

ASB 591 S: Invention and Innovation in Ancient and Modern Societies

W 9 - 11:50 a.m.

NURS 8

Section D, Content Code D

3 credits

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Invention (the creation of new ideas, artifacts, technologies, systems, processes, organizational forms, and cultural expressions) and innovation (the modification, diffusion and adoption of inventions) have since the 18th century been the hallmarks of industrial societies and the drivers of wealth creation. The abilities to invent and innovate are defining characteristics of *Homo sapiens*. Before the modern era, though, technical innovation was rare. Societies, rather, employed largely static technologies, often for centuries on end. So pervasive were static technologies that archaeologists today use them to organize prehistory into cultural/temporal sequences. This disparity between the past and present leads to profound questions about invention and innovation, and even about the nature of our species. Is invention constant or variable? If invention is constant, why is innovation variable? What factors condition invention and innovation? What has made the recent era so technologically distinctive?

Given the multifaceted and complex nature of invention/innovation, and their centrality to the human experience, many disciplines have addressed these twin phenomena: Psychology, cognitive science, evolutionary biology, sociology, anthropology, archaeology, economics, and management science have all made contributions to our understanding of why and how humans create novel ideas, things, and solutions. The study is of more than academic interest, as policy-makers, government officials, entrepreneurs, development specialists, university administrators, corporate executives, and venture capitalists have a keen interest in any inquiry that might reveal ways to jump-start, foster, promote, accelerate, or predict the processes of invention and innovation.

Five principles underlie the approach to invention and innovation that the seminar will discuss: (1) a proper understanding of the subject requires a long historical perspective; (2) invention and innovation result especially when creativity and diversity concentrate in particular places, and cities have thus been the privileged setting for the creation of novelty; (3) invention and innovation exhibit diminishing returns; (4) the growing complexity brought about by invention/innovation both necessitates and constrains further invention and innovation; and (5) necessity and failure are the parents of invention, accompanied in industrial societies by greed and desire for power.

The seminar will consist primarily of readings and discussions, supplemented by brief lectures. Readings, discussions, and lectures will cover some of the salient features of invention/innovation, highlighting stylized facts, dominant themes, and persistent mysteries. The

tenor of the seminar will be multidisciplinary. Our discussions will focus on the following questions: Why does invention/innovation occur? How does it happen? Who does it? Where does it happen? Participants will be encouraged to think about how these and other questions about invention/innovation can be answered empirically. The challenge will be to elevate our discussions above mere opinion to a rigorous integration of data-driven analysis and historical narrative.

Students will be expected to participate in the discussions, prepare a research paper, and present the paper to the class at the end of the semester. Students will be evaluated on all aspects of their participation, with emphasis given to their research papers and presentations. The organization of the seminar is as follow.

Session 1 (August 23): Introduction to the seminar, organization, assignments and expectations. *Distinction between invention and innovation.*

Session 2 (August 30): *Invention and innovation: the long historical view* (Sander van der Leeuw). Human beings and their precursors have existed for several million years and in their current guise (*Homo sapiens*), they have roamed over the Earth for around 200,000 years. Although there are clear signs of innovation from at least 50,000 years ago, the rate of innovation increased exponentially from about 10,000 years ago. How did the species survive for so long with a minimal toolkit to defend and nourish itself, and under a wide range of natural circumstances? Why did it take so long to “invent” and accelerate innovation? Why did innovation increase so rapidly, once that point was reached?

Session 3 (September 6): *Invention, innovation, and technology in ancient states and empires* (Joseph Tainter). How did the structure and organization of ancient states differ from those of today? Did rates of invention/innovation differ from those of day? If so, why? What factors incubated invention/innovation or suppressed it?

Session 4 (September 13): *Innovation and modern economics: the growth accounting framework* (José Lobo). Not until relatively recently did economists develop a full appreciation of the extent to which economic growth is a consequence of invention and innovation. According to modern economic growth theory, to understand economic growth one must understand what shapes the accumulation of knowledge. “Growth accounting” is the framework used by modern economics to measure the extent to which innovation and technology contribute to economic growth.

Session 5 (September 20): *Patents as a measure of invention* (José Lobo). The study of economic growth is constrained by a shortage of data. Economists argue that such intangibles as ideas, knowledge, technology, innovation drive the process of growth. While it is relatively easy to build theoretical models that capture this dynamic it is very difficult to find empirical counterparts for the variables that stand for the intangibles. Researchers have recently started using patents to create measures of the intangibles that are hypothesized to be the drivers of economic growth, and to study the economic, social and cultural factors that contribute to the generation of inventions and innovations.

Session 6 (September 27): *Why do humans invent/innovate?* (Joseph Tainter) Do human societies have a persistent propensity to innovate? Does invention/innovation vary with cultural context? With economic context? With political context?

Session 7 (October 4): *Tradition and innovation* (Sander van der Leeuw). The long-term survival of any society depends on its capacity to adapt to internal and external, natural and anthropogenic changes. The adaptation of existing solutions and the invention of new ones in the face of new problems are often balanced by the preservation of norms, organizations and institutions. Social life therefore exhibits a tension—sometimes creative and sometimes destructive—between tradition and innovation, and this tension channels and constraints the process of innovation.

Session 8 (October 11): *The invention of a system of innovation* (José Lobo). The mathematician Alfred North Whitehead remarked (in 1925) that “The greatest invention of the 19th century was the invention of a method of invention.” Whitehead understood that this invention involved the linking of new scientific knowledge to the world of artifacts, but he also understood that this linkage was not easily achieved because a huge gap typically exists between a scientific breakthrough and a new product or process. What was true of the 19th century was even more so in the 20th century as the inventive process became even more powerfully institutionalized and far more systematic than it had been in the previous century. The institutionalization of inventive activity meant that innovation proceeded in increasingly close proximity to organized research. The realization of the economic impacts of scientific and technological advances—the commercialization of knowledge—often requires considerable time, with much incremental learning, modification, tinkering and refinement needing to occur before a new idea turns into a new technology and then into a new source of wealth. This process is littered with failures, bad bets and promising approaches turned blind alleys.

Session 9 (October 19): *The role of cities in invention and innovation I* (Sander van der Leeuw). Inventors and innovators do not operate in isolation; the creation of new ideas is a process that very often involves the integration and recombination of existing knowledge originating from different individuals, locations, institutions and organizations. The privileged role that cities have played in the development of science and technology, and more broadly, in the generation of inventions and innovations—intellectual and material, cultural and political, institutional and organizational—has been well documented by historians, geographers, archaeologists, anthropologists and economists. Why are cities essential to invention and innovation and vice-versa?

Session 10 (October 25): *The role of cities in invention and innovation II* (José Lobo).

Session 11 (November 1): *A common metaphor for thinking about invention/innovation* (José Lobo). A common view, within the disciplines of economics, management science and operations research, of what the process of innovation is like is that is a “Neo-Darwinian combinatorial search process.” What are the origins and components of this answer? What are the implications of such a perspective? How empirically adequate is this metaphor?

Session 12 (November 8): *Constraints to innovation: complexity, diminishing returns and technological cycles I* (Joseph Tainter). Is there a relationship between rates of invention/innovation and how we exploit energy sources? What conditions the productivity of inventing over time? Are there conditions under which inventiveness becomes unproductive within specific fields? Are there conditions under which it becomes unproductive in general?

Session 13 (November 15): *Constraints to innovation: complexity, diminishing returns and technological cycles II* (José Lobo).

Session 14 (November 22): *Sustainability* (Joseph Tainter). What is the relationship of innovation to sustainability and the human future? Can inventiveness forever avert the Malthusian crisis? What conclusions can we reach from our readings and discussions in this course?

Session 15 (November 29): Student presentations.

Session 16 (December 6): Student presentations.