An Emerging Issue: Knowledge Worker Productivity and Information Technology

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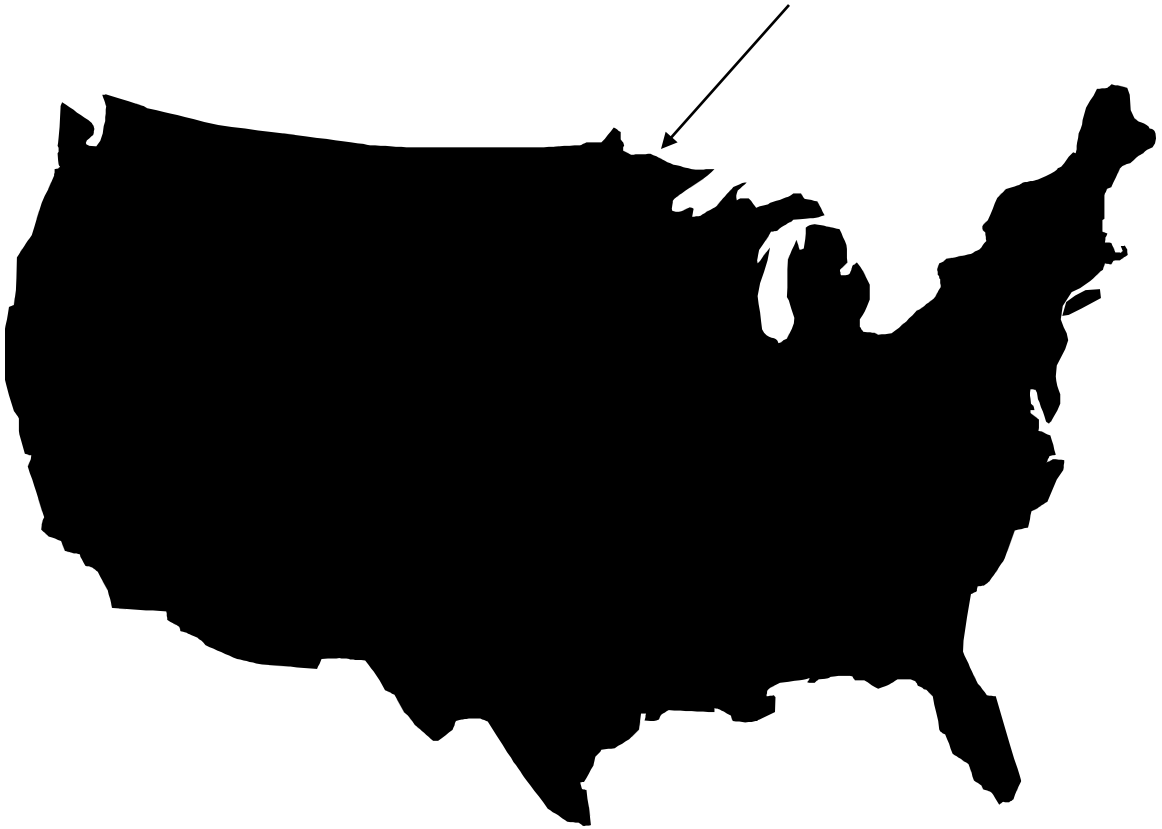
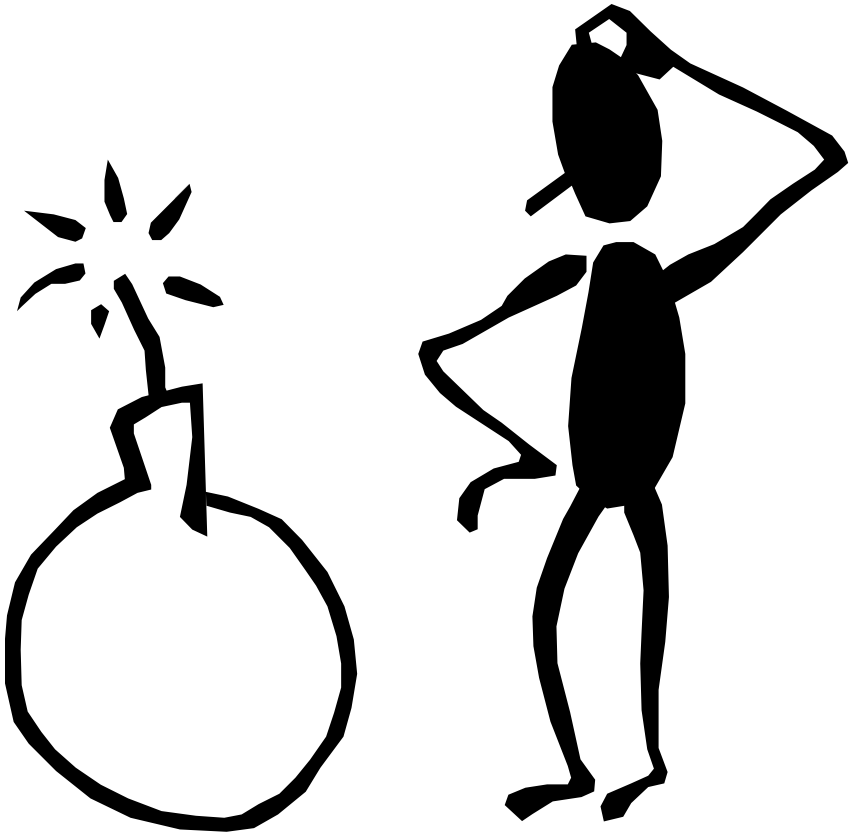
Where is Minnesota?



Knowledge work productivity with information technology -- a problem that needs research by Informing Science



Productivity Effects of Information Technology

- Clear productivity effects
  - Clerical work
    - Same task then reduce need for clerical work
    - Enhanced task or enriched with information
  - Logistics work (schedule and move products, workers, and production)
  - Coordination and communications
  - Customer-Vendor-Manufacturer-Supplier chain of activities. Mass customization.

Productivity Effects continued

- Productivity effects limited or uncertain
  - Information search
  - Analysis
  - Decision making
  - Planning
- **THE UNCERTAIN PRODUCTIVITY COMES FROM THE INTERACTION OF CHARACTERISTICS OF KNOWLEDGE WORK AND INFORMATION TECHNOLOGY**

Very Large Productivity Differences in Knowledge Work

- Among knowledge workers doing same or similar tasks
- Within individuals and groups for different time periods and tasks
- Knowledge work is to a large extent self managed relative to productivity
- Information technology may not result in productivity gains

Three Theories or Premises

- Humans as information processors and decision makers
  - Human attention is the limiting factor
  - Simon made attention a key for satisficing as normal approach to decision making
- Parkinson's first law: (knowledge)work expands to fill the time available for it.
- Drucker's premise

Drucker's Premises

- **To make knowledge work more productive will be the great management task of this century**, just as to make manual work productive was the great management task of the last century. *Age of Discontinuity*, 1978
- The primary resource in post-capitalist society will be knowledge, and the leading special groups will be "knowledge workers." *Post Capitalist Society*, 1993

Knowledge Work

- **Is human mental work performed to generate useful information and knowledge**
- **In doing it, knowledge workers**
  - **Access and use data (observation or in repositories)**
  - **Access and use personal knowledge, organizational knowledge, and external knowledge**
  - **Employ mental models**
  - **Apply significant concentration and attention**

Examples of Knowledge Workers

- **Managers**
- **Professors**
- **Financial analysts**
- **Systems analysts**
- **Accountants**
- **Lawyers**

- ***Characterized by:***
- ***Knowledge and expertise***
- ***Education plus ability to be creative, innovative, solve problems, and create systems***

Types of Knowledge Work Tasks

- Job specific tasks (that may involve knowledge access)
- Knowledge building and maintenance tasks--individual and group
- Work management tasks

Knowledge Building and Maintenance

- **Job specific and general knowledge**
- **Increase knowledge base and network**
- **Maintain individual expertise**
- **Examples:**
  - **Scanning professional literature**
  - **Attending professional meetings**
  - **Learning about new technology**
  - **Learning features of new software**
  - **Building and maintaining a network of contacts**

Work Management Tasks

- ***Manage knowledge work to achieve effective result using time and mental resources efficiently***
- **Maintain work motivation**
- **Maintain readiness to work**
- **Plan, sequence, and schedule activities**
- **Allocate effort and control switching among tasks**
- **Manage collaboration**

Knowledge Work Activities

- **Acquiring knowledge (scan, monitor, and search)**
- **Designing (model, plan, organize, schedule, and author)**
- **Making decisions (formulate, analyze, and choose)**
- **Communication (present, persuade, and motivate)**

Additional Activities With Collaborative Knowledge Work

- **Coordinate and schedule the work of the group**
- **Share information among group members**
- **Manage concurrent activities of group members**
- **Integrate work**

Supplementary Activities for Knowledge Work

- ***Supplemental clerical activities often performed by knowledge workers***
- **Creating input data**
- **Formatting documents and output data**
- **Filing and retrieving documents and data**
- **Receiving and distributing information**

The Measurement of Productivity

- **Measurement of productivity at level of organization is inputs to produce outputs**
- **Clerical productivity can often be measured**
- **Knowledge work productivity is indirect and not measurable in short run.**
  Traditional productivity measures are inadequate. Are two analyses worth twice as much as one?

Three General Ways to Productivity Improvement in Knowledge Work

- **Expansion and/or conservation** of individual and group knowledge work resources
- **Work effectiveness** to increase value in meeting needs of organization (relevant data and effective use of knowledge, expertise, and creativity)
- **Work efficiency** (reduce cost in terms of time and energy

Factors Limiting Knowledge Work Productivity

- Time available
- Human motivation
- Limits to human attention and concentration
- Planning and scheduling of work
- Human cognitive limits
- Dual processing losses
- Task design
- Reuse of processes and structures

Problems With KW Productivity

- **Infinite ability to expand work**
- **Infinite ability to increase quality and extensiveness of work**
- **Ability to work hard and accomplish little or nothing**
- **Knowledge work productivity “used up” in:**
  - **Customization**
  - **Quality**
  - **Expansion of scope/extent**

Motivation Against Improved Knowledge Work Productivity

- **Avoidance of cognitive work**
- **Avoidance of uncertainty and complexity**
- **Urgency drives out importance**
- **Need for completion motivation**
- **Short job scheduling; avoidance of long jobs**
- **Use of pseudo structure to avoid developing new structures**
- **Goal displacement**

Three Ideas Guiding KW Research

- **There are significant differences among individuals and among groups in knowledge work productivity**
- **The approaches employed by the most productive individuals and groups can be analyzed and taught to those who are less successful in managing their work**
- **There are KW principles that can be applied to achieve improved performance**

Objective: Expand KW resources for individuals/groups

- **Proposition: Work hours may be fixed but amount of work resources (effort, concentration, attention, creativity, and ability to effect closure/completion) can be expanded (or conserved from waste)**
- **How accomplished: Motivation, planning, task characteristics, and task management**

Objective: Reduce Effects of Limits on Concentration and Attention

- ***Humans can concentrate on and attend to only a limited number of activities***
- **Reduce effects of limits by making some activities automatic through task design and management**
  - **standard procedures**
  - **reuse (software reuse)**
  - **technology standards**
  - **reduce change to avoid dual processing losses**

Objective: KW Productivity from Planning and Scheduling of Work

- **Motivation and increased energy from:**
  - **Completions (deliverables, check points, etc.)**
  - **Scheduling that matches daily and weekly cycle of energy and motivation**
  - **Completion by a burst of activity when completion is feasible with a sustainable burst.**
- **Improved use of time by performing “rest work” at times when rest is indicated**

Productivity from Planning and Scheduling of Work continued

- **Planning is a cognitive bargain. Up front investment in planning pays off**
- **Reduced coordination costs through task design, group assignment definitions, and scheduling suitable levels of coordination**
- **Use of information technology in planning, scheduling, and coordination**

Objective: Work Efficiency and Effectiveness from Information Technology

- Improved methods and scope for knowledge work with information technology
- Improved data search and analysis
- Improved communications/coordination at less cost
- Efficiency (less time and effort to do given operations)

Knowledge work productivity from Information Technology may be “used up”

- **Unnecessary customization**
- **Unnecessary quality**
- **Unnecessary expansion of scope/extent**
- **Lack of appropriate “stopping rules”**
- **Unproductive search for more data and more analysis**
- **Unproductive use of formatting**
- **Lack of reuse (always a new format/procedure)**

Summary

- **To make knowledge work productive is a challenge to each individual and organization**
- **KW productivity may be improved by expanding or conserving KW resources, increasing effectiveness of outputs, and improving work efficiency**
- **Information technology can aid KW productivity but productivity gains may be lost**
- **Research needed to assist in self management of KW and productive use of technology**

Appendix A: Definitions of Data, Information and Knowledge

Definition of Data and Information

- **Data items are representations of events, people, resources, or conditions. They are the raw material for information.**
- **Information adds value to data by providing recipients with understanding, insights, conclusions, decisions, confirmations, or recommendations.**

Definition of Knowledge

- **Knowledge is information organized and processed to convey understanding, experience, accumulated learning, and expertise as they apply to a problem or activity.**
- **Knowledge is "information in context."**
- **Knowledge reflects associations and guides or rules for behavior.**

Appendix B: Research Approaches and Methods for KW Productivity and Use of Information Technology

Some Knowledge Work Research Propositions

- **Knowledge significantly reduces the "time to automatic action" and conserves scarce knowledge work attention.**
- **Knowledge is more valuable as input in knowledge work than information or data.**
- **Obtaining knowledge as mental models is more valuable for decisions than the data or information used to build mental models.**

Knowledge Work research propositions continued

- **Knowledge management solutions differ in scalability--on what basis?**
- **A network of personal contacts significantly increases one's knowledge potential**
- **Knowledge is highly correlated with variety of work experiences.**

Cost/Benefit Issues for Knowledge Management

- **Cost/benefit in finding relevant knowledge, defining search space, and search stopping rules**
- **Cost/benefit in vetting knowledge sources**
- **Cost/benefit of developing personal expertise versus getting the answer from others**
- **Cost/benefit from knowledge in context**

Theory for Research

- **Human cognition. The way humans process information, use mental models, deal with information overload, dual processes, etc.**
- **Human cognition and task management. How humans manage complex tasks**
- **Human motivation. Effect of systems and system behavior on motivation**

Theory for Research continued

- **Human-computer interaction. Fit between systems and human capabilities**
- **Organization behavior. Effect of communication systems, task changes, availability of information, quality expectations, systems for error control, etc.**
- **Industrial engineering. Organization of work and productivity**

Research Approach 1

- **Collect and analyze data on:**
  - **productivity practices of individuals and groups**
  - **the effects of different work methods**
  - **uses of information technology.**
- **Observation of knowledge workers or through experiments that focus on specific issues.**

Research Approach 2

- **Observation or experiments on the effect of information technology.**
- **Cost of learning time for a new function or feature plus productivity loss during the first few uses**
- **Payback in subsequent use, both in reduced time and energy to perform a function and in increased functionality and/or reduced errors..**

Some Things to Observe

- **Reuse of structures and procedures**
- **Reuse of data**
- **Efficiency in process activities**
- **Efficiency in data access**
- **Efficiency and effectiveness in communication and collaboration**
- **Minimizing of errors and rework**
- **Minimizing of learning costs**

Appendix C: Examples of Technology Functions and Features to Improve KW Productivity

Information Technology to Improve Knowledge Work Productivity

- **Reuse of structures, processes, and procedures**
- **Reuse of data**
- **Effective and efficient data access**
- **Matching of functions and features to task activities**

Information Technology to Improve Knowledge Work Productivity--continued

- **Functions and features that improve efficiency in activities**
- **E-mail productivity features**
- **Software for coordination and collaborative work**
- **Structure, procedures, functions, and features for minimizing errors**

Examples of Reuse of Structures, Processes, and Procedures

- **Templates**
- **Style sheets and report functions**
- **Recorded macros (no logic)**
- **Macros (logic)**
- **Stored queries and stored reports**
- **Custom lists (spreadsheets)**
- **Autocorrect (word processor and spreadsheet) and autotext**