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Audience Structure and the Failure of Institutional Entrepreneurship

Abstract

Across a wide range of empirical settings, research on institutional entrepreneurship has focused on how actors are able to successfully create and transform institutional arrangements. Yet few studies have examined why institutional entrepreneurs may fail. This paper examines how audience structure can lead to entrepreneurial failure through a historical analysis of Edmund Berkeley's efforts to legitimize the notion of computers as "Giant Brains." As a prominent early computer expert and institutional entrepreneur, Berkeley occupied a strong structural position within the insurance industry, enjoyed high status, was widely recognized as a leading authority on computers, and possessed plentiful resources. Nevertheless, he foundered in establishing his innovative vision for the computer, especially in his own industry, insurance, because of its centralized audience structure. In manufacturing, on the other hand, a more decentralized audience structure allowed for a partial legitimization of Berkeley's vision.

Introduction

Over the course of the last two decades, work on institutional change and agency has emerged as the dominant strain of research within institutional analysis (Battilana, Leca & Boxenbaum 2009). At the core of this line of inquiry is the concept of institutional entrepreneurship, which was proposed to characterize the strategic behavior of actors who mobilize their skills, knowledge, and other resources to create or transform institutions (DiMaggio 1988). Across a wide variety of empirical settings, scholars have subsequently investigated how individuals and organizations are able to successfully generate new organizational forms (Greenwood, Suddaby & Hinings 2002), spread novel practices (Rao, Monin & Durand 2005), or institutionalize new norms and beliefs (Oliver 1991) .

One of the central goals of research on institutional entrepreneurship has been to determine a common set of factors that enable entrepreneurs to successfully alter existing institutional arrangements or construct new ones altogether. And drawing on organizational, cultural, and social movement theory, scholars have identified key elements that characterize successful institutional entrepreneurship, such as recognizing opportunities for change (Leblebici et al. 1991), developing sufficient resource capacity (Ganz 2000), framing the issue appropriately (McAdam, McCarthy & Zald 1996), and winning the support of key organizations and individuals (Maguire, Hardy & Lawrence 2004).

However, existing research on institutional entrepreneurship is limited in at least two ways. First, scholars have focused almost exclusively on cases in which entrepreneurs were able to accomplish their strategic objectives and effect institutional change. By contrast, little attention has been paid to those factors that cause entrepreneurs to fail. Yet in order to explain why and

how institutional entrepreneurs succeed in some cases, we also must understand why they are unsuccessful in others. Second, much of the existing research focuses on characteristics and efforts of the entrepreneur at the cost of considering who or what they are trying to change (Aldrich 2010). A full account of institutional change not only addresses who initiates the change, but also how it is received and processed by incumbents and other actors (Fligstein 1997). Groups interpret and respond to the efforts of an institutional entrepreneur differently and their interactions can influence whether change occurs. Yet the audience perspective is largely absent in the institutional entrepreneurship literature.

This paper addresses this research gap by examining the historical case of Edmund Berkeley's efforts to legitimize the notion of new business computers as "Giant Brains." As a pioneering evangelist from the insurance industry, prominent early computer expert, and leading advocate for the use of computer technology in insurance and more broadly, Berkeley seemingly possessed all of the necessary attributes to be a successful institutional entrepreneur. He occupied a central structural position and enjoyed high status within the insurance industry, was widely recognized as a leading expert on computers, and had strong, diverse connections to other actors both within the insurance industry and outside of it. Moreover, his position as one of the leading authorities in this nascent field provided him with access to considerable resources that he was able to wield to advance his strategic objectives. As an innovator in his field, he was able to perceive and articulate the transformative opportunity that computers represented, framing them as "Giant Brains" that could be leveraged to enhance decision-making capabilities within firms. While this conceptualization was well received by the popular press and in other industries, the insurance industry rejected the brain imagery in favor of a more conservative interpretation of the computer. Rather than viewing computers as Giant Brains, they conceived of the computer as a transaction-

processing machine, an interpretation that characterized computers as an extension of existing tabulating machine technology.

The difference in these responses to Berkeley's framing allows us to investigate the role of the audience in institutional change. Our study demonstrates the critical role that audience structure may play in obstructing change even when actors perceive and attempt to act on opportunities for change (DiMaggio 1988; Fligstein 1997; Levy & Scully 2007). In our case, we compare the insurance industry, which rejected the "Giant Brain" view of the computer, with the manufacturing industry, which partially supported that view. When it came to interpreting the computer, the insurance industry constituted itself as a relatively centralized structure of similar groups, while the manufacturing industry was more decentralized, allowing for different opinions to surface. More specifically, the three most relevant insurance associations formed committees to investigate what the computer was and how it could be used within insurance. These committees shaped the insurance industry's conceptualization, adoption, and use of the computer over the subsequent decade. Actuaries, accountants, administrators, and systems men – powerful occupations within insurance organizations – dominated these committees. Berkeley's "Giant Brain" image did not fit with these groups' interest in preserving their strong standing within the insurance industry. More generally, we build the argument that proposed institutional changes must more directly fit in with centralized audience structures; decentralized structures, on the other hand, place fewer constraints on assimilation.

Our analysis of Berkeley's inability to legitimize the idea of computers as "Giant Brains" in the insurance industry demonstrates why institutional change is frequently so difficult to achieve and why institutional entrepreneurs so often fail. Building on this empirical analysis, we develop a

theoretical approach to institutional entrepreneurship that situates the entrepreneurial efforts of individual actors within a system characterized by the structure of its audience and subject to distinct historical macro-structural processes that present significant obstacles to the realization of their entrepreneurial projects.

In the rest of the chapter, we briefly synthesize the existing literature on institutional entrepreneurship, paying particular attention to those factors that are understood to be necessary ingredients for success and those that may contribute to failure. After some notes on data and methods, the empirical section is divided into two main parts. First we map the early discourse around computing in the insurance and manufacturing industries. Second, we present Berkeley's proposed institutional change, and then look at the varied responses to it from the insurance and manufacturing industries. We examine explanations for this difference suggested by existing literature, and then propose an alternative framework that better explains why Berkeley was unable to realize his strategic objectives in spite of possessing all the necessary factors. In the conclusion, we discuss implications and extensions for institutional theory, as well as business and technology history.

Institutional Entrepreneurship

The failure to articulate an endogenous explanation for institutional change represented a crucial limitation of early neo-institutional work (Christensen et al. 1997). In order to rectify this shortcoming, DiMaggio (1988) proposed the concept of institutional entrepreneurship to characterize the behavior of actors who strategically mobilize their skills, knowledge, and other resources to create or transform institutions. Subsequently, work on institutional entrepreneurship has emerged as a central strain of research within institutional analysis (Leca,

Battilana & Boxenbaum 2008). Scholars have expanded their initial focus beyond how institutional arrangements are created to also examine how entrepreneurs transform or deinstitutionalize existing institutions (e.g. Ahmadjian & Robinson 2001; Oliver 1992; Scott et al. 2000). The primary focus of much of this work has been to discern the field conditions that foster entrepreneurship (Strang & Sine 2002), to elaborate the characteristics and social position of effective entrepreneurs (Lawrence & Suddaby 2006: 15), or to identify the different types of strategic behavior in which successful entrepreneurs engage.

Field Conditions

Scholars have identified a variety of field conditions that create space for entrepreneurs to act. In particular, researchers have pointed to different types of crises that enable actors to identify opportunities for change. These include political and economic uncertainty (Fligstein & Mara-Drita 1996), regulatory changes (Edelman 1992), resource scarcity (Durand & McGuire 2005), social upheaval (Maguire et al. 2004), and technological innovation (Munir & Phillips 2005). Maguire et al. (2004), for example, show how the emergence of HIV/AIDS during the 1980s empowered community organizations with strong ties to the HIV/AIDS community, leading to new practices of consultation and information exchange among pharmaceutical companies and community organizations.. As in this example, change may be precipitated by shocks to the environment such as the emergence of HIV/AIDS. However, it may also surface from within the field itself (Durand & McGuire 2005) or from friction at institutional interstices (Clemens & Cook 1999: 449 - 450). Overlap between competing institutions can create “contradictions” (Seo & Creed 2002) that threaten the stability of existing institutional arrangements and introduce opportunities for change.

Consequently, one of the central challenges for institutional entrepreneurs revolves around problem or opportunity identification. Yet scholars disagree about whether fields that are turbulent or stable are more conducive to identifying problems or opportunities. Fligstein (1997: 404), for example, argues that when “the organizational field has no structure, the possibilities for strategic action are greatest.” By contrast, Beckert (1999: 783) contends that stable environmental conditions create greater possibilities for institutional entrepreneurs to engage in strategic action precisely because they provide “the basis for actors to calculate the effects of their actions.”

Social Position

In addition to the influence of field conditions on actors’ ability to successfully identify change possibilities, scholars have also classified an entrepreneur’s social position (Garud, Jain & Kumaraswamy 2002; Rao, Morrill & Zald 2000), or subject position (Maguire et al. 2004), as an important factor in shaping entrepreneurial success. Yet scholars also disagree about the consequences of an actor’s position within the field on their ability to effect change. On the one hand, studies have found that actors located on the periphery of a network are more likely to engage in entrepreneurial activity than those located at the center (Battilana 2006; Leblebici et al. 1991). On the other hand, others have found that change comes more often from the core (e.g. Rao, Monin, & Durand; Greenwood & Suddaby 2006), driven by actors with more diverse networks, higher status, and the clout to implement new things.

Whether in the core or in the periphery, an actor’s position within the field may provide strong ties to other actors, facilitate the transfer of information and other key resources, and endow the actor with legitimacy and formal authority (2006). Building on Aldrich (1999), Dorado (2005)

maintains that entrepreneurs' links to other actors within their network shape their ability to identify and realize prospects for change. Likewise, Lawrence (1999) suggests that entrepreneurs' social position may help them mobilize resources.

Nevertheless, entrepreneurs must have the requisite social skill (Fligstein 1997) to mobilize support for their actions. They must build alliances (Lawrence, Hardy & Phillips 2002), foster collaboration (Hardy & Phillips 1998; Phillips, Lawrence & Hardy 2000), and incentivize key stakeholders. For example, experts may facilitate change by diffusing practices, creating standards and rules, and using their professional authority to validate entrepreneurs' claims (Hwang & Powell 2005). Establishing linkages to other actors provides entrepreneurs with access to novel resources and information, thereby enhancing their strategic adaptability (McCammon et al. 2008) and capacity (Ganz 2000).

Strategic Behavior

Research on institutional entrepreneurship has focused extensively on the conditions that promote problem/opportunity identification and on entrepreneurs' characteristics and position in a field. Yet it has paid less attention to the strategic behavior that entrepreneurs adopt to generate new institutions or transform existing ones. To the extent that it has, it has focused primarily on entrepreneurs' use of discursive strategies, particularly collective action framing (Benford & Snow 2000; Snow & Benford 1988), to specify existing institutional shortcomings and legitimate proposals for change (Seo & Creed 2002; Tolbert & Zucker 1996). Discursive strategies are important because the degree to which a frame resonates with its intended audience influences entrepreneurs' ability to mobilize resources upon which success often depends (Snow & Benford 1988; Zuo & Benford 1995). Rao et al. (2000: 244), for instance, maintain that, "Institutional

entrepreneurs can mobilize legitimacy, finances, and personnel only when they are able to frame the grievances and interests of aggrieved constituencies, diagnose causes, assign blames, provide solutions, and enable collective attribution processes to operate.” In order to do so, entrepreneurs often transpose or recombine practices and forms that are perceived to be legitimate. As such, successful entrepreneurial projects are often the recombination of “existing materials and structures, rather than ‘pure’ novelty” (Hwang & Powell 2005: 180).

Methodology

Given the general lack of research on institutional entrepreneurship failure, we combined theory elaboration (Lee 1999) and theory generation (Eisenhardt, 1989; Graebner and Eisenhardt, 2010) in our analysis. Thus, we were aware of the existing literature on institutional entrepreneurship, and we used the relevant constructs to inform our historical analysis of computers in insurance and manufacturing. As such, we followed Ingram, Rao, and Silverman’s (2012) call for more theoretically informed historical analysis. In particular, we developed a historically grounded understanding of conditions for change within insurance and manufacturing, and of Berkeley’s structural position and strategic behavior. Since we are also interested in the differences in response among the insurance and manufacturing industries, we also analyzed the data from this perspective.

We chose to study the commercial introduction of the computer because the introduction of a radical innovation often creates opportunities for institutional change (Hargadon and Douglas, 2001). By computer, we mean the “business computer” - the technology used to process and manage mainstream corporate applications (as opposed to computational computers, which were originally used in the military). In studying Berkeley’s attempt to effect institutional change, we

chose the insurance and manufacturing industries as our sample, primarily for theoretical reasons (Graebner and Eisenhardt, 2010). These groups differ in how they responded to the new conceptualization of the computer, allowing us to assess the effects of the audience in the institutional entrepreneurship process. Berkeley came from the insurance industry, making it the obvious starting point. We chose manufacturing as the comparison group because it allows us to partially control for alternative explanations, which we address later in the paper.

Since we are interested in institutional change, our data collection strategy focused primarily on the emerging discourse about the computer. Our assumption is that written discourse and exchange represented the belief systems and underlying cognitive understanding of the technology (this is a common approach in the management literature, see (Barr, Stimpert & Huff 1992; Tsoukas 2009). Thus, from a data perspective, we tracked the discourse about existing technology, Berkeley's and competing interpretations of the computer, as well as reactions and changes to existing conceptualizations of office technology. Since much of this discourse centered on how the computer should be used, we also collected data on the actual computer usage as a confirmatory measure of actual institutional changes.

We concentrate our analysis on the mid-1940s to the late 1950s. A nice feature of the computer case for our analysis is that groups within insurance and manufacturing developed conceptualizations of the computer before they adopted the computer in 1954. This allows us to partially isolate aspects of the institutionalization process from technical characteristics and from adoption and use processes. Thus, our time period captures early efforts to understand what the computer was before it was actually commercially available in 1954, as well as the initial period of use of the computer. We stop our analysis in the late 1950s, as technological changes and

learning by using the computer may have altered these initial interpretations of the computer.

In the insurance industry, the discourse about the computer concentrated among certain occupational groups and trade associations (Yates, 2005): The Society of Actuaries (SOA), Life Office Management Association (LOMA), and Insurance Accounting and Statistical Association (IASA). We collected the discourse regarding office technology in general and specifically regarding the computer from the proceedings of these three associations. We also used the Edmund C. Berkeley papers at the Charles Babbage Institute of the University of Minnesota to document Berkeley's early interactions with the computer industry on behalf of Prudential Life Insurance Company (Yates 1997). These papers identify different groups with whom Berkeley interacted, including computer vendors, academics, and other technical professions. Based on these interactions, we also collected data on these groups and their perspectives. We leverage Bingham and Kahl's (Forthcoming) content analysis of this discourse to characterize Berkeley's proposed interpretation and show how it differs from existing conceptualizations. Unlike the insurance industry's discourse, the manufacturing industry's discourse was concentrated at the occupational and firm level. Similar to our data collection strategy in insurance, we collected proceedings and journal discourse about the computer from various occupation and trade associations, as well as firm-level data, particularly from General Electric.

Finally, we supplemented our primary archival data with secondary discussions about Berkeley and about occupational perspectives on computing. To capture how the computer was used, we turned to the Controllershship Foundation, which conducted surveys of early computer usage from various industries from 1954 – mid-1958. We compiled the survey results for the insurance and manufacturing industries to capture early computer usage.

The Field Conditions for Change and Berkeley's Structural Position

To present our analysis, we first consider the factors identified in the institutional entrepreneurship literature that are understood to be necessary for success. In this section, we focus on the enabling conditions for change within insurance and manufacturing and Berkeley's structural position. In the next section, we address Berkeley's strategic behavior. To determine Berkeley's structural position, we describe Berkeley's background and contacts and analyze the general connections between different groups involved in the discourse about the computer. We then present a stylized network map showing Berkeley's strong structural position.

Field Conditions for Change in both Insurance and Manufacturing

At the industry level, manufacturing and insurance were clearly different. Insurance was a heavily regulated industry that competed more on efficiency than through product differentiation. By contrast, manufacturing was less regulated and competed more on product differentiation. However, both industries faced significant growth challenges and uncertainty during this time period. From 1948 to 1953, the dollar value of life insurance in force grew 51%, and the total number of insurance policies (a better indicator of information processing volume) rose by more than 24% (Bureau of Labor Statistics 1955). Growth in insurance employment was 12% during the same period, which was not enough to keep up with the increased data processing load. As a post-war life insurance boom exacerbated the wartime clerical labor shortage, insurance firms looked to technology as a possible solution to the need for increased efficiency. Manufacturing also faced significant growth, but of a different nature. Coming out of WWII, manufacturing was moving from mass-production to providing customers with more product choice. The increase in

product variation made the production process more complex, from sales forecasting through production planning and distribution. Thus,, manufacturing viewed technology as a possible solution to deal with this increased complexity and uncertainty.

Berkeley's Interests and Contacts

Edmund Berkeley earned a BA in mathematics and logic from Harvard University in 1930.¹

After a brief time at Mutual Life Insurance of New York, Berkeley joined the actuarial department at Prudential Life Insurance Company in 1934. Although he excelled in actuarial work, becoming a Fellow of the Actuarial Society, he moved to the methods department in 1941. Within this group, Berkeley drew upon his educational training in symbolic logic to examine its potential application, in combination with new types of electromechanical machinery, to Prudential's methods and processes. In particular, Berkeley promoted the application of symbolic logic to improve punch card tabulating operations. In a 1941 memo, Berkeley advocated an "Algebra of electric accounting [i.e., tabulating] punch card operations: ...If a successful algebra is constructed, the most efficient and economical chain of machine operations to perform a given job will be able to be determined mathematically, and similar problems will be solved mathematically" (Yates, 1997, p. 25). Berkeley was quite prolific on this subject, writing many internal reports on it in the early 1940s (see Longo 2004).

Through his early work, Berkeley became well connected within the academic and practitioner community working on early computing issues. In December 1941, Berkeley helped form the New York Symbolic Logic Group, which included several professors from New York universities, several representatives from insurance, and Dr. Claude Shannon of Bell Labs, who would later be

¹ Except as otherwise indicated, this section on Berkeley is drawn from Yates, 1997.

credited with founding information theory. He also attended the Numerical Computational Devices Symposium, a largely scholarly event sponsored by the Institute of Mathematical Statistics, the American Statistical Association, and the American Mathematical Society. In his report back to Prudential, Berkeley expressed interest in Wallace J. Eckert's paper on punch card calculations in astronomy. Eckert would be hired by IBM after the war and become the first head of Watson Laboratory. Berkeley also met another IBM employee, John C. McPherson, and invited him to attend the newly formed New York Symbolic Logic Group. A paper presented by MIT's S.H. Caldwell on the differential analyzer, with comments by Norbert Wiener, also impressed Berkeley (Longo, 2004). Norbert Wiener would go on to be a major figure in the cybernetics movement, a field that was interested in the workings of the human mind and its relationship with computing. Wiener was a prominent member of the Macy Conferences (1946 – 1953) that helped established the field of cybernetics, publishing two popular books on the subject in 1948 and 1950. Berkeley continued to interact with members of this group by attending mutual conferences such as the Symposium of Large Scale Digital Calculating Machinery at Harvard in January 1947.

Beyond embedding himself in emergent academic fields, Berkeley also interacted with early firms developing new computational devices through his role as a methods expert at Prudential. Before the war, he visited General Electric and Bell Labs. His internal Prudential reports reveal a developing interest in how computing devices could be used within insurance operations and their potential limitations. At the end of November 1942, Berkeley left Prudential to serve in the Naval Reserves for four years. He spent part of that time (August 1945 – April 1946) at Harvard, where he observed and worked with Howard Aiken on the Mark I automatic sequence controlled calculator and helped construct the Mark II. After his service ended in 1946, he intensified his

vendor and developer contacts. In total, Berkeley initiated a total of 60 visits with individuals and groups from Aug. 1 to Dec. 31, 1946. Most notably, he visited Wallace Eckert, now at IBM, at the Watson Laboratory at Columbia University. In addition, he met with another IBM employee, R.R. Seeber Jr., who was involved in the development of the Selective Sequence Electronic Calculator. And he also visited Bell Labs and RCA. Throughout these visits, Berkeley continued to identify specific potential uses of these devices in insurance, reporting his findings and recommendations to Prudential. His reports indicate that IBM, ERA, and Raytheon did not impress him as potential vendors of this new technology.

Rather, Berkeley was much more interested in the proposals of John W. Mauchly and J. Presper Eckert, Jr., who helped develop the ENIAC and founded the Electronic Control Company (ECC), which later became the Eckert-Mauchly Computer Company (EMCC). Berkeley worked closely with this group as they developed the UNIVAC, providing valuable information about Prudential's (and the insurance industry's) information processing and verification requirements. As a result of these interactions, EMCC (which was subsequently bought by Remington Rand in 1950) proposed a computing solution for Prudential, which Berkeley endorsed and for which Prudential eventually signed a contract (but ultimately did not install).

In 1948, shortly after making his recommendation, Berkeley left Prudential to form an independent consulting and publishing company. During this time period, he reached out to two groups interested in the computer: interested members of the general public and a more technical group of computer enthusiasts. In 1949, Berkeley published the book, *Giant Brains, or, Machines that Think*, which was aimed at the general public. This popular book (which sold an estimated 15,000 copies by 1959) represented his most detailed discussion of what a computer

was and how it could be used, as will be described later in this chapter. Also during this period, Berkeley sought to develop an association that would enable engineers, academics, mathematicians, computer vendors, and anyone with a more focused and technical interest in computers to freely share ideas and information. This association engaged many of the technical people he had met throughout his experiences at academic laboratories and computer vendors (Aker 2007; Longo 2007). And by 1947, Berkeley had received letters of interest from 175 people representing 64 different organizations (Aker, 2007). In September 1947, Berkeley convened the first meeting of the Eastern Association for Computing Machinery at Columbia University. By the beginning of 1948, the association had 350 members and dropped Eastern from its name to become the ACM. Berkeley assumed the role of secretary and worked with the executive council to establish the association's by-laws and governance structure. The ACM would continue to grow, becoming a prominent association in the growing computing field, an association that is still active today.

Computer Discourse in the Insurance Industry

As a prominent member of the insurance community, Berkeley also interacted extensively with the three insurance professional and trade associations that were trying to learn about the computer during the immediate post-war era: the Society of Actuaries (SOA), the Life Office Management Association (LOMA), and the Insurance Accounting and Statistical Association (IASA).² SOA, the most prestigious, was a professional society formed in 1889, while LOMA and IASA were occupation-based trade associations. LOMA was formed in 1924 to provide a means for executives and managers to share ideas about systematic office management, including

² There were at least two dozen national insurance associations at around this time, but only these three devoted substantial attention to computing technology (Yates, 2005, 18-19).

the use of office technologies such as tabulating equipment and eventually computers. IASA was formed in 1928 to focus on the use of office technology to support the accounting and statistical functions within the insurance industry. All three had yearly meetings (with published proceedings) at which members presented papers about relevant topics, including their use of pre-computer punch card tabulating systems and their interpretations of the computer. IASA and LOMA also had technology committees that provided yearly progress reports on the latest developments in office technologies, and they sponsored exhibits at the meetings where members could interact with the manufacturers' sales forces about their latest machines. Berkeley frequently presented papers at the meetings of each of these societies. In fact, in 1947 he presented his early impressions of the computer to each society (Berkeley, 1947a, 1947b, 1947c).

Around this time, each of these associations formed a committee to investigate what the computer was and how it could be used in insurance. In 1947 the Society of Actuaries established the "Committee on New Recording Means and Computing Devices," composed of actuaries from the 1st (Metropolitan Life), 4th (Equitable Life), and 14th (Connecticut Mutual) largest U.S. life insurance firms (Yates 2005). Malvin Davis, the Chief Actuary of Metropolitan Life, acted as the chair. This small, centralized committee presented its initial findings and recommendations in an influential 1952 report that would become a blueprint for computer conceptualization, adoption, and use in the insurance industry for over a decade. This report was widely circulated in the insurance industry. In addition, committee chair Malvin Davis was frequently invited to present their findings about the computer at other academic and management conferences.

The committees in the other two associations were similarly small and centralized. Berkeley himself helped form the LOMA committee. Rather than produce reports, the IASA and LOMA

committees sponsored conferences, jointly and individually, in the early 1950s. LOMA and IASA cooperated with Remington Rand to create the “Remington Rand Forum on the Use of Electronics in the Insurance Industry” in 1950, very shortly after that manufacturer’s acquisition of the Eckert Mauchly Computer Company, at which it presented its (still under development) UNIVAC. In 1953, IASA culminated its efforts by independently organizing a two-day conference entitled “Electronics and Its Future in the Insurance Industry,” which included representatives from IBM and Remington Rand and considered applications of computers in insurance in more detail than the earlier Forum.

The generation of these reports and conferences built on pre-existing and deep relationships between these associations and IBM and Remington Rand, which were the two vendors of pre-computer tabulating technology; both firms were now both moving into computers (Remington Rand by acquiring EMCC, and IBM by racing to develop internal capabilities in this area). Interaction of SOA, LOMA and IASA committees with other potential vendors was limited or absent. Certainly, LOMA’s and IASA’s computer conferences only involved representatives from IBM and Remington Rand. The SOA report mentioned no vendors, but clearly reflected knowledge about the UNIVAC, and the committee is known to have run tests of its recommended application on an IBM pre-computer punch card system.

Thus discourse about computers in the insurance industry centered on the report of a small, centralized committee of actuaries and two conferences run by committees of two other associations. It also focused on two vendors already well known to the industry.

The manufacturing industry had a different pattern of discourse regarding the computer. Rather than concentrating discussion within select committees in just three occupational associations, manufacturing discourse was more broadly disseminated among various occupations and firms. Occupations varied in their interest and use of the computer. For example, accounting was primarily interested in how they could properly control and audit business processes that used computers, whereas production planning was interested in how they could leverage the computer to create new ways of managing production (Kahl, King & Liegel Working Paper). As manufacturing firms assessed whether to invest in computing, they paid close attention to these different groups.

For example, consider General Electric, which implemented one of the first commercially available computers for businesses, Remington Rand's UNIVAC, at a new appliance division in Lexington, Kentucky in 1954. In a *Harvard Business Review* article detailing the implementation, Roddy Osborn, a key manager involved in the project, argued that computer operations should not be considered the province of a single department, but as a "data processing center" that served different groups' needs. He argued that "The important concept here is that it [the computer] was not centralized accounting or centralized payroll, but rather centralization of the routine "dog" work involved in each of these operations" (Osborn 1954, p. 106).

One important emergent group in manufacturing was operations research. Operations research emerged from computer work done in WWII and sought to develop and apply management science and computation techniques to improve business practices. Many of their techniques were related to the broader cybernetics movement in that they leveraged computer techniques such as linear programming, queuing theory, and simulation to solve business problems.

Operations research groups developed specific applications for manufacturing, including inventory analysis and sequencing of shop floor activities.

Another influential viewpoint also directly tied with manufacturing was the growing interest in office automation. John Diebold (1952) of Harvard Business School developed the concept of automation in his popular book in 1952. For Diebold, automation meant more than computerizing clerical work as described in the GE implementation. Rather, automation involved feedback that could help control and optimize the process, a concept which resonated with the cybernetic movement. In fact, Diebold even references cybernetics in a paper delivered at an automation conference. Automation became a hot topic in the 1950s, with several conferences and many papers written about the topic. Manufacturers frequently attended these conferences. Insurance firms were much less represented, although Malvin Davis of the SOA computer committee presented at an early conference in 1947.

Finally, unlike insurance firms, manufacturing firms relied on consultants to help purchase and implement computers. For example, GE used Arthur Anderson in their feasibility studies to determine whether to invest in the computer and to help with the programming of the computer itself (see McKenna, 2006; Accenture, 2005). Osborn explained, “we found it wise to employ an independent management consulting firm (Arthur Andersen & Co. Chicago), experienced in computer logic and developments. This firm has been particularly helpful in training personnel, arranging management orientation meetings, and planning conversion of initial applications” (Osborn, 1954: 106). In contrast, the data collected from the insurance community shows little engagement with consultants. Instead, insurance firms performed their own feasibility studies (Kahl & Yates Working Paper).

Berkeley was not in direct contact with manufacturing in the sense that his writing did not appear in manufacturing-related journals and proceedings. However, he was aware of manufacturing and did refer to manufacturing examples in his *Giant Brains* book. He also would have interacted with manufacturing firms at joint conferences, especially as it related to the ACM. So, while there is not a direct tie between Berkeley and manufacturing, his views as represented in the cybernetics movement and the ACM did enter the manufacturing realm.

Summary of Berkeley's Structural Position

Figure 1 provides a stylized diagram of the network relations between the emerging computing community including Berkeley, on the one hand, and the insurance and manufacturing communities interested in computers, on the other, before the computer's adoption in 1954. To construct the map, we coded a tie between groups if they interacted, typically by direct visit as in the case of computer manufacturers, or through joint participation at a conference. Since we are primarily interested in Berkeley's position as an institutional entrepreneur, we first coded the groups that Berkeley interacted with and then, to build out the rest of the map, we considered the interactions of the primary groups within insurance (professional and trade associations) and manufacturing (occupational groups).

Figure 1 highlights Berkeley's strong structural position within the emerging computing community. While both insurance and manufacturing had ties to computing vendors and other important groups, Berkeley's network was more extensive – reaching a greater variety of vendors and academics. In addition, he developed deeper ties in the sense that in some cases he actually worked with other groups or played a primary role in the governance of the association as in the

ACM. This extensive network both broadened his exposure to different ideas and provided Berkeley the political clout to influence others' interpretation of the computer. The complexity and difficulty of understanding computing further solidified his position. In Latour's (2007) language, Berkeley was a "translator" – trying to convey the new technology in terms others who lack such privileged access could understand. Based on this position, the institutional literature predicts that Berkeley was well positioned to successfully effect institutional change, particularly in the insurance industry, but also in the manufacturing industry.

The "Giant Brain": Berkeley's Proposed Institutional Change

In addition to identifying possibilities for change and leveraging the strengths of their structural position, successful institutional entrepreneurs seek to change belief systems, norms, and taken-for-granted cognitive perspectives through strategic behavior. In this case, the institutional change corresponds with the introduction of a radical new technology, the computer, and entails establishing interpretations about this new technology, as well as beliefs about office technology in general. To adequately measure the institutional change requires developing an understanding of existing beliefs toward technology and how Berkeley sought to change this perspective.

Berkeley was an early mover in that he presented some of the first reports about computers in the insurance associations in 1947. These papers provided at least two images of the computer, one as a machine similar to existing tabulating machines and one as a human brain. Berkeley's conceptualization of the computer as a thinking brain was influenced by his educational interest in symbolic logic and his ties with the cybernetic movement. Berkeley further developed this analogy in his *Giant Brains* book. The analogy links the relations associated with human thinking to the processes that the computer performs:

These machines are similar to what a brain would be if it were made of hardware and wire instead of flesh and nerves. It is therefore natural to call these machines mechanical brains. Also, since their powers are like those of a giant, we may call them giant brains (Berkeley 1949, p. 1).

Throughout the book, he develops the analogy to identify the functional and relational characteristics of the computer that correspond with how human brains think. He further defined thinking in terms of specific processes: “a process of storing information and then referring to it, by a process of learning and remembering” (Berkeley 1949, p. 2). He categorized this process along three main functions: “Calculating: adding, subtracting, ...; Reasoning: comparing, selecting, ...; Referring: looking up information in lists, ...” (Berkeley 1949, p. 181). For Berkeley, computers use symbolic languages and physical equipment to handle, transfer, remember, and reason with information just as the human brain uses natural language and nerve cells.

By describing the computer as a thinking machine, Berkeley emphasized using the computer to help make business decisions. For example, the business example he provides in his *Giant Brains* book details how the computer can be used to help schedule and plan production within a factory:

The machine takes in a description of each order received by the business and a description of its relative urgency. The machine knows (that is, has in its memory) how much each kind of raw material is needed to fill the order and what equipment and manpower are needed to produce it. The machine makes a schedule showing what particular men and what particular equipment are to be set to work to produce the order. The machine turns out the best possible production schedule, showing who should do what when, so that all the orders will be filled in the best sequence. What is the “best” sequence? We can decide what we think is the best sequence, and we can set the machine for making that kind of selection, in the same way we decide what is “warm” and set the thermostat to produce it! (Berkeley 1949, p. 1).

Within insurance, Berkeley (1947a, 1947b, 1947c) explained that a computer could be used to decide whether to underwrite an applicant for insurance.

Bingham and Kahl (forthcoming) analyze the content of Berkeley's conceptualization of the computer and show that it significantly departed from conventional thinking about office technology and its uses in insurance. They treat conceptualization in terms of a schema – the categories and their relations and show the differences between Berkeley's brain analogy and the pre-existing schema. The existing schema concentrated around categories such as “clerk,” “punch card,” “policy,” “tabulator,” and “machine,” and the relations between these categories centered on creating or inputting information on cards through the action of a “punch,” processing the punch cards (“sort,” “file,” “merge,” “matching”), and writing out the output (“print,” “list,” “post”). The brain analogy, in contrast, contained mainly new categories and relations associated with decision-making: categories, such as “problem” and “operation”; and relations, such as “solve,” “examine,” and “think.” In fact, their analysis reveals that the brain analogy only shared 12% of the pre-existing schema categories and 26% of the relations. Consequently, both in terms of the language used to describe the computer and the proposed uses of the computer, Berkeley's conceptualization of the computer as a human brain represented a significant departure from prevailing interpretations of office technology.

Varied Responses from Insurance and Manufacturing

Despite Berkeley's strong structural position, his conceptualization of the computer as a brain met with mixed results. The insurance industry, in which his structural position was strongest, rejected Berkeley's view in favor of one that focused on efficient transaction-processing. In fact, early respondents to Berkeley's paper on computing at the Society of Actuaries' 1947 annual

meeting criticized the brain analogy. One respondent even mocked Berkeley, stating “I confess a certain apprehension that Mr. Berkeley may turn up next with automatic ears or atom-splitting digestive organs” (Wells 1947, p. 1). E.F. Cooley, Berkeley’s colleague from Prudential, argued: “I might use the term "giant brains" to tie in my subject with the more or less popular literature on this subject. But I hate to use that term since there are false implications in it, implications that these machines can think, reason and arrive at logical conclusions, and I don't agree that this is true” (Cooley 1953, p. 355). In an internal employee magazine, *Metropolitan Life* (1956) directly asserted that computers were not like brains and could not replace people. Bingham and Kahl (forthcoming) note that of the 26 papers about computing presented in the insurance associations, only 5 portrayed the computer as a brain, 4 of which were authored by Berkeley. The remaining 21, including the SOA 1952 report, presented a more incremental interpretation of the computer as a machine that processes transactions similarly to, but more rapidly than, a tabulating machine. In contrast to the decision-making emphasis of the brain analogy, they show that the transaction view emphasized how computers can “sort,” “merge,” and “punch” information to process transactions. Their analysis reveals that this transactional view of the computer dominated thinking within insurance.³

Moreover, this view also dominated early uses of the computer. Table 1 shows the most popular applications initially developed on the computer within insurance from 1954 to mid-1958 coded by whether they were transaction-oriented or decision-oriented applications (bold). 80% of the most frequent applications focused on transaction processes such as premiums – premium

³ They also show that over time the decision-oriented view consistent with Berkeley’s analogy prevailed. However, this transition cannot be attributed to Berkeley as much of the change occurred through learning by using, technological advancement, and criticism by consultants.

distribution, premium billing, premium collections, premium reserves⁴ – or accounting functions - payroll and commission accounting. Only 20% were decision-oriented applications, such as planning/budgeting, and underwriting.

In contrast, the manufacturing industry supported both Berkeley's brain analogy and the more incremental transaction-oriented view of the computer. Osborn's description of the GE implementation showed support for both views. He explained that computers should be used to reduce the "dog work" of a department, which supports the transactional view. However, he also recognized that the computer can be a "management tool" which supports the decision-oriented view. Table 2 shows the most popular applications initially developed on the computer within manufacturing, with similar coding as Table 1. While transaction-oriented applications like payroll are the most popular, the material and production planning applications that Berkeley highlighted as an example of using the computer like a brain in his book are also well represented. In fact, GE tried to implement both payroll and production planning applications, recognizing that the planning applications represented "new information" and a new way of doing things. In general, the most popular applications initially developed were relatively evenly split between transaction-oriented (52%) and decision-oriented (48%).

And the manufacturing industry was not alone in its acceptance of the brain analogy. It also permeated the popular imagination. One historian of the computer industry notes "By the early 1950s, through the reappearance of the term in many popular publications, 'giant brains' became the leading metaphor for early electronic digital computers" (Yost 2005, p. 1).

⁴ These applications reflect the Consolidated Functions Ordinary approach advocated in the SOA 1952 report.

Possible Explanations

What explains the difference in the acceptance of the brain analogy by insurance and manufacturing? To answer this question, we first consider potential explanations prevalent in the literature and show that they are incomplete. We then develop the argument that a more comprehensive explanation must consider the structure of the audience groups interpreting the proposed changes of the institutional entrepreneur.

Industry Differences

The industry differences between insurance and manufacturing can potentially explain why manufacturing accepted the brain interpretation of the computer and insurance did not. For this argument to be successful, however, manufacturing operations and processes themselves or the industry conditions must be more likely to support decision-oriented applications than insurance operations or conditions. Yet closer examination of work practices in both industries reveals that both had a mix of transaction-oriented and decision-oriented processes, and that uses of earlier technology favored transaction-oriented processes. However, each industry faced different kinds of challenges that can help explain the differences in their responses.

First, both industries involve a combination of transaction and decision-oriented processes. In insurance, the activities associated with actuarial studies involved significant computations, and underwriting involved making decisions about whether to insure the potential customer. In fact, Berkeley even singled out underwriting as a brain-like use of the computer. Similarly, in manufacturing managing material requirements and production schedules also involved significant decision making, which Berkeley also singled out in his book. In addition, basic inventory control and customer order processing were more transaction-oriented.

Second, both insurance and manufacturing were early and important users of tabulating technology. By the 1940s, virtually all insurance firms used tabulating equipment. Indeed, IBM historians have noted that “Insurance companies were among the largest and most sophisticated business users of punched-card machines in the late 1940s and 1950s” (Bashe et al. 1986, pp. 176-177). Similarly, manufacturing was a heavy user of tabulating equipment and card filing systems. Production-oriented textbooks during the 1940s and early 1950s highlight the use of tabulating equipment and Kardex card machines to manage inventory records and assist in production control. In both cases, much of the existing technology was used to process transactions as opposed to make business decisions. In the case of insurance, firms had generally divided and specialized insurance operations as they grew, and they used tabulating equipment in line with this approach. A typical insurance application performed a single, narrowly defined operation such as computing policy premiums or payroll. In manufacturing, the card systems were used to maintain control over inventory as opposed to make decisions about inventory levels and determine when new inventory needed to be ordered.

However, while both industries had both types of processes and were significant users of tabulating technology, they experienced different challenges during this time. As noted, insurance faced issues of increasing efficiency given the clerical labor shortage, but manufacturing faced issues of growing complexity given the expansion of products after World War II. These differences certainly contributed to insurance’s focus on improving transaction-processing and manufacturing’s interest in improved decision-making around the production planning process. However, these industry issues do not completely explain the responses. As noted, manufacturing was just as interested in transaction-processing applications (see Table 2).

If we associate increased complexity with a focus on decision-making, some additional factor must be considered to explain the mixed interpretations and uses within manufacturing.

Technological Differences

Hargadon and Douglas (2001) argue that design features of a new technology can influence how customers think about it. In particular, design features that invoke existing institutional scripts can make them more recognizable and spur adoption. In the case of the early computer, there essentially were two different designs – one that resembled existing tabulating machines and one that did not. Perhaps the differences in interpretation of the computer between insurance and manufacturing could be explained in terms of the two industries adopting different kinds of computers with different design features.

Both of the tabulating incumbents, IBM and Remington Rand, offered computers that were radically different from tabulators, as well as devices that were only incrementally different. Remington Rand, through its acquisition of EMCC, had taken an early lead in computers that by design were radically different from tabulating machines. The Univac computer system filled a room with its large central processor, many Uniservo tape drives, and tape-to-card and card-to-tape converters. The room had to be specially prepared, with reinforced floors to support the weight and a powerful air conditioning system to reduce heat emitted from the many electronic tubes. This computer looked radically different from tabulators. Moreover, its selling price was around \$1.25 million, a substantial capital investment. IBM was working to catch up with the Univac technically, developing the large, tape-based 701 (available in 1953) for scientific and defense use and the 702 (available in 1955, but replaced by the more reliable 705 in 1956) for commercial use.

Both firms also developed more incremental devices with designs that shared fundamental features of both tabulating and computer technology. IBM intended its 650 model, released in 1955, as an interim, small computer to keep its installed base of tabulator users from moving to other computer vendors as it completed development of bigger, magnetic-tape-based computers (Ceruzzi 1998). The 650 shared some essential features of the larger, 700 series computers such as stored program capability, and some of tabulating machines, such as using cards rather than magnetic tape as its input, output, and long-term storage medium. Aside from technical differences, the 650 also closely resembled tabulating machines visually. The IBM 650 was housed in a cabinet of the same design and appearance as that of an IBM 604 tabulator, and it could be rolled into an existing tabulator installation to fit where the 604 had been (Yates 2005). Remington Rand also recognized the need for an incremental hardware solution for customers not yet ready for the large UNIVAC, and it released two smaller, punch-card machines (the UNIVAC 60 and 120) in the mid 1950s. However, these machines, which lacked any internal storage capability, were technically closer to tabulators than to computers. Although the UNIVAC 60 and 120 were reasonably successful in the tabulator market, they did not really compete with the IBM 650. Several other early entrants into the computer market offered small and inexpensive drum-based computers during the early and mid-1950s, but they were slow, harder to program, less reliable, and tended to require IBM punch-card peripherals for customers desiring card input and output (thus diverting much of the revenue to IBM) (Ceruzzi 1998, pp. 38-46).

If the technical design played a primary role in the emergent conceptualization of the computer, we would expect insurance companies to more readily adopt the smaller computers that resembled the tabulating machines as opposed to the larger, less tabulating like computers.

Consistent with this argument, 68% of insurance implementations used the smaller IBM 650; whereas, only 23% adopted the larger UNIVAC or IBM 700 series (Foundation 1958). However, manufacturing had similar adoption patterns: 65% bought the IBM 650 or comparable UNIVAC 60 or 120, and 27% adopted the larger UNIVAC or IBM 700 series. Moreover, this argument does not fit temporally. As described in the previous sections, both the insurance and manufacturing industries started to develop their conceptualization of the computer before it was commercially available. Therefore, while the technical design of the computer may have reinforced certain interpretations after 1954, it cannot fully explain the differences between these industries in accepting a particular conceptualization of the computer before commercial adoption in 1954.

Competition among Multiple Interpretations

Another possible explanation focuses on competing conceptualizations of the computer. Within insurance, Berkeley's brain analogy was not the only interpretation of the computer offered. As previously discussed, Bingham and Kahl (forthcoming) document a competing analogy that described the computer more as a tabulating machine. This interpretation emphasized the transaction processing aspects of the computer over the decision-making orientation of the brain analogy. It was the view presented by the SOA 1952 report and it was much more consistent with the pre-existing schema of office technology.

However, not unlike insurance, manufacturing was also exposed to broader competing views about the computer. Through operations research and participation within academic and industry conferences, manufacturing firms were exposed to the brain analogy associated with Berkeley and the cybernetics movement. However, the automation movement's heavy emphasis on

manufacturing also meant that they were exposed to the more transaction-processing emphasis of the computer as well. Osborn's description of the GE implementation showed support for both the transactional and decision-oriented view of computers. He explained that computers should be used to reduce clerical work, which supports the transaction view, but also recognized that the computer can be a "management tool," which supports the decision-oriented view. Consequently, since both groups experienced similar competing views, competition alone cannot explain the difference in acceptance of the brain analogy.

The Role of Audience Structure in Institutional Change

The previous explanations do not fully consider the audience who interprets the institutional entrepreneur's message. Sociologists have long connected the structure of social groups to their conceptual structure and how the groups respond to and integrate new information. Durkheim (1912 [2001]) argued that a group's conceptual structure reflects its social organization. Building off of Durkheim, Mary Douglas (1966) showed that the social structure of various religious groups played an important role in whether they accepted or rejected anomalous concepts. More recently, Martin (2002) argued that conceptual structures that are highly interrelated and those that have strong consensus are harder to change. Such structures reflect groups that have cognitive authority and a clear power structure – more centralized social structures that reflect homogenous views. Collectively, this work reveals the importance of examining the role of the social structure of the audience interpreting the institutional entrepreneur's proposals in the overall outcome of the institutional change. Consequently, we analyzed the social structure of both the insurance and manufacturing industries to understand which groups did the work of interpreting the computer.

Our analysis revealed that the insurance industry differed significantly from manufacturing in terms of the structure of how the new conceptualizations of the computer were received and processed. In insurance, this structure was centralized among similar groups put in charge of figuring out the computer (committees within 3 occupational associations). Using a typical organizational chart for an insurance firm from the 1950s (see Life and Health Insurance Handbook, 1955), we identified the various occupational groups that worked in a life insurance firm. We then investigated at what level each of these groups engaged in discussing the computer. Our analysis revealed that initially not all groups within the insurance industry were interested in the computer. For example, underwriters, insurance agents, and legal professionals did not develop the same level of discourse as the SOA, IASA, and LOMA. The main groups represented in these associations included actuaries, administration, accounting, and systems men (the group responsible for business forms development and process design (see Haigh, 2001). As a result, early discussion of the computer was centralized among only a few specific occupational groups within their associations.

In addition, as previously mentioned each of these associations formed committees to investigate the computer. For example, the SOA established The Committee on New Recording Means and Computing Devices for this express purpose. Such committees were a common organizational form within the insurance industry, used to govern and make risk decisions within the firm as well (Life and Health Insurance Handbook, 1955). Kahl and Yates (working paper) describe these committees as “cognitive authorities” (Martin’s term) in the sense that others within the group deferred to these committees to interact with the computer vendors and develop an interpretation of the computer and how it can be used within insurance. They argue that these groups were initially interested in learning more about the computer because they were heavily involved in the

application and management of existing office technology. For example, the bulk of clerical work to process billing and claims around policies occurred in the various sub-groups of office administration, whereas accounting functions such as payroll and premium accounting resided within accounting. The administration group also contained the technical groups responsible for maintaining office technology.⁵ For instance, “Systems men,” who were responsible for designing the forms as well as the processes used by office equipment, were part of these technical groups (Haigh, 2001). Actuaries used office technology mostly for computational purposes, while the administrative and accounting groups used technology to process routine business information.

We characterize this audience structure as centralized in the sense that there was relatively little occupational variation in who investigated how the computer should be used and by whom. These efforts were further concentrated within the committee members who had centralized control. To the extent that actuaries, administrators, and accounting represented different tasks and interests, they were more aligned in that they were heavy users of the pre-existing technology primarily for clerical operations. The most computationally focused group, actuaries, interestingly, did not focus on this kind of work in their initial analysis of the computer. Indeed, the SOA report on computing rejected actuarial applications as insufficiently large to justify acquiring this expensive and powerful technology and emphasized using the computer for processing of policyholder premiums – a transaction-oriented process that they eventually called Consolidated Functions Ordinary (this corresponds to the Premium functions highlighted in Table

⁵ Sometimes the methods group was under the control of accounting, specifically the controller who also was interested in business process control. (For more information on these analysts, see (Haigh 2001)).

1).⁶ In addition, Kahl and Yates trace how this conceptual discussion at the association-level transferred to the firm level. They show how the same occupational groups who dominated the early conceptual discussion prior to the release of the computer participated in the feasibility committees responsible for deciding whether the individual insurance firm would purchase a computer. Consequently, these groups had the authority to control how the computer was used inside the firm.

In contrast, the structure in the manufacturing industry was much more heterogeneous and lacked a centralized power structure. Unlike insurance, manufacturers did not develop cognitive authorities in the form of industry-wide committees that investigated what the computer was and how it could be used. Consequently, much of the early discussion about the computer occurred within different occupational groups – in particular, accounting, engineering, production planning (which was emerging as an occupational group during this time period – see Kahl, King, and Liegel (working paper)), and operations research. As previously mentioned, our investigation into the various journals and proceedings of these groups revealed that these groups varied in how they conceptualized the computer. Some, like accounting or industrial engineering, characterized the computer in Diebold’s language of automation, focusing more on transaction processing aspects of the computer and how to control computer processes. Others, like production planners and operations researchers, emphasized the brain-like uses of the computer to help make managerial decisions.

⁶ Because actuaries frequently became company presidents during this period, it is not surprising that they took a broader perspective than simply that of their department in the SOA report, looking at a range of possible applications and deciding that the policy-centered, transactional application was the best initial application for insurance companies.

At the firm level, similar to insurance firms, manufacturers formed groups to conduct feasibility studies on whether computing warranted investment (Haigh 2001). But the feasibility studies in manufacturing differed from insurance in significant ways. First, manufacturing was more likely to bring in external consultants to help with the process. Roddy Osborn, the system manager in charge of the GE computer implementation, identified “Employ a competent consultant” as his number one recommendation for planning for a computer (Osborn, 1954: 107). Consulting external partners introduced different opinions. Second, whereas in insurance the feasibility committee exercised authority to which others within the organization deferred, in manufacturing these committees did not exercise this authority. Instead, they often sought input from different groups. For example, at GE Osborn was “Not content with presenting the opportunities as we saw them, we asked all managers and supervisors to review the areas of their respective operations and search for activities in which high-speed data processing would be helpful. We suggested that they report all possible applications, for us to consider until proved practicable or impracticable (Osborn, 1954:102).” Part of this rationale of getting input from different groups was to develop broader support for the computer once implemented. Osborn explained that the “Selling” of computer applications involves offering initial applications to all management functions” (Osborn, 1954: 101). Finally, once the computer was implemented at GE, Osborn argued that computer operations should not be considered the province of a single department, but as a “data processing center” that served different groups’ needs.

To summarize, through the use of committees with members of select occupations at the industry-level and within the firm, the insurance industry developed a centralized structure of similar groups who exercised their authority over the computer. In contrast, manufacturing lacked the centralized structure and sought out more diverse opinions from the different occupational groups

within the firm, as well as from external consultants. Table 3 illustrates the implications of these different audience structures. It aggregates the applications implemented from each industry from the Controllershship surveys by the different occupational groups. For the insurance industry, close to 83% of all applications initially implemented were for the centralized groups - the administrative, accounting, and actuarial occupations. In contrast, a broader array of occupations implemented applications within the manufacturing industry. In fact, linking Table 3 with Table 2 also shows that different occupations had different interpretations of the computer. That is, most accounting applications were transactional in nature, whereas, operations research was more decision-oriented and manufacturing applications mixed both transaction and decision-oriented applications.

More generally, examination of the different social structures of audiences interpreting and using the computer in insurance and manufacturing helps explain why Berkeley was unsuccessful in selling his conceptualization of the computer to insurance, but had partial success with manufacturing. Berkeley's view of the computer as a brain that supported decision-oriented applications did not fit with views of the groups who had centralized authority over interpreting the computer and who were interested in preserving the status quo. Because manufacturing had less centralized control in its discourse around the computer, there were fewer constraints on assimilation, allowing Berkeley's views to resonate with some of the occupational groups. The more heterogeneous groups given a voice in the manufacturing audience allowed for more variety of opinion.

Conclusion

By documenting the role that actors and agency play in processes of institutional change, the

growing body of research on institutional entrepreneurship has rectified a crucial limitation of early neo-institutional analysis. To date, however, scholars have focused almost exclusively on cases in which entrepreneurs were able to successfully effect institutional change. From these studies, scholars have identified a set of factors common to entrepreneurial success. These elements include field conditions that allow for problem/opportunity recognition, sufficient resource capacity, framing that resonates with potential constituents, and the support of key organizations and individuals. While such studies provide valuable insights into why institutional entrepreneurs are occasionally successful, they do little to explain why efforts to create or change existing institutional arrangements so often fail. This suggests that in order to better understand why some entrepreneurs succeed, research on institutional entrepreneurship needs to pay greater attention to failure.

Consequently, our analysis of Berkeley's inability to legitimize the idea of computers as "Giant Brains" in the insurance industry contributes to the literature on institutional entrepreneurship by demonstrating why institutional change is frequently so difficult to achieve. Despite Berkeley's ability to recognize the transformative potential of the computer, his strong structural position within the insurance industry and nascent computer community more broadly, his access to resources, and strong ties to other prominent actors in this emerging field, Berkeley was unable to institutionalize his vision of the computer as a Giant Brain. In our historical case, neither technological differences, nor industry variation, nor a lack of competing interpretations about the computer can fully explain the failure of giant brain analogy within the insurance industry. Rather, our analysis highlights the importance of the audience structure in shaping the success or failure of institutional entrepreneurship. Because groups interpret and respond to the efforts of an institutional entrepreneur differently, a more comprehensive account of institutional change must

address not only who initiates the change, but also how it is received and processed by incumbents and other actors within the field (Aldrich, 2010). Differences in how these actors perceive change initiatives may well determine whether or not an institutional entrepreneur is able to succeed. In our case, we have examined primarily customers who adopt the technology, but in this volume there are more complex technologies that act as platforms that mediate transactions between different audiences (see Cusumano, 2012 and Leblebici, 2012). This work suggests that additional work could be done to investigate contexts in which there are multiple audience members and how this influences the institutionalization process.

In our case, we show that the key factor in determining whether or not the view of computers as Giant Brains was accepted was the specific audience structure present in each industry. Our study demonstrates the critical role that centralized audience structures may play in obstructing change even when actors perceive and attempt to act on opportunities for change. The insurance industry, through its committees dominated by actuaries, accountants, administrators, and systems men, was characterized by an audience structure composed of high status actors with clear centralization of control. These powerful occupational groups perceived the Giant Brain image, with its emphasis on enhancing decision-making capabilities, as threatening to their interests. By contrast, the manufacturing industry exhibited a decentralized audience structure in which a diverse range of groups without clear centralization of control and status provided input into how the computer was to be used and for what purpose. While some groups within manufacturing conceived of and indeed used the computer largely as a transaction-processing machine, other groups emphasized its decision-making capabilities. These latter groups were much more receptive of the Giant Brain analogy. This decentralized audience structure allowed for the partial support of the “Giant Brain” view of the computer within the manufacturing

industry in contrast to the insurance industry, where it was rejected.

Our findings have important implications for the strategy of institutional entrepreneurs. Since the audience structure represents a critical element in determining the success or failure of entrepreneurs' change projects, entrepreneurs must pay close attention to the social structure of the field they are trying to transform. To stand a chance of success with centralized audience structures, proposed changes must be perceived to be non-threatening and even complementary to the established power hierarchy. In contrast, decentralized audience structures place fewer constraints on entrepreneurs and likely demand less in terms of assimilation. As a result, entrepreneurs have more leeway in proposing changes that are liable to be seen as radical.

Lastly, while this historical case shows how the politics and audience structure surrounding institutional entrepreneurship may lead to the failure of specific institutional projects in the short-term, such failures may lay the groundwork that leads to the transformation of the broader institutional environment over time. Even though Berkeley's conceptualization of the computer as a giant brain was initially rejected by the insurance industry, Bingham and Kahl (forthcoming) show that decision-oriented rhetoric gradually replaced the transactional view over the next twenty years. They attribute this shift to learning by using the computer, advances in computing technology in data management and processing, criticism from consultants, and the rise of the "systems movement" within insurance. They also show that this transition involved the re-integration of the decision-oriented perspective that dates back to Berkeley's "Giant Brain" metaphor. So, while Berkeley himself was not able to change beliefs and attitudes about office technology or about the computer in the insurance during the 1950s, his ideas laid the groundwork for eventual institutional change. Future historical analysis should investigate the

delay in this transformation as a means to better understand the temporal dynamics of institutional change.

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Figure 1: Network of Early Discussion of the Computer, 1945 – 1954

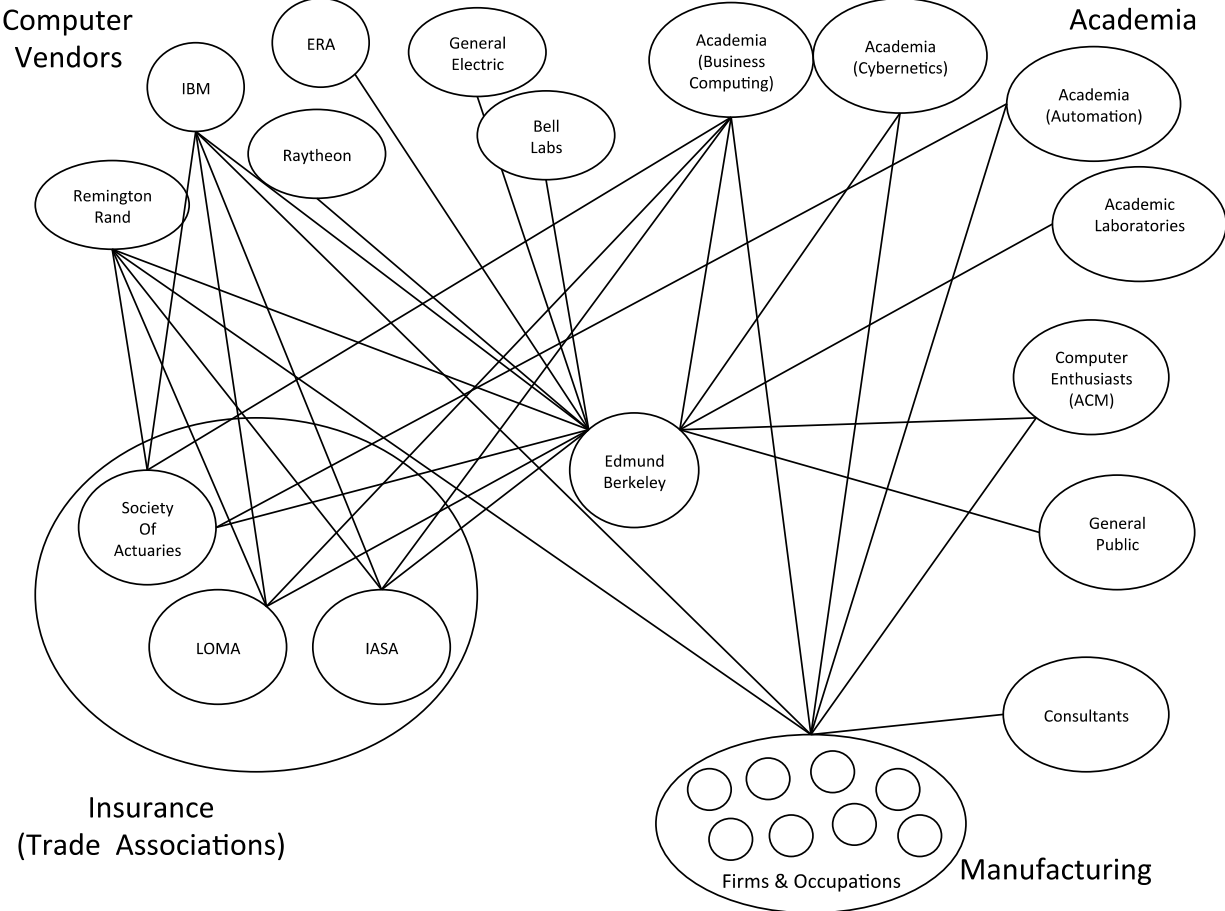


Table 1: Early Uses of the Computer in the Insurance Industry, 1954 – mid 1958

Computer Application	Frequency
Commission Calculations/Accounting	26
Premium Distribution	26
Premium Billing	23
Actuarial Studies	23
Valuation of Reserves	18
Payroll	16
Premium Collections	16
Loan Accounting	16
Dividend Procedures	15
Premium Reserves	15
Policy Issue	11
Claim Distribution	11
Expense Distribution	11
Automotive Rating	10
Financial /Operating Reports	10
State Book Reports	9
Underwriting Experience	8
General Accounting	8
Sales or Revenue Accounting	7
Employee Benefit Plan Accounting	7
Customer Billing	6
Sales Revenue Analysis	6
Accounts Receivable	5
Personnel Records	5
mortgage loan accounting	4
Labor Distribution	4
Special analysis for planning/control	4
district agents records and production synopsis	4
premium payment records	3
Planning/Budgeting	3
ROI	3
Accounts Payable	2
Selective Underwriting	2
Cost Accounting	2
Agency Experience	2
Mortgage Amortization	2
Total	343
% Transaction-Oriented	80%

% Decision-Oriented

20%

Bold = decision-making application.

To code applications, we referred to descriptions of how firms used these applications. In cases where there were no descriptions, we coded applications with the words “report”, “planning”, or “budgeting” as decision oriented applications since these words are associated with managerial decision making. Lastly, our default was transaction-oriented applications.

Table 2: Early Uses of the Computer in the Manufacturing Industry, 1954 – mid 1958

Computer Application	Frequency
Payroll	147
Labor Distribution	102
Cost Accounting	88
Engineering Computations	80
Employee Benefits	75
Material Production Requirements	66
Inventory Control	64
Sales Revenue Analysis	57
Production/Planning	52
Finished Stock Inventory	51
Sales or Revenue Accounting	50
Special analysis for planning and control	48
Design Problems	45
Scientific Research	43
Raw Material and Stores Inventory	43
Customer Billing	41
General Accounting	38
Operations Analysis	38
Planning/Budgeting	37
Personnel Records	37
Financial /Operating Reports	35
Purchase Planning & Control	31
Accounts Payable	29
Sales Forecasting	24
Machine Load Scheduling	22
Accounts Receivable	20
Economic Research	19
Salesman Incentives	9
Process Control	9
Work Labor Control	8
Total	1408
% Transaction-Oriented	52%
% Decision-Oriented	48%

Bold = decision-making application.

To code applications, we referred to descriptions of how firms used these applications. In cases where there were no descriptions, we coded applications with the words “report”, “planning”, or “budgeting” as decision oriented applications since these words are associated with managerial decision making. Lastly, our default was transaction-oriented applications.

Table 3: Occupational Concentration of Early Computer Usage, 1954 – mid 1958

<u>Insurance Industry (1954 - Early 1958)</u>		<u>Manufacturing Industry (1954 - Early 1958)</u>	
Occupation	Percentage of all Applications	Occupation	Percentage of all Applications
Administrative	35.2%	Manufacturing	27.5%
Accounting	30.9%	Accounting	27.4%
Actuary	16.6%	Human Resources	14.9%
Agent	5.6%	Sales	12.8%
Investment	5.6%	Engineering	11.3%
General Management	3.3%	Purchasing	2.1%
Underwriting	2.6%	General Management	1.7%
Legal	0.3%	Shop Floor	1.4%
		Distribution	0.5%
Total	392	Computer Technicians	0.3%
		Operations Research	0.1%
		Total	1499