15.575: The Managerial View of the Firm and Knowledge Work

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Agenda

1. Framing this week’s reading
2. Change: The Importance of Complementarities
3. Information Processing Exercise
4. Limitations: The role of Bounded Rationality
5. Break
6. Organizational Structure
7. Discussion of assignments
8. Conclusions
Framing this week's discussion

- Different ways to model firm (Milgrom & Roberts, Drucker, Gailbraith)
- What firm's must consider when changing strategies (Milgrom & Roberts, Ichniowski et al. Brynjolfson et al., Drucker)
- Limitations in our decision capabilities (Radner)

Role of Information technology in organizational structure and decision making
Making change: The Importance of Complementarities

What are they (Milgrom and Roberts)?

- Definition:
  - if the levels of any subset of the activities are increased, then the marginal return increases in any or all of the remaining activities.
  - It follows that if the marginal costs associated with some of the activities fall, it will be optimal to increase the level of all the activities in the grouping. (p.514)

- Mathematically:
  Let $X = (X_1, \ldots, X_n)$ be level at which activities acted
  Let $\Pi(X)$ be resulting profit function (assumed smooth)
  Activities are mutually complementary if
  for all $i, j$, $\frac{d^2\Pi}{dX_i dX_j} \geq 0$
Making change: The Importance of Complementarities

Examples:

Milgrom & Roberts:

- Mfg Eqp
- Product Line
- Marketing
- Engineering
- Organization

ICH

Problem solving teams $\rightarrow$ Worker productivity

Worker productivity

PS FA PS IP PS ES
Making change: The Importance of Complementarities

What are consequences of this view?

- When making change decision it is important to analyze activities not in isolation, but as part of a coherent system
  - Ichniowski – does his study confirm this result?
  - Any real-life examples?
- Adoption of clusters of activities is not coincidental
- The adoption process may be erratic
  - Why?
  - But, should not see extended periods of time in which one activity is in place and its complement is not
- We must identify which activities are complements
  - Identification - Not just technology variables, also include organizational (Brynjolffson, Hitt)
    - Brynjolffson et al’s matrix of change
    - Has Ichniowski left out any variables?
  - Operationalize – determine interaction effects
What are consequences of this view?

- Operationalizing Milgrom and Robert's model – Issues with complement activities in empirical analysis (Ichniowski)
  - Omitted variable bias, multi-collinearity, degrees of freedom (p.296-98)

Variation in worker Productivity

$X_1$ $X_2$ $X_3$

If omit, leads to bias estimates
Leads to inefficient estimates
Must be Creative

$X_1 \times X_2$
Run out of DF

How does Ichniowski solve this problem?
Making change: The Importance of Complementarities

What are limitations of this view?

- Discussion of complementarities is very internally focused. How has the Internet changed which activities we include in our analysis?
  - Change from “design for manufacturability” to customer-driven enterprise.
  - How is customer captured in his model? Is there a better way?

- What are the constraints on the model?
  - Non-convexities
  - Capital/budgeting constraints
  - Any information-based constraints not considered?
Limitations – The Role of Bounded Rationality

What is bounded rationality?

- Definition: Expectations placed upon decision maker exceeds capacity of present day humans and computers. We are uncertain about the logical implications of what we know (Radnor)
- If we are bounded rational, what do we recognize about our situation?
  - Communication is costly
  - Understanding is flawed
  - Realize that not likely to find mathematically best solution – indeterminancy
- What are the resource requirements for decision making?
- If we decentralize decision making what are the additional considerations?
  - Creates cost of delay: computational delay must increase unboundedly with size of the problem
  - Memory and communication costs
  - Is it efficient to use every piece of information available?

Is bounded rationality a cost issue or something more serious?

-Gordon – short presentation and discussion of the paper. How much discussion do we want here as opposed to later?

-Aggregate numbers are impressive but the revival seems to have taken place within the 12 % whereas in the 88 % capital deepening has been unproductive.
Limitations – The Role of Bounded Rationality

What is Indeterminancy?

- Decentralized form and bounded rationality also impact whether an optimal decision is made and power relationships between groups
- How does game theory help illustrate indeterminancy?
  - Could be infinite number of Nash profiles, ranging from infinite to worthless. How does this result come about?

This argument yields a difficult challenge: We are uncertain about the implications of what we know and our models do not yield sharp predictions

-Gordon – short presentation and discussion of the paper. How much discussion do we want here as opposed to later?

-Aggregate numbers are impressive but the revival seems to have taken place within the 12% whereas in the 88% capital deepening has been unproductive.
More bounded

Less bounded

From these observations, what can we conclude about how firms should use technology....
What are the implications of bounded rationality on firm structure?

- Firms may organize in certain ways to contain issues associated with bounded rationality
- Key issue is uncertainty (Galbraith)

Galbraith’s Argument:

- Greater the uncertainty of the task, the greater the amount of information that has to be processed
- 3 different strategies to deal with uncertainty problem: increase planning, increase flexibility, lower performance
- Costs dictate with strategy choose

Firms will act in one of 4 ways
## Organizational Structures

Galbraith’s 4 strategies:

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<thead>
<tr>
<th>Perspective</th>
<th>Effect</th>
<th>Cost</th>
<th>Example</th>
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<tr>
<td>Create Slack Resources</td>
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<td>Self-Contained Tasks</td>
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<td>Lateral Relationships</td>
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Organizational Structures

Are these 4 strategies exhaustive?

Can technology impact the environment in order to reduce uncertainty?

An Example: How technology can dampen the bullwhip effect

Variability creates uncertainty

Demand Variability

Position in supply chain