

* Research

John Jackman

1



*First formal research experience - NSF summer program at RPI

* Studied the kinetics of a dye reaction related to solar energy

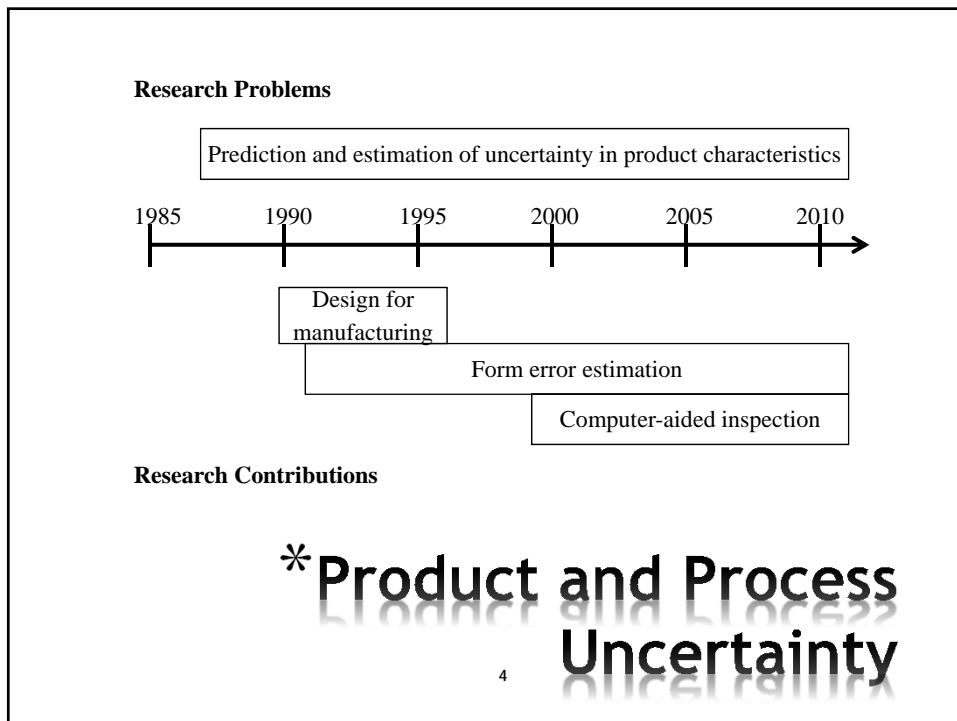
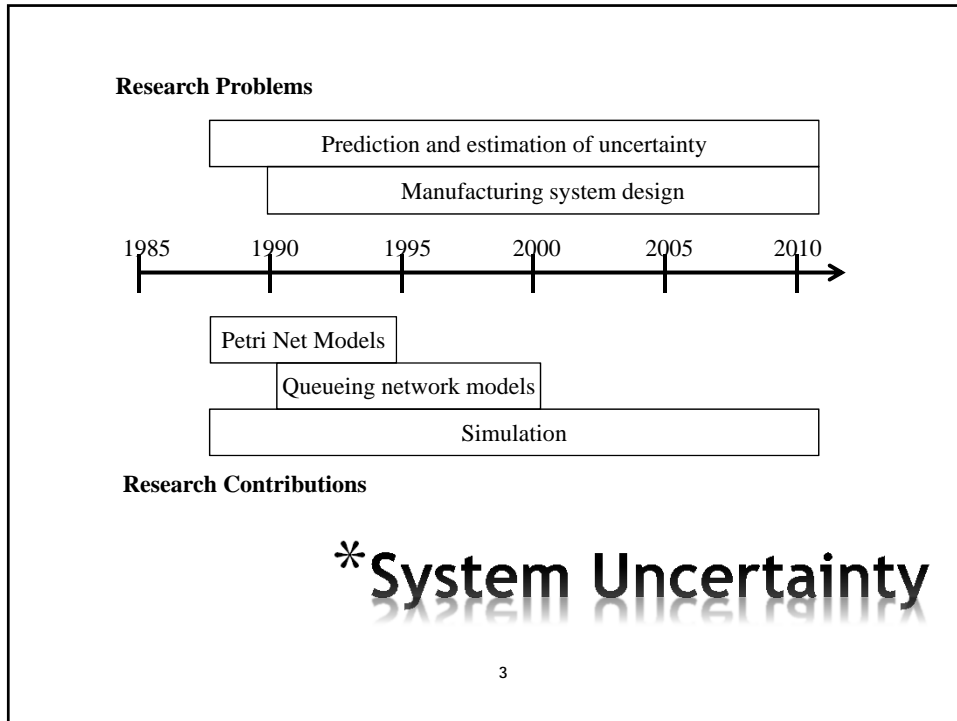
*Research in the pharmaceutical industry

* Researcher

* Research Supervisor

*Academic Research

* Context



- *Research is a skill that can be learned
- *Research should be fun
- *Research will be tedious at times
- *Research will be frustrating at times

*Research Premises

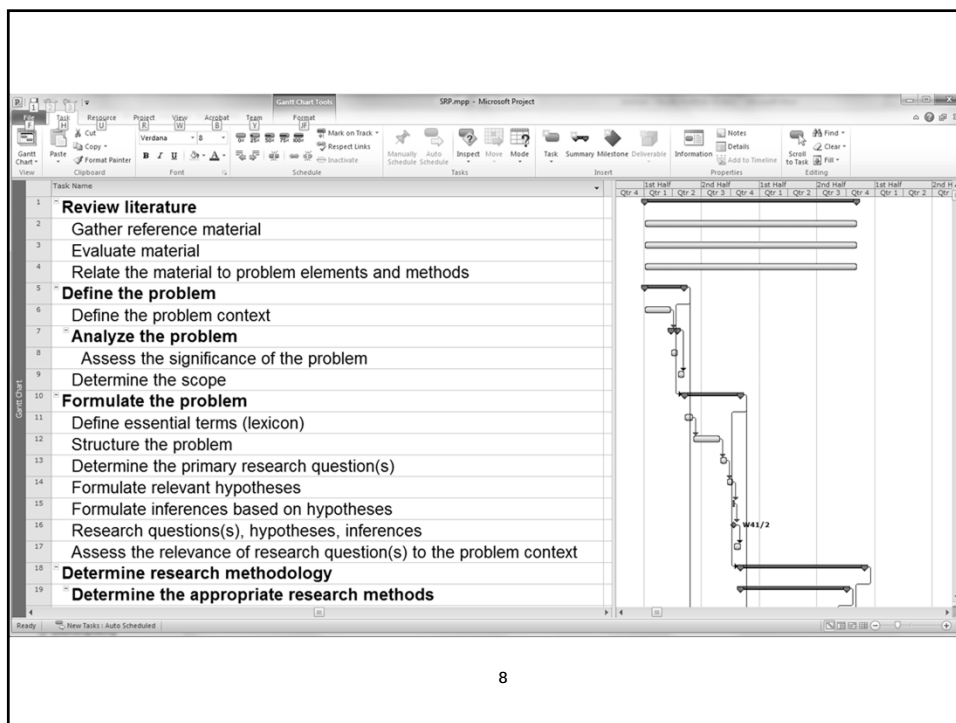
5

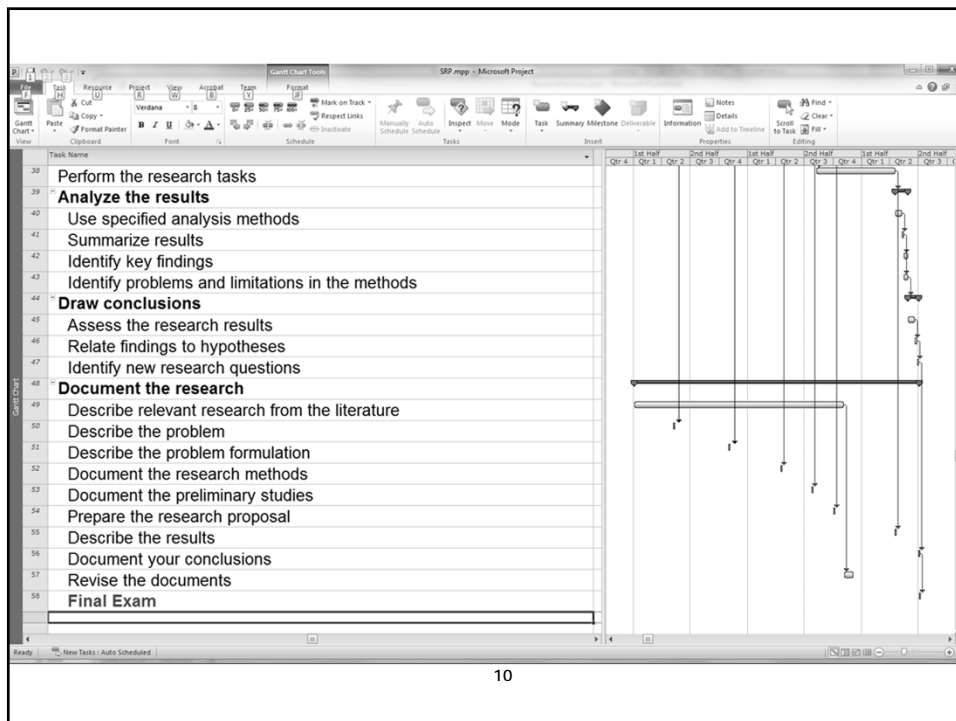
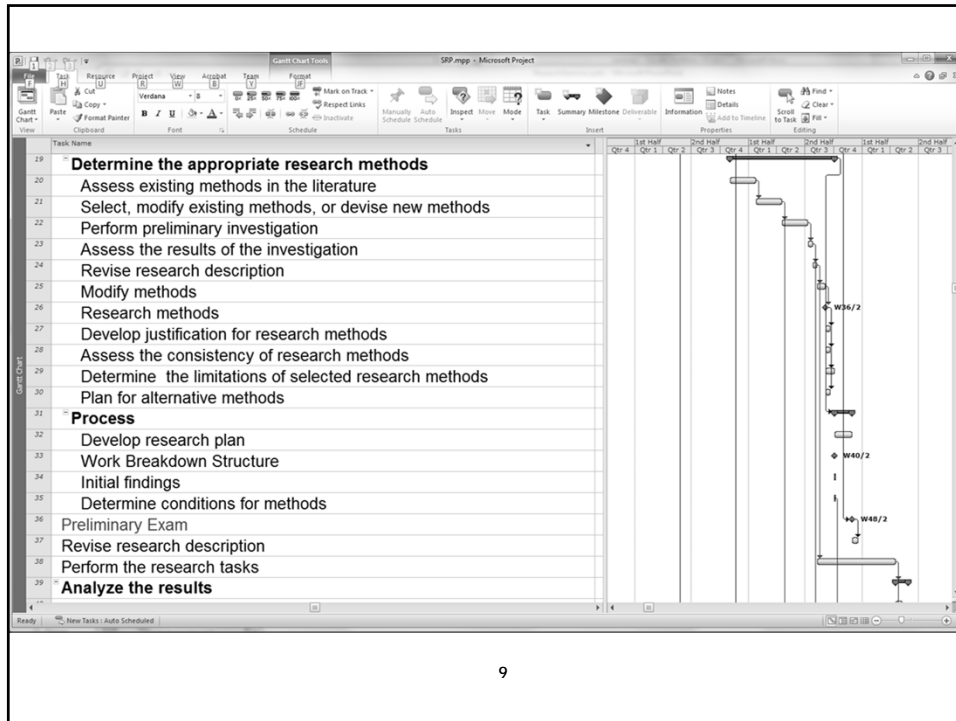
- *Focus, focus, focus!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
- *Get organized
- *Have a plan
- *Have an alternative plan
- *Stick to the plan!



*Fundamentals

6





- *Develop a good research question
- *Develop one or more threads
- *Stick to the thread(s)



*Where do I start?

11

- *The Uses of Argument, Stephen Toulmin, Cambridge University Press
- *The Craft of Research, 3rd edition, Wayne C. Booth , Gregory G. Colomb , Joseph M. Williams

*Some Recommended Reading

12

- *Well-defined research problem
- *Tendency to wander without convergence
 - *Everything flows from the problem definition
 - * Follow the thread!
- *Don't create a solution looking for a problem
 - * Tail wagging the dog

*Challenges

"A problem well stated is a problem half solved."
13 Charles F. Kettering

- *Condition (Scientific Merit)
 - * Knowledge gap - what don't we know?
- *Consequence (Broader Impacts)
 - * Impact of the knowledge gap (of greater significance than the knowledge gap)
 - * Benefit to society
 - * Benefit to the research community

Condition: We don't know why electric power generation is not keeping pace with usage.

Consequence: We will not be able to answer the question: How do we satisfy future power requirements?

*Research Problem

- * Newton's First Law of Motion -
 - * a body at rest will remain at rest unless an outside force acts on it
 - * Don't wait for the problem to come to you!
 - * Be Pro-active!
 - * Be informed
 - * Observe a real problems in a domain
 - * Talk to other researchers
- * Formulate a research question
- * Define a research problem

* Evolution of Research Problem

15

- * Domain
 - * You need to know something in a specific domain
 - * You need a context
- * Research Topic
 - * What will you study?
- * Research Question
 - * What are you trying to find?
- * Significance/Relevance
 - * Will anyone care about your work?

* Main Elements

16

- * Relevance
 - * "I am studying the position of a postage stamp on envelopes."
 - * Address a problem that you and others will find interesting!
 - * Others - your committee, related research community
- * Scope
 - * "I want to study the performance of a new forecasting method for each nation's economy."
 - * Focus!
- * Feasibility
 - * "I want to study anti-gravity devices."
 - * Know the limits!

* Fundamental Considerations

17

- * Make a list of phenomena that you are interested in studying
- * Don't know of any phenomena?
 - * Back up and select an area of interest
 - * Explore, read what is happening in this area
 - * Read the conclusions section of journal articles in the domain
- * Constrain the topic by adding qualifications (time, scope, ...)

* Some Simple Steps

18

- * How and why?
- * Start writing down questions
 - * How does X affect Y?
 - * How do the key parameters affect the performance of X?
 - * Why does X occur when Y and Z are present?
 - * Why does X have this type of behavior?
 - * How can we achieve better performance than X?
- * What is the significance of knowing the answer to your questions?

* Research questions

19

- * Topic
 - * I am studying _____
- * Add a question
 - * I am studying _____ because I want to determine/find out how/why _____
- * Add relevance/significance/motivation
 - I am studying _____ because I want to determine/find out how/why _____ so that/in order to _____.

* Laying the foundation

20

*A hot plate is placed underneath a laser beam. When the hot plate is on, the beam appears to move randomly.



- I am studying temperature effects on laser light because I want to know why there are fluctuations in the beam in order to control the disruption of a laser beam that is targeting an object.

*Research Description

The Energy Challenge
Wind Energy Bumps Into Power Grid's Limits
 By Matthew L. Wald
 Published: August 26, 2008
 New York Times

When the builders of the Maple Ridge Wind farm spent \$320 million to put nearly 200 wind turbines in upstate New York, the idea was to get paid for producing electricity. But at times, regional electric lines have been so congested that Maple Ridge has been forced to shut down even with a brisk wind blowing.

That is a symptom of a broad national problem. Expansive dreams about renewable energy, like Al Gore's hope of replacing all fossil fuels in a decade, are bumping up against the reality of a power grid that cannot handle the new demands.

The dirty secret of clean energy is that while generating it is getting easier, moving it to market is not.

23

***Exercise 1**

The Royal Society for the Protection of Birds
<http://www.rspb.org.uk/ourwork/policy/windfarms/index.aspx>

The available evidence suggests that wind farms can harm birds in three possible ways - disturbance, habitat loss (both direct and/or indirect) and collision.

Some poorly sited wind farms have caused major bird casualties, particularly at Tarifa and Navarra in Spain, and the Altamont Pass in California. At these sites, planners failed to consider adequately the likely impact of putting hundreds, or even thousands, of turbines in areas that are important for birds of prey.



24

***Exercise 2**

HONOLULU (AP) — The wind farm on Oahu's North Shore that suffered a fire this week is an industry pioneer that uses storage batteries to even out the electricity it supplies.

Energy Secretary Steven Chu two years ago hailed the project as having the potential to set an example for other wind developers around the nation. The department guaranteed a \$117 million loan to Kahuku Wind Power for facility's construction.

On Wednesday, flames destroyed the building housing the farm's batteries. The structure was still emitting heat and smoke the next day.



Hawaii's Kahuku Wind Farm Is An Industry Pioneer, Despite Fire Setback

AP | By Audrey McAvoy Posted: 08/02/2012 11:29 pm

*Exercise 3

Ill wind: Farmers find problems with wind power generators

February 19, 2012 10:15 pm By Matthew Wilde
Cedar Valley Business Monthly Online

READLYN, Iowa --- Green energy has some Northeast Iowa farmers seeing red. Not with the concept, but with a wind energy company.

More than a dozen grain and livestock producers who purchased wind turbines to cut energy costs and help the environment have had nothing but problems. The company that sold the turbines --- Earth Linked Energy Solutions of Story City --- is teetering on the brink of bankruptcy. Customers say the turbines cost far more than they've saved.



*Exercise 4

- *Explore!
- *Take risks!
- *Get organized
- *Start reading
- *Write down questions
- *Formulate multiple problem descriptions



***Summary**