Professionalization of bibliometric research assessment. Insights from the history of the Leiden Centre for Science and Technology Studies (CWTS)

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Abstract

In recent years, the use of quantitative metrics in research evaluation has grown considerably. This article recasts the emergence of evaluative bibliometrics as an academic research field and quantitative research assessment as a field of professional experts in the Netherlands by focusing on one expert organization that has shaped both: the Centre for Science and Technology Studies (CWTS) at the University of Leiden. Based on Abbott’s theory of professions and drawing on a comprehensive data set, including both archival and interview data, we show that the new professional field has been fostered by political actors in the Dutch science policy arena and that expertise was predominantly institutionalized in CWTS as a leading research institute and a provider of bibliometric research assessment services. Since the 2010s, CWTS has been challenged by ready-made bibliometric solutions provided by large database providers and publishing houses that increasingly attract non-experts to perform bibliometric assessments.

Key words: research evaluation; evaluative bibliometrics; professions; expert organizations; professional jurisdiction; peer review.

1. Introduction

In recent years, the use of metrics in research evaluation and the number of actors producing and applying bibliometric methods and indicators have grown considerably (Hicks 2012; Todeschini and Baccini 2016). However, this growth has not led to widely accepted professional standards in the use of bibliometrics in research assessment: several position papers are indicative of this demand for such standards and their effective enforcement across the community of bibliometricians and science policy stakeholders (Glanzel and Schoepflin 1994; De Rijcke and Rushforth 2015; Hicks et al. 2015).

The purpose of this article is to provide a better understanding of this ongoing process of professionalization.

Both evaluative bibliometrics as an academic research field and quantitative research assessment as a field of professional experts have gradually emerged since the 1980s (see for example, Milojevic and Leydesdorff 2013; De Rijcke and Rushforth 2015). This article reconstructs the emergence and proliferation of both fields in the Netherlands by focusing on one expert organization that has shaped them since their inception: the Centre for Science and Technology Studies (CWTS) at Leiden University (LU). However, this article does not simply tell a story about how CWTS was founded and developed, but its history is embedded in a more general sociological framework that explains how new professional fields emerge or decline. For this purpose, the article draws on Abbott’s sociology of professions, the most comprehensive theoretical treatise currently available (Abbott 1988, 1991).

According to Abbott, societally relevant problems constitute areas amenable to professional work (Abbott 1988, 1991). Based on abstract academic knowledge, typically produced and preserved in colleges and universities, professionals as well as expert organizations lay claim to these task domains, thereby constituting what Abbott calls a ‘professional jurisdiction’—a legally or publicly conferred licence to provide specialized expert services. In addition, professionals and expert organizations use artefacts in their work, including classifications, databases or expert systems. Professionals and expert organizations, as employers of professionals, address a lay audience that turns to them for individual treatment. Typical examples are doctors or lawyers (professionals) and hospitals or law-firms (expert organizations). Their lay audience typically seeks either legal advice (clients) or medical treatment (patients).

Quantitative research assessment can be understood as a professional field in which both individual professionals and expert...
organizations with advanced capabilities in conducting bibliometric analyses provide services in the context of a growing demand from research institutes, universities, and research funders to evaluate scientists or research units. The intellectual underpinnings of social claims to expertise in quantitative research assessment are provided by the academic specialty of evaluative bibliometrics. This academic field, including evaluative citation analysis, has gradually emerged since the 1970s and has expanded considerably since the 2000s (Milojevic et al. 2011; Zhao and Strotmann 2014; Liu et al. 2015; Yang et al. 2016). Furthermore, and in contrast to mature professions, such as medicine and law, professionals and expert organizations have developed limited capabilities so far for effectively controlling this new professional field. Ad hoc standards set by various individual bibliometric practitioners, consultancies, and contract research organizations are widespread—a situation that has invited considerable criticism (Cagan 2013; Hicks et al. 2015). For example, Chamberlain (2013) finds that article-level metrics differ across providers such as PlumAnalytics or Altmetrics because of varying sources and points of time of data collection.

This article recasts the history of CWTS as an expert organization within the Dutch science policy arena. The article shows that CWTS simultaneously assumed a double role as a leading research institute in the new academic field of evaluative bibliometrics and as a key provider of bibliometric research assessment services, first in the Netherlands and Belgium, and later internationally. Since 2010, CWTS’s expertise has been increasingly challenged by ready-made bibliometric solutions commercialized by large database providers and publishing houses, such as Thomson Reuters and Elsevier. If these ready-made solutions prevail, Abbott’s theory suggests that quantitative research assessment seems unlikely ever to develop into a full professional jurisdiction (Abbott 1991).

The article is structured as follows. First, we outline key elements of Abbott’s theory of professions (Section 2.1) and apply them to the task domain of bibliometric research assessment (Section 2.2). This opening is followed by an outline of our data and methods (Section 3). Then, we trace historically how the arena of science policy has developed in the Netherlands since the late 1960s (Section 4.1). The article continues with a discussion of the historical development of CWTS as an expert organization using four periods: inception, formation, expansion, and consolidation (Section 4.2). Following a summary of our findings (Section 5), we reflect on the current situation of bibliometric research assessment as professional jurisdiction (Section 6).

2. Theoretical framework

2.1 Elements of Abbott’s theory of professions

According to Abbott, expertise is institutionalized in three distinct forms: professionals, organizations, and commodities, with the latter comprising artefacts like classifications, databases, and expert systems (Abbott 1991). By connecting the technical means of using these tools to professional problem-solving strategies, these artefacts become instruments capable of routinizing part of the professional work (Drijvers and Gravemeijer 2004). In these three forms, expertise is brought to bear on societally relevant problems by the application of abstract knowledge to individual cases. The application of expertise to specific problem domains, including the use of commodities, establishes a work area for professionals and expert organizations. Once professionals have been legally granted the right to establish exclusive control over and access to a work area, they have secured a full jurisdiction in Abbott’s terms. In fully established professional jurisdictions, such as the medical profession, these work areas are stable, although alternative expertise may co-exist with them, such as Chinese medicine. Fully established professional jurisdictions comprise distinct problem diagnoses, inferences, and treatments (cognitive claim), and they are associated with particular workplaces, such as hospitals or law firms, that have been recognized as legitimate in either the public or legal arena or in both (social and cultural claims).

Cognitive claims are based on abstract knowledge that is guided by principles of logical consistency and rationality (Abbott 1988: 53). Moreover, abstract knowledge not only legitimizes professional practice by connecting it to the values of rationality, logic, and science but also enables professions to instruct and train students entering the profession. In addition, it generates new professional mechanisms of diagnosis, inference, and treatment: ‘Academic knowledge excels at invention precisely because it is organized along abstract lines, rather than syndromic ones. It can make connections that (...) may reveal underlying regularities that can ultimately reshape practical knowledge altogether’ (Abbott 1988: 55).

When professions put forward social and cultural claims for jurisdiction, they ask for exclusive rights and legitimate control of a particular kind of work, including ‘absolute monopoly of practice and of public payments, rights of self-discipline and unconstrained employment, control of professional training, of recruitment, and of licensing’. Such claims can be made either in the legal system ‘which can confer formal control of work’, or such claims are made in the arena of public opinion, including mass media, and higher education. Successful claims in the legal system are made either in parliament, which ‘grants statutory rights to certain professional groups’; in courts, ‘where such rights are enforced and the actual boundaries of loose legislative mandates are specified’; or directly in the state bureaucracy (Abbott 1988: 59–63).

Jurisdictions develop over many years, and public images about what professionals do seldom change. Nevertheless, jurisdictions may become challenged, by either the rise of new technology or new competitors entering the jurisdictional contest. Therefore, an important concept in Abbott’s theory of professions is competition between various suppliers of both abstract academic knowledge and applied expertise for a given problem area. Competition includes either attacks on abstract knowledge (cognitive claims) or attacks on the monopolies for specific kinds of work (social and cultural claims). For example, psychiatry challenged legal conceptions of criminality in terms of cognitive claims; in turn, psychotherapy and social work challenged psychiatry on its social and cultural claims (Abbott 1988: 55–63).

Most important, although competition can lead to the emergence of new professions with new jurisdictions, it often leads to ‘limited settlements’ where professional work areas are configured in complex (and sometimes unstable) ways. One such settlement is the division of labor where two professions have equal shares of the jurisdictional domain, such as architects and various types of engineers with respect to building houses (Abbott 1988: 73). Another settlement is the subordination of a lower-status profession to a dominant one, as in the case of nurses who are subordinated under medical doctors (Abbott 1988: 72). Finally, there is also a weak form of professional control: advisory jurisdiction, in which one profession interprets, buffers, or partially modifies actions of another profession, for example when the clergy interprets the ultimate meanings of medically defined illness (Abbott 1988: 75–6).

Abbott’s theory can be summarized in the following way. First, it introduces the levels by which expertise, based on abstract
academic knowledge, addresses societally relevant problems: via individual professionals, expert organizations, and commodities. Secondly, it specifies the processes by which the application of abstract knowledge to complex individual cases occur: diagnosis, inference, and treatment. Thirdly, it argues that laying claims to jurisdiction includes cognitive claims that connect professional practice with the values of rationality, logic, and science, and that enable professions to instruct and train students entering the profession. Fourth, it argues that laying claims to jurisdiction includes social and cultural claims that strive for exclusive control of work domains through conferring formal control via legal entitlements and claims through persuasion in the public arena. Fifth, both types of claims are subject to competition, which can result in various configurations of division of professional labor: shared jurisdiction, subordination of one profession by another, and advisory jurisdiction.

It is noteworthy that Abbott (1988) studied the legal profession, the information profession—including librarians, accountants and journalists, and the professionalization of psychiatry and psychoanalysis. Therefore, the theory was developed in the context of a broad empirical spectrum of cases and historical evidence. Indeed, this is one key strength of this theory: despite the fact that it was developed in the 1980s, and thus may seem somewhat outdated, it provides very useful analytical categories and conceptual guidance regarding bibliometric research assessment as a new and emerging profession. In particular, Abbott’s theory anticipated several developments, such as the computerization and digitization of information and communication processes in general.

2.2 Bibliometric research assessment as new professional jurisdiction?
Assessments of the quality of scientific work, as conducted in universities and public research institutes, are of considerable societal interest. Traditionally, the task domain of determining scientific quality was controlled by scientists themselves through peer review, either ex ante (research proposals) or ex post (papers submitted to journals), or a combination of both (hiring faculty, tenure decisions, ad hoc committees) (Zuckerman and Merton 1971; Hemlin 1996; Heinzé 2002; Bornmann and Daniel 2010; Van Leeuwen and Moed 2012; Musselin 2013). Therefore, those who did research also evaluated it. In Abbott’s theoretical terms, academic scientists acted as professionals within their own academic disciplines. They had a monopoly over establishing who performed well in research and who did not.

The situation changed with the advent of evaluative bibliometrics as a new academic research community (Whitley 2007). The community began to develop after Eugene Garfield introduced the Science Citation Index (SCI) in 1964 and started publishing journal rankings for the whole of science and technology (Garfield 1964, 1972; Narin 1976). Since that time, a growing number of computer scientists, library scholars, mathematicians, physicists, sociologists, and others embarked upon studying scientists’ productivity and the growth of research fields, and they developed indicators to capture research quality and impact (Wouters 1997). As will be shown below (Section 3), the development of this community was also influenced by Dutch policy makers in the late 1960s and early 1970s.

The emergence of evaluative bibliometrics as an academic field does not automatically generate a new professional jurisdiction of bibliometric research assessment. Before that can happen, bibliometric experts have to convince relevant actors in the public and legal arenas to confer on them exclusive rights for conducting bibliometric research assessment. As mentioned above, various configurations are possible for how different types of experts divide their professional labour in particular societal problem areas. Therefore, this article takes a systematic approach to examining the relationship of evaluative bibliometrics as an academic field to quantitative research assessment as a professional field:

A. The article shows how the Dutch science policy arena has stimulated the formation of quantitative research assessment as a new professional jurisdiction since the late 1960s.
B. The article shows that the professional responsibility for quantitative research assessment was institutionalized predominantly in the form of an expert organization that both built up expertise in the academic field of evaluative bibliometrics and provided professional services in assessing research quality: CWTS.
C. The article argues that the new professional field of quantitative research assessment experts in the Netherlands is subordinate to the older jurisdiction of peer review and may develop into an advisory jurisdiction in the future.

3. Data and methods
3.1. Data sources
The article draws on two data streams: archival and interview data. Regarding the science policy arena in the Netherlands, legislative texts were used, including the Comprehensive Higher Education and Research Act (WHW) that formally established the university quality control system (Ministerie van Onderwijs en Wetenschappen 1992). In addition, policy documents, such as the White Paper Higher Education Autonomy and Quality were examined (HOAK), (Ministerie van Onderwijs en Wetenschappen 1985). Furthermore, stakeholder reports from the Royal Netherlands Academy of Arts and Sciences (KNAW) and national evaluation protocols published by the Dutch University Association (VSNU) and by KNAW, VSNU, and the Netherlands Organisation for Scientific Research (NWO), were included (VSNU 1993; 1994; 1998; KNAW et al. 2001; KNAW 2005; VSNU et al. 2003, 2009, 2015). Secondary literature provided the background on the characteristics of the Dutch science system and the Dutch science and higher education policy since the mid-1960s (Cohen and Van der Steege 1982; Schwarz 1984; Blume 1985; Goedegebuure and Westerheijden 1991; Van der Meulen et al. 1991; Rip and Van der Meulen 1995; Van Steen 1995; Van der Meulen 1997; Van Steen and Eijffinger 1998; De Boer et al. 1999; Van Der Meulen 2007; 2010; Van Drooge et al. 2013).

Regarding evaluation practices in the Netherlands, the article examined a total of 295 reports issued by review committees during all VSNU protocol and Standard Evaluation Protocol (SEP) evaluation cycles (1994–2015). With respect to the history of CWTS, annual reports, reports of the Faculty for Social and Behavioral Sciences of Leiden University, self-evaluation reports by CWTS and review committee reports and 492 CWTS reports from contract research projects were examined (1983–2015), (CWTS 1986–2010; FSW 1995; 2000; CWTS 2008; Leiden University 2008; QANU 2016).

The archival data were complemented by 12 expert interviews with former and current CWTS staff members (Anthony van Raan, Henk Moed, Cornelis van Bochove, Paul Wouters, Thed van Leeuwen, Ed Noyons, Clara Calero-Medina), science policy experts of the Rathenau Institute (Barend van der Meulen, Jan van Steen), the KNAW (Jack Spaapen), former policy advisors of the VSNU (Frans van Steijn), and of Quality Assurance Netherlands
Universities (QANU, Roel Bennink). All interviews were conducted face to face (including two Skype calls) between April 2015 and July 2016. They lasted between 60 and 180 minutes and were all audio-recorded and fully transcribed. In addition, we included findings from an earlier case study on CWTS (Braam and van den Besselaar 2010).

3.2. Data coding
Legislative texts, policy documents, annual reports, and secondary literature provided the main sources for a document analysis to identify significant historical events by which major developments both in the history of Dutch science policy and the organizational trajectory of the CWTS could be mapped (see Figs 1, 7 and 8).

Evaluation reports from the VSNU and SEP evaluation cycles were coded regarding their use of bibliometric indicators. Three groups were distinguished: reports with peer review only, peer review complemented by ready-made bibliometric analyses, and peer review complemented by advanced bibliometrics. Archival material obtained from CWTS was analysed in quantitative terms to characterize funding (1994–2014), staff (1987–2014), and types of clients (1986–2015). Regarding clients, both an institutional and country classification were used, the former including (a) universities and research institutes, (b) research funders, (c) Dutch and foreign ministries and European Commission, and (d) companies and others.

All interviews were thematically coded with MaxQDA. Major themes are centered around important actors, such as the Ministry of Education, Culture and Science (MOCW), the Organisation for Economic Co-Operation and Development (OECD), Statistics Netherlands (CBS), or CWTS. Additional topics were coded, including the evolution of the Dutch evaluation protocols and the role and function of bibliometric indicators in research evaluation. The coding was used to identify relationships between categories of interest and to structure the interpretation of historical events (Miles and Huberman 1994; Maxwell 1996).

The article thus is based on a unique data repository, including a comprehensive archival dataset by which both the history of Dutch science policy in terms of quantitative research assessment and the organizational development of CWTS as expert organization can be mapped. Several new variables were generated from the archival data, providing valuable insights in addition to the results obtained from conventional document analysis. Efforts were made to effectively triangulate archival and interview data whenever possible.

4. Analysis
4.1. Science policy arena in the Netherlands
Prior to 1960, a dedicated science policy did not exist in the Netherlands. Dutch universities were considered as part of state bureaucracy, and the governance of administrative affairs of these public organizations was closely supervised by the MOCW whereas in academic matters, a high degree of autonomy prevailed (De Boer et al. 1999).

However, like in many other countries, the unprecedented growth of the scientific workforce led to questions regarding national funding priorities. In this regard, science policy was considered to provide a rational basis for allocation mechanisms and a means towards better co-ordination between universities and government (Blume 1985). Hence, in 1966, the Advisory Council for Science Policy (RAWB) was established in order to co-ordinate and stimulate the new policy area (Wouters 1999).

The new national science policy arena received institutional legitimacy from two events in the international science policy arena that highlighted the need for quantitative science and technology indicators. First, the OECD published its ‘General Report: Gaps in Technology’, in which national differences in scientific and technological potential were examined (OECD 1968; Godin 2003: 686). Secondly, the US National Science Foundation (NSF) published its ‘Science Indicators’ report, in which a comprehensive quantitative description of national research efforts in the United States was undertaken: ‘These indicators, expanded and refined in the coming years, [were] intended to measure and monitor U.S. science (...) and to chart its changing state.’ (NSF 1972: 1).

Figure 1. Science policy arena in the Netherlands.
The Dutch response to these two influential indicator reports followed suit (Van Steen 1995; Wouters 1999). At the level of the national scientific leadership, the response came from a publicly funded research council: the Foundation for Fundamental Research on Matter (FOM). Following a visit to the NSF and Garfield’s Institute for Scientific Information (ISI) in the early 1970s, FOM’s director for research, Cees Le Pair, advocated the cautious use of citation data as a complement to peer review (Wouters 1999: 138). Hence, Le Pair commissioned the first bibliometric studies in the Netherlands (Chang 1973; Chang and Dieks 1976; Dieks and Chang 1976). Anthony van Raan, the future director of CWTS at LU, was a PhD student at Utrecht University and worked as a physicist at FOM at that time, and he frequently discussed the issue of quantitative research assessment with Le Pair (Section 4.2).

At the national government level, in 1973, the first Dutch Minister for Science Policy (MW) was appointed. The MW was responsible for the coordination of national science policy. The MW did so in (at least) two ways: a) he published a Science Policy Memorandum, which promoted research quality and effectiveness as well as social and economic relevance of research; and b) he coordinated, between 1974 and 1989, a series of evaluations of academic disciplines in Dutch universities (Verkenningscommissies), (Minister voor Wetenschapsbeleid 1974; Van der Meulen et al. 1991). These evaluations were intended as planning tools both to survey strategic research areas and formulate national research priorities, and some of them already made use of publication and citation data (Schwarz 1984: 234; Van der Meulen et al. 1991: 96). In addition, the RAWB, in 1978, recommended strengthening the hitherto weakly organized and dispersed field of science studies in the Netherlands with a particular focus on strategic research relevant for science policy needs (Wouters 1999: 142).

It is fair to say that by the late 1970s, the arena of national science policy had been firmly established in the Netherlands, and concurrently a demand for quantitative research assessment had emerged. As we will show in Section 4.2, this policy context nurtured the building of organizational capabilities in quantitative research assessment at LU. However, before turning to the history of CWTS, we outline how the policy arena developed from the early 1980s onwards.

At the national policy level, indicator testing and development took place in the early 1980s, especially at RAWB, and the Directorate General for Science Policy (DGW), which became part of the MOCW in 1975. Of note is RAWB’s report on Dutch health science, which at the time represented an exemplary methodological exercise: it combined citation analyses with expert opinion to assess the performance of health sciences and establish research priorities in the Netherlands (Rigter 1986; Wouters 1999: 153). In addition, RAWB set up an internal working group and started the Science and Technology Indicators Project (WTI) which, in its first report in 1984, provided the first dedicated quantitative description of Dutch science, including bibliometric output indicators (Wouters 1999: 160–2). RAWB and its successor, the Advisory Council for Science and Technology (AWT), continued this report series with two follow-up volumes in 1988 and 1991.

The activities of RAWB resonated well with the agenda of the DGW, which set up its own internal indicator working group in 1987, and published an indicator report, in collaboration with the Ministry of Economic Affairs, in 1992. In the same year, the Netherlands Observatory of Science and Technology (NOWT) was established: it published its first biannual report in 1994 and has continued to do so until 2010 (Van Steen 1995; personal communication Van Steen 2016, 2017). Therefore, by the early 1990s, the Dutch government had undertaken considerable efforts to establish quantitative assessment of Dutch science and technology with the purpose of informing national science policy.

In line with Abbott’s theory of professions, the emergence of this new jurisdiction was also influenced by higher education legislation. Here, another important division at MOCW was in charge: the Directorate General for Higher Education and Scientific Research. In this regard, the white paper HOAK was highly influential: it stated that universities may operate autonomously within boundary conditions set by the government, thereby making them more flexible (Ministerie van Onderwijs en Wetenschappen 1985). In return, HOAK argued, universities would be obliged to set up systems of quality control. The HOAK principles were codified in the WHW act, which prescribed the establishment of a national system of quality control of university research under the auspices of VSNU, the corporate representative of Dutch universities (Ministerie van Onderwijs en Wetenschappen 1992). Thus, the Dutch parliament conferred responsibilities for research assessment on the universities, and VSNU then codified evaluation principles (VSNU 1993, 1994, 1998). In this way, another important step in the professionalization of quantitative research assessment in the Netherlands was taken by the mid-1990s.

The VSNU protocol comprised a combination of self-evaluations and peer visitations from abroad (VSNU 1993, 1994, 1998). Although the standard procedure was defined by VSNU for all universities except the university hospitals who had their own procedures under the auspices of KNAW, disciplinary committees within VSNU (the so-called ‘chambers’) could specify in more detail the data and information to be included in the self-assessments. Especially in the natural sciences, bibliometric data were deemed feasible additions to the predominantly peer review-based evaluations (VSNU 1993: 39; VSNU 1998: 13). Therefore, Dutch universities practiced and became familiar with a quality control system for research in which bibliometric indicators were embedded, at least in the natural and life sciences.

The VSNU protocol was not, however, met with unanimous support in the Dutch science policy arena. Criticism came not only from representatives of the humanities and social sciences but also from scientists represented within KNAW (Interview, Spaapen). Therefore, a joint working group, the Quality Control of Scientific Research Group (KWO), in which representatives of KNAW, NWO, and VSNU were members, was set up in the early 2000s (Van Drooge et al. 2013: 5). The KWO prepared a new evaluation procedure, the SEP. It abandoned the national comparison of academic disciplines and gave universities more freedom to choose the format in which they wanted to conduct their research quality assessment while maintaining a common procedural framework (Interview, Bennink), (Van Der Meulen 2010: 518). In addition, the responsibility for commissioning bibliometric analyses was delegated from the disciplinary chambers to the executive boards of universities. The SEP has been in operation since 2003 (VSNU et al. 2003, 2009, 2015).

In summary, a science policy arena with new political and administrative actors emerged in the Netherlands during the late 1960s and early 1970s, among them the RAWB (1966), the MW (1973), and DGW (1975). These actors shaped the emerging jurisdiction of quantitative research assessment in the 1980s, via the use of bibliometric data and indicators in a series of nationwide disciplinary evaluations and via the publication of science and technology indicator reports and white papers. Therefore, the Dutch government and its state bureaucracy took important initial steps in the professionalization process. In the early 1990s, parliament passed
legislation in which universities were granted more autonomy and self-governance in return for systematic and regular research assessment. Therefore, the responsibility for research assessment, including the use of bibliometric indicators, was transferred to the universities and their corporate representative (VSNU), which then codified evaluation principles, first at the national level (1994–2002), and since the 2000s together with KNAW and NWO more flexibly at the local, national, and international levels (2003–2021).

4.2. CWTS as expert organization

4.2.1. Inception: 1980–1985

The nucleus of what later became CWTS was a working group around physicist Anthony van Raan and mathematician Henk Moed, affiliated with the Rector’s office at LU. The recruitment of van Raan as head of this working group in 1980 was no coincidence. First, it followed the decision of LU’s executive board in 1979 to change its policy for allocating resources among its faculty and research centers (Braam and Besselaar 2010: 175–6). Secondly, van Raan had experience with bibliometric methods. Before joining LU, he was a PhD student at Utrecht University and employed first as a physicist at the University of Bielefeld (1973–77) and then at FOM where he had frequently discussed issues of quantitative research assessment with Cees Le Pair, then FOM’s director of research (Interview, van Raan; Van Raan 2013). Under the leadership of Ton Kassenaar (LU’s rector, 1979–1985), the working group’s assignment was to use bibliometric indicators both for assessing the quality of LU’s research in the natural and medical sciences and for suggesting a new funding scheme that came to be known as the ‘z-model’ (Interviews, van Raan, Moed; Van Raan and Frankfurt 1980; Moed et al. 1985). Its application in a series of assessments was unprecedented in scale and considered exemplary (Moed et al. 1983; Van Raan 2013).

At the time when van Raan conducted its bibliometric pilot exercise at LU, two important events occurred that provided momentum for his group. First, in 1982, an evaluation report by the Verkenningcommissie Biochemistry (1982) was issued. This report made use of citation analysis to rank Dutch biochemists. Yet, as van Raan’s group could convincingly show, misspellings and incomplete references in the publication data provided by the ISI led to a disadvantage for a biochemistry research group at LU (Interview, Moed). Secondly, in 1983, Ben Martin and John Irvine from the Science Policy Research Unit at the University of Sussex asserted in their assessment of radio astronomy that publication and citation measures were acceptable partial indicators of research progress and should be used in the evaluation of basic research (Martin and Irvine 1983). This pioneering study drew controversial reactions after it was shown that the underlying data were not entirely complete (Moed and van Raan 1985; Martin and Irvine 1985). As a consequence of this experience, van Raan’s group made it a principle of their own work to retrieve comprehensive data, process them accurately, and engage with researchers under evaluation to cross-check data accuracy (Interview, Moed).

In addition to both careful collection and verification of publication and citation data and engagement of those who are evaluated, van Raan’s group in the early 1980s developed its methodology, which has two dimensions (Interviews, van Raan, Moed; Moed et al. 1983). First, it focuses on international comparisons within fields and for that purpose normalizes citation counts and compares research performance with an international benchmark. This dimension is represented in the concept of the Field Normalized Citation Score (CPP/FCSm), also formerly called the ‘crown indicator’ (Interview, van Raan; Waltman et al. 2011a; 2011b; Van Raan 2013). Secondly, it focuses on emerging research groups, most notably young and promising researchers who have not been able to accumulate as much reputation as their older peers. Therefore, the methodology represents a bibliometric ‘counter force’ useful for breaking open situations in which accumulated reputation rather than recent research performance prevailed (Interview, Moed; Moed 2005). Most important, the methodology builds on an in-house database derived from ISI data (Moed et al. 1995; Moed 1996).

Summing up: in terms of Abbott’s theory, van Raan’s group in the early 1980s developed the basic structure of its cognitive claim. Their methodology comprises four elements: 1) the meticulous collection and careful processing of publication and citation data; 2) the engagement with the research groups under evaluation, both in terms of data validation and feedback discussion regarding bibliometric results; 3) a focus on recent performance rather than accumulated reputation, including an international comparative perspective; and 4) an in-house database derived from raw data provided by ISI. These four elements were key in establishing trust both with their clients (the Rector’s office at LU) and with those who were the subjects of bibliometric evaluation (research groups at LU).

4.2.2. Formation: 1986–93

Before UL’s rector left office in 1985, it was decided that van Raan’s group should move to the Faculty of Social and Behavioral Sciences (FSW) and join the Leiden Institute for Policy Research. This move was no coincidence because sociology professor Mark van de Vall was interested in hosting van Raan’s group. Van de Vall was active in building a policy oriented ‘data-based sociological practice’ (Lamnek 1995: 304). Therefore, van Raan and his colleagues were placed in a friendly academic environment in which their new bibliometric approaches were highly welcome (Interview, van Raan). Three years later, in 1989, van Raan’s group was named the Centre for Science and Technology Studies (CWTS). In 1991, CWTS was endowed with a professorial chair in Quantitative Science Studies (the first in the Netherlands), held by the director of CWTS, Anthony van Raan (CWTS 1993).

Once established as a research unit, CWTS managed to acquire a stream of contract research projects. The increasing volume of research income allowed CWTS to expand its workforce (Fig. 2). In this regard, a first multi-year programme funded by MOCW (1986–1991) was undertaken to investigate the feasibility of applying bibliometric indicators to measure growth and performance in several fields of science and to establish a system of foresight in science policy based on bibliometric indicators. It included ‘Mapping of science: combined co-citation and co-word analysis’ (WTIA1), ‘Indicators of research performance and knowledge transfer: humanities and social sciences’ (WTIA2), ‘The scientific base of technological development’ (WTIA3), ‘Indicators of research performance and knowledge transfer: electrical engineering and electronics’ (WTIA4), the ‘Early warning system’ (WTIS), ‘Data-analytical methods and techniques, in particular mapping techniques’ (WTIA5), and ‘Role of instrumentation in the development of research fields’, (WTIA7), (CWT 1988, 1990, 1991).

In addition, NWO commissioned CWTS to conduct performance analyses in the project ‘Netherlands Science Indicators’ (1990–2000). Here, CWTS conducted performance analyses of Dutch university groups and institutes, mapped Dutch scientific activities in a worldwide context, and examined the effects of NWO grants in
terms of research performance. As part of these projects, CWTS developed a monitoring system for performance assessment of research groups within university and NWO structures and conducted strengths–weaknesses analyses on a national disciplinary level (CWTS 1990: 11).

At about the same time, CWTS expanded its client base to Flanders in Belgium when the Flemish parliament increased autonomy for universities and introduced obligatory research assessments, a situation similar to that in the Netherlands (Luwel 2000: 285). The University of Ghent was the first to commission CWTS with a bibliometric evaluation of the research performance of its science and medical faculties in 1990, followed by the Catholic University of Leuven and the University of Antwerp in 1991 (Van den Berge et al. 1998). For a period of 12 years, CWTS conducted regular follow-up evaluations of Flemish universities (De Bruin and Moed 1993b). During that time, an extended version of CWTS’s in-house database was created with a specialization in Flemish research in the natural, life, and technical sciences (Luwel 2000).

CWTS not only relied on public support but also established a long-term cooperation (1986–2010) with the large publishing house Elsevier, which commissioned contract research and contributed funds for blue-sky research in the area of journal mapping and science mapping. Van Raan argues: ‘That was very, very important. It was about 25–30 percent of the Institute’s budget. Elsevier has played a very, very important role in the history of the Institute. Without Elsevier, it would not have worked.’ (Interview, van Raan).

The research contracts from MOCW, NWO, the Flemish universities, and Elsevier helped CWTS improve its indicator methodology and expand its in-house database. Regarding the latter, CWTS invested considerable time and energy in author disambiguation and unification of institutional addresses as well as new keywords parsed from publication titles. The raw data from ISI were also matched with other databases such as the medical database PubMed. Therefore, CWTS’s in-house database was successively enlarged: first, it comprised data on LU, then data on Dutch universities, then data on Flemish universities, and so forth (Interviews, van Raan, Moed).

The database extension was closely connected to improving CWTS’s core methodology: the field-based normalization and the identification of emerging and leading research groups. Over time, the CPP/ FCSm was complemented by other indicators capturing the position of a research group in the SCI journal spectrum, their collaboration with other research groups, and their cognitive orientation (Moed et al. 1995). Therefore, from the late 1980s to the early 1990s, CWTS was ready to broadly communicate its cognitive claim in the emerging academic field of evaluative bibliometrics. First, in 1988, CWTS began the Science and Technology Indicators Conferences, a series that has continued ever since. Second, in the same year, Anthony van Raan published the 1st Handbook of Quantitative Studies of Science and Technology (Van Raan 1988). Third, in 1993, CWTS provided the first description of its in-house database for national research assessment (De Bruin and Moed 1993b).

In summary, based on initial successes in applying bibliometric indicators to research groups at the LU (1980–83), van Raan’s group managed to attract several multi-year contract research projects, expanded its workforce, and further developed its field-normalization methodology and its in-house database. By the end of the 1990s, CWTS had established itself as an expert organization for the Dutch and the Flemish governments and for the universities in these two countries. In terms of Abbott’s theory, CWTS placed social claims in the emerging jurisdiction of quantitative research assessment, particularly in the natural and life sciences where bibliometric evaluation methods were welcomed as complementary to peer review. Clearly, in the field of evaluative citation analysis, CWTS moved from the periphery towards the center during this period.

4.2.3. Expansion: 1994–2007
The year 1994 marked the beginning of a period of expansion for CWTS because the first cycle of national evaluation protocols devised by VSNU started. CWTS provided about 90 per cent of the advanced bibliometric analyses commissioned by the universities in the first VSNU evaluation (1994–97). It was in this context that CWTS forcefully placed its social claim in the emerging jurisdiction (Interview, van Raan). The success with which CWTS made its social claim had to do with how it framed its expertise: it offered the bibliometric method primarily as a diagnostic tool to identify emerging and leading groups but also inactive groups (Interviews Moed, van Bochove).

The relevance of CWTS as a provider of bibliometric analyses in the context of the Dutch university evaluation scheme was strengthened by the NOWT, in which CWTS, since 1992, and in cooperation with the Maastricht Economic and Social Research Institute, provided a national monitoring of the development of Dutch science (Interview, van Steen). CWTS assumed that role with respect to bibliometric output data, in addition to data that were gathered by CBS, OECD, Eurostat, and the universities themselves (Interview, van Steen). The dominant position of CWTS as a provider of advanced bibliometric analyses in the second VSNU cycle (1998–2002) remained unchallenged.

The expansion period also meant both a substantial increase in the revenues from contract research and a stabilization in its workforce. Between 1994 and 2007, the inflation-adjusted amount of contract funding quadrupled (Fig. 3, see Supplementary Table 2). As a consequence, CWTS employed on average between eight and nine scientists and four to five technicians, a comparatively large organizational capacity in evaluative bibliometrics (Fig. 2, see Supplementary Table 1). Following this considerable expansion, CWTS became an independent research institute within the FSW in 1998 (CWTS 1998; Van Raan 2013). Yet, the restrictions regarding hiring or retaining staff and increasing wages were largely set by university rules. Therefore, in 2002, the creation of CWTS B.V. as an independent contract research organization (100 per cent subsidiary of the Leiden University Business Development Holding) aimed at providing more
flexibility in these respects. In addition, the foundation of the CWTS company underlined the ambition of CWTS’s leadership to extend its social claim in the emerging jurisdiction.

In the 2000s, CWTS expanded its range of services by introducing benchmark studies and university rankings. In addition, as of 2002 CWTS started to offer the training course ‘Measuring Science and Research Performance’ to students, researchers, policymakers, librarians and other professionals. Most important, by the mid-2000s, CWTS had substantially expanded its client base (Figs 4 and 5, see Supplementary Tables 3 and 4). This expansion became evident when, in 2007, the Higher Education Funding Council England commissioned CWTS to initiate the use of bibliometric performance analyses in the British Research Assessment Exercise (CWTS 2008: 22).

Closely related to the expansion of CWTS’s activities, the years 1994–2007 saw considerable efforts by CWTS to consolidate its cognitive claim in the field of evaluative bibliometrics. In 2004, Henk Moed (and others) published the 2nd Handbook of Quantitative Science and Technology Research (Moed et al. 2004).

Figure 3. Funding sources of CWTS, 1994–2014, inflation-adjusted.

One year later, Henk Moed published Citation Analysis in Research Evaluation, which has become a standard textbook in quantitative research assessment (Moed 2005). Based on its field-normalization methodology, CWTS also continued to introduce new bibliometric indicators, including percentile indices (Tijssen et al. 2002). It is also noteworthy that in the years 1993–2007, the number of papers in the main academic journals of evaluative bibliometrics (JASIST, Scientometrics, Research Policy, and Research Evaluation) jumped from around 200 to 500 indicating that the expansion of CWTS occurred in the context of considerable field growth (Braam and van den Besselaar 2010: 180).

In summary, in the expansion phase, based on its expertise in providing quantitative research assessments for Dutch universities, particularly in the context of the national evaluation scheme, CWTS generated considerable growth in contract project funding. In addition, CWTS broadened both its portfolio of evaluation services and its client base. Likewise, CWTS deepened its cognitive claim, first by distributing its field-normalization methodology and science mapping technique, second by substantially extending its in-house database, and third by publishing influential handbooks and textbooks. Thus, by the mid-2000s, CWTS had established a central position in the emerging jurisdiction of quantitative research assessment not only in the Netherlands but also in several European countries. Since the mid-1990s, CWTS has held a core position among all institutions in research on evaluative citation analysis.

4.2.4. Consolidation and diversification: 2008 and onwards

In 2008, CWTS entered a new phase in its development as an expert organization when the MOCW decided to dedicate 1.5 million Euro as recurring institutional funding per year for CWTS (Interviews, van Bochove, van Raan). This funding allowed CWTS to significantly increase its research staff (Fig. 2, see Supplementary Table 1) and appoint a new professorial chair of Science Policy in 2008 (Cornelis van Bochove). In addition, CWTS set up a PhD program and thus devoted more resources to training and educating students in the field of evaluative bibliometrics. The review report published in the course of the periodical evaluation of CWTS according to the SEP rates the research quality as excellent (Leiden University 2008). This points to a consolidation of CWTS in the academic field.

In 2010, when Anthony van Raan retired and Paul Wouters started as new CWTS director, another professorial chair was established in Science and Innovation to which Robert Tijssen was recruited. Wouters introduced a new research program that emphasized renewed attention for the mathematical characteristics of bibliometric indicators and the mechanisms at work in research evaluation processes. Web-based metrics constitute a new field of indicator development and testing. A major change consisted in adding a qualitatively oriented research line studying the effects of research assessment practices on scientific knowledge production by means of ethnographic methods (CWTS 2012). The institute thus diversified its approach in terms of research-driven bibliometric services.

The strong position of CWTS in terms of cognitive and social claims in the emerging jurisdiction did not remain uncontested, however. First, the cognitive claim: in the so-called ‘crown indicator debate’, Lundberg, Opthof, and Leydesdorff challenged CWTS’s main indicator (Lundberg 2007; Opthof and Leydesdorff 2010). The CPP/FCSm indicator had acquired this name in the mid-2000s to communicate and market the successful cognitive claim in the wider public. The challengers asserted that CWTS uses ISI subject categories for field normalization despite their demonstrated shortcomings as a taxonomy of science. Another criticism was wielded against the mathematics underlying the CPP/FCSm indicator (Interviews, van Leeuwen, Moed). Following this debate, CWTS replaced the CPP/FCSm with the Mean Normalized Citation Score (MNCs), (Interviews, van Leeuwen, van Raan).

Figure 4. Client types of CWTS, 1986-2015. Sources: CWTS R&D Project reports from the CWTS archive.
Nevertheless, based on its original field-normalization methodology, CWTS continued to introduce new bibliometric indicators in the consolidation period, including the Source Normalized Impact per Paper (SNIP), and software tools, such as the visualization software VosViewer for science mapping in 2010 (Noyons et al. 1999; Van Eck and Waltman 2010), and published a review of the literature on citation impact indicators (Moed 2010; Van Eck and Waltman 2010; Waltman et al. 2011a; 2011b; Waltman et al. 2013; Van Eck and Waltman 2014; Waltman 2016).

Second, the social claim: new competitors emerged, such as research groups at the Karolinska Institute in Sweden, the Scimago Lab in Spain, or the contract research company Science Metrix in Canada. More important than academic competitors, however, was the fact that large database providers introduced ready-made products in the late 2000s: Thomson Reuters (Web of Science, formerly ISI) introduced InCites, and Elsevier (Scopus) introduced SciVal. These web-based software tools use publication and citation data to generate institutional metrics including selected benchmarks and performance and cooperation maps. Therefore, the competition in the jurisdiction of quantitative research assessment increased considerably (Interview, van Raan).

Furthermore, the use of bibliometrics in quantitative research assessment received considerable criticism. This criticism resulted in an increased focus on societal relevance of research in the modified SEP (cycle 2015–21), where the evaluation criterion of research productivity was abandoned (Interview, Spaapen). Hence, a noticeable decline in advanced bibliometric analyses commissioned by Dutch universities set in, while at the same time more bibliometric ad hoc analyses were conducted, thereby challenging the formerly dominant position of CWTS as an expert organization (Fig. 6, see Supplementary Table 5).

CWTS employed three strategies to fortify its position as expert organization. First, by broadening its service portfolio with ‘advanced analytics’, a new service category to complement the classic benchmarking and performance studies. Here, mapping, network analysis, and visualization techniques are used to generate collaboration profiles, new types of benchmark studies, and representations of scientific fields (CWTS company profile 2012). Advanced
analytics requires more computer power as well as a much higher number of working hours by CWTS staff and is geared towards providing strategic advice to client institutions. Second, by diversifying its research portfolio by including the study of altmetrics and indicators for societal impact of research. Third, by reaching out more than before to international clients. Its clients include the following countries (in alphabetical order): Australia, Croatia, Denmark, Finland, France, Germany, Kuwait, Poland, Qatar, South Africa, Spain, Sweden, and the USA (Fig. 5).

In summary, the latest phase is characterized by an expansive consolidation and diversification of CWTS both in institutional terms, as illustrated by the new basic funding, and by the fact that CWTS is the leading institute in the academic field of evaluative bibliometrics in the Netherlands (and abroad). However, some of CWTS’s cognitive claims were challenged in the academic field, and new competitors with commercial products within the jurisdiction of quantitative research assessment have increasingly challenged CWTS’s formerly dominant position as an expert organization. CWTS has answered these challenges by broadening and diversifying both its service portfolio and its international client base. CWTS has maintained its central position among institutions in the academic field of evaluative bibliometrics, including evaluative citation analysis, despite the strong expansion of this research area since the mid-2000s.

5. Summary

This article shows that Abbott’s theory of professions offers a highly suitable and also comprehensive theoretical framework to explaining the emergence and development of the new jurisdiction of quantitative research assessment without further developing the theoretical framework. Focusing on the Netherlands, in which this new jurisdiction emerged in the 1970s, the article describes how both new political and administrative actors, including RAWB (AWT), MW (DGW), and MOCW, and scientific stakeholders, including VSNU, NWO, and KNAW, shaped this new professional field. Most important, the article discusses the role of CWTS in this development: it built up organizational capabilities in evaluative bibliometrics and at the same time provided professional expertise for research funders and universities. In this way, the relationship between evaluative bibliometrics as an academic field and quantitative research assessment as a professional field was institutionalized via CWTS as an expert organization.

CWTS issued a continuous stream of cognitive claims in the new academic field of evaluative bibliometrics (Fig. 7). The basic structure of that claim is CWTS’s distinctive diagnostic approach: the field normalization methodology that allows international comparisons and the identification of emerging and leading research groups. The recent diversification of research lines of CWTS has not lead to a substantial change of cognitive claims (QANU 2016: 12), thus it was and still is based upon a customized, unique bibliometric data system derived from raw publication and citation data (first from ISI, later from Thomson Reuters, today from Clarivate Analytics). CWTS invested considerable efforts into not only carefully collecting and processing publication and citation data but also from the very beginning engaging research groups under evaluation, both in terms of data validation and feedback discussion. CWTS deepened its cognitive claim with the Science and Technology Indicators Conference series and the publication of Handbooks of Quantitative Studies of Science and Technology (Fig. 7).

In line with Abbott’s theory of professions, CWTS’s cognitive claims (Fig. 7) were made in competition with other professionals and expert organizations. For example, the handbook series competes in the academic field with the Handbook of Science and Technology Studies series featuring non-quantitative approaches, the first edition of which appeared in 1995, and the fourth edition in 2016 (Jasanoff et al. 1995; Felt et al. 2016). Furthermore, the Handbook of Bibliometric Indicators: Quantitative Tools for Studying and Evaluating Research can be regarded as the third edition of the quantitative handbook series but was published by competitors of CWTS (Todeschini and Baccini 2016). Similarly, the Leiden Ranking competes with several other global university rankings, most important the Shanghai Ranking (first published in 2003) and the Times Higher Education Ranking (first published in 2004).
The cognitive claims paved the way for placing social claims (Fig. 8, see Supplementary Table 6). By the middle of the 1990s, CWTS had established itself as an expert organization not only for both the Dutch and the Flemish governments but also for the broader research communities in universities. In the 2000s, CWTS deepened and broadened its social claim in the emerging jurisdiction, first in the context of the VSNÜ evaluation scheme and the NOWT, and second with the increase and diversification of clients: CWTS significantly expanded its geographical reach beyond the Netherlands and Belgium and enlarged its professional services to include benchmark studies and rankings (Figs 5 and 8).

In line with Abbott’s theory of professions, CWTS’s social claims were made in competition with other professionals and expert organizations. For example, the Nordic Institute for Studies in Innovation, Research and Education (NIFU) in Norway and the Centre for Research & Development Monitoring (ECOOM) in Belgium provide bibliometric analyses for their national audiences. The most obvious threat to CWTS’s position are, however, ready-made bibliometric products distributed by large database providers and publishing houses, including Thomson Reuters and Elsevier, both former clients and partners of CWTS. By increasing the share of advanced analytics in bibliometric services and diversifying its research portfolio CWTS has made attempts to counter these threats.

6. Discussion

Tracing the history of the Dutch science policy arena in connection with the history of CWTS illuminates how CWTS as an expert organization has placed cognitive and social claims in the new jurisdiction since the 1980s. This article aims at contributing to a better understanding of how the new professional field of quantitative research assessment started to compete with the established jurisdiction of peer review. Both the introduction of the SCI (and related databases) and the increasing political efforts to make scientists accountable to the public nurtured the emergence of the new jurisdiction which, in turn, questioned the old monopoly of academic researchers in evaluating their peers’ work.

In this closing section of the article, we discuss the type of settlement that can be observed between peer review and quantitative research assessment today, again with a focus on the Netherlands. This discussion further applies Abbott’s theory of professions to the case of bibliometric research assessment as professional field, but it does not aim at extending the theory itself. As outlined above, Abbott’s theory is highly useful in providing conceptual guidance, and as a consequence, there seems no direct need to make modifications or additions to the theory despite the fact that it was developed in the 1980s.

First, while the societal problem area of research evaluation is still under the jurisdictional control of academic researchers, they no longer exercise a monopoly over evaluating their peers (Wouters 1997: 49). Clearly, academics perceive metrics-based research assessment practices as a threat to their academic autonomy. This perception is evident, for example, in the reports published by the ‘Science in Transition’ movement in the Netherlands (Dijstelbloem et al. 2013). Critics of citation analysis suggest that the complex activity of research evaluation is becoming entirely quantified. Yet, as this article shows, CWTS never launched a full-blown attack on peer review. Rather, its social claim was confined to complementing and validating the outcome of peer review: ‘The ideal evaluation has a peer review portion and a bibliometric portion, each independent from the other, with bibliometrics never used as a stand-alone tool.’ (Interview, van Raan).

CWTS’s leadership always used bibliometric indicators and methods as diagnostic tools for revealing selected aspects of scientific quality, such as productivity and impact (in Abbotts’ terms: diagnosis), but the conclusions drawn from such insights, including funding or tenure decisions, were left to research administrators and academics (in Abbott’s terms: inference and treatment). Given the expanding client base of CWTS, this complementary social claim
seems to be accepted. Our interpretation receives further support when taking into account the dominance of peer review as a standard procedure vis-à-vis the optional inclusion of metric-based performance assessments in the Dutch evaluation protocols. Therefore, it can be concluded that quantitative research assessment in the Netherlands has settled as a jurisdiction subordinate to research evaluation based on peer review.

Second, this subordinate jurisdiction of quantitative research assessment has been actively constructed by political actors in the Dutch science policy arena. It seems noteworthy that (at least) two political strategies were used. The first strategy was, as mentioned above, the building-up of organizational capabilities in policy-relevant science studies (evaluative bibliometrics) via research projects and R&D reporting infrastructure. CWTS clearly benefited from these political efforts and successfully built-up expertise in the new academic field of evaluative bibliometrics. Once these capabilities had been established, the second strategy was put in place: the Dutch parliament enforced legislation that required systematic and regular research assessment from universities in return for more autonomy and self-governance. Although the new legislation did not specify the extent to which bibliometric expertise had to be included in research evaluations in universities, the VSNU disciplinary protocols codified bibliometric data as feasible additions to the predominantly peer review-based evaluations, especially in the natural and medical sciences.

Third, the codification of quantitative research assessment in the VSNU and SEP protocols created a demand for professional bibliometric expertise. CWTS was uniquely qualified to deal with clients such as universities and research institutes and to arrange license agreements with the commercial database providers that are a prerequisite to performing sophisticated bibliometric analyses. As a result, CWTS assumed a leading position in the subordinate jurisdiction, mainly in the Dutch–Flemish region, but increasingly also internationally. Factors contributing early on to the strong position of CWTS were, on the one hand, a clear demarcation from early bibliometric exercises with a less prudent handling of issues of data accuracy and, on the other hand, the early investment in building a highly reliable in-house database based on highly qualified academic and technical staff. Over time, the new jurisdiction attracted other expert organizations, including ECOOM in Flanders and NIFU in Norway, and professional groups, such as the librarians from the University of Wageningen (Van Veller et al. 2010; Petersohn 2016). However, the fact these competitors partly followed the methodology put forward by CWTS indicates the latter’s strong position in the field.

Finally, while competition between expert organizations in the subordinate jurisdiction reflects its growing societal relevance, a recent threat to the professional authority of CWTS (and other expert organizations) emerges from ready-to-use forms of bibliometric expertise that are available as commercial products by database providers and publishing houses, such as Clarivate Analytics or Elsevier. There seems to be a risk of de-professionalizing the expert field by routinizing bibliometric workflows in software products and therefore allowing non-experts to perform bibliometric routines (Abbott 1991). The same holds for alternative indicators, such as the h-index, that facilitate self-made bibliometric assessments of individual scientists without a sophisticated use and maintenance of citation databases (Leydesdorff et al. 2016). The tendency towards de-professionalization—in a theoretical and not a normative or negative sense of the word—is illustrated by the growing share of ready-made bibliometric analyses (Fig. 6), which doubled from 11 per cent in the first SEP cycle (2003–09) to 21 per cent in the most recent SEP cycle (2009–15). Therefore, it seems possible that the current settlement may develop into a weaker form: an advisory jurisdiction in which expert organizations, such as CWTS, would retain the right to interpret or buffer the actions taken by competitors but would have no effective cognitive or social control over the interlopers’ bibliometric practice.

**Supplementary data**

Supplementary data is available at Science and Public Policy online.

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