IPRO 319 Logistics Outsourcing Tool

FINAL REPORT

final report

Instructor: Herb Shields
Sponsor: Warehouse Education and Research Council and the Kern Family Foundation

Team:
Juhan Bae
HyoungTae Cho
Sean Christopherson
Amol Venkat Gunale
Maxime Hacker
Kerstin Hammer
Kabir Mehta
Tito Rodriguez
Sasha Romanova-Smith
Nickolay Schwarz

Semester Problem

"How to maximize the profit of a warehouse?"

"Outsourcing - Yes or No?"

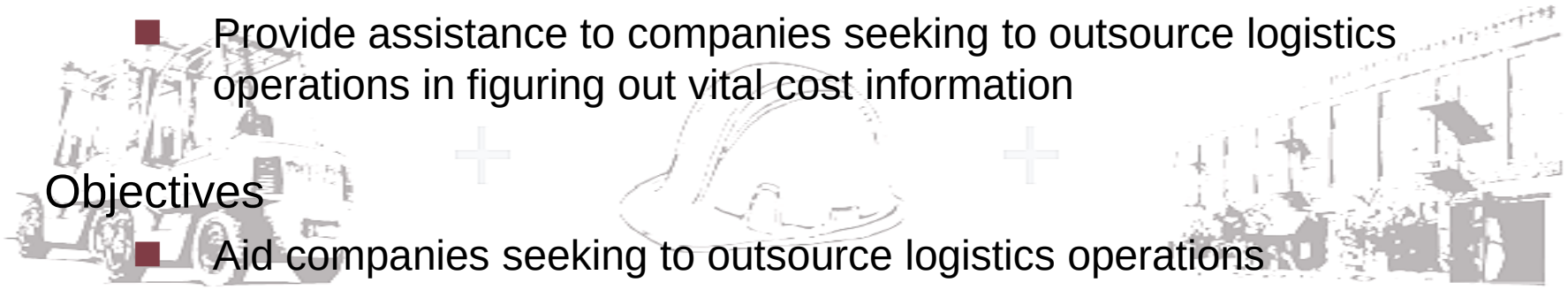
"What are the actual costs? How are they itemized?"

Problem

- Help companies deal with cost analysis through a web-based tool.
- Provide assistance to companies seeking to outsource logistics operations in figuring out vital cost information

Objectives

- Aid companies seeking to outsource logistics operations
- Create mathematical model of distribution operation
- Create a web-based application for efficient cost analysis



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Milestones

1 **Project planning phase**
- Identify Objectives
- Task Division

Create Project Plan 09-22

2 **Research Phase**
- Library Research
- WERC Research –web
- Interview Industry Workers

Create Midterm Deliverables 10-20

3 **Division into Sub-teams**
- Mathematical Modeling
- Tool Development
- Marketing

Create Final IPRO Deliverables 11-22

4 **Presentations**

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Initial Task Division

Overall Team Assignments

- No sub-teams for project planning and research phases

Amol Gunale
Assistant Team Leader

Tito Rodriguez
Team Leader

Sasha Romanova-Smith
Secretary

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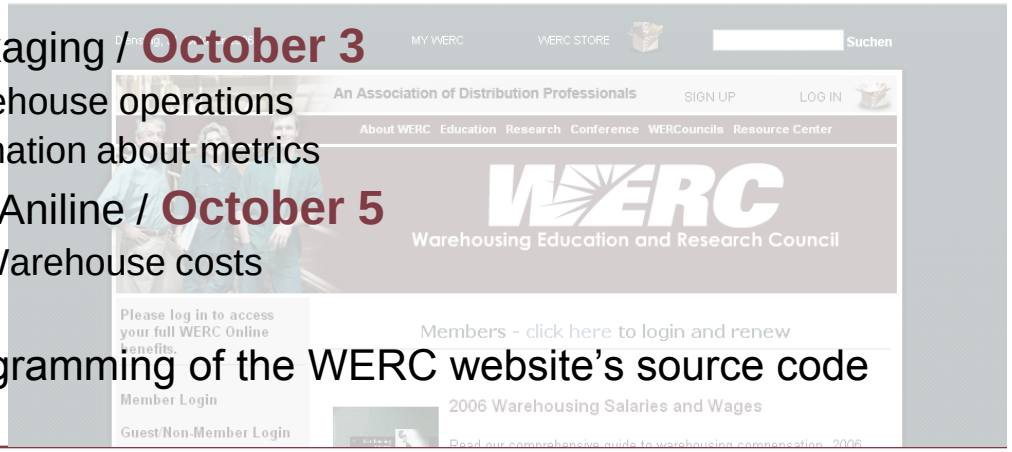
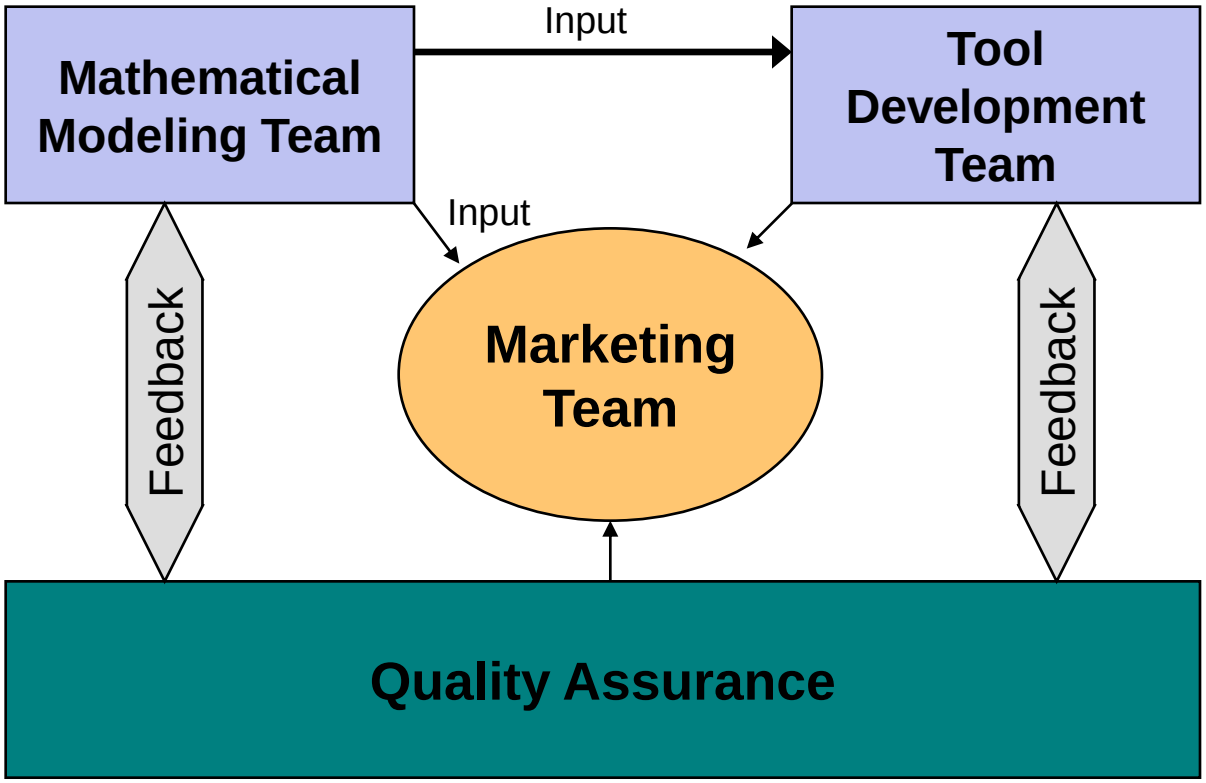
Research Phase

- Library and Online Journal Research
  - Materials Handling Management Journal
  - Logistics Management Journal
  - WERC website resources
- Interviews with Professionals
  - Strive Group / **September 22**
    - Warehouse Operations and Activities
    - Financials
- Mark Wozniak at Liquid Packaging / **October 3**
  - Information about warehouse operations
  - Providing useful information about metrics
- Bob Horwath from Keystone Aniline / **October 5**
  - Financial issues and Warehouse costs
- Research the layout and programming of the WERC website's source code



Division into Sub-teams



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Mathematical Modeling Sub-Team

- The team described the mathematical relationships between input and output variables (costs) using MS Excel. This model is the basis for the logic of the web tool.

Sean Christopherson
Manufacturing Tech. and Management

Amol Gunale
Master of Industrial Technology and Operations

Nick Schwarz
Sub-team leader
Computer Science

Tito Rodriguez
Business

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Mathematical Modeling

- **Objective**: to create a model for the development team to utilize in their web tool for calculating **warehouse efficiency** and **benchmarking**

Research Contributions:

- Defined input and output variables
- Formulated calculations
- Defined basic model structure for generating outputs
- Implement output parameters of other companies for comparison

Our Primary Focus:

- Building and Equipment
- Labor, Maintenance, Utilities
- Output Results and Benchmarking

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Mathematical Modeling Building

	Pallet warehouse	Rack warehouse
Building	INPUTS	
Building space (Cu. ft)	1,000,000	250,000
Pallet/Rack Warehouse	0.75	0.85
Input Pallet Size	9600	1920
# of Pallets allowed	78.125	110.6770833
on the floor		
How high/deep do you stack	2	3
# of Pallets stored @ CAP	156.25	664.0625
Building cost groups	Cost	Cost
Rent cost		
Total costs:		

Input field **Output field**

Mathematical Modeling Equipment

EQUIPMENT COST

a) OWN

	Group type	# in group	Usage period (in month)	Total cost	Cost per month	Total work hours in day	Avg machine use hour	Rate of use of machine group	Productive cost per month	Maintance cost
group	Forklifts	5	24	120000	5000	16	14	0.875	4375	

b) Rent

	Group type	# in group	Cost per month	Total work hours in day	Avg machine use hour	Rate of use of machine group	Productive cost per month
group	Forklifts	5	6000	16	15	0.9375	5625

Input field Calculated output field

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Mathematical Modeling Labor

LABOR COST

	Position (designation)	Regular working hours calculations: Head Count		Cost/hr		hrs/day		Total	% of TOTAL	Overtime hours calculations: Head Count		Overtime Cost/hr		Overtime hrs/day		Total	% of TOTAL 2
Administration																	
1	Chief Operating Officer	1	x	20	x	8	=	160	6.41%	1	x	0	x	0	=	0	0.00%
2	Secretary	1	x	15	x	8	=	120	4.81%	1	x	0	x	0	=	0	0.00%
3	Helper 1	1	x	8	x	8	=	64	2.56%	1	x	0	x	0	=	0	0.00%
4	Helper 2	1	x	8	x	8	=	64	2.56%	1	x	0	x	0	=	0	0.00%
Finance																	
1	Chief Financial Officer	1	x	20	x	8	=	160	6.41%	1	x	0	x	0	=	0	0.00%
2	Subordinate 1	1	x	15	x	8	=	120	4.81%	1	x	0	x	0	=	0	0.00%
3	Subordinate 2	1	x	12	x	8	=	96	3.85%	1	x	0	x	0	=	0	0.00%
4	Subordinate 3	1	x	12	x	8	=	96	3.85%	1	x	1	x	2	=	2	1.75%
Operations																	
1	Plant Manager	1	x	18	x	8	=	144	5.77%	1	x	0	x	0	=	0	0.00%
2	Assistant Plant Manager	1	x	16	x	8	=	128	5.13%	1	x	0	x	0	=	0	0.00%
3	Line Manager 1	1	x	14	x	8	=	112	4.49%	1	x	0	x	0	=	0	0.00%
4	Line Manager 2	1	x	14	x	8	=	112	4.49%	1	x	0	x	0	=	0	0.00%
Material Handling employees																	
1	Forklift operator (receiving)	4	x	10	x	8	=	320	12.82%	4	x	4	x	4	=	64	56.14%
2	Forklift operator (delivering)	4	x	10	x	8	=	320	12.82%	3	x	2	x	2	=	12	10.53%
3	Packaging workers (Permanent)	3	x	8	x	10	=	240	9.62%	2	x	3	x	3	=	18	15.79%
4	Packaging workers (Temporary)	3	x	8	x	10	=	240	9.62%	3	x	2	x	3	=	18	15.79%
						TOTAL 1	=	2496	100.00%					TOTAL 2		114	100.00%

Labor cost variables: Regular Working Hrs Cost
Overtime Working Hrs Cost
Productive Hrs Cost Calculation

Input fields

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Mathematical Modeling Labor/Utilities

Productive Hrs Cost calculation.

Number of vacation days (except weekends)	Weeks of vacation	hrs/day	unproductive hrs/day	productive hrs/day	cost/hr	working days/week	working weeks/year	Cost for productive hrs
6	1.20	8	1.5	6.5	8	5	50.80	13208

Maintenance, utilities and other costs:		Cost per month
	Total Equipment maintenance	
	Total building maintenance	
Other maintenance cost		
Utilities	electric	
	gas	
	water	
other utilities		
Miscellaneous and other costs		
	Total main cost per month	0

Input field Calculated output field Total Output field

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Mathematical Modeling Outputs

- Overall outputs:
  - total costs in each group
  - cost distribution structure
  - warehouse capacity
  - pallet cost
  - productive cost distribution
  - # pallets stored at capacity
  - divisions costs
  - % distribution
  - efficiency

Cost Variables (USD)	Pallet	Rack	% of distribution over overall cost	Productive cost
Building cost group	100000		19.46	N/A
Equipment cost group	110000		21.40	
Labor cost group	240000		46.69	
Utilities cost group	34000		6.61	N/A
Maintenance cost group	25400		4.94	N/A
Other cost group	4600		0.89	N/A
Total cost:	**514000**		100%	
Cost per pallet	**27.70**			

Output field (from previous sheets) **Calculated output field**

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Mathematical Modeling Benchmarking

Inputs for market comparison

Number of orders held	
Number of orders shipped	
Avg capacity used	
Total number of orders	
Occupied capacity # pallets	
Number orders picked	
Number of orders filled completely	
Number of error free orders	
Total warehouse hours	
Total storage capacity	

Basic outputs

Key metrics	Value	Calculation formula	Low	Average or median	High	Best in class	Actual median
Employee productivity vs. standard		Total time worked/standard time	81-89,9	89.6-96.8	96.8-108.1	>108.1	95
Productive hours to total hours		Hours paid / total hours worked	75-84	84-88	88-95	>95	85.8
Administrative cost as a percentage of total cost		admin cost/B8	20-30	7-20	1.8-7	<1.8	10.4
Overtime hours		Labor page	10-12	5-10	3 5	<3	7
Backorders as a percentage of total orders		C12/C15	6.24-12.24	3.88-6.24	1.5-3.88	<1.5	5
Average warehouse capacity used		C14/(Build cap value)	70-80	80-85	85-92	>92	85
Equipment/Forklift capacity used		Equip time used/total time available	25-45	45-78	78-87	>87	62.5
Annual storage utilization, %			70.0	80.0	90.0	N/A	77.8
Orders per hour			2.8	8.0	26.5	N/A	57.4
Order fill rate, %			93.0	97.5	99.0	N/A	94.1
Order accuracy, %			96.5	99.0	99.5	N/A	96.4
Order cycle time, hours			3.0	12.0	32.0	N/A	25.3
Total inventory turnover rates			4.0	6.0	12.0	N/A	11.3

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Tool Development Sub-Team

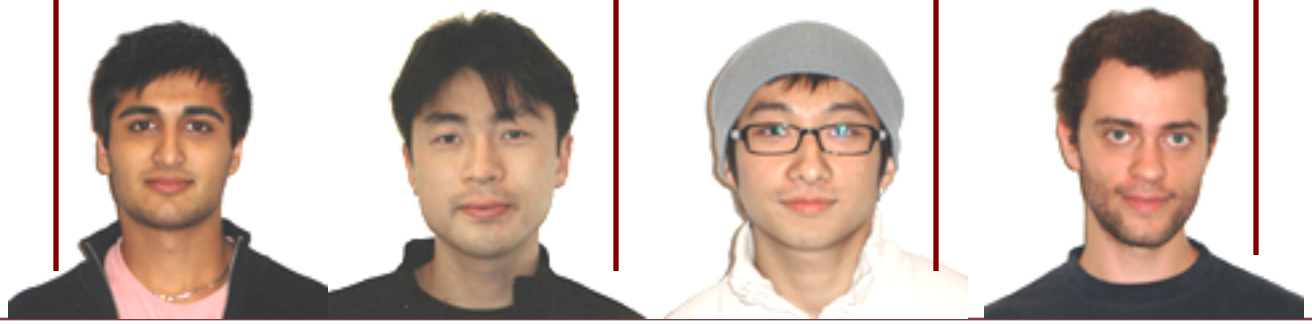
- The team developed the web version of the Logistics Outsourcing Tool. We got the cost relationships and input variables from the mathematical modeling team

HyoungTae Cho
Computer Science

Maxime Hacker
Computer Science

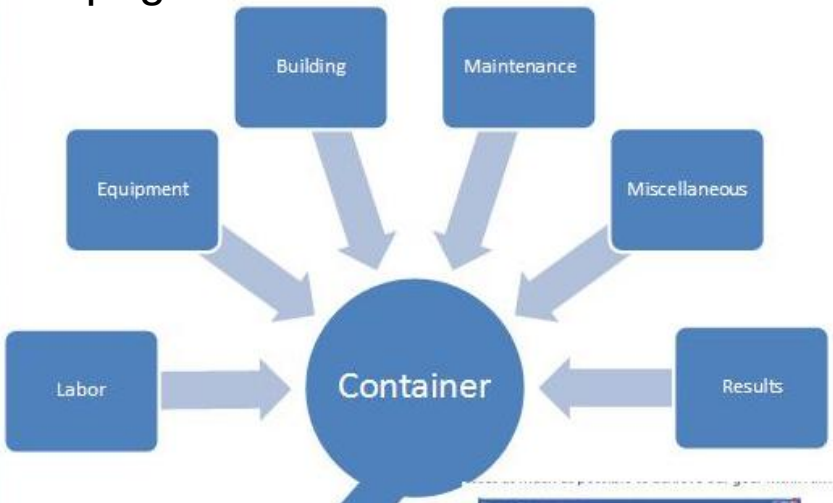
Kabir Mehta
Sub-team leader
Computer Engineering

Juhan Bae
Computer Engineering

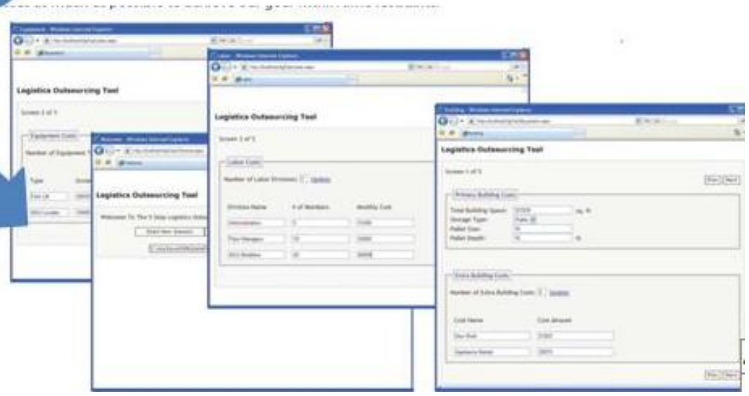


Tool Development Tool Features

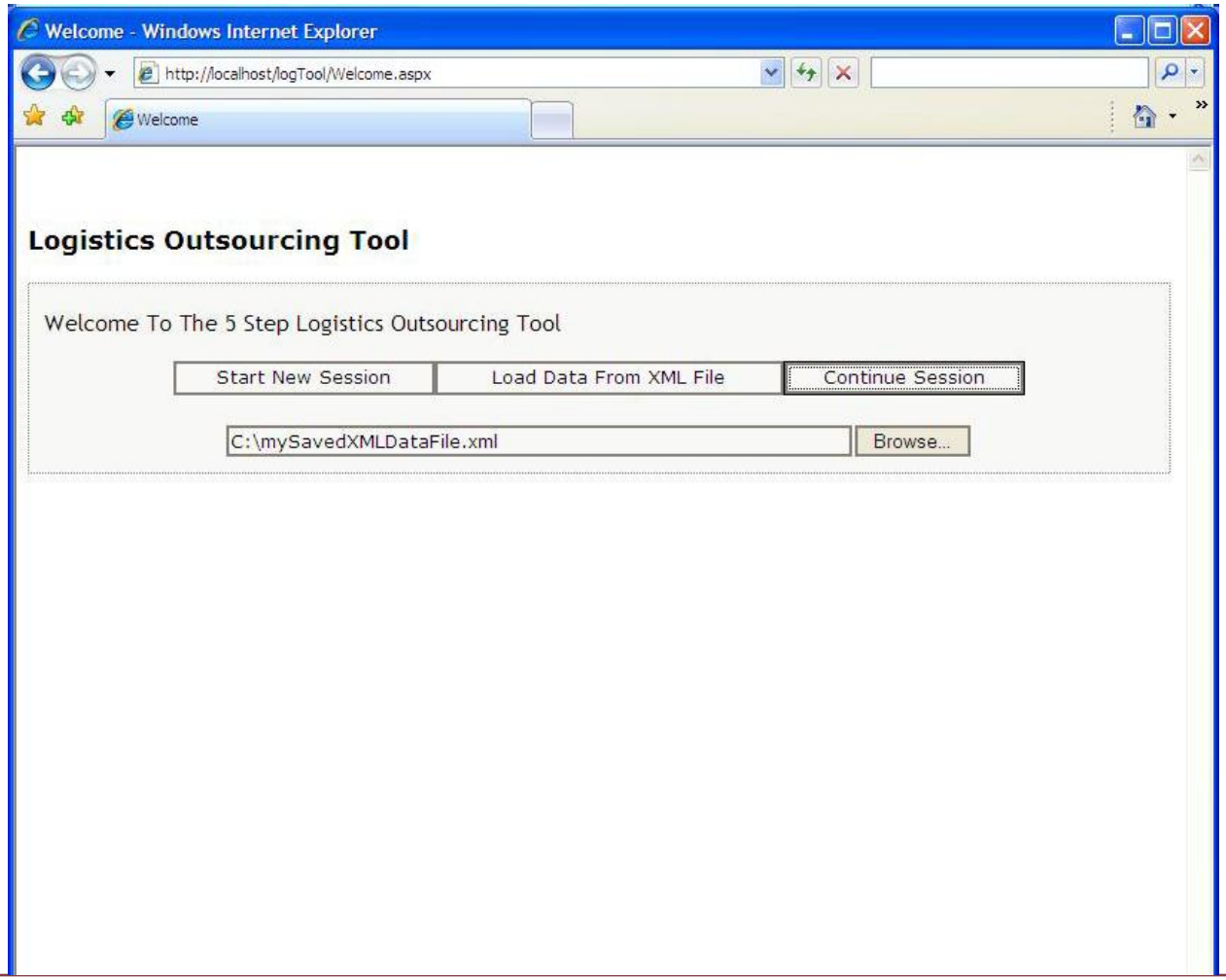
- Data structure for each page of the tool:
  Building
  Labor
  Equipment
  Maintenance
  Miscellaneous
  Results



- Each structure is contained in a wrapper object called “**Container**”.
- The user-end web application is driven by “**Container**”. It holds the user’s data and performs necessary calculations.



Tool Development Screenshot



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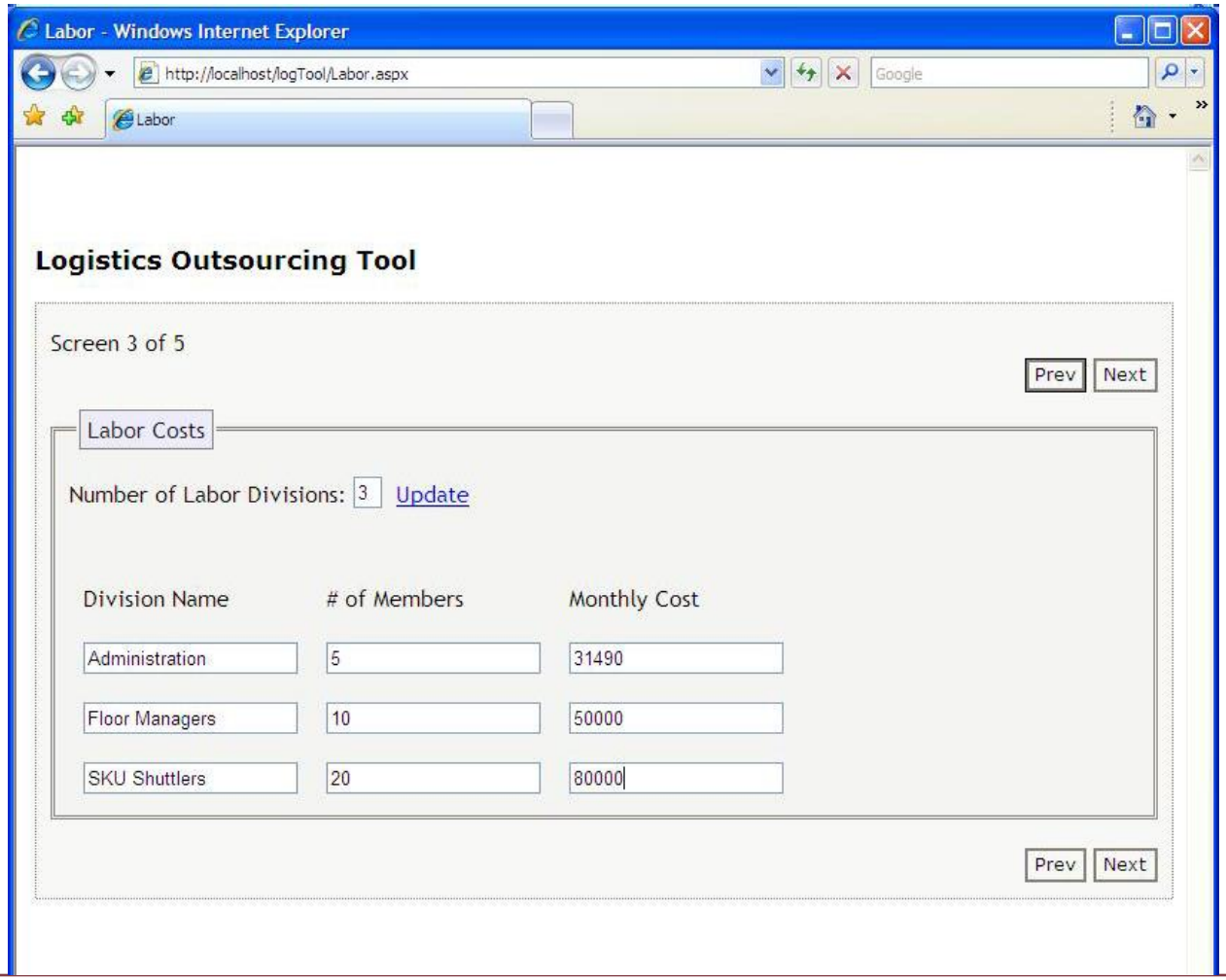

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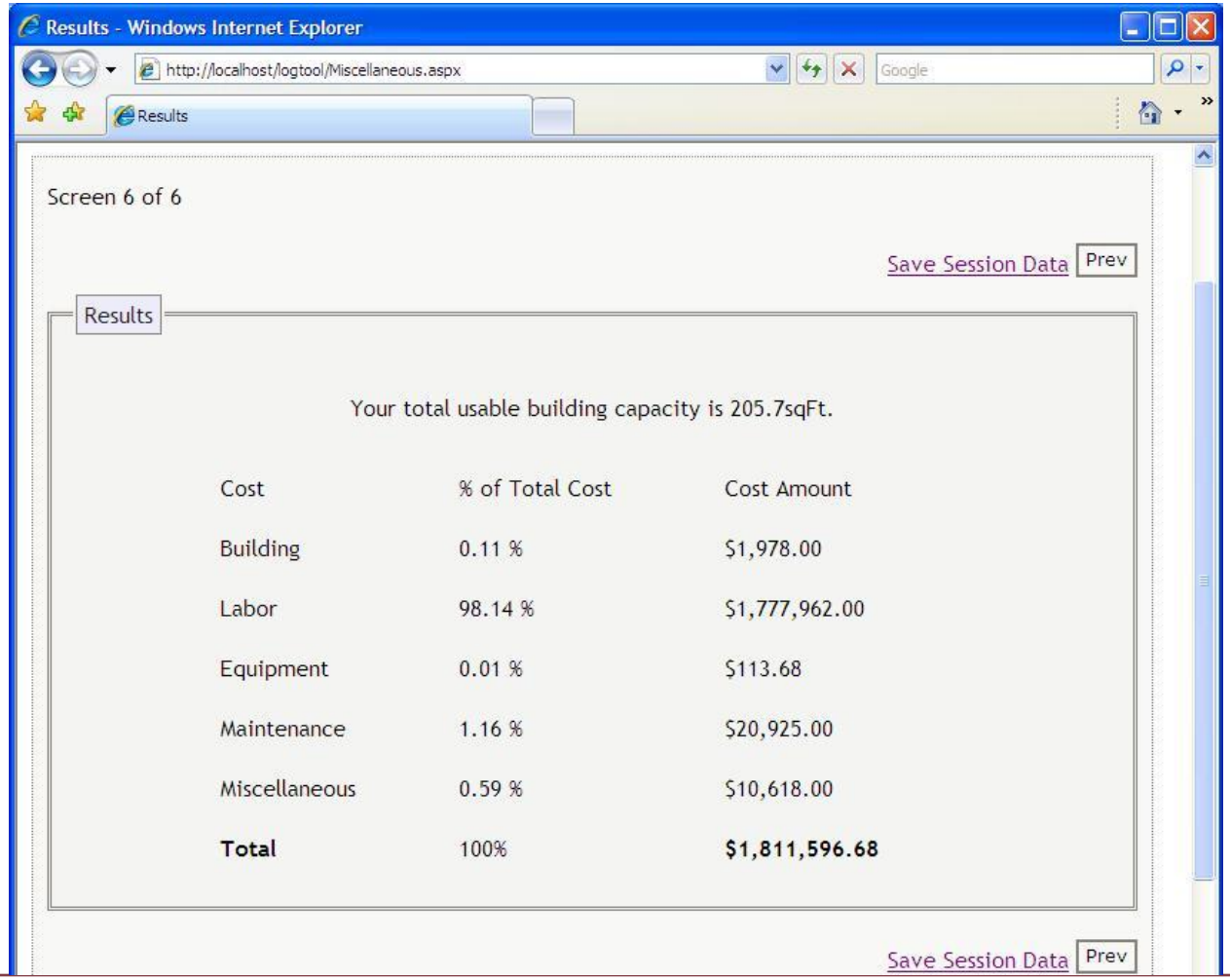
Tool Development Screenshot



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Marketing Sub-Team

- The team created all marketing materials, IPRO Day deliverables, and presentations for the sponsor and class guests. We also facilitated coordinating project documentation throughout the semester.

Kerstin Hammer
Computer Science

Sasha Romanova
Sub-team leader
Architecture

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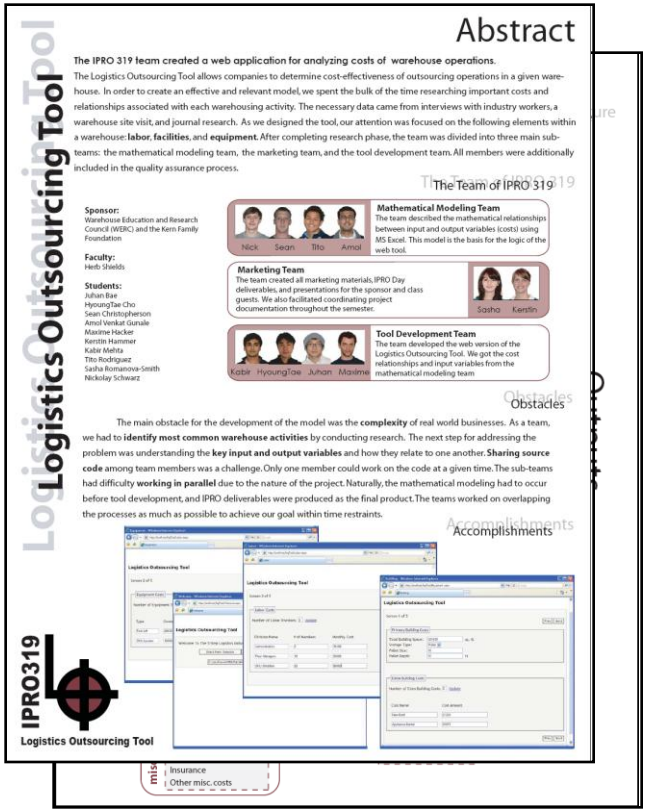
Marketing Deliverables



Abstract

The IPRO 319 team created a web application for analyzing costs of warehouse operations.

The Logistics Outsourcing Tool allows companies to determine cost-effectiveness of outsourcing operations in a given warehouse. In order to create an effective and relevant model, we spent the bulk of the time researching important costs and relationships associated with each warehousing activity. The necessary data came from interviews with industry workers, a warehouse site visit, and journal research. As we designed the tool, our attention was focused on the following elements within a warehouse: **labor**, **facilities**, and **equipment**. After completing research phase, the team was divided into three main sub-teams: the mathematical modeling team, the marketing team, and the tool development team. All members were additionally included in the quality assurance process.

Logistics Outsourcing Tool

The Team of IPRO 319

Sponsor:
Warehouse Education and Research Council (WERC) and the Kern Family Foundation

Faculty:
Herb Shields

Students:
Juhan Bae
HyoungTae Cho
Sean Christopherson
Amol Venkat Gunale
Maxime Hacker
Kerstin Hammer
Kabir Mehta
Tito Rodriguez
Sasha Romanova-Smith
Nickolay Schwarz

Mathematical Modeling Team
The team described the mathematical relationships between input and output variables (costs) using MS Excel. This model is the basis for the logic of the web tool.

Marketing Team
The team created all marketing materials, IPRO Day deliverables, and presentations for the sponsor and class guests. We also facilitated coordinating project documentation throughout the semester.

Tool Development Team
The team developed the web version of the Logistics Outsourcing Tool. We got the cost relationships and input variables from the mathematical modeling team

Obstacles

The main obstacle for the development of the model was the **complexity** of real world businesses. As a team, we had to **identify most common warehouse activities** by conducting research. The next step for addressing the problem was understanding the **key input and output variables** and how they relate to one another. **Sharing source code** among team members was a challenge. Only one member could work on the code at a given time. The sub-teams had difficulty **working in parallel** due to the nature of the project. Naturally, the mathematical modeling had to occur before tool development, and IPRO deliverables were produced as the final product. The teams worked on overlapping the processes as much as possible to achieve our goal within time restraints.

Accomplishments

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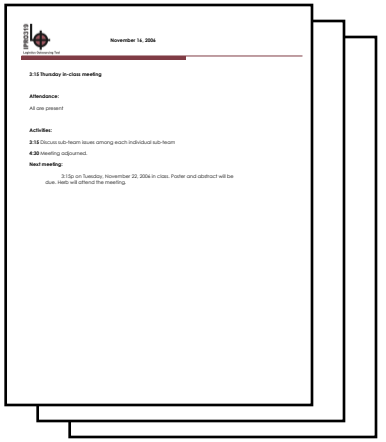
Insurance
Other misc. costs

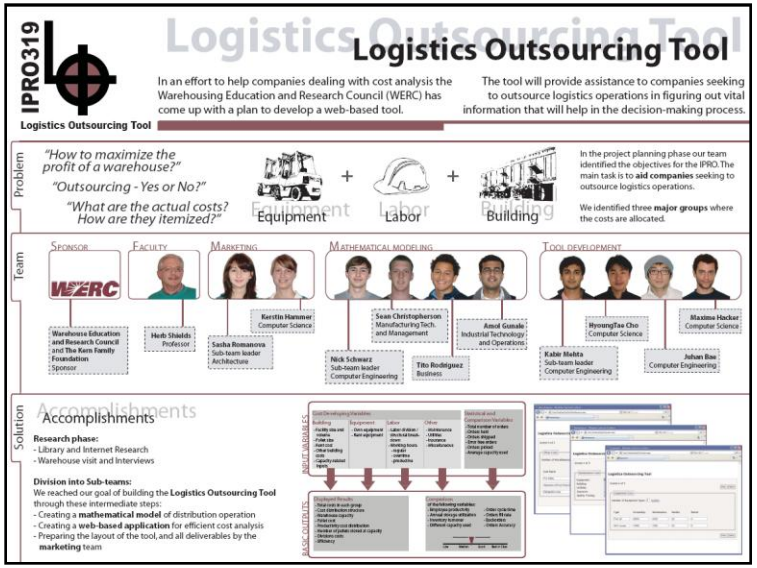


November 16, 2006

3:15 Thursday in-class meeting

Attendance:
All are present

Activities:
3:15 Discuss sub-team issues among each individual sub-team
4:30 Meeting adjourned.
Next meeting:
3:15p on Tuesday, November 22, 2006 in class. Poster and abstract will be due. Herb will attend the meeting.



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Logistics Outsourcing Tool

Logistics Outsourcing Tool

In an effort to help companies dealing with cost analysis the Warehousing Education and Research Council (WERC) has come up with a plan to develop a web-based tool.

The tool will provide assistance to companies seeking to outsource logistics operations in figuring out vital information that will help in the decision-making process.

Problem

"How to maximize the profit of a warehouse?"
"Outsourcing - Yes or No?"
"What are the actual costs? How are they itemized?"

Equipment + Labor + Building

In the project planning phase our team identified the objectives for the IPRO. The main task is to **aid companies** seeking to outsource logistics operations.

We identified three **major groups** where the costs are allocated.

Team

Sponsor: Warehouse Education and Research Council and The Kern Family Foundation — Sponsor

Faculty: Herb Shields — Professor

Marketing: Kerstin Hammer — Computer Science; Sasha Romanova — Sub-team leader, Architecture

Mathematical Modeling: Sean Christopherson — Manufacturing Tech. and Management; Amol Gunale — Industrial Technology and Operations; Nick Schwarz — Sub-team leader, Computer Engineering; Tito Rodriguez — Business

Tool Development: HyoungTae Cho — Computer Science; Maxime Hacker — Computer Science; Kabir Mehta — Sub-team leader, Computer Engineering; Juhan Bae — Computer Engineering

Solution

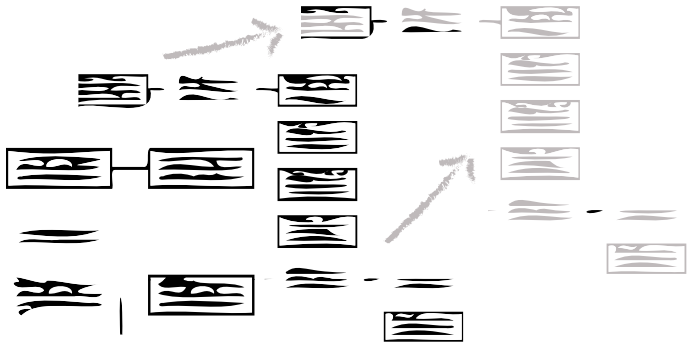
Accomplishments

Research phase:
- Library and Internet Research
- Warehouse visit and Interviews

Division into Sub-teams:
We reached our goal of building the **Logistics Outsourcing Tool** through these intermediate steps:
- Creating a **mathematical model** of distribution operation
- Creating a **web-based application** for efficient cost analysis
- Preparing the layout of the tool, and all deliverables by the **marketing** team

The IPRO Experience What we have learned

Project Management



Too many cooks spoil the broth

- Assign the work properly
- Communicate between sub-teams and each team's members
- Monitor and control project work
- Review the status and provide information about the progress of the project
- Manage changes in the project

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The IPRO Experience What we have learned

Communication

Ethics

Respect is mightier than forceful persuasion.

- Communicate and build trust
- Speak with respect
- Accept other team members and each person's role
- Consider problems in cross-cultural communication
- Non-verbal communication is very important

The IPRO Experience What we have learned

Team is not built in a day.

- Take some time to build a team with patience
- Establish rules for team behavior in one of the first meetings
- Make an effort to be a team member
- Accept the role of each team member
- Find ways to create early success in each sub-team and for the whole IPRO team

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Questions and Answers

- Thank you for your time and attention.

Please provide the team with any feedback you have.