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Americas Conference on Information Systems (AMCIS)

8-15-1997

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1. Introduction

In a previous paper (Seni and Hodges 1996) we proposed that every technological theory, including those in IT, knowingly or not, rests on a foundation of philosophical assumptions. In most cases these foundations remain implicit, unexamined, and largely unevaluated. As these theories are established, become accepted, and grow, they carry with them and spread their implicit philosophical frameworks. Those that are particularly successful then form a mutually reinforcing system composed of a technological theory and its implicit *spontaneous philosophy* of technology. One of the tasks of the philosophical investigation of a technology is to unearth and try to reconstruct some of these foundations so as to make them available to examination, criticism and improvement.

In this paper we argue that *Scientific Management* and *Process Engineering* share, at least in part, some of the same foundations. In fact, we argue that the former is the philosophical progenitor of the latter. Consequently, both have a common, implicit, spontaneous philosophy of technology. The core of this common perspective involves the nature of technological value and the method of its creation.

2. Approach

One of the ìphilosophicallyî interesting by-products of the evolution and ramifications of MIS is the emergence of an implicit technological theory of the firm. It focuses on work processes and the way work is organized in creating value. The method of improvement of work processes according to this theory is called *Process Engineering* (PE) (Harrington 1991).

A parallel situation antedated the development of PE at the turn of the century when new manufacturing technologies in the factory created the need for an explicit theory of productive processes. The technological theory of productive industrial work proposed at the time was *Scientific Management*. (SM.). Its elements were first summarized by F. Taylor in 1911 (Taylor 1967). It eventually gave rise to the field of industrial engineering.

Lack of space precludes an analysis of the intellectual history of these theories. We shall therefore assume the reader to be familiar with them and simply state the results of our ìreconstructionî as a number of conclusions organized according to the framework outlined in Seni and Hodges (*idem*) (based on the philosophical system proposed in Bunge (1967)). In this framework, every consistent philosophy is made up of a system of ideas covering the following; (a) an ethics or theory of specific value problems (*axiology*) which the field addresses, (b) an *ontology* or theory of its object, (c) an *epistemology* or theory of what constitutes appropriate knowledge in the field, (d) a *methodology* specifying appropriate rules of inquiry.

3. Axiology: On the Concept of Technological Value

1. Both SM and PE address the problem of designing artifacts for improving *technical value*. In the case of SM the artifact in question is a *productive task* or a production process. In the case of PE it is a *business process* which is ancillary to production.
2. Both SM and PE rely on the fundamental idea that the technical value of an artifact can be improved by improving the method of performing the work or the process of its production.
3. Thus both SM and PE rely on the idea that the technical value of a material product resides in the productive work which it embodies. This idea implies that the technical value of a product resides

in the *amount of technological knowledge* which goes into it, so to speak. The more objective, the truer and the deeper this knowledge, the greater the technical value of the object.

4. SM defines the invention of value in terms of designing work routines which secure and improve both the *prosperity* of owners and the *prosperity* of workers. The welfare or value to users or to society as a whole are by-products. PE approaches technical value as a matter of responding first to the *needs and wants* of users which in turn provide value to the firm and to the worker as second order results through market transactions.
5. For Taylor, the ultimate technical value is *progress*. It resides in the increased prosperity of workers and employers. *Productivity* (that is, *efficiency*) is the means. And *learning* and *training* in eliminating unproductive work is the means to productivity. For Harrington, *progress* is continuous improvement in the value of the firm. This depends on the value added by its production and its business processes. In turn this is the result of value produced for the customer. Maximum value to the customer at the lowest cost possible (that is, *quality*) is the means of continuous improvement. And the analysis and improvement of productive processes involves knowledge growth as well; identifying and learning to overcome sources of disvalue. Thus for both SM and PE, material progress is preceded by cognitive progress in the firmís technologies.
6. Technical value applies to the actions of goal-directed systems of two kinds; either (a) a producer-product system (e.g. a firm) designing an artifact to perform certain functions for a potential buyer, or (b) a user (e.g. a customer) of the artifact intending to perform certain functions to meet expected needs and wants. In both cases producing or using actions are constrained by the agentís resource endowment expressed in terms of *costs and price*. The levels of goal-attainment express the *effectiveness* of performance. Thus, technical value and quality are measures of the effectiveness of a system in performing certain functions. And an indicator of relative value to cost is a measure of the *efficiency* of the artifact produced, either in terms of production costs or in terms of the costs of acquisition and use. Thus, the most general indicators of the technical value of an artifact or man-made system are its *effectiveness* and its *efficiency*. These two concepts are the theoretical core of the ideas in SM and PE.
7. Both SM and PE define *progress* as improvement in technical value and both propose that this can be attained by embodying technological knowledge in the production process (the ìscientific theoryî of the task or the ìanalysisî of business process analysis). Whereas SM stresses efficiency in production and argues for effectiveness as a consequence (i.e. value to the buyer), PE stresses the precedence of effectiveness (to both external and internal customers) and efficiency as an economic and competitive necessity.

4. Ontology: On the Nature of Work in the Organization

1. Both SM and PE are based on the idea that the firm is both a social system and a man-machine system. Both also implicitly assume that it is a knowledge system as well. Both SM and PE are based on the idea that performance is improved as shared knowledge (in the form of a technological system) grows in scope and becomes increasingly systemic. Thus both SM and PE conceive the firm as a *learning organization* (Senge 1990).
2. Both SM and PE share a systemic ìtransversalî value-chain view of the firm as a sequence of activities transforming input into valued output (Seni 1991). This is in opposition to the classical sociological and vertical view of the firm as a hierarchy of roles, functions, powers and responsibilities.
3. Both SM and PE call for a shift in the conventional management perspectives of their times. This involves a move away from a classical control model of management geared to maintaining a stable state (Schon 1971) towards a dynamical model of continuous progress.

5. Epistemology: On the Function of Objective Knowledge in the Improvement of Value

1. Both SM and PE are based on a criticism of arcane primitive work or craft production as distinct from technological production.
2. In both SM and PE the main source of disvalue in the firm and in its products stems from the application of personal, tacit, and idiosyncratic theories of work maintained in the organization as part of firmís craft ìknowledge systemî.
3. Both SM and PE rely on the principle that value can be improved by rational redesign of value-producing tasks and work processes. This redesign involves the invention of a rule-system derived from an objective theory of performance, that is, on a *rational plan* for each process.
4. Both SM and PE share the idea that value and technique are related by ìembodied knowledgeî i.e. value producing knowledge that is ìinî the making of a thing.
5. Neither learning nor the design of improvement can be itself routinized. Taylor warns of the misuse of SM by unimaginative ìefficiency expertsî who reduce technological method to technique. And Harrington warns of the naive focus on process measurement in PE.

6. Methodology: On Method in ìScientific of Workî and ìProcess Improvementî

1. In SM, the unit of analysis is the *task* as part of a more general process of production. A task is performed by a team. It is composed of sub-tasks subdivided down to the level of action sequences performed by individual workers. In PE the unit of analysis is a *business process*. It is also composed of sub-processes, which in turn are composed of activities broken down to the processing of elementary units of information.
2. Both SM and PE propose a *management methodology* based on *technological method* (Seni 1995, St-Amant and Seni 1996, Seni and St-Amant 1996). That is, both propose that management be understood as *sociotechnology*,

The following table compares the general method proposed by Taylor for SM with the approach proposed by Harrington for PE:

Basic elements of SM (Taylor)	Basic elements of PE (Harrington)
1. Develop a ìscienceî (or technological theory) of each task to replace the old rule-of-thumb method.	1. Organize for improvement by building leadership, understanding and commitment. 2. Understand the process
2. Select, train, teach and develop the members of the team performing the task one man at a time.	3. Streamline: Improve the efficiency, effectiveness and adaptability of the business process
3. Cooperate with members of the team to insure that the work is done according to the ìprinciples of the scienceî developed.	4. Implement a system to control the process of ongoing improvement.
4. Share in the responsibility for the work in an equal division of labor between management and worker	5. Implement a continuous improvement process

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