Spring 5-4-2024

MPEM Capstone Presentation

Stetson Ratzlaff

MASTER OF PROJECT, ENGINEERING AND MANAGEMENT

STETSON RATZLAFF

MAY 1, 2024

ADVISOR: TODD HOFFMAN

COMMITTEE: TIM KOBER, SONYA ROSENTHAL, DAVE RATHGEBER

MONTANA
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AGENDA

- **Bio**
- **Program Goals**
- **Program Benefits**
- **Committee Questions**
- **Committee Answers**
- **Overall Program Thoughts**
- **Suggested Program Improvements**

BIO

- **From Helena, MT**
- **B.S. Environmental Engineering, Montana Tech – 2021**
- **Solid Waste Project Engineer @ Great West Engineering**

What Is My Job?

- **Preliminary Engineering Report**
- **Grant writing**
- **Predesign survey**
- **Design of project**
- **Draft engineering plans, specifications, & reports**
- **Project inspection**
- **Post construction reports**
- **Operations & maintenance assistance**

PROGRAM GOALS

- **Learn management styles and practices**
- **Prepare myself for a future management role**
- **Understand what tasks & challenges managers face**
- **Bring new insight to my company**

PROGRAM BENEFITS

- **Management mindset**
- **Improved communication**
- **Expanded knowledge base**
- **More marketable**

COMMITTEE QUESTIONS

- **MPEM 5010 Entrepreneurship & Economic Feasibility**
  - Porter Lumber, Inc.
- **MPEM 5020 Project & Engineering Management**
  - Lightning Speed Communication Co.
- **MPEM 5180 US Energy Policy and Energy for Sustainability**
  - MT Energy Development

MPEM 5010 - PORTER LUMBER, INC.

- **Mr. Porter is seeking a bank loan of $200,000 to help fund the rapid growth of his lumber business**
- **Analyze the income statement and balance sheets from 1990-1992 & quarter 1 of 1993.**
- **Determine if Porter Lumber can take on additional debts & recommend changes to financial operating strategy**

Porter Lumber Company, INC.

Income Statement - For the years ended December 31, 1990 through 1992 and for the three months ending March 31, 1993
(in thousands)

	December, 31			March, 31	December, 31	
	1990	**1991**	**1992**	**1993**	**1993**	**1993**
Net Sales	1,481	1,830	2,358	621	2,977	2854
Cost of Goods Sold:						
Beginning Inventory	222	194	368	409	465	757
Plus: Purchases	1,222	1,748	1,102	632	1,391	1675
	1,444	1,942	1,470	1,041	1,856	2,433
Less: Ending Inventory	194	368	409	497	516	884
Cost of Goods Sold	1,250	1,574	1,061	544	1,340	1,549
Gross Profit	231	256	297	77	375	358
Operating Expenses	75	109	146	41	184	179
Net Operating Profit	156	147	151	36	191	179
Plus: Purchase Discounts	9	9	11	1	14	11
	165	156	162	37	205	190
Less: Customer Discounts	33	42	57	15	72	69
Profit Before Taxes	132	114	105	22	133	121
Net Tax Expense	57	48	44	9	56	51
Net Income	75	66	61	13	77	71
Less: Dividends	-	-	20	5	25	24
Profits Retained in Business	75	66	41	8	52	47

	Projection is made using Q1 of 1993 and 1992 values with 26.25% growth for Q2,Q3,Q4.
	Projection is made using 1992 values with 26.25% growth

Porter Lumber Company, INC.

Statement of Financial Position - As of December 31, 1990 through 1992 and as of March 31, 1993 (in thousands)

	December, 31			March, 31	December, 31	
	1990	**1991**	**1992**	**1993**	**1993**	**1993**
Assets						
Cash	3	3	3	4	3	3
Accounts Receivable	114	153	230	256	290	474
Inventory	194	368	409	497	516	884
Total Current Assets	311	524	642	757	810	1361
Property (Less Accumulated Depreciation)	22	23	25	24	25	25
Deferred Charges	5	6	10	8	10	10
Total Assets	338	553	677	789	845	1396
Liabilities						
Taxes Payable	57	48	44	9	56	51
Notes Payable-Bank	0	0	43	50	56	245
Notes Payable-Trade	0	0	0	47	0	47
Notes Payable-Employees	0	0	0	10	0	10
Accounts Payable	115	298	350	421	442	752
Notes Payable-Smith	48	0	0	0	0	0
Accruals	5	8	0	4	4	4
Total Current Liabilites	225	354	437	541	557	1109
Owners' Equity						
Capital Stock	38	58	58	58	58	58
Retained Earnings	75	141	182	190	230	229
Total Owner's Equity	113	199	240	248	288	287
Total Liabilites and Owners' Equity	338	553	677	789	845	1396

	Projection is made using Q1 of 1993 and 1992 values with 26.25% growth for Q2,Q3,Q4.
	Projection is made using 1992 values with 26.25% growth

Porter Lumber Company, INC.

Calculated Ratio's & %'s - For the years ended December 31, 1990 through 1992 and for the three months ending March 31,

	December, 31			March, 31	December, 31	
	1990	**1991**	**1992**	**1993**	**1993**	**1993**
Percentage Increase in Sales		23.6%	28.9%		26.3%	21.0%
Percentage change in net income		-12%	-8%		26%	16%
Annual Net Income/Average Net Worth	0.33	0.26	0.23		0.40	0.74
Profit as Percentage of Sales	5.06%	3.61%	2.59%	2.09%	2.59%	2.48%
current ratio	1.50	1.56	1.55	1.46	1.52	1.26

	Projection is made using Q1 of 1993 and 1992 values with 26.25% growth for Q2,Q3,Q4.
	Projection is made using 1992 values with 26.25% growth

PORTER LUMBER, INC.

- **What is Mr. Porters business strategy & is it successful?**
- **How has the business been financed in recent years & what changes have been made?**
- **Should Mr. Porter be given the $200,000 loan?**
- **Recommendations for operating and financial strategy.**

MPEM 5020 - Lightning Speed Communication Co.

- **Principle engineer tasked with establishing a project team to place a strategic communication device on St. Thomas Island**
- **Project includes:**
  - Conducting a site inspection with local and government representatives
  - Present project approach to Lightning Speed Board
  - Presentation of Project Execution Plan (PEP) to St Thomas Government

Lightning Speed Communication Co.

- **Victoria – Project manager with 23 years of experience**
  - Strong communication skills
  - Similar project experience
- **Eric – Deputy project manager with 2.5 years of experience**
  - Eager to learn
  - Problem solver

Lightning Speed Communication Co.

1. **How will you issue the project to Victoria & Eric**
   - Project kickoff meeting will provide
     - Objectives
     - Timeline
     - Milestones
     - My Expectations
     - Client Expectations

Lightning Speed Communication Co.

2. **What do you expect the roles to be? What issues are you expecting?**
   - Victoria: Project manager in charge of coordination, oversight, management and quality assurance
   - Eric: Deputy project manager in charge of technical support, site inspections, and supporting project manager
   - Issues:
     - Communication
     - On-site work
     - Project complexity

Lightning Speed Communication Co.

3. **How do you expect the Presentation to the board to be planned & conducted?**
   - Principal Engineer
     - Guidance during preparation, present project team organization, Q&A
   - Project Engineer
     - Bulk of prep, present project breakdown & how it meets boards strategic requirements
   - Deputy Project Engineer
     - Presentation Review, Speak on technical/field aspects of strategy and how it meets boards strategic requirements

Lightning Speed Communication Co.

4. **How will you interact with Victoria & Eric during the PEP presentation?**
   - Regular communication with the project team and milestone meetings at 50%, 75%, 90% and 100% completion.

Lightning Speed Communication Co.

5. What information is expected to be in PEP?

PEP Heading	Specific Content	Why it's Included
Executive Summary	Concise overview of the project objectives, approach, and timeline.	Highlights what is included and covered in the PEP.
Introduction	Background information on the project and its strategic importance.	
Management and Team Structure	Roles and responsibilities of management and the project team.	Identifies people the clients will see and interact with on a regular basis.
Stakeholders	Description of the stakeholders and their need for the project.	Identifies the clients and their needs.
Project Scope	Detailed description of the project scope, including deliverables and milestones.	Prevents scope creep and ensures everyone understands what is and isn't included in the project.
Project Timeline	Comprehensive timeline outlining key project activities and deadlines.	Ensures that everyone is aware of the project's schedule and can plan accordingly
Project Controls	Implementation of project management tools that monitor project progress and issue management	Monitors and guides a project according to pre planed schedule and budget

Lightning Speed Communication Co.

PEP Heading	Specific Content	Why it's Included
Budget	Initial budget estimates and cost control measures.	Ensures that the project stays within budget and financial resources are allocated appropriately.
Procurement	Plan for acquiring necessary materials for project. Determine lead times for construction materials.	Ensures that the project is able to continue with the necessary materials as they arrive onsite.
Risk Management	Identification of potential risks and mitigation strategies.	Risk management helps minimize disruptions and ensures smooth project execution.
Quality Assurance	Plan for ensuring quality standards throughout the project lifecycle.	Ensures that deliverables meet the required quality criteria.
Technical Approach	Overview of the technical aspects, including device installation and commissioning.	Ensures that technical requirements are clearly defined and understood.
Legal & Regulatory Compliance	Compliance with legal and regulatory requirements, including permits and approvals.	Ensures that the project operates within legal boundaries and obtains necessary permits and approvals.
Communication Plan	Strategy for internal and external communication throughout the project.	Ensures that stakeholders are informed and engaged throughout the project lifecycle.
Conclusion	Summary of key points and next steps.	

MPEM 5180 - MT Energy Development

- **Determine a power generation & supply for a town of 100,000 homes**
- **Consider both sustainability & cost**
- **Consider efficiencies of energy sources and transmission losses.**

MT Energy Development

MPEM Capstone Project- Energy Source Analysis						
Energy Source	**Cost Per MW**	**Max Output (MW)**	**Distance of High-Voltage Transmission Line (KM)**	**Cost of High-Voltage Transmission Line**	**Energy Source Efficiency**	**Output with Plant Inefficency (MW)**
Wood	$ 4,000,000	200	10	$ 1,000,000	25%	50
Coal	$ 3,500,000	6000	25	$ 2,500,000	35%	2100
Natural Gas (Single)	$ 1,200,000	500	25	$ 2,500,000	40%	200
Natural Gas (Combined)	$ 650,000	800	25	$ 2,500,000	57%	456
Nuclear	$ 5,300,000	1000	50	$ 5,000,000	45%	450
Geothermal	$ 8,000,000	50	10	$ 1,000,000	12%	6
Solar (PV)	$ 1,000,000	2000	50	$ 5,000,000	16%	320
Solar (CSP)	$ 4,275,000	580	50	$ 5,000,000	24%	139.2
Wind	$ 1,300,000	20000	30	$ 3,000,000	35%	7000

Assumptions:

1) High-Voltage Transmission Line has a cost of $100,000 per Kilometer
2) High-Voltage Transmission Line has an efficiency of 94%
3) Electricity use per home is 14 MWh/Yr

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MT Energy Development

MPEM Capstone Project- Energy Source Analysis						
Energy Source	**Transmission Losses (MW)**	**Maximum Total Output (MW)**	**Maximum Output/Yr (MW)**	**Electrical Exceedance or Shortage (MW)**	**Total Cost**	**Cost Per MW**
Wood	3	47	411,720	(988,280)	$ 5,000,000	$ 106,383
Coal	126	1974	17,292,240	15,892,240	$ 6,000,000	$ 3,040
Natural Gas (Single)	12	188	1,646,880	246,880	$ 3,700,000	$ 19,681
Natural Gas (Combined)	27.36	428.64	3,754,886	2,354,886	$ 3,150,000	$ 7,349
Nuclear	27	423	3,705,480	2,305,480	$ 10,300,000	$ 24,350
Geothermal	0.36	5.64	49,406	(1,350,594)	$ 9,000,000	$ 1,595,745
Solar (PV)	19.2	300.8	2,635,008	1,235,008	$ 6,000,000	$ 19,947
Solar (CSP)	8.352	130.848	1,146,228	(253,772)	$ 9,275,000	$ 70,884
Wind	420	6580	57,640,800	56,240,800	$ 4,300,000	$ 653

Assumptions:

1) High-Voltage Transmission Line has a cost of $100,000 per Kilometer
2) High-Voltage Transmission Line has an efficiency of 94%
3) Electricity use per home is 14 MWh/Yr

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MT Energy Development

MPEM Capstone Project- Energy Source Cost Analysis											
Total Ranking	Total Cost Ranking	Cost Per MW Ranking	Cost Per MW/h over Life Ranking	Energy Source	Cost Per MW	Cost of High-Voltage Transmission Line	Maximum Total Output (MW)	Total Cost	Cost Per MW (W Inefficiency)	Plant Life Expectancy (Yr)	Cost Per MW/h over Life of Plant
1	1	3	1	Natural Gas (Combined)	$ 650,000	$ 2,500,000	429	$ 3,150,000	$ 7,349	35	$ 10.27
2	3	1	4	Wind	$ 1,300,000	$ 3,000,000	6,580	$ 4,300,000	$ 653	30	$ 16.36
3	2	4	2	Natural Gas (Single)	$ 1,200,000	$ 2,500,000	188	$ 3,700,000	$ 19,681	35	$ 12.07
4	5	2	3	Coal	$ 3,500,000	$ 2,500,000	1,974	$ 6,000,000	$ 3,040	45	$ 15.22
5	6	5	5	Solar (PV)	$ 1,000,000	$ 5,000,000	301	$ 6,000,000	$ 19,947	30	$ 22.83
6	4	8	5	Wood	$ 4,000,000	$ 1,000,000	47	$ 5,000,000	$ 106,383	25	$ 22.83
7	9	6	7	Nuclear	$ 5,300,000	$ 5,000,000	423	$ 10,300,000	$ 24,350	50	$ 23.52
7	8	7	9	Solar (CSP)	$ 4,275,000	$ 5,000,000	131	$ 9,275,000	$ 70,884	25	$ 42.35
9	7	9	8	Geothermal	$ 8,000,000	$ 1,000,000	6	$ 9,000,000	$ 1,595,745	25	$ 41.10

Assumptions:

1) High-Voltage Transmission Line has a cost of $100,000 per Kilometer
2) High-Voltage Transmission Line has an efficiency of 94%
3) Electricity use per home is 14 MWh/Yr

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MT Energy Development

MPEM Capstone Project- Energy Source Emission Analysis					
Total Emissions Ranking	**Energy Source**	**C02 equivalent emissions kg/MWh**	**Total C02 Equivalent Emissions Kg per Year**	**Metric tons per yr**	**Metric Ton CO2 Equivalent per Household**
1	Nuclear	0	-	-	-
2	Wind	1	1,260,000	1,260	0
3	Solar (CSP)	5	6,720,000	6,720	0
4	Solar (PV)	10	13,440,000	13,440	0
5	Geothermal	112	156,800,000	156,800	2
6	Natural Gas (Combined)	374	523,600,000	523,600	5
7	Natural Gas (Single)	444	621,600,000	621,600	6
8	Wood	965	1,351,000,000	1,351,000	14
9	Coal	1000	1,400,000,000	1,400,000	14

Assumptions:

1) High-Voltage Transmission Line has a cost of $100,000 per Kilometer
2) High-Voltage Transmission Line has an efficiency of 94%
3) Electricity use per home is 14 MWh/Yr

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MT Energy Development

MPEM Capstone Project - Life Cycle Emission Analysis of Combined Natural Gas Power Plant			
Emission Source	**C02 equivalent emissions kg/MWh**	**Total C02 Equivalent Emissions Kg per Year**	**Metric tons per yr**
Natural Gas Production & Distribution	125	174,300,000	174,300
Ammonia Production & Distribution	0.4	560,000	560
Construction & Decommissioning	2	2,800,000	2,800
Power Plant Operation	374	523,600,000	523,600
Total	501	701,260,000	701,260

Table 13: Breakdown of Resource Consumption for Power Plant and Pipeline

Resource	% of total from power plant construction & decommissioning	% of total from pipeline construction
Natural gas (in ground)	< 0.0%	< 0.0%
Coal (in ground)	6.0%	27.7%
Oil (in ground)	25.1%	7.1%
Iron scrap	5.5%	94.5%
Iron (Fe, ore)	5.7%	94.3%
Limestone ($CaCO_3$, in ground)	91.1%	8.9%

Note: Because of significant figures some of the percentages in this table are not actually zero and therefore are denoted as less than zero percent.

1) Electricity use per home is 14 MWh/Yr
2) Plant life is expected to be 30 years
3) Construction is expected to last 2 years
4) Construction & decommissioning includes the construction of natural gas pipeline

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OVERALL THOUGHTS

- **Professors were understanding of work & school responsibilities**
- **Learned management & communication practices**
- **Understand company finances**
- **The opportunity to take summer courses is very beneficial.**

SUGGESTED IMPROVEMENTS

- **Not having the opportunities to take some courses was frustrating**
- **List of when courses are offered would be helpful (specifically summer).**