2009 DUKE/GEORGIA TECH INNOVATION SURVEY

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Funding
- Ewing Marion Kauffman Foundation
- National Science Foundation

Type of data
Nongovernment survey data

Availability of Data Set
Provide approved researchers with remote access to a more detailed data file as part of secure data enclave.

Activity Measured
2006-2008

Data Collected
2009

Number of Observations
Target sample – 20,000 businesses

KAUFFMAN Symposium on Entrepreneurship and Innovation Data 2008

OVERVIEW

Innovation is becoming more open, often involving multiple organizations in a division of innovative labor (DoIL). The division of innovative labor in the economy is conceived of as the distribution across firms and other organizations of the following steps in the innovation process: 1) research/idea generation, 2) development, and 3) commercialization. Despite its importance, there is little broad-based, systematic evidence on the extent or nature of the DoIL, its impact on firm performance, or the rate of technical advance. By surveying over 20,000 firms in manufacturing and selected service industries, the project will collect the first systematic data on the DoIL for the United States. The collected data will quantify key features of the DoIL. They also will provide the basis for empirically testing models of the DoIL, and its effects on innovative performance, which will be developed in the course of the project. The project addresses a number of important questions, such as:

- The extent to which start-ups, as compared with established firms, are new-idea generators.,
- The extent to which large established firms draw upon outside sources for the key inputs about developing new products and processes.
- The importance of universities as sources of industrial innovation.
- The extent to which firms' use of external knowledge inputs increases their innovative performance.

THE INNOVATION SURVEY

In order to collect data on innovation and the DoIL, we are proposing to collect original data through a firm survey. While innovation surveys have been conducted in Europe, Canada and elsewhere (though not with the same analytic focus), this will be the first U.S. national innovation survey.i Our questionnaire will be administered to marketing or other executives knowledgeable about the firm's products and services. For all of our questions, we will ask respondents to answer with reference to either a specific, defined industry or a specific innovation project and its commercialization, as appropriate.

Data elements and why an innovation survey?

Although we currently are identifying the data elements to be gathered and formulating questions for our survey instrument (see appendix for a draft questionnaire), prior innovation surveys mounted in Europe and Canada (cf., Arundel, et al. 2006),ii research in this area and our ongoing theoretical work already point to data elements of interest.iii For example, we will inquire whether the respondent's firm realizes revenue from new or significantly improved goods or services or from licensing intellectual property (IP) based on recent inventions, the share of revenue accounted for by these new or improved products, services or inventions, and, more generally, whether the firm is

engaged in manufacturing, marketing, and sales and service. For those respondents who report revenues from innovations, we will ask, for a focal innovation project, which of the firm's activities (e.g., research and development, manufacturing, marketing, etc.) contributed importantly to the project or its commercialization, and whether the key knowledge input(s) into the firm's innovative activity originated from another firm or from a public research institution (e.g., a university or government lab), and, if so, if the external idea was obtained through a collaborative relationship, a license, a service contract, an acquisition, or informal means (knowledge spillovers). Other data elements of interest include the firm's age, its R&D expenditures, its industry, the number of rivals, employment, and sales and sales growth. A draft questionnaire is provided in the appendix.

Note that we are inquiring about innovation in general, not just R&D. This distinction is fundamental to developing an understanding of the drivers and impacts of the DoIL for three reasons. First, Schmookler (1959), Kleinknecht (1987) and Arundel et al. (2006) suggest that fewer firms report R&D expenditures than report innovative activity,iv and, the discrepancy is especially acute for the smallest firms. As a consequence, any survey that focuses on R&D performance (e.g., NSF's RD-1 survey) rather than on innovation may not completely characterize the role and importance of start-ups and small firms in the DoIL. Second, the discrepancy between innovating versus R&D-performing firms also is acute among service sector firms because a good deal of the innovative activity in such firms does not occur in formal R&D units. Further, accounting practices, reflecting the Financial Accounting Standards Board Statement No. 2, generally do not admit as R&D any innovative activity that is performed for a customer, which is common in services. Thus, focusing on R&D performers alone will miss the degree to which service sector firms are innovative.v Third, an analysis of only R&D performers will miss those firms that may only introduce new products and services based on inventions acquired from the outside, via a license or contract. Such firms play a potentially important but under-studied role in innovation.

Once the data are collected, we will match our data set to other available data sets, including Compustat financial data for public firms, patent data, and the Carnegie Mellon Survey (CMS) on the Nature and Determinants of Industrial R&D (cf. Cohen et al., 2000, 2002a, 2002b). The latter will be a source of industry-level data for the manufacturing sector on variables, such as the strength of patents and the use and importance for industrial R&D of public research.

WHY THE AMERICAN INNOVATION SURVEY IS IMPORTANT

Understanding the innovation process is hampered by: 1). a lack of data on innovation—as opposed to R&D or patents, 2) a focus on single actors rather than the entire innovation process, 3) a lack of models that integrate the role of various actors in a division of innovative labor (henceforth, DoIL) across various stages of the innovation process.vi The research will address these shortcomings. We will measure innovation separately from R&D and the contribution of various actors to the DoIL, and develop models of how firms participate in a DoIL and, in turn, the nature and extent of the DoIL in the aggregate. Our study will include original data collection through a large-scale innovation survey administered to firms in the manufacturing sector and selected service sector industries, a description of our findings, and the development and testing of economic models of the DoIL and its impacts on firms' innovative performance. These results will advance the science of innovation policy by generating new data on innovative activity, creating new metrics, and developing new models for understanding the innovation process and for guiding policy and firm strategy.

Background

What we are calling "innovative labor" spans a number of activities. For analytical convenience we divide them into the following, though such a division is sometimes difficult and even arbitrary: 1) research and idea generation: generation of ideas and the refinement of the idea, including evaluation of different approaches to advancing the idea towards commercial viability; 2) development: reduction of those ideas and knowledge to commercial practice, including the scientific and engineering work of developing prototypes or "beta" versions; 3) commercialization: combining new or improved products and services with other capabilities, such as manufacturing, marketing, sales and service to introduce the new products and services to the marketplace. What we are calling the "division of innovative labor" refers to the distribution of these activities across separate firms and other organizations, including universities and government labs. For a given technology, these activities, at one extreme, may be integrated fully into a single organization, or, at the other, may be distributed across several different organizations.

In their corrective to the Schumpeterian (1942) argument that large, established firms are the key locus of innovation, Jewkes, Sawers and Stillerman (1969) highlighted the importance of the DoIL when they argued that neither small nor large firms were the engines of technological progress. Rather—in a view subsequently echoed by Nelson, Peck and Kalachek (1967), Scherer (1980), Dorfman (1987), Cohen (1995), and Baumol (2002)—they stated: "It may well be that there is no optimum size of firm but merely an optimal pattern for any industry, such a distribution of firms by size, character and outlook as to guarantee the most effective gathering together and commercially perfecting of the flow of new ideas." (1969, p. 168).

Economic theory suggests that a DoIL should increase system-wide efficiency and enhance the rate of technical progress by promoting specialization and, in turn, the efficiencies from scale, learning and the exploitation of comparative advantage emphasized long ago by Adam Smith (1776 [1937], Ch. 1). For example, assuming that the firms best equipped to invent are not necessarily the firms most capable of commercializing invention, society benefits when rights over an innovation can transfer between them.

However, not all industries and technologies lend themselves to the distribution of complementary innovative activities across firms. The market-based transmission of knowledge and know-how that underpins a DoIL faces hurdles. It requires that information be applicable outside the context in which it was developed (i.e., not "firm-specific"), transmissible (in contrast to, for example, tacit knowledge), and protected from misappropriation. For example, the details of an invention typically need to be disclosed prior to its sale, but such disclosure can remove the buyer's incentive to buy the invention (e.g., Arrow, 1962; Nelson, 1959). Although patents in principle address this "disclosure paradox," patents in practice offer effective protection in only a small number of industries (Scherer et al., 1959; Mansfield, 1986; Levin et al., 1987; Cohen et al., 2000). Williamson (1991) and Teece (1986) highlight the role of transaction costs in limiting market transactions in knowledge. Mowery (1983) and Kline and Rosenberg (1986) note the need for ongoing coordination and mutual adjustment across different innovation stages, which can impede the writing of complete contracts. Finally, von Hippel (1990) and Arora and Gambardella (1994) highlight the direct costs involved in transmitting context-dependent information across firms.

Notwithstanding these impediments to the emergence of a DoIL, qualitative accounts suggest that large, integrated firms may now rely more on outside sources of knowledge as a basis for new products and processes (Chesbrough, 2003). Research on the growth of technology licensing (e.g., Arora et al., 2001; AUTM, 2007; Athreye and Cantwell, 2007; Robbins, 2006) also suggests that innovative activities have become more distributed across firms and other institutions over the past two decades or so. But data on licensing is incomplete, and reflects only a part of the story. In general, there is little systematic, broadly based evidence on the extent of the DoIL. As a result, these basic questions remain: Is it true that large firms now rely extensively on outside sources for the key ideas and knowledge behind their innovations? If so, how does this vary across industries and technologies? What is the role of small firms and start-ups: Are they primarily idea-generators, or do they mainly develop and commercialize ideas that otherwise might be left on the shelf in universities or inside large firms? What drives the observed DoIL and its various forms? And, what are the consequences for firm performance? Our efforts underway to collect and analyze data and develop economic models should begin to address these questions.

Contributions of this research

This research project includes an innovation survey, model development, and empirical analysis. We envision the initial innovation survey research project, which currently is underway, to be the first of two surveys. However, each of these survey research projects will be self-contained and will support the analysis of distinct questions. We envision two surveys because each involves different types of respondents within the firm. In addition, the first survey is designed to generate the firm sample list for the second survey.

This project is designed to make important contributions to both the intellectual understanding and broader practical development of the science of innovation and science policy by collecting new data, creating new metrics and developing new models of the innovation process.

The data we plan to collect will be the first systematic data on the DoIL in the United States. Our data will help establish, for instance, the extent to which start-ups, as compared with established firms, function as generators of new ideas, or if use of external knowledge inputs improves innovative performance. These data also will provide the basis for developing and empirically testing formal models of the DoIL and its effects on performance, thereby filling a gap in our understanding of the innovation process. These

economic models and empirical findings will advance substantially our understanding of the science of innovation.

Our analysis and findings will provide a critical addition to the empirical basis for formulating science and innovation policy. Our analysis will inform policies for improving the efficacy of the markets for technology, which underpin the DoIL, and whose importance was stressed in the recent report of the Dept. of Commerce Committee for Measuring Innovation (2008). For instance, current patent reform proposals include post-grant review, which might increase patent quality, thereby reducing transaction costs and facilitating licensing. By analyzing the contributions of both small firms and start-ups, as well as that of universities, to the DoIL our analysis also should inform assessment of policies, such as the Small Business Innovation Research Program, designed to support small firm innovation, as well as policies, reflected in the Bayh-Dole Act and related legislation, designed to support the contributions of public research to industrial R&D and the commercialization of innovation.

Procedures for accessing the data set

The project's data management plan has the dual goals of maintaining the confidentiality and integrity of the data while ensuring broad access for the scientific community. The principal investigators plan to involve other scholars in the project by developing a user consortium of a select number of mostly junior scholars interested in studying innovation. One challenge of making our data accessible to this user consortium and others is that the data will be gathered with the promise of confidentiality of respondent-level information. To respect this important commitment, we will use the National Opinion Research Center (NORC) Data Enclave, which has agreed to support this effort. The NORC Data Enclave is designed to protect the information against access by unauthorized individuals and for unauthorized purpose, while providing a work space that facilitates researcher access to the data. In addition, researchers are provided with a collaborative environment designed to facilitate creation of meta data and encourage innovative uses of the data. This data management plan is designed to both serve the needs of the scientific community and ensure the respondent confidentiality needed to collect these data. We will work closely with NORC to ensure both of these goals are met.

METHODOLOGY

Sample and data collection methods

To conduct our survey, we will contract with the NORC at the University of Chicago, one of the nation's leading contract survey firms. The primary sampling frame will be Dun & Bradstreet's (D&B) Selectory database of U.S. companies. We will ask our respondents to answer some of our questions with reference to their firm's activities within a defined, focal industry to gather data on a line-of-business basis.[vii] This is especially important for larger, multiproduct firms active in numerous lines of business.

While we would have preferred a sampling frame containing an official list of all existing businesses, no publicly available list exists. Our judgment was that D&B was the best frame available.[viii] We are familiar, however, with the limitations of the D&B data as a sample frame. Perhaps the greatest limitation is that many of the firms listed in the frame are no longer in business. Mathematica, the survey firm administering the Kauffman Firm Survey (KFS), reported that as many as 17 percent of the firms listed were out of business.[ix] This is, however, a conservative estimate since the KFS was a survey of start-ups, and the mortality rate of start-ups is much higher than that of firms generally (e.g., Dunne, et al. 1988). D&B personnel suggest that the out-of-business rate for the whole database is about 5 percent. We expect the rate for our sample to be somewhere between these two figures. We will address this problem by confirming the existence of all units via phone (see below). Duplicates, on the other hand, with less than 0.1 percent of the listed firms having duplicate listings in the KFS, appear not to be a problem. Finally, we also have concerns about the accuracy of industry assignments in the D&B database. We will collect additional data to confirm and reassign as necessary. In addition to its use in the KFS, the D&B database has been used recently as a sampling frame for studying small firm innovative activity (NFIB, 2005).

We likely will limit the sample to firms with ten or more employees operating in the manufacturing and selected business service sectors (NAICS 31-33, 51, 52 and 54). We will select from the populations of single-location firms plus headquarters locations of multilocation firms. While each unit typically represents a separate firm, some large multiproduct firms may have multiple headquarters, in which case they will be treated as separate "business units" (i.e., a firm's activities in a line-of-business) in our population. Using the D&B database, we will draw a systematic random sample of 30,000 firms, stratified by three-digit North

American Industry Classification System codes and firm size (e.g., 10-99, 100-499, 500-999, 1000+ greater).x We will sample the largest firms (e.g., *Fortune* 500) with certainty. This strategy will ensure sufficient coverage across strata and will increase the efficiency of population estimates. Population estimates will be adjusted to account for the sampling strategy. We also will consult with a sampling expert at NORC to refine this sampling strategy and assure it is statistically valid. The D&B data includes phone and address information, as well as names of one or more contact persons per location. The initial target respondent is the head of marketing or equivalent manager in that location. However, we may adjust the informant according to firm structure and availability. For example, a small firm might not have a separate marketing or sales manager, in which case we might survey the owner, general manager, or other informed respondent. NORC has extensive experience with firm surveys, and we will work closely with its staff to develop a sound interview protocol.

Thus, we will provide NORC a list of 30,000 firms, with an initial target respondent name and phone number and initial industry assignment and size information (from D&B). Screening questions will confirm the employment, functional department and job title of the respondent, and the age of the firm (to assure we have substantial start-up representation). We also will ask the respondent to describe a "focus industry," which will be the basis for the rest of the questionnaire (cf., Cohen, Nelson and Walsh, 2002b). NORC will do the initial phone screening as part of the interview protocol. We will delete out-of-business firms from our sample. If the firm is in business, but the target respondent information is missing or incorrect, NORC will update the target respondent information if this can be done in an initial phone call. Difficult cases (a projected 20 percent of the initial sample) will be referred to the Principal Investigators for further processing to obtain a valid target respondent for NORC to contact for the interview. The goal is a final, verified sample list of at least 22,500 firms representing all industries and size classes in our population. In order to validate the sample representativeness, and as a possible source of sampling weights for subsequent analyses, we will compare the industry and detailed size distribution in our sample with published and custom U.S. Census report data. We also will use Census data to compare the percentage of R&D-performing firms in each industry-size strata to both D&B's and respondents' reporting of R&D activity.

The survey will be administered by phone and should take eight minutes, on average. NORC will administer it using computer-assisted telephone interviewing (CATI). The survey protocol will include multiple callbacks to increase response rate. Based on consultations with NORC, we have set our target response rate at two-thirds (i.e., a target of 15,000 respondents). The instrument will be pretested using interviews with target population respondents to ensure that the questions are understood easily and appear to be measuring their intended variables. We also will work with NORC to do formal cognitive testing on items measuring the key variables, particularly "innovation."

Second survey research project

As noted above, one outcome of this survey will be a sample of innovating (not just R&D-performing or patenting) firms. This sample will form the basis of a future project in which we will survey the informant responsible for innovation-related projects within the firm. The goal of this follow-on project will be to gather detailed information about the sources and channels of knowledge flows, the organization of the firms and their management, and the uses of patents and their impact on innovation, which would update analyses of patent use and effectiveness based on 1994 data (Cohen et al., 2000). This second survey is not yet funded. An important benefit of the current project, however, is to provide a valid sample for such a second survey.

REFERENCES

Arora, A. 1995. Licensing tacit knowledge: Intellectual property rights and the market for know-how**.** *Economics of Innovation and New Technology,* http://www.informaworld.com/smpp/title%7Econtent=t713641545%7Edb=all%7Etab=issueslist%7Ebranches=4. 4**4:**1, 41–60.

Arora, A., A. Fosfuri, and A. Gambardella. 2001. *Markets for technology: Economics of innovation and corporate strategy*. Cambridge, MA: MIT Press.

Arora, A., and A. Gambardella. 1994. Evaluating technological information and utilizing it: Scientific knowledge, technological capability, and external linkages in biotechnology. *Journal of Economic Behaviour and Organization* 24:1, 91-114.

Arora, A., and A. Gambardella. 1994. The changing technology of technical change: General and abstract knowledge and the division of innovative labour. *Research Policy* 23:5, 523-532.

Arrow, K.J. .1962. Economic welfare and the allocation of resources for invention. In R.R. Nelson (ed.), *The rate and direction of inventive activity.* Princeton: Princeton University Press.

Arundel, A. 2007 Innovation survey indicators: What impact on innovation policy? In OECD, *Science, technology and innovation indicators in a changing world: Responding to policy needs*. Paris: OECD Publishing, 49-64.

Arundel, A., C. Bordoy, P. Mohnen, and K. Smith. 2006. Innovation surveys and policy: Lessons from the CIS. Mimeo, MERIT, University of Maastricht.

Association of University Technology Managers [AUTM]. 2007. *AUTM U.S. Licensing activity survey: FY2006, survey summary.* Deerfield, IL: AUTM.

Athreye, S., and J. Cantwell. 2007. Creating competition? Globalisation and the emergence of new technology producers. *Research Policy* 36:2, 209-226.

Baumol, W.J. 2002. *The free-market innovation machine—Analyzing the growth miracle of capitalism.* Princeton: Princeton University Press.

Chesbrough, H. 2003. *Open Innovation*. Boston: Harvard Business School Press.

Cohen, W.M. 1995. Empirical studies of innovative activity. In P. Stoneman (ed.), *Handbook of the economics of innovation and technological change*. Oxford: Blackwell Publishers.

Cohen, W.M., A. Goto, A. Nagata, R.R. Nelson, and J. Walsh. 2002a. R&D spillovers, patents and the incentives to innovate in Japan and the United States. *Research Policy* 31,1349-1367.

Cohen, W.M., R.R. Nelson, and J.P. Walsh. 2000. Protecting their intellectual assets: appropriability conditions and why U.S. manufacturing firms patent (or not). NBER Working Paper 7522 (revised, 2005, as mimeo, Duke University).

Cohen, W.M., R.R. Nelson, and J.P. Walsh. 2002b. Links and impacts: The influence of public research on industrial R&D. *Management Science* 48:1-23.

Department of Commerce. 2008. Innovation measurement: Tracking the state of innovation in the economy. A Report to the Secretary of Commerce by The Advisory Committee on Measuring Innovation in the 21st Century Economy. Washington, D.C.: Dept. of Commerce. January.

Dorfman, N.S. 1987. *Innovation and market structure: Lessons from the computer and semiconductor industries.* Cambridge, MA: Ballinger.

Dunne, T., M.J. Roberts, and L. Samuelson. 1988. Patterns of entry and exit in U.S. manufacturing industries. *Rand Journal of Economics* Winter:495-515.

Gault, F. (ed.) 2003. *Understanding innovation in Canadian industry.* Montreal: McGill-Queen's University Press.

Jewkes, J., D. Sawers, and R. Stillerman. 1969. *The sources of invention*, *2nd edition*. London: Macmillan.

Kleinkecht, A. 1987. Measuring R&D in small firms: How much are we missing? *Journal of Industrial Economics,* 36:253-56.

Kline, S.J., and N. Rosenberg. 1986 An overview of innovation. In R. Landau and N. Rosenberg (eds.), *The positive sum strategy.* Washington, D.C.: National Academy Press.

Levin, R.C., A.K. Klevorick, R.R. Nelson, and S.G. Winter. 1987. Appropriating the returns from industrial R&D. *Brookings Papers on Economic Activity*, 783-820.

Mansfield, E. 1986. Patents and innovation: An empirical study. *Management Science* 32:173-181.

Mowery, D.C. 1983. The relationship between intrafirm and contractual forms of industrial research in American manufacturing 1900-1940. *Explorations in economic history* 20:351-74.

Nagaoka, S., and J.P. Walsh. 2008. Inventions and the invention process in Japan and the US. Presentation to Innovation Process and Performance: Findings from Inventors Surveys in Japan, the US and Europe. Research Institute for Economy, Trade and Industry International Symposium. Tokyo. January 11. http://www.rieti.go.jp/en/events/08011101/pdf/1-3&1-4_E_Nagaoka&Walsh_PPT.pdf

National Research Council [NRC]. 2004. *A patent system for the 21st century.* Washington, D.C.: National Academies Press.

National Research Council [NRC.] 2005 *Measuring research and development expenditures in the U.S. economy*. Washington, D.C.: National Academies Press.

Nelson, R.R. 1959. The simple economics of basic scientific research. *Journal of Political Economy.* 67:297-306.

Nelson, R.R., M.J. Peck, and E.D. Kalachek. 1967. *Technology, economic growth and public policy.* Washington, D.C.: The Brookings Institution.

NFIB. 2005. National Small Business Poll. *Innovation*, 5:6.

OECD. *Science, technology and innovation indicators in a changing world: Responding to policy needs*. Paris: OECD Publishing.

OECD/Eurostat. 2005. *Oslo manual: Guidelines for collecting and interpreting innovation data*, *3rd ed*. Paris: OECD Publishing.

Robb, A., D. DesRoches, T.M. Mulcahy, and S.A. Shane. 2005/2006. Kauffman Firm Survey (KFS) - baseline/first follow-up: study metadata documentation. Available at SSRN: http://ssrn.com/abstract=1024312.

Robbins, C.A. 2006. *Measuring payments for the supply and use of intellectual property*. Bureau of Economic Analysis. U.S. Department of Commerce. Washington DC.

Rosenberg, N. .2001. Economic experiments. *Industrial and corporate change,* 1:1, 181-203.

Scherer, F.M. 1980. *Industrial market structure and economic performance*, *2nd ed.* Chicago: Rand McNally.

Scherer, F.M., et al. 1959. *Patents and the corporation*, *2nd ed*. Boston: privately published.

Schmookler, J. 1959. Bigness, fewness, and research. *Journal of Political Economy* 67:628-632.

Schumpeter, J.A. 1934. *The theory of economic development*. Cambridge, MA: Harvard University Press.

Schumpeter, J.A. 1942. *Capitalism, socialism, and democracy.* New York: Harper.

Smith, A. 1776; 1937. *An inquiry into the nature and causes of the wealth of nations*. Modern Library Edition, New York: Random House.

Smith, K. 2005. Measuring innovation. In J. Fagerberg, D.C. Mowery, and R.R. Nelson (eds.), *The Oxford Handbook of Innovation.* New York: Oxford University Press.

Stigler, G. 1951. The division of labor is limited by the extent of the market. *Journal of Political Economy* 59:3, 185-93.

Teece, D.J. 1986. Profiting from technological innovation. *Research Policy* 15:6, 285-305.

von Hippel, E. 1990 Task partitioning: An innovation process variable. *Research Policy* 19, 407-418.

Williamson, O.E. 1991. Comparative economic organization - the analysis of discrete structural alternatives. *Administrative Science Quarterly* 36:4, 269-296.

APPENDIX: DRAFT SURVEY INSTRUMENT

The Duke/ Georgia Tech Innovation Survey

Purpose of the Questionnaire:

The purpose of this questionnaire is to collect information about innovation in the United States between 2006 and 2008. The collected information will be used by academic researchers to conduct analyses to improve our understanding of innovation and, in turn, inform government policy and managerial practices bearing on innovation.

Confidentiality

Your name, contact information and all information provided will be kept strictly confidential and will not be reported, released or disclosed in any way that identifies you or your firm.

Who should respond? What is the period and business activity covered?

To allow a comparison of enterprises with and without innovation activities, we request **all** enterprises to respond to **all** questions, unless otherwise instructed. Where possible, answers should be provided relating to activity during the three **calendar years** 2006 to 2008. Where precise figures cannot be provided for the calendar years, **your best estimates are acceptable.**

Please describe the market for which you are mainly responsible (i.e., occupies the majority or plurality of your
time).:_____.

Below we will refer to this market as your **focal market or industry**. If your enterprise is part of a larger corporate group or serves more than one market, please answer all questions **only** for the unit or units serving this focal market.

Information Required and Definition of Innovation

This questionnaire asks for information relating to innovation activities. For the purpose of this survey, **innovation is defined as** changes in your products, processes or the services introduced to enhance your competitive position or performance. Innovation reflects the outcome of spending on innovation activities, including, but not limited to R&D, as well as on new types of machinery and equipment employed in your manufacturing processes, training, goods and service design or marketing, as well as in-licensing technology from other organizations.

Who is paying for this work?

This effort is funded by the National Science Foundation and the Kauffman Foundation.

Definitions:

Product (good or service) innovation

A product innovation is the market introduction of a **new** good or service or a **significantly** improved good or service with respect to its capabilities, such as quality, user friendliness, software or subsystems. The innovation must be new to your enterprise, but it does not need to be new to your market. It does not matter if the innovation originally was developed by your enterprise or by other enterprises.

Process innovation

Process innovation is the use of new or significantly improved methods for the production or supply of goods and services. The innovation must be new to your enterprise, but it does not need to be new to your industry. It does not matter if the innovation was developed originally by your enterprise or by other enterprises. Purely organizational or managerial changes should not be included.

Q1. During the three-year period 2006-2008, did your firm create a product or process that was commercialized (by you or another firm) in your focal industry?:

a. New or significantly improved goods? (Exclude the simple resale of new goods purchased from other enterprises and changes of a purely cosmetic nature) YES NO

b. New or significantly improved services? YES NO

c. New or significantly improved process for making a good/providing a service YES NO

If no to all of the above, please go to question 12, otherwise:

Q2A. If YES: Please think of your most recent innovation (good, service, process). Which one of the following would best describe this innovation?

-Good
-Service
-Process

Q2B. By whom was this innovation developed? [Please check the most appropriate response.]

a. Mainly by your enterprise or enterprise group [ ]

b. Mainly by your enterprise together with other enterprises, institutions or individuals [ ]

c. Mainly by other enterprises, institutions or individuals [ ]

***If a or b is your answer to Q2B*:**

Q2C. Within your firm, which of the following functions contributed substantially to the creation and development of this innovation?

A. Research and Development [ ]
B. Manufacturing [ ]
C. Sales and Marketing [ ]
D. Top Management **[ ]**
E. Other_____ [ ]

Q3A. Which of the following were key sources of information for the development of this innovation? *Please check all that apply.*

A. Other enterprises within your enterprise group [ ]
B. Suppliers of equipment, materials, services, or software [ ]
C. Clients or customers [ ]
D. Competitors or other enterprises in your industry [ ]
E. Consultants, commercial labs, or private R&D institutes [ ]
F. Universities or other higher education institutions [ ]
G. Government or public research institutes [ ]
H. None of the above

Q3B. Of the above, which one was the MOST important external source of information?

_____

Was this most important organization located within one hour (by car) of your firm?
YES NO

Q4. For each of the knowledge sources for this innovation, please indicate the means of acquiring the knowledge? *Please check all that apply.*

	License	Contract	Acquisition	Informal means	Alliance/ joint venture
A. Other enterprises within your enterprise group	[ ]	[ ]	[ ]	[ ]	[ ]
B. Suppliers of equipment, materials, services, or software	[ ]	[ ]	[ ]	[ ]	[ ]
C. Clients or customers	[ ]	[ ]	[ ]	[ ]	[ ]
D. Competitors or other enterprises in your industry	[ ]	[ ]	[ ]	[ ]	[ ]
E. Consultants, commercial labs, or private R&D institutes	[ ]	[ ]	[ ]	[ ]	[ ]
F. Universities or other higher education institutions	[ ]	[ ]	[ ]	[ ]	[ ]
G. Government or public research institutes	[ ]	[ ]	[ ]	[ ]	[ ]

Q5. Was this most recent innovation:
A. New to your focal market? (i.e., your enterprise introduced a new good or service onto your market before your competitors) YES NO
B. *Only* new to your enterprise? (i.e., your enterprise introduced a new good or service that was essentially the same as a product already available from your competitors in your market) YES NO

Q5A. Was the innovation introduced to the market by your firm or licensed out to another firm?

In-house [ ]
Licensed out [ ]

Q6. Please estimate as a percentage of your total sales revenue in 2008 in your focal market: *(Informed estimates are acceptable here.)*

a. Products or services introduced during 2002-2004 that were **significantly improved** ____%
b. Products or services introduced during 2006-2008 that were **new to your enterprise but not new to your market** ____%
d. Products or services introduced during 2006-2008 that were **new to your market** ____%

Q7. About how many firms, worldwide, can introduce competing innovations in time to effectively diminish your firm's profits from your innovations? _____

We will now pose a number of general questions about your enterprise as a whole and its activities in your focal industry or market.

Q8. During the three-year period 2006-2008, did your enterprise engage in the

following activities targeted toward your focal market or industry?

a. Manufacturing	YES	NO
b. Delivery of a service	YES	NO
c. Marketing	YES	NO
d. Sales and sales support	YES	NO

Q9. During the three-year period 2006-2008, did your enterprise engage in the following innovation activities targeted toward your focal market or industry?

a. Intramural (in-house) R&D Creative work undertaken within your enterprise on an occasional or regular basis to increase the stock of knowledge and its use to devise new and improved goods, services or processes.	YES	NO	DK
b. Acquisition of R&D services from another firm or institution Same activities as above, but purchased by your enterprise and performed by other companies, public or private research organizations or individuals, and involving payment in some form.	YES	NO	DK
c. Acquisition of machinery, equipment and software Acquisition of advanced machinery, equipment and computer hardware or software for the purpose of implementing a new or improved method of production or delivery of a service, or to produce new or significantly improved goods, services.	YES	NO	DK
d. Acquisition of existing knowledge of an innovation or related know-how. Purchase or licensing of patents and nonpatented inventions, know-how, and other types of knowledge from other enterprises, organizations or individuals.	YES	NO	DK
e. Training Internal or external training for your personnel specifically for the development and/or introduction of innovations	YES	NO	DK

Q10. Technology Acquisition and Monitoring

A. Do you have a Web site that allows outsiders to offer new ideas or knowledge for your firm to use or commercialize? YES NO DK

Follow-on: When did you first create such a Web site? ____

B. Do you assign anyone in the firm the responsibility for looking outside the firm for new inventions, product ideas, etc. that your firm might be able to use? YES NO DK

Follow-on: When was such a person first assigned this responsibility? _____

Q11. For the three-year period 2006-2008, please provide an approximate breakdown

of your revenues in your focal market or industry among your:

a. Products or non-R&D services _____%
b. R&D services _____%
c. Licensing of intellectual property associated with patents or copyrights _____%
d. Contracts or licenses due to the sale of know-how or knowledge not associated with patents _____%

100%

Basic economic information on your enterprise

Informed estimates are acceptable if exact figures are not available

Q12. Approximately, what was your enterprise's *total* revenues for 2006 and 2008?

Revenues include the market sales of goods and services based on the amount earned; **include** exports and taxes.

2006 _____
2008 _____

Q13. Approximately, what was your enterprise's revenues in your focal industry or market for 2006 and 2008?

Revenues include the market sales of goods and services based on the amount earned; **include** exports and taxes.

2006 _____
2008 _____

[ASK ONLY ABOUT EMPLOYEES?]

Q14. Approximately, what was your enterprise's *total* number of employees in 2006 and 2008?[7]

2006 _____
2008 _____

Q15. Approximately, what was your enterprise's number of employees in your focal industry or market in 2006 and 2008?

2006 _____
2008 _____

Q16. Approximately what proportion of your enterprise's employees (in your focal industry or market) in 2008 were educated with a PhD/MD or equivalent? _____%

OTHER QUESTIONS TO CONSIDER ASKING (or obtain from archival sources):

1. **AGE OF COMPANY-[may be available from D&B]**
2. **DATE OF ENTRY INTO THE FOCUS INDUSTRY**
3. **EIN [get from commercial database]**
4. **PATENT EFFECTIVENESS? [MAY USE THE CMS FOR THOSE SCORES]**

[i] In Europe, four generations of innovation surveys, the "Community Innovation Survey" (CIS), have been developed and administered in various countries (e.g., OECD/Eurostat, 2005; OECD, 2007; Gault, 2003; Smith, 2005; Arundel et al., 2006). Also, NSF conducted pilot innovation surveys in the United States in 1994 and 2003 (NRC, 2005) for samples of modest sizes, realizing response rates of about 57 percent in both instances.

[ii] We have recruited Anthony Arundel as a consultant to this project. Based at the OECD and MERIT, Arundel has coordinated across the numerous CIS efforts. In addition to using the CIS data himself, he also has evaluated the CIS efforts (Arundel et al., 2006; Arundel, 2007).

[iii] Question wording will build upon prior related surveys, including the CIS and the analogous surveys from Canada, the Carnegie Mellon Survey (Cohen et al., 2000), the PatVal inventor surveys conducted in Europe (Giuri et al., 2007), and the recent RIETI/Georgia Tech US-Japan Inventor Survey (Nagaoka and Walsh, 2008).

[iv] The recently conducted Georgia Tech inventor survey, which was limited to inventions patented in the United States, Japan and Europe, also found that about 20 percent of these inventions originated outside R&D units (Nagaoka and Walsh, 2008). This share may be even higher if unpatented inventions are included.

[v] The Department of Commerce Committee for Measuring Innovation (Dept. of Commerce, 2008), as well as the National Research Council committee report on the measurement of R&D expenditures (NRC, 2005), note that service sector firms play an important, though largely unrecognized, part in generating innovation.

[vi]Recent reports of the Department of Commerce Advisory Committee for Measuring Innovation (2008) and the NRC (2005) emphasize the need to go beyond R&D and patents and the need to collect data on and develop understandings of the collaborative nature of innovation.

[vii] We framed questions similarly in the Carnegie Mellon Survey (Cohen et al., 2000).

[viii] The D&B database is compiled from a large number of sources. Historically, the basis was credit reports, but D&B also accesses information from credit card companies, shippers and other commercial companies that likely would be used by a business. In addition, D&B also contacts state governments for newly registered firms (Robb et al., 2005/2006).

[ix] E-mail communication, February 26, 2008.

[x] The sample size of 30,000 is determined partly to provide a sufficiently large sample list for the second-stage survey project. Based on the KFS experience, we assume that fewer than 7,500 of our respondents will be out of business. We further assume a two-thirds response rate from our live sample, given that we are conducting a brief phone survey, yielding a respondent sample of 15,000. We then assume that at least 20 percent of these firms innovate, yielding a sample of 3,000 for our second stage survey.