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