

THE EVOLUTION OF COLLABORATIVE INNOVATION AT A DISTANCE:  
EVIDENCE FROM THE PATENT RECORD

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ABSTRACT

This paper analyzes changes in collaborative innovation groups as reflected in multi-inventor patents. The nature of collaborative processes leading to significant technical advances has been the focus of considerable sociological and managerial studies. These studies have sought to understand the features of contacts and interactions between multiple researchers needed to promote effective collaboration. Two different types of collaborative efforts leading to technological innovations have been considered in the past: first, multi-party innovations within a particular field where the objective is to effectively combine and coordinate the work of numerous similarly trained specialists and, second, multi-party innovations involving linkages and combinations of the work of parties from different disciplines.

One area of ongoing study and concern has been the type of personal interactions between multiple researchers that are advantageous in promoting effective communications and exchanges of ideas of the sort needed to produce new designs and discoveries. Early research focused on means to improve face-to-face interactions between multiple researchers in business and university environments. Newer projects have sought to establish, expand, and improve research efforts involving physically distributed innovation groups relying on modern communication systems. These newer types of physically displaced groups depend heavily on new communication technologies such as telephone and internet linkages to help multiple innovators in physically separate locations to work effectively within teams. Communications technologies make critically important contributions to these distributed innovation efforts by helping team members to keep apprised of the each others' work, to share findings quickly and effectively, to coordinate and combine their results in useful ways to design new innovations and research projects, and to avoid duplication of design and testing efforts.

The present research project seeks to use patent records to measure changes in group innovation patterns across two dimensions: increases in the frequency of multi-inventor groups producing patentable innovations and increases in the prevalence of physically-displaced innovation groups among multi-party inventions. The research design utilizes a randomly selected sample of 800 patents each from 1976 and 2006 to measure two characteristics: 1) the

percentage of patented inventions that were products of group innovation (that is, which had two or more co-inventors associated with the relevant patent) and 2) the percentage of the multi-inventor patents that involved at least one researcher who was physically remote from his or her colleagues and thereby probably not able regularly commute and engage in face-to-face interactions with fellow inventors. For the purposes of this research, a patented invention was considered to be the product of a physically-displaced multi-inventor group if at least one of the multiple inventors listed in the corresponding patent was located more than 40 miles from the lead inventor specified for that patent.

The research tested two hypotheses. First, it was expected that the advent of the Internet and the improvement of other communications technologies between 1976 and 2006 would have resulted in a significant increase in the frequency of collaborative efforts over this period and a greater fraction of patented innovations emanating from group innovation as reflected in a greater percentage of multi-inventor patents. Second, it was expected that the advent of greater communications capabilities between 1976 and 2006 would enable greater innovation at a distance, resulting in a greater percentage of multi-inventor patents in which the inventors were not all in the same local geographic area.

Interestingly, the results of the research supported both of these hypotheses, but suggested that the changes in the prevalence of physically-displaced innovation groups were small. Multi-inventor advances were found to be significantly more prevalent in the post-Internet patent sample than in the pre-Internet set. However, while there was a statistically significant increase in the percentage of multi-inventor patents with physically separated inventors, the change in this percentage was rather small, suggesting that the Internet has only rarely made group innovation at a distance substantially easier or more effective. In short, it appears that distance still matters and face-to-face interactions still may be very important even as more and more researchers work in groups to produce multi-party innovations. While the communication capabilities of the Internet may still be important in promoting local interactions, the ability to form or continue effective innovation groups appears to depend on some need for or advantage of physical interactions.

Further research will be needed to determine the precise nature of the continuing advantages afforded by physical interactions between multiple innovators. There may be several different sources of these physical proximity advantages. These may include advantages afforded by organizational contexts, such as the fact that researchers may work best together on particular inventive projects if they are already associated with a particular corporation or university facility and therefore have preexisting and beneficially coordinated research resources and infrastructure. Alternatively, it may be that joint use of essential physical resources that are only located at a particular facility explains why successful researchers tend to locate around a common physical point. Yet another possibility is that the communication of research ideas or partial results is still most effectively accomplished through physical interactions between multiple innovators. If this is the case, it may be possible to rethink and augment communications methods to make communication at a distance more effective for researchers and to better facilitate innovation without physical interactions. Finally, it may be that researchers who share social interactions of

the sort facilitated by physical proximity form better teams and are more productive than their physically remote counterparts. If this is the case, the solution for better innovation at a distance may lie in mechanisms for innovation team building that will operate in addition to the interactions needed for particular engineering or research projects.