



Technology Shocks and Problem-Solving Capacity

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Introduction

- **Thus far, we have heard that:**
 - IT has played a big role in the new economy and will in the future
 - Wages are higher in technology intensive jobs
 - Labor demand has changed
 - Today's jobs increasingly require non-routine cognitive skills



Introduction

- **What is the link between IT and higher skill demand and wages?**
 - Today's firms are investing in the problem-solving capacity of its workers
 - Problem-solving capacity is an important input in the production function
 - Two “technology shocks”- innovations in IT and in human resource management practices – facilitated the shift to problem-solving



Outline of Presentation

- **The magnitudes of the IT and HR technology shocks**
- **Performance outcomes**
- **Problem-solving capacity**
- **Changes in decision rights**
- **Who invests in problem-solving capacity?**
- **Conclusion**



The Information Technology Shock

- **From 1980 to 1999**
 - The speed of microprocessors increased 100 times
 - The cost of performing 1 million instructions per second has fallen from \$100 to 20 cents
 - The cost of sending 1 trillion bits of information fell from \$120,000 to 12 cents



The Information Technology Shock

- **Gains accelerated over time:**
 - Moore's Law: the density of transistors doubled every 18 months
 - Personal computers were widely adopted in 1990s
 - Intranets and Internet development in late 1990s



The Information Technology Shock

- **Investments in computers and software**
 - Grew 19% from 1990-2000
 - Grew 28% from 1995-2000
- **Investment in software rose:**
 - 1980 \$10 B
 - 1990 \$50 B
 - 1999 \$225 B



The Human Resource Management Technology Shock

- **Japanese successfully introduced system of innovative HRM practices to raise product quality and performance**
- **U.S. managers were faced with the decision as to whether to adopt this new managerial technology or not**



The Human Resource Management Technology Shock

- **These innovative practices included:**
 - Problem-solving teams
 - Rotation across jobs
 - Information sharing
 - Training
 - Incentive pay
 - Job security
 - Careful hiring

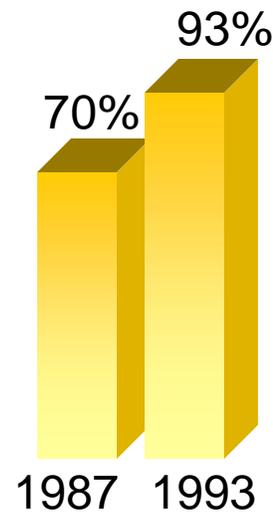


Innovative HRM Practices Adopted Through 1980-1990s

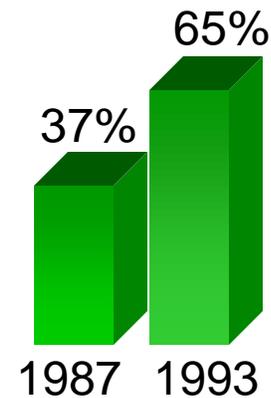
- **TQM practices were adopted progressively from the early 1980s to early 1990s by 76% of large firms**
- **Year introduced:**
 - Prior to 1986: 19%
 - 1986 – 1988: 25%
 - 1989 – 1990: 32%
 - 1991 – 1993: 24%

Innovative HRM Practices Adopted Through 1980-1990s

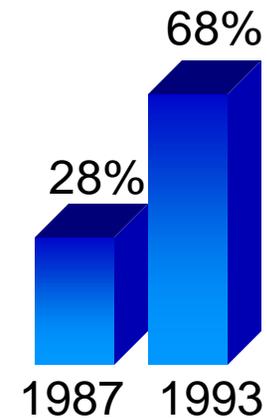
- **From 1987 to 1993:**
 - Percent of large firms with:



Teams



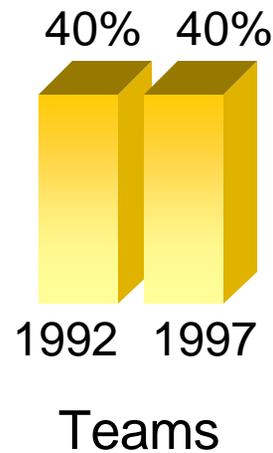
Extensive
Teams



Self-managed
Teams

Innovative HRM Practices Adopted Through 1980-1990s

- **From 1992 to 1997:**
 - Percent of all establishments





Innovative HRM Practices Adopted Through 1980-1990s

- **Adjustment to the HRM shock occurred in the 1980s and 1990s, but may have lessened over time**



Effects of IT and HRM Technology Shocks

- **Changes in performance**
 - Most empirical work suggests that innovative HRM practices raise performance when multiple practices are adopted (Ichnowski, et.al.)



Effects of IT and HRM Technology Shocks

- **Changes in performance**
 - Recent empirical work suggests that IT investment has become performance enhancing (Barua and Mukhopadhyay, et.al.)
 - Small set of researchers have combined IT and HRM (organizational change) to emphasize the joint gains (Breshnahan, Brynjolfsson, and Hitt)



How Do Innovative HRM and IT Raise Performance?

- **The Role of Problem-Solving Capacity**
- **Define “problem-solving” capacity:**
 - Problem-solving aptitude, K_i , arises from education, training, experience, and talent

The Role of Problem-Solving Capacity

- Define “problem-solving” capacity:

- Connective capital is the worker’s access to the problem-solving talents of his co-workers:

$$CC_i = \sum d_{ij} K_j, \quad j = 1, \dots, N_i, \quad j \neq i$$

When d_{ij} is the problem-solving network of contacts



The Role of Problem-Solving Capacity

- “Problem-solving” capacity is

$$Q_i = K_i + CC_i$$



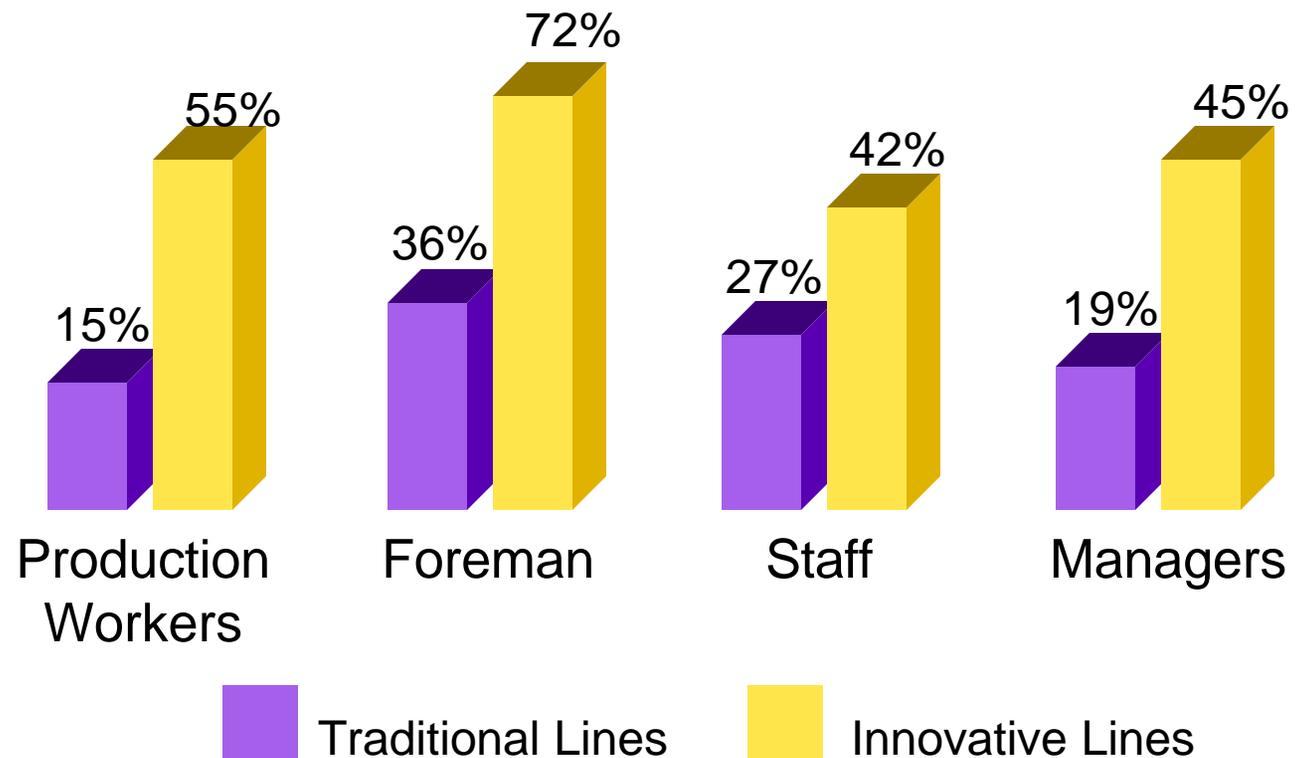


Investments in Problem-Solving Capacity

- **Comparing across steel mills, data is gathered on each worker's education and communications network**
- **In more innovative HRM environments:**
 - Workers have more problem-solving aptitude
 - Workers have more connective capital

Direct Communication Ties

- Each worker talks to what percent of co-workers?



Investments in Problem-Solving Capacity

- **Problem-solving output**

$$q_i = BX_i^f Q_i^\partial$$

is raised by innovative HRM and IT use





Changes in Decision Rights

Produced by Innovative HRM and IT

- **Firms should co-locate the decision-making authority with employees who have the most relevant information (Jensen and Mechling, 1992; Baker, 1992)**



Changes in Decision Rights

- **HR Innovations are adopted because:**
 - Production workers process valuable information
 - The U.S. comparative advantage lies in information-intensive production



Changes in Decision Rights

- **IT investments enhance these effects by:**
 - Giving all individuals more information
 - Facilitating communications
- **Decision-making authority is more decentralized and thus firms require greater investments in problem-solving capacity**



Building Problem-Solving Capacity

- **Requires complementary investments in HRM practices and IT**
- **Changes labor demand to place much greater value on non-routine cognitive skills**



Investing in Problem-Solving Capacity – Is it for Everyone?

- **Clearly different firms have different rates of return to these investments**
- **In our study of steel minimills, plants producing more complex products gain the most from innovative HRM**



Conclusion

- **Firms today are likely to invest heavily in the problem-solving capacity of their workforce**
- **Problem-solving capacity is a function of the aptitudes of each worker, but also grows with his connective capital – his access to the problem-solving talents of his co-workers**



Conclusion

- **The IT and HRM technology shocks largely coincided in the 1980s and 1990s**
- **Investments in HRM innovations and IT are investments in building problem-solving capacity**