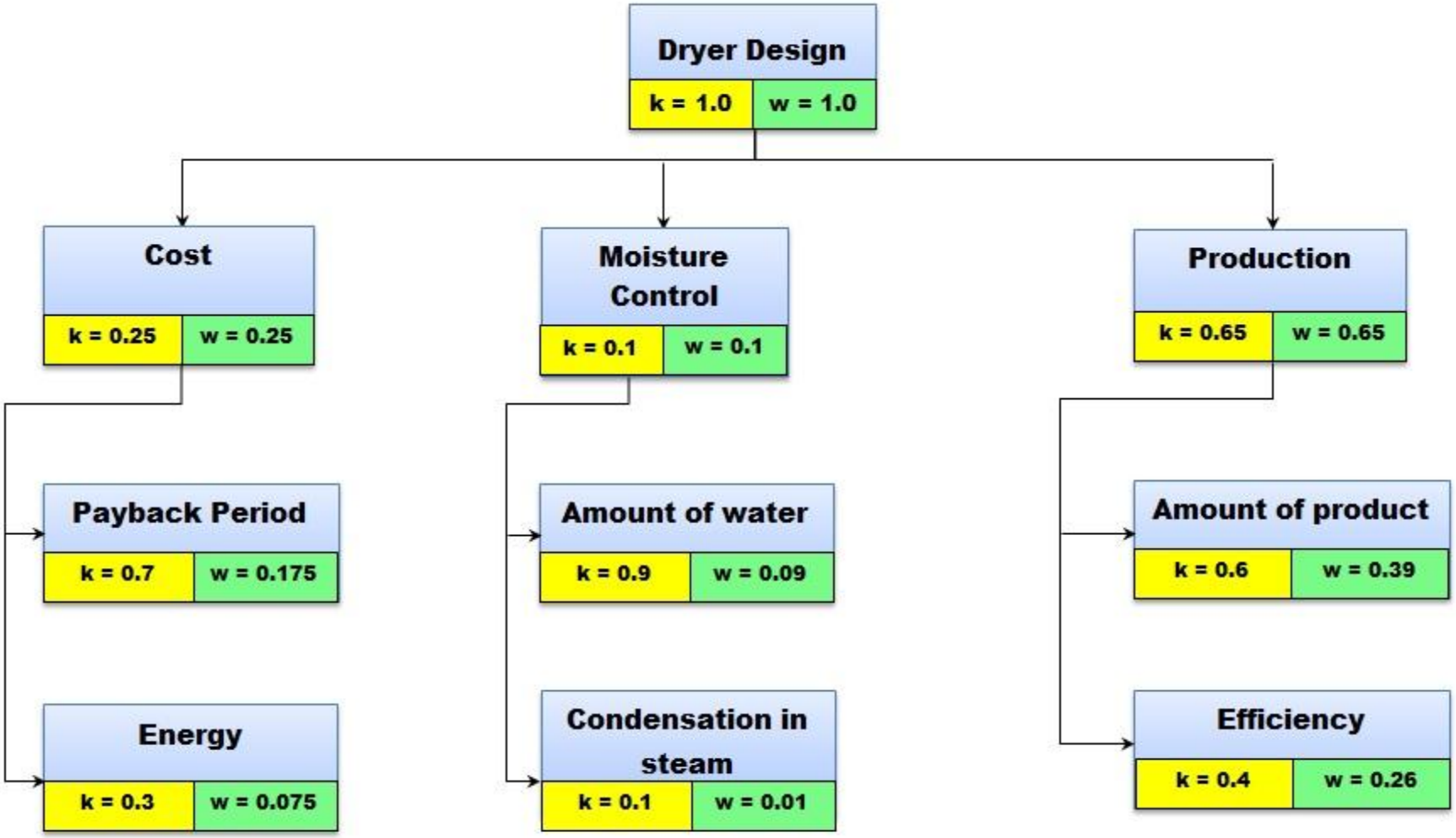
Osborn's Checklist

Ideas	Adapt	Modify	Magnify	Minify	Substitute	Rearrange	Combine
Rebuild Steam Traps	Buy new steam traps (Industrial Automation Services)	Eliminate need for steam traps	More Steam Traps	Less, more effective steam traps	New steam trap design	Rework how dryer uses steam	
Insulate	Performance contracting insulators, new insulation for steam travel	Insulate entire steam travel distance	More insulation	Different insulation			
Boiler	Look at efficiency of a new boiler	Modify boiler piping	More boiler production	Less boiler use	Look into boiler shut down and start up data	Put small boiler in for dryers	<- less distance steam has to travel
Fuel(Boiler)	Natural gas, coal, No. 6 Fuel	Different boiler fuel source	Run at full capacity for maximum efficiency	Reduce to one boiler from two	Different fuel		Steam system changes
Steam properties	Look at other plants operating conditions	Change steam properties (Latent heat, pressure, density)	Ramp up steam energy	Minimize steam energy	Change steam for natural gas	Max combination of properties to maximize efficiency	

Osborn's Checklist

Ideas	Adapt	Modify	Magnify	Minify	Substitute	Rearrange	Combine
Dryer Fuel	Natural gas conversion	Look into alternative fuels	Max out steam energy transfer	Maximize efficiency to minimize fuel	New steam coil design	Rearrange heat transfer system	
Steam system	Minimize transportation of steam	Eliminate steam	Increase steam capacity to maximize efficiency	Minimize steam use in plant	Substitute out new fuel for dryers	Move boilers	
Product	Look at other plants operational conditions	Only run certain product through dryer 3	Maximize bed depth	Less output from dryer	Run product multiple times through dryer	Change bed arrangement	
Dryer Air Flow	Analyze air flow	Maximize heat transfer	Minimize fan speed	Increase air flow for dryer air	Pull in fresh air in between sections	Dry air between sections	
Dryer size	Buy new dryer	Maximize product bed depth	Increase bed surface to decrease depth	Decrease bed surface area to maximize air flow	New machine to dry product		

Weighted Criteria Tree



Analytical Hierarchy Process

Judgment of Importance	Numerical Rating
Extremely more important	9
	8
Very strongly more important	7
	6
Strongly more important	5
	4
Moderately more important	3
	2
Equally important	1

Pairwise Comparison Matrix

	Cost	Moisture Control	Production
Cost	1	3	1/5
Moisture Control	1/3	1	1/5
Production	5	5	1
Total	19/3	9	7/5

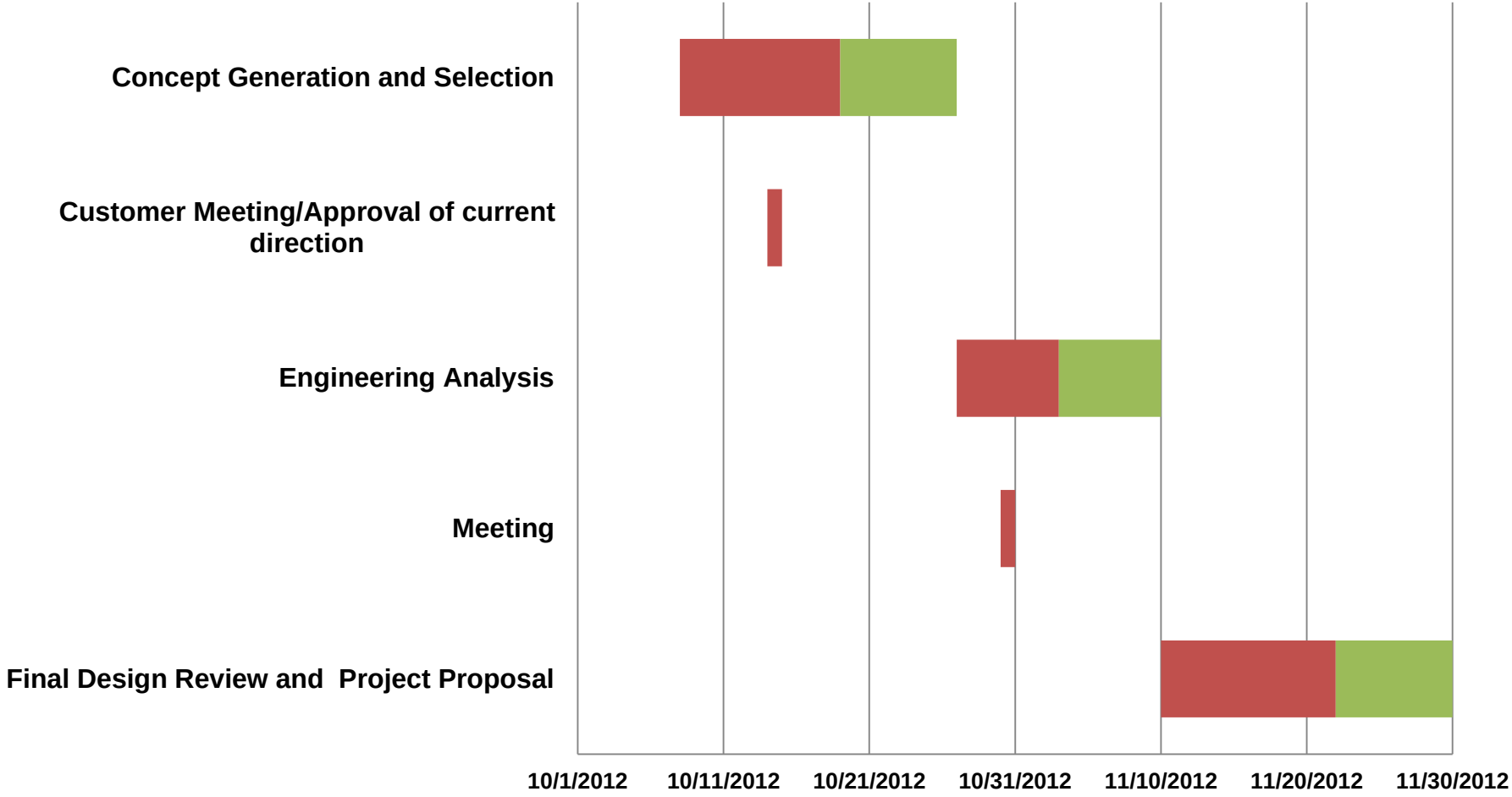
Normalized Importance and Overall Importance

	Cost	Moisture Control	Production	Overall Importance
Cost	0.158	0.333	0.143	0.211
Moisture Control	0.053	0.111	0.143	0.102
Production	0.789	0.556	0.714	0.686

Decision Matrix

	Value	Normalized Value	Value	Normalized Value	Value	Normalized Value	Total
Change steam properties. (Latent heat, pressure, density, etc.)	9	1.899	7	0.714	8	5.488	8.101
Analyze air flow	10	2.11	5	0.51	7	4.802	7.422
Pull in fresh air between section	7	1.477	5	0.51	7	4.802	6.789
Natural Gas Conversion	1	0.211	10	1.02	8	5.488	6.719
New steam coil design	7	1.477	8	0.816	6	4.116	6.409
Dry air between sections	5	1.055	5	0.51	7	4.802	6.367
New steam trap design	7	1.477	5	0.51	6	4.116	6.103
Buy new steam traps	3	0.633	6	0.612	6	4.116	5.361
Look at other plants operating conditions	10	2.11	4	0.408	3	2.058	4.576
Increase bed surface area so depth will decrease	3	0.633	4	0.408	5	3.43	4.471
Performance contracting insulators, new insulation for steam travel	5	1.055	5	0.51	4	2.744	4.309
Minimize transportation of steam	4	0.844	6	0.612	4	2.744	4.2
Run product multiple times through dryer	1	0.211	5	0.51	3	2.058	2.779
Scale 1-10	10 = best, 1 = worst						

Gantt Chart



	Final Design Review and Project Proposal	Meeting	Engineering Analysis	Customer Meeting/Approval of current direction	Concept Generation and Selection
Date	11/10/2012	10/30/2012	10/27/2012	10/14/2012	10/8/2012
Presentation (Days)	12	1	7	1	11
Report (Days)	8		7		8

Conclusion

- **Problem Statement – Dryer 3 efficiency**
- **Concept Generation – Osborn's Checklist**
- **Concept Selection – Change steam properties, air flow**
- **Updated Gant Chart**

References

- **Clint Chadwick**
  Environmental Coordinator
  Nestle Purina Pet Care, Flagstaff, AZ

- **Chad Girvin**
  Processing Maintenance Team Leader
  Nestle Purina Pet Care, Flagstaff, AZ