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## Academic entrepreneurship and institutional change in historical perspective

R. Daniel Wadhvani<sup>a</sup>, Gabriel Galvez-Behar<sup>b</sup>, Joris Mercelis<sup>c</sup> and Anna Guagnini<sup>d</sup>

<sup>a</sup>University of the Pacific, Stockton, CA, USA; <sup>b</sup>IRHIS, Université de Lille, Lille, France; <sup>c</sup>Department of History of Science and Technology, Johns Hopkins University, Baltimore, MD, USA; <sup>d</sup>Università di Bologna, Bologna, Italy

### ABSTRACT

This article provides a historical perspective on academic entrepreneurship and its role in institutional change, and serves as an introduction to a special issue devoted to the subject. Unlike approaches that define academic entrepreneurship narrowly as the commercialization of academic research, we argue that historical research and reasoning justify a broader conceptualization focused on the pursuit of future forms of value in academic knowledge production, application, and transmission. Understood in this way, academic entrepreneurship has long been a significant driver of institutional change, not only within the academic world but also in shaping the organization of markets and states. The article develops this argument in three major sections. First, it draws out themes implicit within the historiography of science and technology that highlight the role of entrepreneurship in reshaping academia and its relationship to society. Second, it establishes conceptual foundations for more explicitly examining the processes by which academic entrepreneurship acted as a driver of institutional change. Finally, it synthesizes the findings of the articles in the special issue pertaining to these entrepreneurial processes. The article concludes by arguing for the role of history in rethinking academic entrepreneurship in our own time, and by outlining directions for further research.

### KEYWORDS

Academic entrepreneurship; institutional change; history of science and technology; history of higher education

Entrepreneurship, we are often reminded, is an intrinsically elusive concept. It is all the more elusive when attempts are made to apply it to seemingly non-commercial fields of life. Over the past 20 years, a growing body of literature has been produced on one such field, namely academia (Rothaermel, Agung, and Jiang 2007; Siegel and Wright 2015a, 2015b). The main focus of this literature on academic entrepreneurship is on the commercialization of research and teaching activities carried out within higher education institutions. It often assumes that academic entrepreneurship is a relatively new development.

Institutions of higher education and research, however, have never been ‘ivory towers’ (Martin 2012; Shapin 2012). Especially from the nineteenth century, academic teachers and researchers have sought out opportunities related to the practical application of academic knowledge for the development of technologies, businesses, and novel social and governmental practices. In pursuing opportunities for the development of teaching and research

facilities, the launching of new disciplinary sectors, and the application of knowledge to other fields of social life, academic entrepreneurs often shaped or reshaped institutions, by defining strategies and mobilizing various resources. In some cases, these initiatives were directed toward important but relatively circumscribed aspects of the social and economic life that defined patterns of interaction between the academic world and the rest of society. In other cases, the efforts of academics as agents of institutional change were from the start of a more far reaching and strategic character. Irrespective of its scale, the consequences of academic entrepreneurship extended well beyond the immediate commercial or practical purposes that are sometimes associated with the goal or outcome of such efforts. In no small way, academic entrepreneurship played a role in shaping the trajectories of knowledge development, the structure of establishments where knowledge was produced and transmitted, and the relation of such structures to modern markets, society, and the state.

In this special issue, we examine the process by which academic entrepreneurship created institutional change in historical perspective, with an emphasis on the scientific and technological areas of academia. In doing so, we draw attention not only to the involvement of individual higher education scientists in entrepreneurial activities, but also to the collective and cumulative dimensions of academic entrepreneurship. Our focus is on the social processes and mechanisms through which academic entrepreneurship reshaped institutions and institutional orders. Historical research and reasoning provides an especially valuable way to examine the relationship between academic entrepreneurship and institutional change because it offers the critical distance and retrospective vantage point from which to consider the long-term consequences of entrepreneurial action, including the sometimes difficult to study processes of long-term institutional change (Wadhvani and Jones 2014).

This introductory article outlines the historiographical background for why the effort to analyze the relationship between academic entrepreneurship and institutional change is important, defines the key terms and conceptual underpinning for the issue, and introduces the main findings from the papers. We first clear the ground for a historical analysis of academic entrepreneurship by contrasting the focus on commercialization characteristic of much recent research with a number of findings emerging from the historiography of science, technology, and education that are also relevant to the theme of academic entrepreneurship. Next, we establish some key conceptual and theoretical foundations that allow us to define the framework in which the special issue has been cast. The subsequent section introduces the individual essays and highlights their common intellectual contributions. We end by discussing the implications of the special issue, how it seeks to make a contribution to the current debate on this theme, and possible paths forward.

### **Academic entrepreneurship and history: not just commercialization**

Our approach for studying academic entrepreneurship departs in a very important way from the large body of literature on the rise of entrepreneurship within academia that economists, sociologists, management scholars, and science and innovation policy researchers have produced in the last few decades. Scholars from this diverse group of disciplines have sought to examine and explain the changes that have been taking place in the organization of higher education and research systems since the WWII, notably the development of 'market' or 'entrepreneurial' universities (Berman 2011; Etzkowitz 2003). They have focused their attention on what they regard as the distinctive feature of that process, namely the direct

involvement of academic organizations and actors in the commercialization of knowledge originating from within those establishments. According to a comprehensive and oft-cited review of this kind of literature, for example, the majority of English language articles on academic entrepreneurship examined either (1) the creation of new firms or (2) the relationships between research universities' organizational design and their effectiveness in commercializing inventions (Rothaermel, Agung, and Jiang 2007). Over the past decade, academic entrepreneurship has continued to be discussed primarily in relation to university–industry technology transfer (see the literature survey of Siegel and Wright [2015a]). Moreover, even scholars who argue that a 'rethink' of academic entrepreneurship is necessary do not fundamentally question the emphasis on commercialization. Rather, they suggest looking beyond formal academic technology transfer offices and science parks and their involvement in patenting, licensing, and the creation of spin-off firms, and paying more attention to other forms of commercialization and the broader range of actors involved (Siegel and Wright 2015b).

A second feature of this set of works on academic entrepreneurship that stands in contrast to the approach of this special issue concerns the periods of time under consideration. Most of these studies do not go further back than the 1970s–1980s. There are, to be sure, some notable exceptions (Martin 2012). With regard to the European system of higher education, for instance, Geuna and Muscio (2009, 94) have pointed to organic chemistry as a field where academic scientists and business firms closely collaborated in the nineteenth century. Other scholars mention a few well-documented examples of scientists (for instance, the chemist Justus Liebig in Germany and the physicist William Thomson [Lord Kelvin] in Britain) who were involved in the creation of new business enterprises in the course of their academic employment (e.g. Etzkowitz 1983; Shane 2004). As for the other side of the Atlantic, there seems to be a growing awareness that entrepreneurial responses to market opportunities and pressures have long been a feature of the American higher education system (Etzkowitz 2003; Greenberg 2007, 83; Rosenberg and Nelson 1994; Washburn 2008, chapter 2). In particular, nineteenth-century Morrill Act land-grant colleges and universities, which initiated programs in agricultural science and other practically oriented fields, are frequently brought up as precedents to present-day universities with a mission to contribute to regional economic development. It is also acknowledged that U.S. universities' involvement in patent management activities predated the Bayh–Dole Act of 1980 by several decades (Mowery and Sampat 2001; Mowery et al. 2004). Still, consistent with Etzkowitz's (1983) claim that 'the traditional ethos of science did not permit [erosion of ...] the boundary between science and private, profit-seeking-business', the literature on academic entrepreneurship produced by these branches of scholarship continues, on the whole, to characterize such earlier cases as exceptions. The widespread assumption is that prior to the 1970s, academic scientists pursued work that 'interested them intellectually regardless of whether they had clear economic potential' (Berman 2011, 35). More often than not, earlier historical developments and events seem to be brought up to highlight what are supposed to be fundamental differences with the contemporary transformation of academia. The use of history in these studies, moreover, can be quite Whiggish and sometimes inspires a simplistic vision of entrepreneurial activity as a step in the natural evolution of a university system that emphasizes economic development in addition to the more traditional mandates of education and research' (Rothaermel, Agung, and Jiang 2007, 705).

To challenge this narrow focus on commercialization, as well as this use of history, this special issue draws on works of historians of science, technology, and education that throw light on the relationships between academic entrepreneurship and institutional change since the nineteenth century. It should be pointed out, however, that, with a few notable exceptions (e.g. Carlson 1988; Keith 1984), these historians have used the term ‘entrepreneurship’ – as well as the notion of ‘institutions’ – in a loose and sometimes metaphorical way rather than as clearly defined analytical concepts. In most cases, they have also not taken into account the ongoing debate on the meaning and significance of these concepts. Notwithstanding these important limitations, there are six themes that emerge from the historical literature that are especially relevant to this special issue and that, therefore, will be addressed in more detail in the following paragraphs. They concern (1) the integration of research into academia, including the creation of science laboratories and institutes; (2) entrepreneurial processes associated with the development and promotion of the scientific and technological disciplines; (3) attempts to reform teaching and educational curricula that involved processes of boundary crossing between academia and other spheres of social life; (4) academics’ involvement in institutional innovation outside the higher education systems; (5) the notion that highly centralized higher education and research systems inhibited entrepreneurialism; and (6) the role of key concepts, and language more generally, in initiating and legitimizing major institutional changes. The remainder of this section will consider each of these themes in some detail.

### ***Integrating research into academia***

First of all, historians of science, technology, and education have brought to light aspects of entrepreneurial behavior in the activity of academics engaged in efforts to change the work settings in which they were operating. Those aspects emerge especially in studies of the transformations of individual academic establishments, as well as of higher education systems, from the mid-nineteenth century onward. And here there is already a significant departure from the interpretive perspective outlined above. Rather than identifying the integration of scientific and technological research into higher education establishments as an antecedent to the emergence of entrepreneurial universities, the works of these historians suggest that this development was in itself shaped by entrepreneurial processes of opportunity identification, resource allocation, and legitimization.

Key features of the research university, such as the research seminar and the research-based doctoral dissertation, first emerged in the German kingdoms of Prussia and Hannover in the decades around 1800 (Clark 2008). Support for research in higher education institutions was initially targeted to areas of study such as pedagogy and classical philology. The natural sciences were by no means at the forefront of this innovation. However, the seminars, in a way that was not foreseen by the promoters of that innovation, helped pave the way for the establishment of laboratories as the pedagogical and research equivalent for the experimental sciences. In the new discipline of physics, for example, early academic seminars were forerunners of the fully fledged laboratory-based institutes created in the second half of the nineteenth century (Cahan 1985; Olesko 1991). The institutionalization of chemistry laboratories had already occurred at a significantly earlier date: by 1830 they were commonly used to train students in chemical analysis (Homburg 1999). However, the transformation of these early teaching laboratories into larger laboratories dedicated to not only teaching

but also research purposes was by no means a natural or inevitable process. Instead, historians of science have shown how chemists such as Justus Liebig helped initiate this change by exploiting scientific, political, and economic opportunities (Holmes 1989; Morrell 1972).

Studies of the development of research and teaching laboratories in the German universities and institutes of technology show the extent to which academic scientists individually and collectively became involved in the creation of new scientific infrastructure (Cahan 1985; Jackson 2011). The rise of the civic universities in nineteenth-century Britain, with their strong commitment to the development and transmission of scientific and technological knowledge, has been analyzed in similar terms (Kargon 1977; Sanderson 1972). In France, the early modern tradition of concentrating research in non-university-based structures prevailed well into the nineteenth century. Later the university system was by-passed in favor of ad hoc institutions for the promotion of research such as the *École pratique des hautes études* and the Institut Pasteur (Fantini and Morange 1991; Fox 2012; Paul 1985). And in the United States, the relatively small number of research universities that had emerged by WWI had to further legitimize their commitment to creating new knowledge in the interwar period, while struggling to place it on a firm financial foundation (Geiger 1986). The process of integrating laboratories and related institutions of scientific and technological research into higher education establishments is often described in terms that imply entrepreneurial qualities and processes at work. These include references to an alertness to internal and external opportunities, organizational skills, strategic decision-making, leadership, and the promotion of links and collaborations within academia as well as with actors in political and socioeconomic fields.

The integration of research into academia also depended on the ability to raise funds to cover the costs of the buildings, equipment, and manpower necessary for conducting experimental scientific investigations. These expenses seemed to increase constantly from the second half of the nineteenth century onward. Their rise mirrored not only a dependence on ever-more costly equipment but also the expansion of the scientific enterprise in scale, scope, and complexity, and precisely for those reasons required considerable organizational skills (Capshew and Rader 1992; Fox and Guagnini 1999).

In order to mobilize such resources, academic scientists and science administrators often exploited, as well as promoted, the growing demand for scientific and technological knowledge and expertise from industrial firms and modernizing nation-states. For instance, they established patronage relationships with knowledge-intensive firms who depended on a regular supply of science graduates and/or the services of scientific consultants (Boudia 2001; König 1996; Marsch 2000). They also endeavored to legitimize requests for expensive research facilities by skillfully drawing attention to and exploiting potential medical and military uses of exceedingly expensive laboratory facilities (Heilbron and Seidel 1989). In other cases, they did so by highlighting the economic and national security value of their fields of study (Bonneuil and Pestre 2015; Kohlrausch and Trischler 2014).

### ***Building research schools and disciplines***

The historical literature on the integration of research into academia tends to focus on academic scientists' institution-building efforts, particularly on the way in which economic, commercial, and social links were harnessed to the creation of new institutional settings. Historians of science and technology have, however, not only referred to entrepreneurial

qualities and behaviors in analyses of the organization of the infrastructure of research and education establishments. Similar characteristics are also apparent in publications that examine the process by which new academic knowledge was developed and managed. These latter studies are a reminder that institutional changes affect the epistemic and cognitive aspects of academic activity as much as the organizational ones. We refer here to the process by which academic scientists sought to launch new research programs and schools, forge highly reputed science centers, and establish new disciplinary and interdisciplinary areas in an ever-more specialized and competitive academic landscape.

As historians of science and technology have documented, the creation of research programs and centers entailed the identification of new directions of inquiry, including problems that could only be solved by departing from established routines and experimental methods (Geison and Holmes 1993; Morrell 1972, 1993; Pinault 2000; Servos 1993). In launching such scientific enterprises, the academics involved faced a good deal of risk as both their own reputations and the career prospects of their collaborators were at stake. The success of these initiatives depended on the presence and exploitation of favorable circumstances in particular institutional environments. It involved the capacity of selecting and coordinating collaborators with different scientific and technological skills and competences; the ability to motivate and sustain the combined effort of the members of research teams; and the creation of not only physical but also disciplinary spaces within or outside of existing institutional settings. In addition, it required the capacity to secure recognition for new research agendas, and to establish prominent (and whenever possible hegemonic) positions in a competitive environment. This meant creating effective channels for the diffusion of research results, and career opportunities for students and collaborators. Through the combination of such actions and qualities academic fields were being transformed. The physics department of the University of Bristol, for example, rose from relative obscurity to become an internationally acclaimed research center in the interwar period thanks to what Keith (1984) explicitly characterizes as the entrepreneurial drive of the departmental head.

Similar skills and abilities are highlighted with respect to the closely related, although not necessarily overlapping, attempt to launch and promote new disciplinary areas (or subareas). In this case as well the work of historians of science and technology suggests that academic scientists had to engage in entrepreneurial activities (Geison 1978; Lenoir 1988). These include the securing of academic recognition and legitimization within particular institutions and the scientific community more generally; the controlling of tensions and conflicts that arose within established academic structures due to the emergence of new disciplines; and the creation and management of institutional frameworks meant to enable and sustain the growth of such disciplines, as well as of publication outlets and other channels through which public visibility and scientific recognition could be obtained.

Finally, entrepreneurial qualities are also described in analyses of the creation of research programs and centers that strategically transcended disciplinary boundaries (Mody and Choi 2013). In the interwar United States, as an example, the scientists George E. Hale, Robert A. Millikan, and Arthur A. Noyes conceived and organized a characteristically interdisciplinary enterprise that was pacesetting with regard to both its contents and its institutional embedment in the California Institute of Technology and its surrounding area (Kargon 1982).

### ***Reforms of teaching and educational curricula***

Although historical research invoking entrepreneurial qualities is most commonly found in publications focused on changes in the institutional framework for research, such qualities are also evident in analyses of historical processes of conceiving and implementing new educational programs. The creation of the ‘red brick universities’ in the late nineteenth-century United Kingdom provides a notable example. The educational patterns of these new institutes, which entirely depended on private patronage in a cultural environment that could be quite hostile to academic learning, were shaped by the interests and expectations of their local communities. This however did not mean that academic scientists’ initiative was limited to the adaptation to existing needs; on the contrary, they proactively tried to shape their environment through a process that entailed risky decisions and strategies. This situation is exemplified by Kargon (1977) in his analysis of the University of Manchester in the third quarter of the nineteenth century. Here, academics endeavored to convince possible potential local patrons of the benefits of an advanced education with high academic standards and a strong emphasis on the sciences. More specifically, they claimed that, in economic terms as well as in terms of social status, such a form of instruction would prove more valuable than a strictly functional technical training.

In the United States, reforms of teaching curricula likewise involved academics’ engagement in the identification of new opportunities for educational programs, the securing of physical spaces, and the legitimization of these programs within and outside the schools in question. Historians of science and technology have shown that this occurred at a broad range of establishments and had started well before the creation of America’s first research universities in the late nineteenth and early twentieth centuries. Importantly, these reforms were not just initiated at land-grant colleges that had, in the decades following the Morrill Act of 1862, succeeded in obtaining government funds to offer training in applied scientific and agricultural subject areas (Geiger 1998; Rosenberg and Steinmueller 2013). New educational arrangements were also launched in industrializing cities where institutes of higher learning were rapidly developing, and where decisions about how to organize educational arrangements took into account the new demands and expectations created by the socioeconomic developments affecting local communities. In fact, according to Kargon and Knowles (2002), institutions such as the Case School of Applied Science in Cleveland and the Armour Institute of Technology in Chicago innovatively adjusted their curricula in the last two decades of the nineteenth century to meet the needs of local knowledge-intensive industries.

When it came to the creation of new institutional settings for engineering education at universities such as Stanford and the Massachusetts Institute of Technology (MIT), similar initiatives have also been examined in this light (Lécuyer 2006; Leslie and Kargon 1996; Servos 1980). One study on MIT explicitly uses the notion of entrepreneurship to analyze how the introduction of a cooperative engineering course depended on a matching of supply and demand and to highlight the risk-taking involved in this type of institutional innovation (Carlson 1988). In general, though, the entrepreneurship concept has not been central to the arguments of historians examining the reform of teaching and educational curricula.

### ***Institutional innovation outside the higher education systems***

A notable feature of the history of the sciences since the late nineteenth century concerns the multiplication of the sites of knowledge production (Bonneuil and Pestre 2015;



Szöllösi-Janze 2005). In the decades around 1900, for example, laboratory research not only became more common in higher education institutions, as discussed in the previous paragraphs; research laboratories were also introduced in industry and in government agencies. Moreover, in the same period academic scientists got involved in the creation of research infrastructure outside of the university system, often in collaboration with partners in industry and government. This included the founding of national research councils, hybrid science establishments jointly funded by industry and the state, and institutes devoted to research problems considered of high national importance. In many cases, these initiatives were launched with a strong practical orientation. Historians of science have examined the process by which they were conceived and developed and have identified the complex range of interests involved, including those of the academic scientists, the local and central governments, industry, and the military.

These studies highlight the role of academics as active participants in the creation and development of these new institutions. They show that members of the scientific community often reacted to what they perceived as limitations resulting from the rigidity of the higher education establishments where they were employed, including when these were relatively autonomous private schools. In fact, as early as the end of the nineteenth century, a frequent complaint was that a rapid growth in student enrollments negatively affected scientists' research performance (Fox and Guagnini 1999). In this literature, too, academics' institution-building activities are rarely analyzed in light of an explicitly defined notion of entrepreneurship, although the qualities and characteristics described in some of those studies would have lent themselves to such an interpretation. For instance, we find entrepreneurial processes implicitly at work in studies of the 1887 origin and development of the Imperial Institute of Physics and Technology in Germany (Cahan 1989), and of the Research Institute for Experimental Therapy and the Royal Prussian Institute for Experimental Therapy, set up, respectively, in 1896 and in 1899 (Lenoir 1988, 1997). With respect to the United States, the creation of a National Research Council during the WWI owed much to the vision, as well as opportunism, of the astronomer George E. Hale, who famously regarded the war as 'the greatest chance we ever had to advance research' (Kevles 1968). In the following decades, other scientific institution-builders followed in the footsteps of Hale by developing initiatives to establish a national research fund (Kargon and Hodes 1985). To this purpose they initially turned to industry and the philanthropic foundations, thus continuing the prevailing approach within the U.S. scientific establishment of the time. From the 1930s, and especially after the outbreak of the WWII, however, the federal government was increasingly considered an attractive patron.

### ***Entrepreneurship in centralized higher education and research systems***

Another important theme in the historical literature that is also relevant to contemporary discussions about academic entrepreneurship concerns the relationship between entrepreneurialism and levels of state control. It is often argued that national systems of higher education and research characterized by a strongly centralized control of resources were relatively slow to innovate in the scientific and technological fields and to respond to the changing needs of their environments. Based on such considerations, for example, Carlsson et al. (2009) and Rosenberg (2003) have described the American system as more dynamic and conducive to academic entrepreneurship than its Continental European counterparts.

It is certainly true that some new disciplines (for example, chemical engineering, genetics, and molecular biology) in general were more rapidly introduced in U.S. higher education establishments than in European schools belonging to more centralized academic systems (Harwood 1987; Strasser 2002). It would, however, be wrong to infer from this that academic entrepreneurship could not produce significant results in European countries where centralized systems of higher education and research were in place. This is not to deny that high levels of centralization imposed constraints on the possibility of bringing about institutional change. However, historical analyses have shown how the cohesiveness of those systems was fraught by internal tensions and conflicts, especially in particular historical periods; and how even in highly centralized systems local interests played a role in opening windows of opportunity for change. In their analyses of the complexity of these systems, historians have drawn attention to the way in which members of the academic communities, individually and/or collectively, endeavored to promote institutional changes by identifying those windows of opportunity, especially at the local level. They did this by establishing alliances with potential partners outside the academic sector, and in some cases by adopting strategies that sought to exploit the peculiarities of these systems. What is worth considering, in an historical perspective, is not only to what extent academic entrepreneurship was effective in promoting institutional change depending on the nature of the systems, but also the forms in which this process was carried out.

The French system of higher education, which is commonly regarded as the epitome of centralization, can serve to illustrate the point. The creation in Paris of the *École supérieure de physique et de chimie* in 1882 (Shinn 1981) and of the *École supérieure d'électricité* in 1894 (Ramunni 1995) are good examples of institutional changes outside the sphere of the national system of higher education. Away from the capital, the *instituts* were launched in the 1890s as semi-independent units of several provincial science faculties (Grelon 1989). As historical inquiries indicate, all these initiatives were the result of a close collaboration and partnership between academic scientists, industrialists and local authorities. In fact, the ground for the creation of the *instituts* was paved by the relative autonomy that was given to the science faculties/universities in the last decade of the nineteenth century (Nye 1986). The French system was far from monolithic, and this new context allowed these academic institutes to diversify their educational offerings and their research capabilities, as in Grenoble, for instance (Caron 2000; Guthleben 2016; Pestre 1990). Local institutional initiatives then became the basis for the twentieth-century development of scientific clusters (Chapoulie, Fridenson, and Prost 2010; Grossetti 1995; Grossetti 2016). If anything, this literature suggests that the flurry of academic entrepreneurship around the turn of the twentieth century was to some extent supported from within the centralized system, rather than created in opposition to it. In this way even members of the professoriate of public institutes, who had the status of civil servants, could overcome the rigidities of the system without challenging long-established and deeply rooted traditional settings. The result was a process of growth by layering and conglomeration, where the centralized system in fact ended up integrating and absorbing new establishments originating outside the boundaries of its structure.

### ***Language and institutional change***

Finally, the writings of historians of science and technology point to the importance of language in initiating and legitimizing institutional innovations of the kinds described above.

Drawing on works in conceptual history, literary studies, and/or the sociology of science, scholars like Bud (2014), Godin (2006), Kline (1995), and Schauz (2014) have examined the emergence and significance of keywords such as ‘scientist’, ‘pure/applied science’, ‘basic research’, and ‘innovation’. Their studies indicate that these types of concepts helped bring about institutional changes within academia by defining or contesting the relationships between different disciplines, pedagogical approaches, and areas of investigation. In addition, they show that these keywords were used to negotiate and reconfigure the boundaries between academia and other societal spheres, including industry and the state.

In fact, the scientists who strategically deployed these vocabularies often targeted both academic and broader audiences. In mid-nineteenth-century Britain, for example, the notion of ‘applied science’ helped unite a diverse coalition of educational reformers in defining and justifying the curriculum of a new generation of colleges (Bud 2014). Likewise, in the United States, physicist Henry Rowland’s (1883) passionate plea for ‘pure science’ was meant to attract support for laboratory-based graduate training among not only academic teachers and students but also philanthropists (e.g. Dennis 1987). According to Lucier (2009), moreover, Rowland’s speech was part of a wider attempt to distinguish truth-seeking ‘scientists’, a term that was still relatively new at the time, from ‘professionals’ selling their services on a for-profit basis.

Arguably, the role of language became even more consequential in the twentieth century, due to the challenges and opportunities presented by far-reaching war efforts and the availability of unprecedentedly high levels of public and private funding. In this context, the nineteenth-century emphasis on ‘purity’ of motive – that is, the pursuit of knowledge for its own sake – was either reinterpreted or replaced by new keywords that seemed better suited for highlighting the military, economic, and social relevance of the sciences (e.g. Clarke 2010; Kline 1995; Schauz 2014). At the same time, the desire to limit the amount of government interference in academia contributed to seminal formulations of values and norms that were claimed to be characteristic of the scientific enterprise (e.g. Hollinger 1996).

Taken together, these studies thus point to scientists’ innovative uses of language to protect and advance their interests, address societal problems, and make sense of their work. This literature also demonstrates that they did this by pursuing intra- and extra-academic opportunities, attracting resources, and challenging or legitimizing institutional configurations. As we argue in the next sections of this introduction, these are all processes that are fundamental for understanding academic entrepreneurship. Still, while there are a few theoretically grounded reflections on the significance of institutions (e.g. Björck 2016), the notion of entrepreneurship is almost completely absent from these writings.

## Conceptual foundations

As we pointed out in the previous section, entrepreneurial themes have played an implicit role in historical research on the behavior of academics – individually and collectively – as agents of institutional change. However, historians of science and technology have discussed these themes and processes without focusing on the development of concepts or connecting frameworks that could assist in providing a more analytical approach to studying the relationship between academic entrepreneurship and institutional change. As a result, the research conducted by these historians has not focused on central intellectual questions or problems concerning academic entrepreneurship and has remained marginal to the scholarship on the topic.

To overcome these limitations, the authors and editors for this special issue sought to ensure that the papers were not only thematically related but also drew on common key constructs and explored a set of relationships between these. The aim was to create a connecting interpretive framework pertaining to the relationship between academic entrepreneurship and institutional change, and in this way to allow comparison between studies, enhance the analytical depth of particular papers, and cultivate conversation among scholars, particularly as it relates to entrepreneurial processes. Establishing key terms and concepts is especially important in the case of this special issue because the study of academic entrepreneurship has been inherently cross-disciplinary, engaging science and technology scholars, economists, sociologists and management scholars, as well as historians. Here, we clarify what we mean by three central concepts – entrepreneurship, institutions, and academic entrepreneurship – and we discuss possible relationships between them.

### ***Entrepreneurship and entrepreneurial history***

While studies of entrepreneurship have become common across the social sciences, the focus of this research has varied widely. Entrepreneurship researchers have defined their field based variously on the characteristics of entrepreneurial individuals (Chell 2008), the creation of new organizations (Gartner 1990), and the pursuit of new opportunities (Shane and Venkataraman 2000; Stevenson and Jarillo 1990). This special issue builds on the understanding that entrepreneurship involves the pursuit of opportunities to create future forms of value.

In commercial entrepreneurship, value is typically defined by the creation of new products, services or transactions that customers are willing to purchase and that render a profit for the entrepreneur. But value need not be defined in commercial terms; indeed, historical thought has often emphasized that actors may be motivated by many different kinds of ends (Schumpeter 1954; Wadhvani and Lubinski, *forthcoming*). Hence, future value may be understood variously in terms of civic good, technical efficiency, scientific advancement, or any other end that an entrepreneur may deem worthy.

Entrepreneurial history (Casson and Casson, 2013; Wadhvani 2010) focuses specifically on the nexus between such entrepreneurial actions and processes of historical change (Wadhvani and Lubinski, *forthcoming*). The basic premise of entrepreneurial history is that in pursuing future opportunities, enterprising agents implicitly or explicitly are involved in changing the social, political, and economic order of their present, and are hence inherently engines of historical change. The premise underlies the Schumpeterian claim (Schumpeter 1942) that capitalism is not a stable but rather a constantly evolving system of economic practices and relationships. This assumption distinguishes entrepreneurial history from both classical and neoclassical economic approaches to entrepreneurship, which presume relatively stable, equilibrating markets, as well as materialist historical accounts (such as Marxism), which focus on materialist conflicts of interest as the foundations for the dialectics of change (Wadhvani 2010).

This special issue pays particular attention to three entrepreneurial processes and their relationship to historical change (Wadhvani and Lubinski, *forthcoming*). The first is the process by which actors, individually and collectively, imagine and articulate opportunities related to future forms of value. The second is the process by which entrepreneurial actors assemble resources to pursue these opportunities. Because entrepreneurship involves action

that seeks to render the imagined future a reality, entrepreneurs inherently engage others to allocate resources to pursue the opportunity and to organize resources in a coherent way. The third is the process by which entrepreneurs legitimize their project vis-à-vis the present social, cultural, and political order. Because entrepreneurial history is particularly focused on processes of change, it pays particular attention to when and how entrepreneurs change economic, social, and cultural institutions to pursue their projects.

### ***Institutions and institutional change***

Institutions can be defined as the 'rules, norms and ideologies' that govern behavior. Scott (1995, 33) characterizes institutions as 'social structures that have achieved a high degree of resilience' and categories them based on their 'cultural-cognitive, normative and regulative elements'. Institutions are value laden in that they indicate who should engage in a particular activity, how the activity should be performed, and why behavior should be ordered in that particular way. Over time, such rules, norms, and ideologies can come to be 'taken for granted' by the people involved, and constitute what they see as social reality (Meyer and Rowan 1977).

Institutions can be thought to govern behavior at different levels of social order. For the purposes of the special issue, it is heuristically useful to think of institutions governing behavior within academic fields as well as between the academic world and industry or government. Institutions within academic fields might include the rules and principles along which a research initiative is organized or the boundary separating one discipline from another. Institutions governing the relationship with other fields might include the form of non-governmental organizations engaged in supporting academic research or the rules governing the relationship between industries and universities. Institutions are important because they shape the flow of resources and define legitimate and illegitimate behavior, hence governing orderly behavior between people.

While institutional theory has been employed throughout the social sciences, it is worth noting disciplinary differences in the focus of research. Economic new institutionalists tend to focus on whether institutions create optimal economic outcomes by facilitating efficient transactions (North 1990; Williamson 1981). Sociological new institutionalists consider how institutions create social pressures to conform (DiMaggio and Powell 1983). Lastly, historical institutionalism considers the relationship between multiple institutions (often in institutional configurations) and how these evolve over time (Steinmo 2008; Thelen and Steinmo 1992). Given our interest in institutional change, we adopt a historical institutionalist approach.

Given that institutions are presumed to explain social order, one of the persistent questions that arises is how to explain change. Indeed, as the previous section highlighted, the historiography indicates that the academic world has often undergone significant changes. The emergence of new domains of research and activities required reordering the boundaries and relationships between disciplines. The organization of research councils and research centers required the creation of new institutions governing cooperation between fields. And the relationship between universities and states has been constantly evolving. How then to explain institutional change?

While there are many different scholarly approaches to the subject, our focus is on the relationship between academic entrepreneurship and institutional change. Entrepreneurship has long been recognized as a force driving institutional change (Schumpeter 1947).

Entrepreneurial history helps us examine the process of institutional change not only by bringing specific actors into the narrative, but by considering how new institutions were imaged, resourced, and legitimated (Wadhvani and Lubinski, [forthcoming](#)).

### ***Academic entrepreneurship and institutional change***

How does academic entrepreneurship relate to institutional change? To consider the central intellectual question at the heart of the special issue, we extend the concepts above a little further by considering the specific nature of academic entrepreneurship and how it might reshape the institutional contexts in which it occurs.

Academic entrepreneurship can be understood as a particular form of entrepreneurship that is specific to academic fields. For the purposes of this special issue, it is most useful to regard an academic world or field as a set of organizations and actors that recognize one another as devoted to valuing scientific and humanistic knowledge production and dissemination as central to their *raison d'être*. In other words, actors and organizations in academic fields share a common understanding that they value the production and dissemination of knowledge as crucial to their identities. Organizations such as universities and research institutions are characterized by the production and dissemination of scholarly knowledge as a primary end or purpose of organized activity. Such a purpose does not preclude those organizations from pursuing other ends, such as profit or social impact, but academic actors, institutions, and organizations are only legitimately considered academic if they pursue knowledge creation, application, transmission, or dissemination as a central purpose of their activity. In this sense, the notion of 'the academic field' can be understood to itself be comprised of a set of nested subfields of the sciences, social sciences, and humanities. It can also be understood in relationship to proximate fields to which academic knowledge is applied, such as public/state fields and private/industrial fields (Fligstein and McAdam 2012).

Academic fields cannot and should not be understood in static or functional terms. Indeed, the academic world has undergone dramatic changes over the past few centuries, as the historiography above highlights. Accordingly, it is best to think of academic settings as contextually specific and constantly evolving. The expectation that academic actors should contribute new and original scholarly knowledge, for example, gained a strong foothold in academia as a result of the 'research revolution' of the nineteenth and early twentieth centuries. And the boundaries of what constituted 'academic knowledge' has always been contested and in flux. Indeed, it is the inherently historical character and boundaries of academic fields – the dynamics shaping and reshaping them over time – that are the focus of the papers in this issue.

Following on this, we define academic entrepreneurship as *the pursuit of future forms of value pertaining to academic knowledge production, application, and transmission*. In practice, this may take different forms, aimed either at the internal development and transmission of disciplinary knowledge within academic fields and subfields or at the application of academic knowledge to non-academic fields, such as industry, commerce or the state. One can thus consider academic entrepreneurship opportunities as those pertaining to efforts related to the development of a discipline or area of knowledge, or the application to other fields, such as industry through commercialization or the state through policy. In each of these cases, academic entrepreneurship involves resource acquisition and legitimization processes, and often involves efforts that cross the boundaries of different fields and that seek different kinds of future value. Our definition of academic entrepreneurship is hence different from

the one based more narrowly on the commercialization of academic knowledge; we instead treat commercialization as only one form of academic entrepreneurship.

The description above should make it clear that while academic entrepreneurship involves knowledge creation, application or transmission it is not synonymous with intellectual activity alone. Rather, academic entrepreneurship involves the resource acquisition and legitimacy seeking activities necessary to render such opportunities as realities in practice. For instance, as we have already pointed out, the development of an emerging discipline might involve the identification of new and original lines of research. This could include departing from routine programs, the creation and management of complex and often numerous research teams, winning the resources necessary to develop research in the discipline and building the legitimacy necessary for it to be taken seriously in the academic world. For the development and application of academic knowledge for industry/commercial or policy/public purposes, it requires not only the activity of imaging such applications but also the processes of gathering resources for it and establishing its legitimacy in both the academic and non-academic fields.

It is for this reason that we can consider the process of engaging in academic entrepreneurship as an essential aspect of institutional change. It involves not only processes of change within the academic world, as new disciplines and fields strive for resources and the establishment of academic legitimacy. It also involves the establishment and institutionalization of new ways of organizing the interface between the academic world and other social fields in order to apply academic knowledge beyond the academic world. Academic entrepreneurship is hence inherently involved in institutional change because it was fundamental the establishment of new institutions through which ideas, resources, and legitimacy flowed in a routinized and orderly way. It is the process by which new institutions are established by academic entrepreneurs that is the focus of this special issue.

## Research process and findings

This special issue is the result of an effort to bring together scholars from different sub-disciplines – history of science and technology, economic and business history, and management and organization studies – to examine academic entrepreneurship historically. The dialog was established in the course of sessions organized at two conferences (Society of the History of Technology annual meeting, Dearborn 2014; European Business History Association meeting, Utrecht 2014), and especially during a conference on ‘Academic entrepreneurship in history’ held in 2015 in Ghent and a follow-up workshop in Lille in the next year. What we offer here is a selection of five of the papers that were presented and discussed at those meetings, and in particular those dealing more specifically with the relationship between academic entrepreneurship and institutional change. (For another set of articles, concerned with the commercialization of academic science, see Mercelis, Galvez Behar, and Guagnini 2017). The contributions of those papers are summarized in Table 1.

In the first article, Ellan Spero examines the design of a new institution – the industrial fellowship program – in early twentieth-century America. Using micro-historical research methods, she analyzes a set of correspondence between chemistry professor Robert Kennedy Duncan and industrialist E. Ray Speare in 1906 as they discover their common interest in the application of the rapidly expanding field of chemistry to industrial processes. Spero tracks

in detail the creative, and at times playful, processes by which the two figures consider the possibility for the application of chemistry research to industrial laundries, discuss how a graduate fellowship program funded by industry and focused on applied knowledge could serve the purpose, and imagine how the program would work. Speare, and especially Duncan, it becomes clear, are aware of the broader institution building process in which they are engaged, as they conceive the fellowship program as a model to be replicated.

In the second article, Thomas Brandt shifts our focus from the micro-level processes at work between individuals engaged in academic entrepreneurship to the macro-level institution building processes unfolding over half a century at the level of the nation state. Brandt examines a series of efforts to establish national institutions to support and coordinate scientific endeavors in Norway between the late nineteenth century and the 1950s. Specifically, he shows how early twentieth-century efforts to establish a privately funded science academy were linked to the subsequent interwar push to create a central research institute, and the post-WWII creation of a national research council. Brandt demonstrates that these experiments in institution building were profoundly shaped by the international flow of ideas and models for the organization of science and motivated by a rationale of nation building. He also shows how experiences with one institution building effort shaped subsequent movements, and considers the role of memory and history in the process of long-term institution development.

In the third paper, Gabriel Galvez-Behar's treatment of efforts to shape the scientific institutions in early twentieth-century France in many ways echoes the article by Brandt. Galvez-Behar focuses on the formation of national level institutions over multiple decades and demonstrates the cumulative processes at work as successive generations of academic entrepreneurial groups attempted to establish the central institution through which scientific efforts received resources and were coordinated. But Galvez-Behar also focuses on the

**Table 1.** Summary of the topics and historical methods.

Author	Topic	Academic field	Institutions	Methods
Spero	Design of an industrial chemistry fellowship program in the early twentieth-century U.S.	Chemistry	Industrial fellowship program	Micro-historical analysis of individual correspondence
Brandt	Development of national institutions to fund and support science in Norway	Science generally	Science academy, research institute, research council	Synthesis of secondary and primary research over long time span at the national level
Galvez-Behar	Development of national institutions to fund and support science in France	Science generally	National scientific institutions & funding agencies	Synthesis of secondary and primary research over long time span at the national level
Favero	Relationship between the emergence of statistics as a field and legitimization of fascist state in interwar Italy	Statistics	Statistics as an academic discipline	Synthesis of secondary and primary research at the inter-field level using a biographical lens
Mody	Development of industrial consortia and university centers to fund scientific research in the late twentieth-century U.S.	Micro-electronics	Industrial consortia, university centers	Analysis and synthesis of institutional records and oral histories



contestation between competing groups of academic entrepreneurs to shape the institutionalization of academic science. He highlights both the skill and position of these groups vis-à-vis industry and the state as they tried to influence the design of the national institution, and incorporates the impact of events (e.g. the WWI) and contexts in shaping which ideas and entrepreneurial groups managed to exercise influence.

In the fourth paper, Giovanni Favero shifts attention back from national-level institutions shaping science in general to the dynamics related to the emergence and legitimization of a specific new field of academic knowledge at the boundary between scientific and social disciplines: statistics. Focusing on the figure of Corrado Gini as an academic entrepreneur, Favero uses a biographical lens to examine the processes by which Gini sought to legitimize and institutionalize statistics in the context of the rise and fall of the fascist regime in Italy. Favero focuses in particular on how Gini's efforts to legitimize the new field involved tying it to the applied policies and knowledge production practices of the state. He demonstrates the process of reciprocal legitimization at work between the emerging academic field and the political regime's efforts to establish its authority.

Finally, in the fifth paper, Cyrus Mody pushes us into the late twentieth-century United States to examine the formation of institutions to facilitate collaborative research in micro-electronics. Specifically, Mody examines the introduction of both industrial consortia and university centers as institutional responses by U.S. micro-electronics firms and academic organizations to sharing the costs of basic research needed to remain competitive against increasingly aggressive Japanese firms in the 1980s and 1990s. Mody demonstrates the evolution of these institutional forms through a series of cases, and concludes by showing how university centers, as an institutional model, proved more adaptable in the long run as the needs of industries evolved.

Each of the five papers makes distinct and original contributions to historical perspectives on academic entrepreneurship and their relationship to historical change. But together, they also point to six major or common contributions that challenge preconceived conceptions of the character of academic entrepreneurship and its relationship to processes of change in markets, societies, and states. In the remainder of this section, we draw out these major thematic findings and how the individual papers contribute to them.

### ***The evolving character of entrepreneurial opportunities***

The papers highlight why a focus on commercialization alone (Shane 2004) provides at best a very limited perspective on academic entrepreneurship and its role in economic change. As the historiographical section showed, the boundaries between academic and other fields of social life have long served as a particularly generative space for entrepreneurial imagination and ambition. The articles in the special issue explore the evolving character of entrepreneurial opportunities that arose at the intersection of science and society from the late nineteenth century until the late twentieth century, and the processes by which entrepreneurial actors envisioned and pursued them. The changing character of academic entrepreneurship opportunities over the twentieth century was shaped by, among other factors, the emergence of new academic subfields (Favero), the changing needs of industries and states (Spero, Galvez-Behar, Brandt, Mody, Favero), and the sheer scale and cross-sectoral complexity of these ambitions (Mody, Galvez-Behar, Brandt).

### ***Imaginative processes in academic entrepreneurship***

The special issue also highlights the role of imaginative processes in academic entrepreneurship. The identification and articulation of entrepreneurial opportunities at the intersection of science and society involved creative processes of bridging the constraints and arrangement of the present with newly imagined futures (Beckert 2016). Opportunities were not simply discovered through the synthesis of available information, they were produced by the imaginative process in which entrepreneurial actors engaged. As Schumpeter (1947) had posited, historical research allows authors to examine these creative processes at work, both at the micro-level through the character of interactions and dialog between entrepreneurial individuals (Spero) and at a more macro-level as collective visions of science in the service of industry and the nation shaped institution building efforts over time (Brandt, Galvez-Behar).

### ***The contested character of new institution building***

Much of the literature that has applied institutional theory to systems of entrepreneurship and innovation in academia has posited that institutions create stable patterns in the interactions between universities, industries, and governments, allowing for the categorization of 'typologies' or 'national systems' of innovation (Nelson 1993). But the historical cases examined here suggest a very different picture: contestation and contingent compromise rather than stability, system, and order were the characteristics that defined institution development historically. Rather than marked by the emergence of clearly ordered and stable rules of interaction around innovation, the building of new institutions was marked by a multiplicity of competing, and occasionally cooperating, efforts (Galvez-Behar, Brandt, Mody). Overall, the picture that emerges challenges the contention that orderly innovation systems are inherent to particular countries or groups of countries, and instead suggests the way in which ongoing competition and compromise between rival institutions was in fact the heart of the institutionalization of the relationships between academia, the government, and industry.

### ***The importance of social skill in institution building processes***

In part because of the contested nature of institution building, strategic positioning, social skills, and collaborative processes were crucial to academic entrepreneurship. The exercise of what Fligstein (1997) has called social skill was hence crucial to understanding why and how one particular institutional arrangement emerged and another did not. Given the cross-sectoral character of academic entrepreneurship, several different kinds of skill proved important. Academic entrepreneurs who had recognized status across multiple fields were better positioned to advance their institution building projects (Galvez-Behar, Brandt). Moreover, the abilities to engage in cross-sectoral dialog and reciprocity were crucial to the emergence of successful commonly imagined futures and important to the allocation of resources and legitimacy to those future-oriented endeavors (Spero). And cross-sectoral team formation in some cases proved crucial to the historical success of particular institution building ventures (Galvez-Behar).

### ***The cumulative and evolutionary process of institutional building***

The papers also highlight that the relationship between entrepreneurial processes and historical change was complex, unfolding not through single events or moments but through complex and cumulative sequences of developments over time. A number of historians have emphasized the complex and cumulative processes through which entrepreneurship leads to historical change (Cole 1959; Wadhvani and Jones 2014). Most recently, Galambos and Amatori (2016) have proposed the construct of the 'entrepreneurial multiplier' as the sequential processes through which entrepreneurial endeavors build on one another. The papers support this claim and extend it to the domain of entrepreneurial institution building; new institutions were often pieced together over time, sometimes across multiple generations, as academic entrepreneurs built on or reconfigured the efforts of their predecessors (Brandt). But the papers also add two additional complex dynamics to this process. First, they show how major events played a role in this process by reshaping the paths and logics on which new institutions were built and extended over time (Favero). The WWI, for instance, lent greater weight to both the need to engage in scientific institution building in service of the nation and the justification for coordinating such efforts and engaging in them at a large scale (Galvez-Behar). Second, the papers highlight that some institutions were better able to adapt to such processes of change over time, because they were able to be used toward purposes that had not been initially envisioned (Mody).

### ***Shaping modern markets and states***

Finally, the articles together show that academic entrepreneurial processes played an important role in shaping the emergence of modern academia, the legitimacy and boundaries of the state, and the rules of modern markets. In other words, academic entrepreneurship as a process was an integral aspect of modern state, market, and academy formation. Whereas the literature that draws on neo-institutional theory to explain academic entrepreneurship typically takes for granted the coercive, normative, and cognitive pressures of states, societies, and market contexts in shaping entrepreneurial action (Etzkowitz and Leydesdorff 2000), the historical studies examined here suggest mutually constitutive processes at work. The boundaries and capabilities of states (Favero, Brandt, Galvez-Behar) and markets (Mody) not only shaped academic entrepreneurship but were also shaped by academic entrepreneurial processes.

### **Looking ahead**

In recent years, several scholars have suggested that the scope of the research on academic entrepreneurship (Franzoni and Lissoni, 2009; Siegel and Wright 2015a) and related transformations of the university system (Martin 2012) needs rethinking. The wave of research that has emerged since the 1990s focused narrowly on university technology transfer and university-based startups and understood academic entrepreneurship as a relatively new phenomenon. The recent efforts to rethink this scholarship have sought to broaden the scope of activities studied as academic entrepreneurship and contextualize it within the longer relationship between institutions of higher education and society. This article, and the special issue more broadly, has highlighted that historical research and reasoning should be an integral part of scholarly efforts to reconsider the scope of academic entrepreneurship.

Historical perspective, we have showed, does not only provide a longitudinal perspective onto current phenomena, it allows us to confront the limitations of the concepts and theories we take for granted in the present. The articles produced here suggested to the editors and authors a need to think beyond commercialization as a foundation for academic entrepreneurship. The broader definition not only allowed us to take into account non-commercial endeavors that worked to transform academia internally, but also to consider the complex and evolving relationship between academia, the market, and the state. Moreover, rather than treating academic entrepreneurship as a product of institutional context, it allowed us to tap the promise of entrepreneurial history in examining academic entrepreneurship as a driver of historical change in these relationships.

Of course institutional change in academia has been the object of research in other fields of scholarship; we are well aware of the fact that important contributions could be brought to bear by extending the dialog to those fields, such as science and technology studies and the scholarship on education. The creation of a broader connecting framework for research on academic entrepreneurship remains a task for further cross-disciplinary initiatives. In fact we hope that this special issue will encourage further collaboration and interplay with students of the dynamics of institutional change in academia from other scholarly backgrounds and perspectives.

We are also convinced that much remains to be done in extending historical inquiry on entrepreneurial processes to other areas of academia. This special issue focuses on the natural and engineering sciences because they are areas upon which much of the attention of students of academic entrepreneurship has converged. However, we believe that there is much scope for related studies on academic entrepreneurship in the humanities and social sciences.

Finally, the analysis of historical case studies offers to all of us who are working in institutions of higher education and research an opportunity for reflecting on academic entrepreneurship 'in vivo', as we see it developing and evolving at present around us. It is a good reminder that we are not only observers of this big game. We are all involved in it, more or less actively engaged but nevertheless participants.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Notes on contributors

**R. Daniel Wadhvani** is Fletcher Jones Professor of Entrepreneurship and an associate professor of Management at the Eberhardt School of Business, University of the Pacific. He also holds appointments at Copenhagen Business School and University of Kyoto. He is the co-editor of *Organizations in Time: History, Theory, Methods* and is currently co-editing a special issue of *Strategic Entrepreneurship Journal* devoted to Historical Approaches to Entrepreneurship Research. He has published in leading journals in the fields of business history and management.

**Gabriel Galvez-Behar** is a lecturer in History at the University of Lille (Institut de recherches historiques du Septentrion) and member of the Institut universitaire de France. His work focuses on the history of innovation and particularly on the relationship between intellectual property and scientific institutions over the long term. In 2008, he published *La République des Inventeurs. Propriété et organisation de l'innovation en France, 1791–1922* and he recently co-edited a special issue of *History and Technology*,

"Commercializing Science: Nineteenth- and Twentieth-Century Academic Scientists as Consultants, Patentees, and Entrepreneurs" with Anna Guagnini and Joris Mercelis.

**Joris Mercelis** is an assistant professor at the Department of History of Science and Technology at Johns Hopkins University. He is the author of 'Father of Plastics': Leo Baekeland (1863–1944) and the *Rise of the Science-Industry Nexus* (under contract, MIT Press), and a co-editor (with Anna Guagnini and Gabriel Galvez-Behar) of "Commercializing Science: Nineteenth- and Twentieth-Century Academic Scientists as Consultants, Patentees, and Entrepreneurs" (*History and Technology*, July 2017).

**Anna Guagnini** is a research fellow at the Dipartimento di Filosofia e Comunicazione at the University of Bologna. Her interests lie in the history of technology in late-nineteenth/early twentieth century-Europe, in particular, the organization of technological research and education, and patenting practice and agency in Britain. She is co-editor (with Gabriel Galvez-Behar and Joris Mercelis) of "Commercializing Science: Nineteenth- and Twentieth-Century Academic Scientists as Consultants, Patentees, and Entrepreneurs" (*History and Technology*, July 2017).

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