An Employment-Oriented Definition of the Information Systems Field: An Educator's View

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Abstract

Defining information systems has been a longstanding problem for the field. This paper suggests that, since it may not be possible to develop a universal definition, consideration should be given to a plurality of definitions aligned toward specific purposes. As an implementation of this approach it recommends the following shorter definition for the purpose of education, which emphasizes topics that are being or will be taught to prepare students for employment in the field: Information systems is the field that prepares students to interface between non-technical organizational employees and managers and very technical IT professionals, with a focus on functions that are unlikely to be offshored. It includes general categories of information and communications technology use that currently and/or will employ substantial numbers of employees in organizations. The more detailed definition presented in the body of the paper extends this by identifying five broad subcategories that currently fit within the above definition.

Keywords: Information & Communication Technologies(ICT), Employment, Job Skills, Curriculum design & development

1. INTRODUCTION

Defining information systems is much like the Indian parable of the blind men and the elephant. Like the elephant, the field is huge. As with the blind men, there are many different perspectives. Reflecting this ambiguity, the general public often has difficulties distinguishing information systems from computer science. Wikipedia's definition (2012)—"Information Systems (IS) is an academic/professional discipline bridging the business field and the well-defined computer science field"—hints at this definitional problem through an implicit contrast between IS and the "well-defined" discipline of computer science.

IS academics agree that the field is concerned with information and organizations, and for all practical purposes includes computers. Beyond that, what is included and excluded varies widely. Alter (2008, p. 448) notes that, "The lack of an agreed upon definition of information system (IS) is one of many obstacles troubling the [field]." And this is a significant problem, because the definition of any academic field is quite important to the stakeholders. For internal stakeholders it helps focus the topics of research and teaching in the field. Externally it affects students' decisions to choose this or some other major, and may impact employers' hiring decisions.

This definitional issue has been subject to investigation and debate since the establishment of the field in the 1960s. IS has generally been defined in broad terms to accommodate the many different subtopics that academics want to include in the field. This has led to problems because it is difficult to provide a definition that is inclusive enough to mollify all the various constituencies without making the definition too vague to be meaningful or useful in determining topics that should or should not be researched and taught within academic programs.

Most previous attempts at definition have also been problematic because they have not focused on what is or should be taught in the field. One of the rationales for research in any academic field is to inform teaching (Clark, 1997) but the potential to do so is somewhat dependent on the amount of congruence between what is being taught and what is being researched. The weaker the relationship between these areas, the fewer opportunities there are to inform teaching.

Banville and Landry (1989, p. 58) note both the amorphous definition of the field and also its employment-oriented nature in the following quote: "MIS is a fragmented field or, to put it in other words, an essentially pluralistic scientific field, especially in view of its vocational character." However they didn't follow through on the vocational aspect with any suggestion of a necessary relationship between what is taught and what types of employment students were expecting.

Hattie and Marsh's meta-analysis (1996) raised serious questions about the supposed carryover from research into teaching. They reported that the "overall relationship between quality of teaching and research was slightly positive. On the basis of 498 correlations from the 58

studies, the weighted average correlation was .06. There was less than .1% of the total variability in common" (p. 525). Note that the measures of teaching quality included studies that used multiple measures—student-, peer- and/or self-evaluations.

Given the breadth of the field and diversity of interests, it might not be possible to ever achieve a definition of this field that would be accepted as the dominant perspective. This suggests that having more than one definition, with distinct definitions focused on different purposes, might be at least a useful complement to a "one size fits all" approach.

As a sample implementation of a definition targeted toward a specific purpose, this paper suggests a specialized definition focused on the topics that students need to learn to prepare them for the types of careers that are and will be available in this field. The proposed definition is sufficiently broad to encompass the diversity of common understandings of employment prospects within the field, and yet prescriptive enough to guide decisions about what should or should not be included in academic curricula. The proposed definition could also help counter erroneous ideas among prospective students about the future viability of the field for their careers in view of the increasing trend toward outsourcing of information-technology-related organizational functions, most prominently software development.

2. BROAD DEFINITIONS?

Previous attempts at identifying the field of information systems have typically sought to provide definitions that could encompass the major stakeholders. For example, Alter (2008, p. 463) says that a definition of IS "should help practitioners and educators. It should provide direction for researchers."

However this "one size fits all" approach is based on an implicit assumption whose validity is not seriously questioned, perhaps because it seldom gets surfaced. The assumption is that the topics that need to be covered in information system curricula largely overlap the topics in the field that receive the most academic research.

That assumption ignores the fact that researchers in industry—in firms such as Microsoft that produce technologies, or in consulting firms such as Forrester Research—have immensely more resources than academic researchers. They can work at their research on a full-time basis, and they have much more money to obtain resources that are necessary to or useful for their studies. They are not at all constrained by the glacial pace of academic publishing, which is in marked contrast to the rapid pace of innovation in the field, to get their findings to their clients. Thus it is difficult for typical academic researchers to make significant research contributions to many aspects of topics that are important to the education of students in this field. (Westfall, 1999)

3. A SPECIALIZED DEFINITION

This paper proposes a definition of information systems in terms of the careers that its graduates are preparing for and going into, and the knowledge and skills they need for those positions. Identifying the field in terms of "where the jobs are" focuses on our two most important stakeholders: our students and the organizations that hire them.

An employment-based definition also deals with a problem that has long vexed attempts at a definition. In contrast to most of the extant definitions, it excludes very specialized topics that involve information or information technology just as much and in the same general ways as topics that are widely recognized as part of the field.

3.1 Sample Definitions

Authors of new definitions of IS typically refer to previous definitions. Alter (2008) provides a table summarizing 20 different definitions published between 1985 and 2007. This list does not include earlier definitions e.g., Mason and Mitroff's (1973) seminal, albeit quaintly capitalized defining statement about the object of study: "An information system consists of, at least, a PERSON of a certain PSYCHOLOGICAL TYPE who faces a PROBLEM within some ORGANIZATIONAL CONTEXT for which he needs EVIDENCE to arrive at a solution, where the evidence is made available through some MODE OF PRESENTATION." However the list does show that there have been many different attempts to identify the field. The number of available definitions, in conjunction with their publication dates, also demonstrates by implication that no consensus has developed in regard to what the field actually is.

From a research perspective, a further analysis of a more comprehensive list of definitions over an even longer period might be conducted to show how perceptions of the field have evolved over time. However given the rapid rate of change in the field and the way that it spawns innovations that are quite different from what came before, the potential benefits of attempts to extrapolate from such changes are dubious.

Instead of doing a broad survey going back to the early days of the field, consider the following examples published in the first decade of the new millennium. Also note how different they are from each other.

Alter defines information systems as a subset of work systems in which people and/or machines perform processes and activities to produce products and/or services for internal or external customers. "An IS is a work system whose processes and activities are devoted to *processing* [emphasis added] information." Alter (2008, p. 451)

Alter also indicates that processing information is a necessary component of IS and that systems that use information technology (IT) extensively but don't process information (to any great extent?) are not IS. For example, he specifically excludes "package delivery systems, highly automated manufacturing systems, medical systems that include physical examination or treatment of patients, and transportation systems that use IT extensively." Alter (2008, p. 451)

The Laudon's *Management Information Systems*, currently in its 12th edition (Laudon and Traver, 2011), and one of the most popular (Amazon, 2012) general IS textbooks, defines IS (p. 15) as follows: "An information system can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and

control in an organization. In addition … information systems may also help managers and workers analyze problems, visualize complex subjects, and create new products."

3.2 A Composite Definition

Bacon and Fitzgerald (2001, p. 46) define IS as a field that is a composite of five major sub-areas: "(1) IS development, acquisition & support (2) people & organization, (3) information & communications technology, (4) operations & network management, and (5) information for knowledge work, customer satisfaction & business performance." They identify the last item as the "central, distinguishing theme for the field." Their definition was based on reviews of the literature, course syllabi, curricula proposals; surveys of critical issues in industry and management; and Delphic surveys of academics.

There are several advantages to this approach. First it is *not* a broad and general definition that is so vague that it could easily include topics that many people in the field would not categorize as being part of IS. Second, it does reflect what is being taught in the field, because it is based in part on reviews of course syllabi.

On the other hand, there are some significant weaknesses in this definition. It is retrospective, reflecting what has been important in the field in the past. However IS is a rapidly changing field. To prepare our students for the future, we need to look at what will be important rather than just at what has been emphasized up to this time.

Another possible weakness is that Bacon and Fitzgerald's (2001) definition does not explicitly take into account the realities of a global economy. The availability of jobs in the field is an important issue for students who are studying IS. However specialties that can be outsourced on a large scale to other countries with lower wages are probably not going to be helpful to many careers.

4. KEY ISSUES TO CONSIDER

4.1 IT as the Focus or as a Means to an End?

There are numerous technologies that appear to be very consistent with most definitions of the field of IS. They certainly involve processing information to produce services, corresponding to Alter's (2008) definition. They also involve processing of information to support decision making, as in Laudon and Traver's (2011) definition. However they typically are not taught in information systems programs.

IT is used in organizations to meet organizational objectives. In most organizations in developed countries, hardly any office workers don't use some form of IT. However the majority of employees are not IT professionals. The distinction derives from whether the IT is the focus of the activities, or as an enabler or facilitator of other activities.

For example, accountants use accounting software. Marketers may use geographic information systems (GIS). Some financial analysts use sophisticated data mining tools. Professionals use such sophisticated tools help them do their jobs, which typically do not involve coordinating and facilitating the acquisition, introduction, use and maintenance of IT in their organizations.

As a result, such technologies are not mainstays of IS programs. As an example, GIS were taught in the 1990s in the CIS program at California State Polytechnic University in Pomona. However the courses were dropped because students in the CIS program were generally uninterested, and there were not enough students from other parts of the university to compensate. GIS are now being taught in the Geography Department. (However the latter unit has expressed interest in having CIS program instructors handle the teaching again. In addition to the requirements of their own field, the technical aspects of keeping up with software issues in this area, including writing code to further exploit its possibilities, would be a substantial burden for the other department.

Another distinction is the breadth of IT use. Skills that most college-educated professionals need (in contrast to specialized software such as GIS), such as office productivity software—word processing, spreadsheets, presentations—are generally and appropriately taught in information systems programs to many students who will not be strongly associated with IT itself in their careers.

4.2 Interfacing between Technology and Organizations

As mentioned above, there is no shortage of definitions of definitions of IS. Adding yet another relatively unique one to the list probably would not be helpful. Instead, in the spirit of cumulative science, this paper suggests building on Bacon and Fitzgerald's (2001) work, incorporating salient aspects and modifying it to deal with perceived weaknesses.

Looking closely at their definition, it is apparent that it is a hybrid. The first four parts represent an enumeration of four narrower subtopics—development, people/organizations, technology, and management. The last, which they describe as central and distinguishing, is about the broader information/knowledge aspects of the field and is similar to many of the other, more general definitions that have been proposed.

I first suggest that the last item—their broad, general overarching theme—needs to incorporate ideas about the focal point of the field of information systems. I define this as the organizational space between: (1) relatively non-technical managers and employees in organizations, and (2) very technical employees and outside developers and/or providers of information technology (IT) products and services that the organization is or will be using. Figure 1 shows a graphical representation of this focal point.

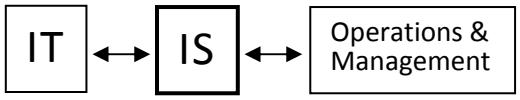

Figure 1: The Information Systems Organizational Space

This first enhancement emphasizes the coordination role of the IS function. On the right are the organizational personnel, who have extensive skills and knowledge related to their own operational and managerial functions in the organization, but generally lower levels of knowledge and skills related to information technology. On the left are the providers of information technology—hardware vendors, software developers, consultants, etc. Some of the latter may be inside or outside the organization. They also have high

levels of skills and knowledge in their own areas, but often a limited understanding of the functions and needs of the primary functional organizational employees.

In between are the IS personnel. They know and understand more about their organizational functions than the vendors and developers, and more about the technologies than the non-technical personnel in the organization. Because of their education in both technical and business issues, they can effectively serve as an interface between the vendors and developers and the remainder of their organizations.

4.3 Recognizing the Implications of Outsourcing

Since the proposed definition is employment-focused, it needs to deemphasize areas where employment will be declining (White and Tastle, 2006). Thus the second enhancement is to qualify the information systems role as functions that would be difficult and/or undesirable to outsource ("offshore") to countries other than where the organizations are based. This qualification provides IS students the assurance that the jobs they are preparing for will not leave the countries where they live.

On the other hand, this does not mean that outsourcing is being overlooked or that there will be fewer employment opportunities for students with IS degrees. Outsourcing should actually lead to more employment opportunities in IS. Economics teaches us that, except in unusual situations, demand increases when costs decline. Spector (2008, p. 198) indicates that "there is high price and innovation elasticity of demand for software people." In other words, the increase in demand is greater than the decline in costs. Thus, other things being equal, to the extent that software becomes cheaper through outsourced development, demand for people in other parts of the information technology supply chain should rise at a greater rate.

Since outsourcing requires extra coordination and other costs (Dibbern, Winkler and Heinzl, 2008), and much of this coordination would require the knowledge and skills of employees within the IS space between organizations and technology suppliers, employment in this space should grow disproportionately larger. The situation becomes an increasing share of a larger pie.

From an employment perspective, it is also necessary to shift the focus from the past and present to the future, because job opportunities in some categories will be declining, and will be increasing in others. So the third enhancement is adding a clause requires early adaptation to emerging information technologies and innovative uses of current and new technologies that will provide substantial employment in the future. This enhancement justifies adding a category for security-related issues to Bacon and Fitzgerald's (2001) enumeration of sub-areas of the field.

4.4 IT Employment

In that this paper argues for a definition is focused on employment, it would be appropriate to look at employment information. The Appendix shows data from the U.S. Bureau of Labor Statistics (2012) on projected employment and job openings in the United States for various computer-related occupations, sorted by total openings.

Note that the "computer programmer" category is projected to have only 12 percent growth in total employment, which is lower than in any other category except for the miscellaneous "computer applications, all other" category. This is consistent with a shift away from positions that focus primarily on computer programming, which can be offshored quite easily if the systems can be designed and specified accurately enough.

Much of the growth is instead in positions which require more interfacing between technical and non-technical personnel or other value-added capabilities. "Systems analysis," which is the prototypical organizational position in the interface between business and technology, is projected to have 222,500 openings (employment growth plus replacements), more than any other IS-related category other than computer support specialists. The "database and systems administrators and network architects" category is projected to have 207,900 openings. Although more allied with software engineering than IS, the two "software developers" categories—which typically require more analysis and interfacing than generic programming—are also projected to have strong growth.

5. THE PROPOSED DEFINITION

5.1 Putting It All Together

Taking all the above into consideration, the proposed definition now becomes: Information systems is the field that prepares substantial numbers of students for positions and functions within the organizational space between: (A) relatively non-technical managers and employees in organizations, and (B) very technical employees and outside developers and/or providers of information and communication technology (ICT) products and services that the organizations are or will be using.

This definition is further qualified by a strong focus on: (C) functions that would be difficult and/or undesirable to outsource to countries other than where the organizations that will employ these students are located, and (D) early adaptation to both emerging information technologies and innovative uses of current and new technologies that will provide substantial employment in the future. Such early adaptation will necessarily require monitoring and evaluation of developments in the field of ICT, and may lead to additions to and changes in the topics enumerated below.

Currently this space is largely defined by relatively larger aspects of the following subcategories: "(1) IS development, acquisition & support" *(except for intensive computer programming)*, "(2) people & organizations, (3) information & communications technology, (4) operations & network management (Bacon and Fitzgerald, 2001, p. 46), and" (5) *information assurance & security issues*. Their definition was modified with the addition of the italicized text to the first item. Also the last item in their definition was replaced to highlight the emerging importance of security-related issues, and also because its previous content has essentially been incorporated into the front-end of the proposed new definition.

A more concise version of the above would be: Information systems is the field that prepares students to interface between non-technical organizational

employees/managers and very technical IT professionals, with a focus on functions that are unlikely to be offshored. It includes general categories of ICT use that currently and/or will employ substantial numbers of employees in organizations.

5.2 Comparison with Curriculum Guidelines

The proposed definition reflects an educator's perspective on preparing students for employment in the information systems field. Thus it should be generally consistent with recognized most recent curriculum guidelines for the information systems discipline in particular, as well as have some correspondence with computing curricula in general.

Computing Curricula 2005 - The Overview Report (Joint Task Force for Computing Curricula, 2006) provides an overarching perspective on five major computing disciplines: computer engineering, computer science, information systems, information technology, and software engineering. It summarizes the evolution of computing disciplines from the 1960s to the time of the report, and discusses the rationale for their differentiation into these five distinct academic programs.

A comparison of the content of Computing Curricula 2005 with the discussion in this paper reveals a correspondence in their overviews. This paper emphasizes the contrast between IS and CS while Computing Curricula 2005 notes a similar pattern but includes more disciplines on either side of the less-versus more-technical divide. Both this paper and that curriculum report also note the parallel distinction of being less- or more-closely associated with organizational needs. The significance of these distinctions is reinforced by Computing Curricula 2005 adding information technology to IS on the one side, and computer and software engineering to CS on the other sides of those divides.

IS 2010 - Curriculum Guidelines for Undergraduate Degree Programs in Information Systems (Topi *et al*, 2010) doesn't attempt to provide a concise definition of the field. However in "The Scope of Information Systems," the last section of part 7 ("Information Systems as A Field of Academic Study") of the report, it provides a broad descriptive overview. The first paragraph notes that the field "encompasses the concepts, principles, and processes for two broad areas of activity within organizations: 1) acquisition, deployment, management, and strategy for information technology resources and services … and 2) packaged system acquisition or system development, operation, and evolution of infrastructure and systems for use in organizational processes …"

The proposed definition in this paper is generally compatible with the IS 2010 description. However it differs from it in the amount of emphasis on several aspects. This paper is more explicit in regard to IS functioning as an interface between technology and technologists on the one side and less technical organizational personnel and activities on the other. This paper also specifically includes the impacts of outsourcing and emerging technologies on employment prospects as significant considerations in curriculum decisions.

6. AN IMPLEMENTATION OF THE DEFINITION

California State Polytechnic University, Pomona, is in the Carnegie classification a "Master's Colleges and Universities" institution. It is teaching-oriented, with faculty instructing up to nine courses per year. Since the "Business Information Systems" program was started at this school in the early 1970s, faculty in the program have been operating on the basis of an employment-oriented definition of information systems such as suggested in this paper (although not always explicitly recognizing it as such).

Even though this program (now identified as Computer Information Systems or CIS) would not be recognized as a leading IS program or a peer of IS programs in Doctorate-granting Research Universities, the emphasis on an employment-oriented operating definition of IS has made it quite successful in terms of its graduates competing for jobs with students from more highly-ranked universities. Some well-known IT firms that recruit primarily at Research I universities also recruit at Cal Poly. This reputation may in part be because it has been operating on the basis of an employment-oriented definition of IS as suggested here. Especially note:

6.1 Skills Needed In Organizations

Since the inception of the CIS program, the emphasis has been on skills needed for employment in this field. Cal Poly participated in the development of the Data Processing Management Association's Model Curriculum in the early 1980s (Mitchell and Westfall, 1981) and has continued to emphasize industry requirements in its course offerings since then. The program and curriculum have evolved, matured and adapted to the changes within the field. Encouraged by the polytechnic philosophy of "learn by doing,", the faculty focuses on their students' understanding and participating in the processes of planning, designing, developing, testing, implementing and maintaining organizational information systems. This includes ensuring the availability, integrity, security and reliability of these systems.

This skills emphasis is reinforced by the requirement that faculty who teach in the program have at least three years of industry experience, as mentioned in the Position Details for an opening in 2012 (Faculty Affairs, 2012). Many of the faculty have had substantially more industry experience, including the author with over ten years in system design, development and support in a 26-year business career.

Cal Poly has a number of alumni who have been successful in careers in or related to information systems. Some of them are on an industry advisory board. Feedback from this source, as well as industry scanning by individual faculty, become inputs to the ongoing process of managing the "portfolio" of course offerings. As an indicator, the CIS program had 35 course listings in the 2001-2003 catalog (Cal Poly Pomona, 2001), and has 37 in the 2011-2012 catalog (Cal Poly Pomona, 2011). The change is based on dropping five courses which had become outmoded or overlapped other course offerings, and adding seven. Four of the new courses are related to information assurance and security, and the other three are for non-CIS majors with a view toward attracting more students into the program.

6.2 Interface Aspects

The Cal Poly Business Information Systems program was one of the first information technology programs housed in a college of business in the United States. It was reputedly the largest in the country in the 1970s (Mitchell and Westfall, 1981). As is typical in such programs, all the students are required to take programming courses. Other courses with programming components include database and web development, and telecommunications.

All the students also receive a thorough coverage of organizational activities as part of the requirements for a degree from the College of Business. Although few graduates go into computer programming—Cal Poly has computer science and software engineering majors for that purpose—this combination provides a strong grounding in both the technical knowledge and skills and organizational issues needed for the interface between organizational and technical functions.

6.3 Technical Emphasis

Identifying information systems personnel as occupying the interface between IT suppliers and the less technical aspects of organizations still leaves the question of how much technical knowledge is needed. Cal Poly requires all CIS majors to complete a six-course core requirement that includes both an introductory and intermediate Java course, and courses in object-oriented systems analysis, databases, web development, and telecommunications. After that, the students must complete four other courses (or three courses and an internship), followed by a team senior project course, to graduate.

The CIS program sees this broad technical emphasis as critical to the success of our graduates in functioning in an interface role. For example, having significant experience with programming provides a basis for a deeper understanding of security issues. However the technical depth is less than that in the computer science program, as indicated by the emphasis on applications rather than theory in the courses (and is also suggested by the substantial number of transfers from CS into CIS, although some of those may be motivated by an interest in a more business-oriented program). For the most part, our students are learning to interface with programmers and other very technical personnel, not primarily do that kind of work.

6.4 Forward-looking Approach

Seeing the value of the object-oriented paradigm, Cal Poly started teaching the SmallTalk programming language in 1993. When Java became more prominent, the core programming courses were switched to it later in the 1990s, well before most schools started teaching any object-oriented languages in either IS or Computer Science programs. The program started teaching object-oriented analysis and design soon after that, and incorporated UML (unified modeling language) into the systems analysis courses in the late 1990s. (After a brief trial of an object-oriented version of COBOL, that language was dropped from the curriculum before the transitory, Y2K-induced surge of interest.)

The Equity Funding scandal in the 1970s involved computer systems that recorded fictitious life insurance policies and other fraudulent assets. Responding to this situation, the American Institute of Certified Public Accountants (AICPA) established standards for information systems auditing (Gallegos et al., 2004). Cal Poly initiated one of the first undergraduate courses in Computer Audit and offered one of the first graduate programs in IT Audit in the United States. This topic became a part of DMPA's Model Curriculum for Undergraduate Education in Information Systems (Gallegos et al, 2004).

Building on this base, the Cal Poly CIS department developed an Information assurance program with multiple courses in that area (IT Audit, IT Security, Computer Forensics, etc.) around 2002. As a result Cal Poly was recognized as a National Center of Excellence in Information Assurance Education in 2005 by the Department of Homeland Security and National Security Agency.

7. SUMMARY

As a way of accommodating the diversity of the field, this paper argues for the need for more than a single, unitary definition of information systems. It then develops an employment-oriented definition to demonstrate an application of this approach. It concludes with an example of the use and benefits of such a definition.

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APPENDIX

Total US Employment and Projections for Computer-Related Occupations

	Employment (000)		Change		Openings
Employment Category	**2010**	**2020**	**(000)**	**Percent**	**(000)**
Computer support specialists	607.1	717.1	110.0	18.1%	269.5
Computer systems analysts	544.4	664.8	120.4	22.1%	222.5
Database and systems administrators and network architects	458.0	588.5	130.6	28.5%	207.9
Software developers, applications	520.8	664.5	143.8	27.6%	197.9
Software developers, systems software	392.3	519.4	127.2	32.4%	168.0
Network and computer systems administrators	347.2	443.8	96.6	27.8%	155.3
Computer programmers	363.1	406.8	43.7	12.0%	128.0
Information security analysts, web developers, and computer network architects	302.3	367.9	65.7	21.7%	110.3
Computer and information systems managers	307.9	363.7	55.8	18.1%	102.8
Database administrators	110.8	144.8	33.9	30.6%	52.7
Computer occupations, all other	209.7	222.0	12.3	5.9%	51.6
Computer and information research scientists	28.2	33.5	5.3	18.7%	10.6
Total Computer Occupations	4191.8	5136.8	945.0	22.5%	1677.1

Source: U.S. Bureau of Labor Statistics (2012)
Notes: entries are sorted by employment openings; rounding affects numeric changes shown in the table.

STATEMENT OF PEER REVIEW INTEGRITY

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