

## **Thesis Plan**

**MIE496**

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### **The Problem**

*Taro Pharmaceuticals* is an international manufacturer of generic pharmaceutical drugs, with locations in Israel, Ireland, United States and Canada. Its Canadian plant produces topical medication in the form of creams and ointments. Because of the high diversity of the product mix and government regulations that require extensive product testing, scheduling manufacturing operations is not a straightforward process. The most complicated process to schedule is the packaging of bulk product in smaller containers (tubes, bottles, jars, etc.). Each quarter, there are about 400 products that need to be scheduled on 7 packaging lines. The order in which products are scheduled is crucial as it determines whether the setup time of the next SKU is going to be 1 hour, or up to 7 hours. There are also a variety of other constraints, such as which products can be manufactured on which lines, what the maximum run size is, how many working shifts each line utilizes. There also exists a measure of uncertainty arising from rush orders and delayed shipments of raw materials. The current scheduling process uses an Excel spreadsheet with several pivot tables.

### **Project Objectives**

The goal of my thesis is to create a working scheduling tool that will automate the process of capacitating the quarterly work plan Taro's packaging operations, and to create a more optimal schedule in the process. As such, there are several objectives that are to be achieved:

1. Design a working model that uses methodologies and principles studied in Operations Research (OR) to assign the work to be done to a set of machines with the goal of minimizing set-up time.
2. Create a graphical user interface for the model that would accept user input and provide them with appropriate output. This tool should be useable by employees with little to no OR knowledge.
3. Meet the needs of the customer by providing a schedule that will result in time and labor savings.

## Steps to be Taken

To meet objective #1, several techniques used in OR need to be evaluated in terms of their feasibility and relevance to the task. So far, I have identified the following three approaches:

- Linear/Dynamic Optimization
- Simulation
- Tabu search

All of these techniques have the potential to give an answer to the problem in the shape of a schedule. However, I will need to spend time formulating the scheduling problem using each of them to see if it is feasible to utilize them within the set time frame.

To meet objectives #1 and #2, I will need to spend a sizeable amount of time learning/gaining more experience with particular software used for each technique. A linear optimization model of the size that I am looking at (with several hundred products to be assigned to six-seven machines in a particular order), a piece of software like *OPL CPLEX* is preferred. For simulation, a tool like *Simul8* would fit the task. For dynamic programming and Tabu search, and for interfacing with the Excel/Access input data, I would need to use either *Java* or *VB6/VB.net*. This is one area where I do not currently have sufficient experience, so I will need to take at least two to three weeks learning the required aspects of the programming language.

To meet objective #3, I will need to design a tool that schedules jobs with less setup time than the current process at Taro. I will need to benchmark my results against their quarterly plans to determine if it exceeds the current metrics.

## Work Schedule

The following table lists the different activities I plan to undertake in order to progress with the thesis project. Milestones are bolded and a due date is listed for each task. Also attached with this document is a Gantt chart showing my schedule in more detail.

Due Date	Activity/ <b>Milestone</b>
Oct 13, 2009	Teleconference held with Taro employees to discuss goals and objectives
Oct 23, 2009	<i>Discussion</i> session held with Taro employees
Oct 23, 2009	Relevant data gathered
Oct 25, 2009	Optimization objectives and constraints defined
Oct 21, 2009	Tabu search (and other heuristics) explored
<b>Oct 27, 2009</b>	<b>Project Presentation</b>
Nov 04, 2009	Linear Programming in OPL/Solver revisited
Nov 11, 2009	Simulation considered
<b>Nov 13, 2009</b>	<b>Decide on preferred technique to create scheduling tool</b>
<b>Nov 19, 2009</b>	<b>Progress Report</b>
Nov 30, 2009	Learn/revisit tool/programming language
Dec 07, 2009	Initial, simplified formulation prepared – do not use some of the more complex constraints
Dec 25, 2009	Complex constraints added to the formulation
Jan 10, 2010	Final formulation programmed, benchmarked against current process
Jan 16, 2010	Graphic User Interface designed
Jan 26, 2010	GUI coded and implemented
Jan 30, 2010	Usability testing performed
Feb 05, 2010	Discussion session held with Taro employees on results
Feb 14, 2010	Suggestions implemented in solution
Mar 03, 2010	Alternate solutions considered
Mar 22, 2010	Finalize thesis paper
<b>Mar 25, 2010</b>	<b>Thesis paper handed in</b>
<b>~Apr 01, 2010</b>	<b>Final Project Presentation</b>

# Thesis Project Gantt Chart

Task	Duration	End
● 1) <b>Data Gathering</b>	12.5d	25/10/09
● 1.1) Teleconference held with Taro Employees	0.5d	13/10/09
● 1.2) On-site visit to Taro Pharmaceuticals	1d	23/10/09
● 1.3) Relevant data gathered	1d	23/10/09
● 1.4) Optimization objectives and constraints defined	2d	25/10/09
◆ 2) <b>Project presentation</b>		27/10/09
● 3) <b>Research/Exploratio of Existing Techniques</b>	34d	13/11/09
● 3.1) Tabu search and other heuristic techniques explored	12d	21/10/09
● 3.2) Linear programming in OPL/ Solver revisited	13d	04/11/09
● 3.3) Simulation solutions considered	7d	11/11/09
◆ 3.4) Decide on preferred technique to create scheduling tool		13/11/09
◆ 4) <b>Progress Report</b>		19/11/09
● 5) <b>Model Creation</b>	55d	10/01/10
● 5.1) Learn/revisit tool/ programming language	14d	30/11/09
● 5.2) Initial, simplified formulation prepared – do not use complex constraints	7d	07/12/09
● 5.3) Complex constraints added to the formulation	< 7d	25/12/09
● 5.4) Final formulation programmed	16d	10/01/10
● 6) <b>Application design</b>	17d	30/01/10
● 6.1) Graphic User Interface designed	3d	16/01/10
● 6.2) GUI coded and implemented	10d	26/01/10
● 6.3) Application usability testing performed	4d	30/01/10
● 7) <b>Feedback</b>	< 11d	14/02/10
● 7.1) Discussion session held with Taro employees on project	1d	05/02/10
● 7.2) Suggestions implemented in solution	< 9d	14/02/10
● 8) Alternate solutions considered	17d	03/03/10
● 9) Finalize thesis paper	14d	22/03/10
◆ 10) <b>Thesis paper handed in</b>		25/03/10
◆ 11) <b>Final project presentation</b>		01/04/10

