Leistungsbewertung der Wissenschaft im Wandel: Eine professionssoziologische Analyse der Anbieter bibliometrischer Dienstleistungen im neuen Expertenfeld der quantitativen Forschungsevaluation

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Eine professionssoziologische Analyse der Anbieter bibliometrischer Dienstleistungen im neuen Expertenfeld der quantitativen Forschungsevaluation

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1 Einführung und Zusammenfassung der Ergebnisse

1 EINLEITUNG: Forschungsfrage – und Stand sowie theoretische Einbettung

Praktiken der Leistungsbewertung sind konstitutiv für die wissenschaftliche Forschung (Merton, 1973) und unterliegen einem steten Wandel (Chubin & Hackett, 1990; Cronin, 2014). Seit der Erfindung des Science Citation Index (Garfield, 1964) sind Methoden der quantitativen Forschungsevaluation mit dem Ziel der Steuerung des Wissenschaftssystems zur Steigerung nationaler Wettbewerbsfähigkeit und Lösung gesellschaftlicher Probleme entwickelt worden (Ruivo, 1994; Kostoff, 1996; van der Meulen, 1997; Kuhlmann & Bührer, 2000; Godin, 2003; Gingras, 2016, S. ix). Diese Methoden umfassen diverse statistische, bibliometrische oder szientometrische Verfahren, ökonometrische Modelle, Längsschnitt-, Kosten-Nutzen-, Vergleichsgruppen- und Wirkungsanalysen zur Herstellung unterschiedlicher Indikatoren, wie zum Beispiel Input- und Outputindikatoren sowie Produktivitäts- und Wirkungsindikatoren (King, 1987; Martin, 1996; Kostoff, 1996; Kuhlmann & Bührer, 2000; Kuhlmann & Heinze, 2004a). Insbesondere die bibliometrische Indikatorik, basierend auf Publikations- und Zitationszahlen, verbreitet sich zunehmend in nationalen Evaluationssystemen und institutionellen Bewertungspraktiken (Butler, 2003; Hicks, 2012; Fiala, 2013; Aagaard 2015; Hammarfelt, Nelhans, Eklund & Aström, 2016). Entsprechend sind sowohl die Genese, Diffusion und Eigenschaften, aber auch die Effekte quantitativer Forschungsevaluationsmethoden Gegenstand eines wachsenden Literaturkorpus in den Bereichen Science Policy Studies, Wissenschaftssoziologie, Informationswissenschaften, Hochschulforschung, Politikwissenschaften sowie Governance- und Innovationsforschung (de Rijcke, Wouters, Rushforth, Franssen & Hammarfelt, 2016).

Die Diversität der analytischen Perspektiven und Ansätze wird von aktuellen wissenschaftspolitischen Debatten flankiert, die vor dem Hintergrund konstitutiver (Dahler-Larsen, 2014) und nicht-intendierter Folgen der „Metrifizierung“ von Bewertungspraktiken (Weingart, 2005; Burrows, 2012; Gläser, 2015) einen verantwortungsvollen Umgang mit den neuen Technologien der Leistungsmessung fordern (Cagan, 2013; Hicks, Wouters, Waltman, de Rijcke & Rafols, 2015). Die in der wissenschaftlichen Fachgemeinschaft der Bibliometriker bekannten methodologischen Problematiken, wie zum Beispiel der Umgang mit den in der Bibliometrie typischerweise auftretenden schiefen Verteilungen (Seglen, 1992) sowie die darauf aufbauenden Vorschläge für angemessene und valide Indikatorenkombinationen (Hicks et al., 2015; Moed & Halevi, 2015) konnten jedoch nur unzureichend bis gar nicht die Evalua-

tionspraxis auf nationaler oder institutioneller Ebene beeinflussen. Diese seit mehr als zwanzig Jahren wiederholt thematisierte, jedoch nie überwundene „regulatorische Schwäche“ der Bibliometrie (Glänzel & Schoepflin, 1994; de Rijcke & Rushforth, 2015) ist Ausgangspunkt der vorliegenden Dissertation.

Für die Standardisierung und Kontrolle bibliometrischer Expertise ist nicht nur zentral, welche Indikatoren und Kennzahlen geeignet und angemessen für die jeweiligen Bewertungskontexte sind (Gingras, 2016), sondern auch wer diese unter welchen Bedingungen und Annahmen herstellt und mit welchen Interessen und Motiven sich die Nutzung von quantitativen Methoden der Forschungsevaluation verknüpfen lässt.

Vor diesem Hintergrund rückt die vorliegende Arbeit die Produzenten und Nutzer von Metriken sowie Kennzahlen in den Vordergrund und befasst sich damit mit einer Fragestellung, die in der neueren Forschung bisher nur vereinzelt aufgegriffen worden ist. In der Science-and-Technology-Studies-Literatur werden die Akteurskonstellationen der „citation as infrastructure“ (Wouters 2014, S. 61) oder der „research evaluation infrastructure“ (Aström, 2016), der als „regulatory science“ bezeichneten Szientometrie (de Rijcke & Rushforth, 2015, S. 1954) und Indikatoren als „boundary objects“ (Leydesdorff, Bornmann & Wouters, 2016, S. 2131) untersucht. Kennzeichnend ist allerdings, dass über all diese Beiträge hinweg kein einheitliches Verständnis der Produzenten und Nutzer bibliometrischer Expertise entsteht und diese nicht systematisch zueinander in Beziehung gesetzt werden.

Eine theoretisch fundierte Analyse der verschiedenen Akteure verfolgt das vom Bundesministerium für Bildung und Forschung von 2014 bis 2017 geförderte Verbundprojekt „BibPro: Forschungsevaluation im Wandel: Die Institutionalisierung der Bibliometrie als interdisziplinäres Forschungsfeld und professionelles Expertenfeld“ (Förderkennzeichen: 01PY13013) der Bergischen Universität Wuppertal und des GESIS Leibniz Institut für Sozialwissenschaften, in dessen Rahmen die vorliegende Dissertation erstellt wurde. Das Ziel des Vorhabens bestand darin, die doppelte Institutionalisierung der Bibliometrie als eines interdisziplinären Forschungsfelds einerseits und als eines professionellen Expertenfelds andererseits soziologisch und historisch zu untersuchen. Dabei wurden die zentralen korporativen und individuellen Akteure sowohl des Forschungsfelds als auch des Expertenfelds bestimmt und in ihren Beziehungen zueinander untersucht.

Den theoretischen Rahmen für das Projekt bildet die professionssoziologische Theorie Andrew Abbotts (1988; 1991). Abbott definiert Professionen allgemein als Expertengruppen,

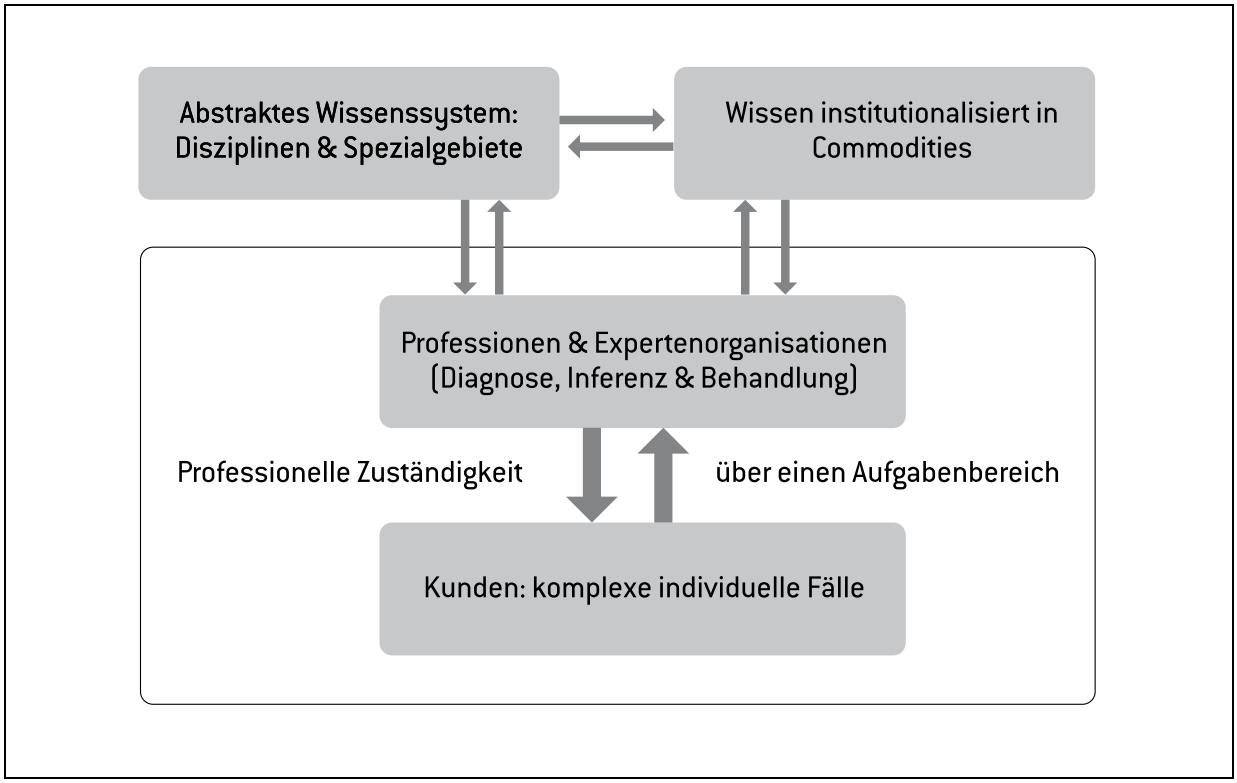
die abstraktes Wissen auf komplexe individuelle Fälle anwenden. Sie streben nach der Einrichtung einer exklusiven Zuständigkeit („Jurisdiction“) für einen von ihnen definierten gesellschaftlichen Aufgabenbereich. Dabei befinden sie sich im Wettbewerb mit anderen sich professionalisierenden Gruppen und Expertenorganisationen.

Entscheidend für den Erfolg im Wettbewerb um eine professionelle Jurisdiktion ist das abstrakte akademische Wissen einer Profession, auf dessen Basis kognitive Zuständigkeitsansprüche auf einen gesellschaftlich relevanten Aufgabenbereich erhoben und individuelle Fälle mittels der professionellen Mechanismen der Diagnose, Inferenz und Behandlung auf eine spezifische Art gelöst werden. Das abstrakte Wissen kann auch in Form von sogenannten „Commodities“ institutionalisiert sein. Darunter versteht Abbott (1991) Artefakte wie z. B. Handbücher, Formeln, Algorithmen, Klassifikationen, Datenbanken und Software.

Die kognitiven Ansprüche müssen in diversen Arenen, insbesondere in der Gesetzgebung und Rechtsprechung, im massenmedialen Diskurs und direkt am Arbeitsplatz verteidigt werden (soziale Ansprüche), um eine volle Jurisdiktion zu erhalten. Gelingt das nicht, so entstehen zeitlich begrenzte Formen der professionellen Jurisdiktion, sogenannte „jurisdictional settlements“, wie zum Beispiel die Arbeitsteilung zwischen zwei Professionen, die Unterordnung einer Profession unter eine dominante Gruppe oder eine beratende Jurisdiktion (siehe Abbildung 1).

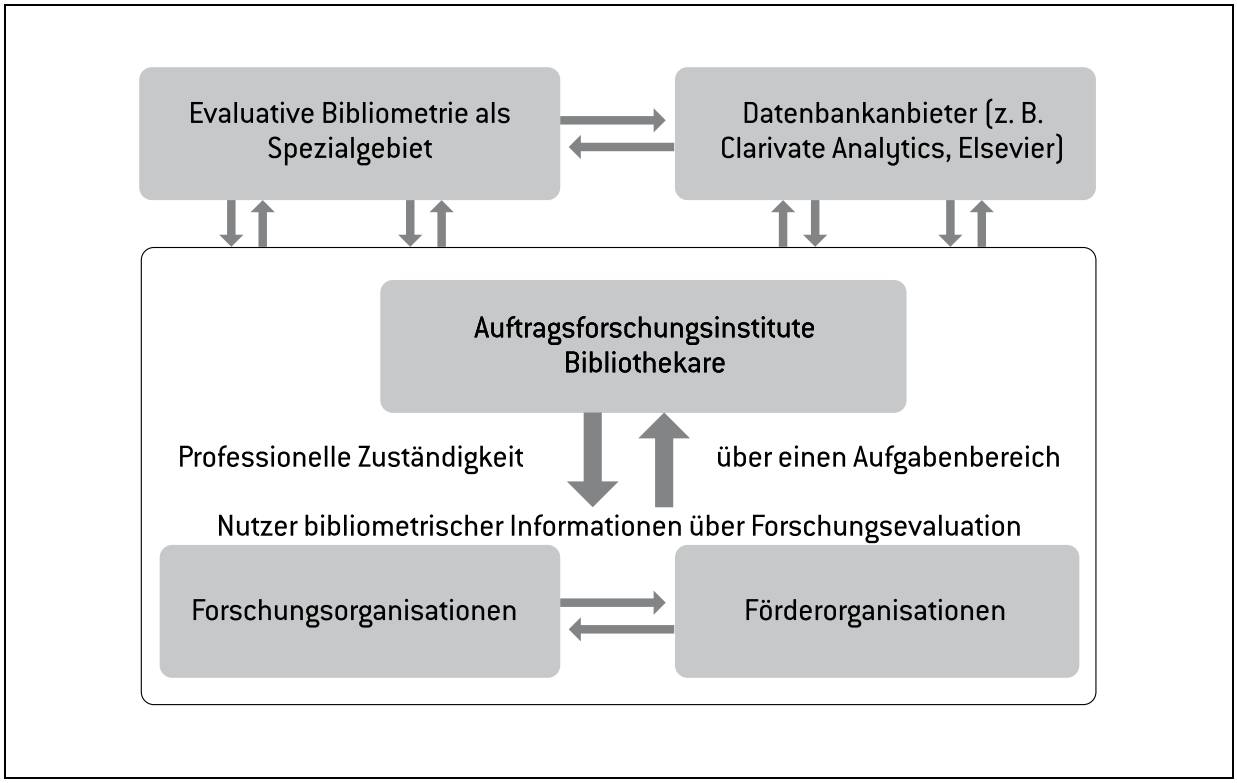
Dieser theoretische Rahmen wird auf die quantitative Forschungsevaluation als neu entstehendes, gesellschaftlich relevantes Aufgabenfeld übertragen, um die Professionalisierungsdynamiken und Akteurskonstellationen systematisch zu erfassen. In diesem Feld konkurrieren verschiedene professionelle Gruppen und Expertenorganisationen um eine möglichst exklusive professionelle Zuständigkeit für die Ausübung ihrer bibliometrischen Expertise, um diese auf die individuellen Fälle der Leistungsbewertung ihrer Klienten, Forschungsförderer und -organisationen anzuwenden (siehe Abbildung 2).

Abbildung 1: Professionelle Jurisdiktion nach Abbott (1988)



Quelle: Jappe & Petersohn (2015)

Abbildung 2: Jurisdiktion der quantitativen Forschungsevaluation



Quelle: Jappe & Petersohn (2015)

Die vorliegende Dissertation befasst sich schwerpunktmäßig mit zwei Trägern bibliometrischer Expertise: Erstens mit Expertenorganisationen, in diesem Falle Auftragsforschungseinrichtungen, die wissenschaftsnahe kommerzielle Dienstleistungen im Bereich der evaluativen Bibliometrie erbringen (am Beispiel des Centre for Science and Technology Studies der Leiden Universität, CWTS, *Aufsatz 1*), zweitens mit der Profession der wissenschaftlichen Bibliothekare und deren bibliometrischen Dienstleistungen für die Wissenschaftler und Forschungsadministratoren ihrer Universitäten (*Aufsätze 2 und 3*). Die Untersuchung konzentriert sich auf die Länder Niederlande, Großbritannien und Deutschland.

Die Dissertation untersucht, welche kognitiven und sozialen Zuständigkeitsansprüche diese beiden Akteursgruppen in der neuen professionellen Jurisdiktion der quantitativen Forschungsevaluation erheben und welche professionellen Mechanismen der Diagnose und Behandlung sie anwenden. Anhand des CWTS wird des Weiteren die Wechselbeziehung zwischen dem Forschungs- und dem Expertenfeld untersucht. Hierbei wird deutlich, wie die kognitiven Ansprüche des CWTS aus dem wissenschaftlichen Spezialgebiet der evaluativen Bibliometrie abgeleitet werden und die professionelle Praxis des CWTS in seinen bibliometrischen Analysen anleiten.

2 DATEN UND METHODEN

Um eine akteurszentrierte Perspektive auf die Professionalisierungsdynamiken im Expertenfeld der quantitativen Forschungsevaluation zu ermöglichen, wurden zwei umfangreiche Datensätze zur Expertenorganisation CWTS (*Aufsatz 1*) und zu wissenschaftlichen Bibliothekaren erhoben (*Aufsätze 2 und 3*).

Die Studie zum CWTS (*Aufsatz 1*) basiert auf einem Interview- und einem Archivdatenset. Das Interviewdatenset besteht aus 12 leitfadengestützten Experteninterviews mit ehemaligen und aktuellen Mitgliedern des Instituts sowie wissenschaftspolitischen Experten. Nach vollständiger Transkription erfolgte die Auswertung mittels einer thematischen Kodierung in der Software MaxQDA.

Das Archivdatenset besteht aus rund 50 Gesetzestexten, Verordnungen und Weißpapieren zur niederländischen Wissenschafts- und Hochschulpolitik in den Jahren 1960 bis 2016 und Jahres-, Fakultäts- und Evaluationsberichten des CWTS von 1983 bis 2016, die im Hinblick auf zentrale Ereignisse und deren Deutungen analysiert wurden. Weiterhin wurden quantitative Daten zum CWTS, wie die Entwicklung des Personal- und Finanzaufkommens im Zeitverlauf, ermittelt.

Ein Kernbestandteil des Archivdatensets sind 295 Evaluationsberichte aus der periodischen, nationalen Evaluation niederländischer Universitäten und Forschungsinstitute und 492 Projektberichte aus der Kontraktforschungsaktivität des CWTS, die im Rahmen mehrerer Forschungsaufenthalte am CWTS in Leiden sowie am Rathenau Institut in Den Haag erhoben wurden.

Die Projektberichte wurden hinsichtlich der Auftraggebertypen (Ministerien, Universitäten und Forschungsinstitute, Unternehmen und Förderorganisationen) und deren Auftraggeberländer ausgewertet. Ziel der Auswertung der Evaluationsberichte war die Klassifizierung von Berichten nach dem Einsatz von Evaluationsmethoden (Nur Peer Review, Peer Review und avancierte bibliometrische Analysen sowie Peer Review und vorkonfektionierte bibliometrische Analysen). In beiden Fällen wurden anschließend Häufigkeitsverteilungen ermittelt.

Die beiden Datensets wurden miteinander verknüpft, um die Entstehung der wissenschaftspolitischen Arena in den Niederlanden ab Ende der 1960er-Jahre zu rekonstruieren und zu den Entwicklungsphasen des CWTS als bibliometrischer Forschungs- und Expertenorganisation in Beziehung zu setzen.

Die Studien zu den bibliometrischen Dienstleistungen und Kompetenzen wissenschaftlicher Bibliothekare basieren ebenfalls auf einem Interview- und Dokumentendatenset (*Aufsatz 2*) sowie einer unter Informationsprofessionellen, Bibliothekaren und Forschungsmanagern durchgeführten Umfrage (*Aufsatz 3*).

Insgesamt 25 leitfadengestützte Experteninterviews mit Angehörigen der Informationsprofession sowie rund 188 Dokumente, wie Konferenz- und Workshoppräsentationen, Blogs, Mailinglisteneinträge und Fachartikel sowie Bibliothekswebseiten wurden mithilfe einer qualitativen Inhaltsanalyse in *Aufsatz 2* ausgewertet. Das Kodierschema wurde auf Basis der professionssoziologischen Theorie Abbotts entwickelt.

Im Zentrum der daran anschließenden Studie (*Aufsatz 3*) stand die Kategorisierung von bibliometrischen Dienstleistungen in insgesamt 99 (Teil-)Aufgaben und deren Zuordnung zu Einsteiger-, Kern- und Spezialistenaufgaben im Rahmen einer Umfrage. Diese Aufgaben bilden die Basis für ein Kompetenzmodell, welches der Weiterentwicklung der Profession dient.

3 STRUKTUR DER ARBEIT UND ERGEBNISZUSAMMENFASSUNG

Die drei Aufsätze stellen erstmals die kognitiven und sozialen Zuständigkeitsansprüche einer Expertenorganisation und Profession in dem entstehenden Expertenfeld der quantitativen Forschungsevaluation in das Zentrum der Untersuchung. Sie nehmen dabei systematisch Bezug auf zentrale Elemente von Abbotts professionssoziologischer Theorie, welche sich als geeignete und nach wie vor zeitgemäße Analyseperspektive für die beobachteten Professionalisierungsdynamiken erweist.

Ungeachtet der wichtigen Impulse, die für die Entwicklung der Bibliometrie als eines wissenschaftlichen Spezialgebiets durch die Erfindung des Science Citation Index in den USA ausgingen (Garfield, 1964), werden mit den Niederlanden, Großbritannien und Deutschland drei europäische Länder untersucht. Für die Auswahl der Niederlande und Großbritanniens spricht, dass beide Länder in Europa eine Vorreiterrolle in der Institutionalisierung von zyklischen Qualitätsbewertungsverfahren auf nationaler Ebene einnehmen. Vorläufer der heute gängigen, nationalen Forschungsevaluationssysteme gibt es in den Niederlanden bereits seit 1982 und in Großbritannien seit 1986 (Willmott, 1995; van der Meulen, 2007). Beide Länder werden in der vorliegenden Untersuchung (*Aufsatz 1*) jedoch nicht direkt miteinander verglichen, da sich lediglich in den Niederlanden mit dem CWTS eine weit über die Landesgrenzen hinaus bedeutsame Expertenorganisation der evaluativen Bibliometrie entwickelt hat. Eine vergleichbar einflussreiche Expertenorganisation gibt es in Großbritannien nicht.

Eine vergleichende Perspektive weist der *zweite Aufsatz* zu wissenschaftlichen Bibliothekaren in Großbritannien und Deutschland auf, da sich erstens die Ausbildungssysteme der beiden Länder im Hinblick auf die Profession unterscheiden: Während es in Deutschland dezidierte Studiengänge und Ausbildungswege für das wissenschaftliche Bibliothekswesen gibt, erfolgt in Großbritannien eine allgemeine, vom Berufsverband akkreditierte Hochschulausbildung in „Library and Information Science“, die erst in der beruflichen Praxis zu einer Ausdifferenzierung nach Bibliothekstypen führt (Enser, 2002; Plassmann, 2006, S. 259-268; Gantert, 2016, S. 32-40). Zweitens bestehen zentrale Unterschiede in der Institutionalisierung von Systemen und Verfahren der Leistungsbewertung in den beiden Ländern. Dem etablierten nationalen Verfahren des Research Excellence Framework steht eine in Deutschland wesentlich heterogenere, föderale und vorwiegend institutionelle Evaluationspraxis gegenüber (Kuhlmann & Heinze, 2004b; Stern, 2016). Wie der vorliegende Aufsatz zeigt, wirken sich diese Unterschiede jedoch nicht maßgeblich auf die professionellen Ansprüche der Profession in der Jurisdiktion der quantitativen Forschungsevaluation aus.

Die drei Aufsätze nehmen unterschiedliche zeitliche Perspektiven auf die Professionalisierungsprozesse quantitativer Forschungsevaluation ein. Der *erste Aufsatz* ist stärker historisch angelegt und betrachtet die Entstehung des CWTS im Kontext der Herausbildung einer neuen wissenschaftspolitischen Arena über einen circa 50-jährigen Zeitraum ab 1965 bis ca. 2016. Die beiden Aufsätze über die professionellen Ansprüche und Kompetenzen wissenschaftlicher Bibliothekare richten den Fokus auf aktuelle professionelle Praktiken (*Aufsatz 3*) bzw. die ersten Instanzen des Auftretens bibliometrischer Dienstleistungen, die anhand des Datenmaterials ab circa den 1980er-Jahren ermittelt wurden, bis zu heutigen Dienstleistungsangeboten (*Aufsatz 2*).

Die drei Aufsätze sind konzeptuell als Einzelfallstudien angelegt, jedoch bietet es sich vor dem Hintergrund der jeweiligen untersuchten Zeiträume an, sie in chronologischer Reihenfolge darzustellen.

3.1 AUFSATZ 1

Professionalization of Bibliometric Research Assessment. Insights from the History of the Leiden Centre for Science and Technology Studies (CWTS)

Die historisch-soziologisch angelegte Analyse der Entstehung des CWTS als Expertenorganisation im Kontext der niederländischen Wissenschaftspolitik und Hochschulgovernance ergibt vier zentrale Befunde.

1. Zentrale politische, administrative und beratende Akteure der wissenschaftspolitischen Arena haben im Zuge der Umsetzung einer evidenzbasierten Wissenschaftspolitik in den Niederlanden erstens die Entstehung der evaluativen Bibliometrie als eines wissenschaftlichen Spezialgebiets gefördert. Sie trugen damit zweitens maßgeblich zur Eröffnung der professionellen Jurisdiktion der quantitativen Forschungsevaluation als Expertenfeld bei. Die von der Ministerialbürokratie initiierte und geförderte Nachfrage nach bibliometrischer Expertise wird durch entsprechende parlamentarische Gesetzgebungsmaßnahmen, welche die Notwendigkeit regelmäßiger Leistungsbewertungen im Forschungssektor regulieren, kodifiziert. Das begründet die Relevanz des staatlichen Sektors für die Entstehung professioneller Felder sowie die Notwendigkeit, professionelle Zuständigkeitsansprüche in der legalen und politischen Arena erfolgreich zu behaupten.

2. Während zu Beginn des politisch geförderten Aufbaus der professionellen Jurisdiktion der bibliometrischen Forschungsevaluation noch verschiedene Forschungsgruppen in der quantitativen Wissenschaftsforschung an unterschiedlichen Universitäten und einem wissenschaftspolitischen Beratungsorgan aktiv waren, so institutionalisiert sich die professionelle Zuständigkeit für das neue Expertenfeld in den Niederlanden primär in der Form einer Expertenorganisation, dem CWTS an der Universität Leiden. Dieser Institutionalisierungsprozess verläuft in vier historischen Entwicklungsphasen, der Anfangsphase (1980-1985), der Gründungsphase (1986-1993), der Expansionsphase (1994-2007) und der wissenschaftlichen Expansions- und Konsolidierungsphase (2008-2015).

In den ersten beiden Phasen von den 1980er-Jahren bis Mitte der 1990er-Jahre entwickelte das CWTS die Grundstruktur seines kognitiven Anspruchs, welcher auf der Entwicklung der Methode der Feldnormalisierung, der Entwicklung einer speziell an die Zwecke der Forschungsevaluation angepassten Version der Zitationsdatenbank Web of Science des Institute for Scientific Information, Philadelphia (später Thomson Reuters, heute Clarivate Analytics) sowie einer sorgfältigen Datenvalidierung und -vervollständigung mit den evaluierten Wissenschaftlern basiert. So konnte das CWTS Anfang der 1990er-Jahre vor allem die wissenschaftspolitische Arena für sich gewinnen und eine mehrjährige, ministerielle Forschungsförderung einwerben. Zudem setzte es seine entwickelte Methodik erstmals in der institutionellen Evaluation belgischer Universitäten ein.

Die Expansionsphase ab 1994 ist durch die Einführung neuer Indikatoren und Dienstleistungen, wie vergleichender Analysen und bibliometrischer Kartierungen, geprägt. Sie zeichnet sich durch eine Ausweitung der Kundenbasis aus, die sich von staatlichen Institutionen hin zum Hochschulsektor verschiebt und zunehmend internationalisiert. In den Niederlanden etabliert sich das CWTS als der wichtigste Anbieter bibliometrischer Dienstleistungen im Rahmen der standardisierten Evaluationsprotokolle. Gleichzeitig nimmt der Wettbewerb im Expertenfeld durch das Entstehen anderer Kontraktforschungsinstitute und kommerzieller Datenbankanbieter zu (z. B. der Entwicklung der Zitationsdatenbank Scopus durch Elsevier in 2004).

Ab 2008 beginnt eine Phase der wissenschaftlichen Expansion und Konsolidierung für das CWTS, die durch eine neue regelmäßige Grundfinanzierung und einen Wechsel der Institutsleitung eingeleitet wird. Mit neuen Dienstleistungen und Methoden versucht das Institut den Herausforderungen des Wettbewerbs im Feld der evaluativen Bibliometrie zu begegnen.

3. Es ist zu betonen, dass ungeachtet dieser erfolgreichen Institutionalisierung der Jurisdiktion der quantitativen Forschungsevaluation in den Niederlanden das Expertenfeld weiterhin der qualitativen Leistungsbewertung durch die wissenschaftlichen Fachkollegen (Peers) untergeordnet ist („subordinate jurisdiction"). Das CWTS nimmt hierbei auf der Basis seiner distinkten kognitiven und sozialen Zuständigkeitsansprüche („cognitive and social claims") und des Aufbaus einer organisationseigenen Inhouse-Datenbank auf der Basis des Web of Science (Clarivate Analytics) eine Schlüsselposition ein mit seiner auf die Diagnosefunktion spezialisierten bibliometrischen Analyse und seiner hohen bibliometrischen Forschungskapazität.

4. Die professionelle Zuständigkeit des CWTS wird zunehmend von der Routinisierung bibliometrischer Expertise in kommerziellen Softwareprodukten von großen Verlagen und Firmen, wie Elsevier und Clarivate Analytics, gefährdet und könnte sich daher in Zukunft in eine schwächere Form der professionellen Zuständigkeit, nämlich in eine beratende Jurisdiktion („advisory jurisdiction"), wandeln.

3.2 AUFSÄTZE 2 UND 3

Professional competencies and jurisdictional claims in evaluative bibliometrics: The educational mandate of academic librarians

Competencies for bibliometrics

Im *zweiten Aufsatz* werden bibliometrische Dienstleistungen britischer und deutscher wissenschaftlicher Bibliothekare untersucht und als wachsende professionelle Ansprüche („cognitive and social claims") an der entstehenden Jurisdiktion der quantitativen Forschungsevaluation eingeordnet. Vor dem Hintergrund der zunehmend unter Druck geratenen klassischen bibliothekarischen Zuständigkeit der Bereitstellung von Informationen sehen sich wissenschaftliche Bibliothekare mit der Anforderung konfrontiert, ihre professionellen Aufgaben zu erweitern und umzudeuten. Der Aufsatz bietet drei zentrale Befunde:

1. Das erste Ergebnis besteht darin, dass bibliometrische Dienstleistungen an wissenschaftlichen Bibliotheken ein neues Aufgabenfeld darstellen. In Erweiterung der traditionellen bibliothekarischen Zuständigkeit der Bereitstellung von Informationen („access jurisdiction") diagnostizieren Bibliothekare ein Informationsproblem im Hinblick auf die Frage der Leistungsmessung an Forschungsorganisationen. Ihr Lösungsansatz besteht in der Bereitstellung

bibliometrischer Informationen für ihre Klienten (z. B. Wissenschaftler sowie Verwaltungs- und Leitungspersonal von Forschungsorganisationen). Es können drei Säulen der Problembehandlung identifiziert werden: Im Wesentlichen bieten Bibliothekare und Informationsprofessionelle unterschiedliche Formen der Information über bibliometrische Datenbanken, Indikatoren und Methoden an. Weiterhin betreiben sie ein Schulungsangebot für verschiedene Nutzergruppen an Forschungseinrichtungen, welches sich von Gruppentrainings bis hin zu Onlinekursen erstreckt. Schließlich bieten einige Bibliothekare vereinzelt auch bibliometrische Analysen und Beratungsleistungen an.

2. Aus den untersuchten bibliometrischen Dienstleistungen ergibt sich die zweite Schlussfolgerung: Die professionellen Ansprüche wissenschaftlicher Bibliothekare im neuen Expertenfeld quantitativer Forschungsevaluation haben einen speziellen, bildungsorientierten Charakter und bestehen weniger – wie im Falle des CWTS in den Niederlanden (*Aufsatz 1*) – in einem Angebot zur Leistungsmessung durch die Bereitstellung bibliometrischer Analysen und Berichte, also einer bibliometrischen Diagnose von wissenschaftlicher Qualität ergänzend zum etablierten Peer-review-Verfahren. Vielmehr bestärken Bibliothekare ihre Nutzer darin, bibliometrische Methoden eigenständig kompetent einzusetzen und vermitteln das hierfür nötige Grundlagenwissen. Sie bauen hierfür besonders auf ihre aus den Informations- und Bibliothekswissenschaften bestehende, akademische Wissensbasis sowie auf erfahrungsbasiertem Wissen auf. So hat die Profession des Bibliothekswesens eine ausgewiesene Kompetenz im Umgang mit Metadaten und Literaturdatenbanken, die sie in neue bibliometrische Dienstleistungen einbringen kann.

3. Diese Befunde deuten drittens darauf hin, dass sich im Expertenfeld der bibliometrischen Forschungsevaluation eine Arbeitsteilung zwischen verschiedenen professionellen Gruppen entwickelt. Das Ausmaß exklusiver Kontrolle über bibliometrische Dienstleistungen, d. h. das Bestreben, alleiniger Anbieter von Informationen und bibliometrischen Berichten sowie Analysen zu sein, ist im untersuchten Sample der Bibliothekare verhältnismäßig gering ausgeprägt. Stärker entwickelt ist dagegen der professionelle Anspruch, neutrale Beratungsleistungen zu erbringen und damit dem Kunden die Entscheidung über die strategische Verwendung der Informationen zu überlassen oder die Nutzer zu ermächtigen, grundlegende bibliometrische Analysen selbst kompetent durchzuführen. Das bedeutet, dass Bibliothekare durch ihren bildungsorientierten Ansatz den in ihrer Einrichtung tätigen Forschungsreferenten für eigene Dienstleistungen, beispielsweise im Bereich der strategischen Beratung basierend auf bibliometrischen Informationen, zuarbeiten. Diese werden von den Bibliothekaren als

berechtigte Expertengruppe innerhalb der entstehenden Jurisdiktion der quantitativen Forschungsevaluation betrachtet. Außerhalb der professionellen Zuständigkeit der wissenschaftlichen Bibliothekare liegen zudem datengestützte bibliometrische Dienstleistungen mit stärker analytischem Charakter, welche von IT-Experten oder Statistikern mit fundierten Programmierkenntnissen erbracht werden können. Es deutet sich daher eine Arbeitsteilung im Hinblick auf die bildungsorientierten und auf Informationsbereitstellung orientierten Dienstleistungen des Bibliothekswesens und vermehrt datengetriebenen sowie analytisch orientierten Dienstleistungen an.

Der *dritte Aufsatz* schließt an die im zweiten Aufsatz postulierte These, dass bibliometrische Dienstleistungen in der Tat ein neues, professionelles Aufgabenfeld im Bereich des Bibliothekswesens konstituieren und dieses einen spezifisch bildungsorientierten Zuschnitt hat, an. Die Publikation und Verbreitung der Ergebnisse des *zweiten Aufsatzes* haben vor dem Hintergrund eines wachsenden Markts für Stellen mit bibliometrischem Aufgabenprofil das Interesse britischer Informationsprofessioneller und Bibliothekare geweckt. Der *dritte Aufsatz* bietet dahingehend eine praktische Handreichung für die professionelle Community in Großbritannien, indem ein Kompetenzmodell basierend auf empirisch ermittelten, bibliometrischen Aufgaben für Schulungs- und Ausbildungszwecke sowie Stellenausschreibungen entwickelt wird. Der Aufsatz gelangt zu folgenden Ergebnissen:

1. Erstens wurde eine konsolidierte Liste mit insgesamt 99 Aufgaben mit Bezug zur evaluativen Bibliometrie erstellt. Dazu zählen zum Beispiel die Erläuterung der Definition von Bibliometrie, das Ermitteln verschiedener bibliometrischer Indikatoren, wie zum Beispiel des H-Index oder Journal Impact Faktors in bibliometrischen Datenbanken, die Erläuterung von Unterschieden in der Indikatorik basierend auf der genutzten Zitationsdatenbank, die Beratung im Hinblick auf geeignete bibliometrische Datenquellen und Softwaretools, die Ermittlung strategischer Kooperationspartner, Berechnung des Impacts von Forschungsgruppen oder Unterstützung von Drittmittelanträgen und Jahresberichten, die Identifikation von zentralen Zeitschriften oder Empfehlungen zur Erhöhung der eigenen Zitationsrate.

Diesen Aufgaben werden 12 Kategorien zugeordnet, die allgemeine Anwendungsmöglichkeiten von bibliometrischen Daten und Methoden von der Nutzung von Metriken, Datenbanken sowie Softwaretools für spezifische Aufgaben unterscheiden. Weiterhin wurde in Tätigkeiten zur Datenverarbeitung und -präsentation, Schulungstätigkeiten, Aufgaben der strategischen Beratung der Universitätsleitung zu verschiedenen Zwecken und in allgemeine pro-

fessionelle Fähigkeiten, wie die Kenntnis der lokalen Organisations- und Kommunikationsstruktur unterschieden.

Die Differenzierung nach diesen Kategorien soll ermöglichen, den Tätigkeitsfeldern anschließend Kompetenzlevel für zukünftige Trainings- und Schulungsprogramme zuzuordnen. Die Aufgabenbeschreibungen wurden zudem unter der Annahme angefertigt, dass sie neben den Bibliothekaren auch von Forschungsreferenten ausgeführt werden können. Daher wurde die Umfrage ebenfalls an Verbände der Forschungsreferenten verteilt. Die Mehrheit der 92 Antworten stammt aus dem bibliothekarischen Umfeld (55), darüber hinaus erfolgten 20 Antworten aus dem Bereich Forschungsadministration und -planung.

2. Von den 99 Tätigkeiten wurde ein Drittel (32) von mehr als 50 % der Umfrageteilnehmer als Kernaufgaben gewertet. Sie kennzeichnen Aufgaben, die ein etablierter Professioneller im Bereich Bibliometrie ausführen kann. Darunter fallen zum Beispiel die Erklärung von geeigneten Tools für bestimmte Indikatoren sowie die Unterschiede in den Werten von Metriken, die aus der Nutzung verschiedener Datenbanken und Softwaretools resultieren sowie die Grundsätze eines verantwortungsvollen Umgangs mit bibliometrischen Daten. Auch analytische Aufgaben, wie die Unterstützung von Forschungsanträgen sowie die jährliche Berichterstattung gehören dazu.

Ein gutes Viertel der Tätigkeiten (27) wurde von mehr als 50 % der Respondenten als Spezialistentätigkeiten gewertet, die avancierte Methoden- und Fachkenntnisse erfordern. Hierzu gehören die Anwendung bibliometrischer Daten und Indikatoren zur Evaluation des Outputs von Forschungsgruppen und Instituten sowie die Analyse von Kollaborationen und die Durchführung von Benchmarkstudien zu vergleichbaren Fachbereichen. Insbesondere die Nutzung von speziellen Netzwerkanalyse- und Grafikprogrammen und selbst programmierten Anwendungen, anstelle der Nutzung vorgefertigter, kommerzieller Tools, zählt zu diesem Bereich.

Einstiegstätigkeiten (17) machen mit rund 17 % den kleineren Anteil der Tätigkeiten nach Einschätzung von mehr als 50 % der Befragten aus. Sie können durch Berufseinsteiger ausgeführt werden. Das Auffinden verschiedener Indikatoren, wie des H-Index oder der Journal Citation Reports in Web of Science gehören dazu sowie die Erläuterung der Vorteile von Open Access oder von Autoren-Identifikatoren, wie zum Beispiel ORCID. Der Bereich umfasst zudem allgemeine professionelle Fähigkeiten, wie die Kenntnis und den entsprechenden

Umgang mit der lokalen Organisations- und Kommunikationskultur einer Forschungseinrichtung.

Eine Kombination aus Einstiegs- und Kernkompetenzen, die insgesamt 65 von 99 Aufgaben begründen, kennzeichnet nach Angaben der Umfrageteilnehmer im Wesentlichen ein bibliometrisches Stellenprofil.

3. In Bezug auf die Differenz zwischen Spezialisten- und Kernaufgaben ergibt sich ein überwiegend konsistentes und zudem detaillierteres Bild der Ergebnisse des *zweiten Aufsatzes*. Der Schwerpunkt bibliometrischer Dienstleistungen im Bereich des „Empowerments" von Akademikern und anderen Nutzern durch Informationen und Schulungen wird bestätigt.

Ein wesentlicher Unterschied besteht jedoch darin, dass dieser Ansatz nicht als exklusiver, professioneller Anspruch wissenschaftlicher Bibliothekare in Großbritannien zu gelten scheint. Er kann auch Forschungsmanager umfassen, da sich keine statistisch signifikanten Unterschiede in der Aufgabenwahrnehmung zwischen diesen beiden Gruppen ergaben. Dieser Befund muss durch weiterführende Untersuchungen zur professionellen Gruppe der Forschungsadministratoren und -manager empirisch validiert werden.

4. Die systematische Auflistung und Bewertung von professionellen Aufgaben im Bereich der evaluativen Bibliometrie resultiert in einem öffentlich zugänglichen Kompetenzmodell, das im Rahmen einer Creative-Commons-Lizenz verbreitet und modifiziert werden darf. Damit sollen britische Forschungseinrichtungen bei der Entwicklung von Lehrplänen sowie der Rekrutierung und Ausbildung von geeignetem Personal unterstützt werden. Zudem dient es der professionellen Weiterentwicklung von in diesem Tätigkeitsbereich aktivem Personal.

4 DISKUSSION UND AUSBLICK

Insgesamt zeichnen die drei Studien ein differenziertes Bild des Expertenfelds der quantitativen Forschungsevaluation. Anstelle des vereinfachten Bilds eines „professionellen Bibliometrikers" (Lindgren, 2011, S. 8) wird deutlich, dass es sich vielmehr um verschiedene Expertengruppen- und Organisationen handelt, die auf Basis der wissenschaftlichen Erkenntnisse des akademischen Felds der evaluativen Bibliometrie kognitive und soziale Zuständigkeitsansprüche an das neue Aufgabenfeld richten. Gleichzeitig stellen die Experten in der neu entstehenden, professionellen Jurisdiktion der quantitativen Forschungsevaluation die übergeordnete Zuständigkeit der wissenschaftlichen Fachkollegen für Fragen der Qualitätsbewertung in der Wissenschaft grundsätzlich nicht infrage (van Raan, 1996, S. 404).

Nach Abbott (1988) ist abstraktes Wissen zentral, um die benötigte Legitimität für professionelles Handeln zu generieren. Die Frage, ob das Spezialgebiet der evaluativen Bibliometrie bzw. der evaluativen Zitationsanalyse in der Lage ist, eine solche benötigte Legitimität bereitzustellen, wurde im Projektkontext untersucht (Jappe, Heinze & Pithan, 2018). Der professionssoziologische Theorierahmen wurde zu diesem Zweck wissenschaftssoziologisch durch Whitleys (2000, S. 29-32) Konzept der „reputationalen Arbeitskontrolle“ ergänzt. Der Begriff stellt auf den Grad der Standardisierung und Formalisierung von Kommunikation, Forschungstechniken und Behandlung von Forschungsfragen innerhalb der wissenschaftlichen Fachgemeinschaft ab. Diese reputationale Arbeitsorganisation wird operationalisiert als Anzahl der Forschungsbeiträge, in diesem Falle der Entwicklung neuer Zitationsindikatoren, die jeweils aus Zentrum und Peripherie des Felds der evaluativen Zitationsanalyse stammen, sowie als Anzahl von Neuzugängen im Feld.

Die Studie ermittelt, dass das Feld der evaluativen Bibliometrie eine offene soziale Struktur mit einer hohen Anzahl an Neuzugängen und zahlreichen einflussreichen Indikatorenentwicklungen aus der Peripherie aufweist und damit eine geringe reputationale Arbeitskontrolle. Die sozio-kognitiven Strukturen des Forschungsfelds schränken daher seine wissenschaftliche Autorität und damit die Fähigkeit, eine professionelle Praxis der quantitativen Forschung zu standardisieren und zu legitimieren, signifikant ein (Jappe et al., 2018).

An diesen Befund anschließend untersucht eine weitere Studie zum Expertenfeld der evaluativen Bibliometrie im Projektkontext, welche bibliometrischen Zitationsindikatoren in der Evaluationspraxis tatsächlich angewendet werden von bibliometrischen Expertenorganisationen und ob sich in diesem Zuge professionelle De-facto-Standards entwickeln (Jappe, 2018).

Die Untersuchung dieser Frage ist vor dem Hintergrund einer Diskussion über die verbreitete Nutzung bibliometrischer Indikatoren und Daten durch Nicht-Experten zentral. Während sogenannte „bibliometrische Amateure“ einerseits als Gefährdung der wissenschaftlichen Integrität der evaluativen Bibliometrie und des Bewertungssystems der Wissenschaft wahrgenommen werden (Gläser & Laudel, 2007, S. 116), sehen andere Autoren die Nutzung bibliometrischer Indikatorik durch Nicht-Experten, zum Beispiel durch wissenschaftliche Gutachter im Peer-Review-Prozess, als eine durchaus wünschenswerte Form der sogenannten „citizen bibliometrics“, die sich im Kontext fachspezifischer Bewertungspraktiken entwickeln kann (Leydesdorff et al., 2016; Hammarfelt & Rushforth, 2017).

Hierbei verschwimmen jedoch die Grenzen zwischen bibliometrischen Experten und Laien sowie zwischen Anbietern und Nutzern bibliometrischer Expertise.

Gegenüber der normativ-positiv aufgeladenen Vorstellung einer „citizen bibliometrics“ basieren die Befunde aus der Dissertation und dem Projekt auf einem theoretisch fundierten Verständnis von Professionalisierung in der evaluativen Bibliometrie, die anstelle einer normativen eine primär analytische Rahmung aufweist. Aus den Wechselwirkungen zwischen Forschungs- und Expertenfeld lässt sich im Zusammenspiel der Studien ein vielschichtiges Bild des derzeitigen Professionalisierungsprozesses zeichnen. Aus Abbotts Perspektive ist die beobachtbare Dynamik als ein interdependentes System zu verstehen, das verschiedenen Kräften des Wandels technologischer, professionsinterner und organisationaler Natur ausgesetzt ist („jurisdictional shifts“).

Zugleich tragen die Befunde der Dissertation und des Projekts zu den aktuellen Debatten zur Standardisierung bibliometrischer Metriken bei: Der Erfolg einschlägiger Initiativen (Cagan, 2013; Hicks et al., 2015) erscheint trotz der verbreiteten, öffentlichen Wahrnehmung eher fraglich.

Vor dem Hintergrund der bisherigen Ergebnisse zeichnen sich abschließend mindestens drei Forschungsdesiderata ab.

1. In der entstehenden Jurisdiktion der quantitativen Forschungsevaluation nimmt das CWTS als Expertenorganisation eine herausragende Position ein, da es einen exklusiven Zugang zu einer speziell für den Zweck der Forschungsevaluation modifizierten Zitationsdatenbank besitzt (Moed, 1996). Das CWTS übernimmt zudem eine wichtige Ausbildungsfunktion im Rahmen verschiedener Schulungsformate, wie dem seit 2003 bestehenden, hauseigenen Bibliometrie-Kurs, einer im Jahr 2018 neu eingeführten, eigenen Summer School und der Mitorganisation der European Summer School for Scientometrics seit 2010.

Nicht in jedem der untersuchten Länder gibt es solch zentrale Expertenorganisationen mit derartigen Kapazitäten für die bibliometrische Auftragsforschung und Weiterbildung. Das ehemalige Institut für Forschungsinformation und Qualitätssicherung (iFQ, jetzt DZHW) und das Fraunhofer Institut für System- und Innovationsforschung (FhG-ISI) spielen in Deutschland eine teilweise vergleichbare Rolle, wenn auch mit geringerem Auftragsvolumen und internationaler Kundenreichweite. In Großbritannien sind weniger Auftragsforschungsinstitute als vielmehr Firmen, wie zum Beispiel Research Fish oder Evaluametrics Ltd., aktiv, die jedoch nicht über eine vergleichbare Inhouse-Datenbank wie das CWTS verfügen.

In Norwegen und Kanada hingegen existieren mit dem Nordic Institute for Studies in Innovation, Research and Education (NIFU) und der Beratungsfirma Science-Metrix Expertenorganisationen, die mit dem CWTS vergleichbare organisationale Kapazitäten in der evaluativen Bibliometrie aufweisen (Salini, 2016). Eine soziologisch-historisch angelegte Untersuchung dieser Organisationen vor dem Hintergrund der jeweiligen länderspezifischen Forschungspolitik würde das Wissen um die professionellen Zuständigkeiten von Expertenorganisationen in der Jurisdiktion der quantitativen Forschungsevaluation erweitern und vertiefen.

2. Zitationsdatenbanken ermöglichen nicht nur die Entwicklung avancierter bibliometrischer Dienstleistungen als Diagnosetool für die Leistungsbewertung, sondern setzen Expertenorganisationen auch zunehmend unter Wettbewerbsdruck, indem sie bibliometrische Expertise routinisieren und automatisieren. Weiterhin entziehen sie professionellen Anbietern zusätzlich die Kontrolle über die Anwendung bibliometrischer Daten und Indikatoren durch Nicht-Experten. So bieten Softwaretools, wie „Publish or Perish“ seit 2006, „SciVal“, „InCites“ oder „Microsoft Academic Search“ seit 2009 und die in 2018 von Digital Science veröffentlichte, neue Zitationsdatenbank „Dimensions“ maßgeschneiderte bibliometrische Performanz-, Benchmarking- und Kooperationsanalysen an. Zusätzlich beinhalten die Zitationsdatenbanken Web of Science, Scopus, Google Scholar und die Softwaretools vorkonfektionierte bibliometrische Indikatoren, die sich durch ihre Inklusion in diese technische Infrastruktur rascher verbreiten als die komplexe Indikatorik professioneller Anbieter, die avancierte Methoden der Datenerhebung- und Verarbeitung und hohe Rechenkapazitäten voraussetzen (Jappe et al., 2018). Abbott (1988; 1991) hat mit seiner Theorie die Gefahr der Entprofessionalisierung durch diese „commodities“ antizipiert, was zeigt, wie zeitgemäß und angemessen sie für die untersuchte Fragestellung ist.

Eine zunehmende Bedeutung als zentrale „commodity“ in der professionellen Jurisdiktion erlangen zudem sogenannte Forschungsinformationssysteme. Diese spezialisierten, institutionellen oder nationalen Datenbank- und Informationssysteme dienen zur Erhebung, Verwaltung und Bereitstellung von Informationen zu Forschungsaktivitäten und -ergebnissen (Herwig & Schlattmann, 2016). Sie ermöglichen eine bessere Abdeckung von verschiedenen Publikationsformaten und von in kommerziellen Datenbanken unterrepräsentierten Fächern, wie den Sozial- und Geisteswissenschaften. Zusätzlich bieten sie oft die Möglichkeit, automatisierte Berichte mit Publikations- und Zitationsindikatoren für die universitäre Steuerung bereitzustellen (beispielhaft hierfür stehen „Pure“ von Elsevier und „Converis“ von Clarivate Analytics) (Van Leeuwen, van Wijk & Wouters, 2016, S. 3).

Die Rolle dieser Commodities sowie ihrer Produzenten verlangt nach einer weiterführenden empirischen Untersuchung, die Elemente der professionssoziologischen Theorie Abbotts mit denen der politischen Ökonomie vereint, um auch die Auswirkungen wirtschaftlichen Handelns auf das System der wissenschaftlichen Leistungsbewertung und die Wissenschaftspolitik zu untersuchen.

3. Schließlich wäre es wünschenswert, eine Betrachtung der professionellen „Anbieterseite“ bibliometrischer Expertise im Hinblick auf die genutzte bibliometrische Indikatorik auf eine breite quantitative Basis zu stellen, um ein möglichst repräsentatives Bild der aktuellen Evaluationspraxis und möglicher De-facto-Standards zu erhalten. Diese Analyse sollte durch eine Untersuchung der Nachfrageseite durch Klienten aus der Wissenschaftspolitik und den Förder- und Forschungsorganisationen flankiert werden. Da sich die Expertengruppen der quantitativen Jurisdiktion der Forschungsevaluation mit ihren professionellen Zuständigkeitsansprüchen auf die Diagnosefunktion in der Leistungsbewertung spezialisiert haben, ist es wünschenswert diese Perspektive mit den Entscheidungen („treatment“), welche auf Basis der bibliometrischen Diagnosen getroffen werden, zu verknüpfen. So ließe sich ein vollständiges Bild der Anbieter und Nutzer von professionellen Praktiken der quantitativen Forschungsevaluation zeichnen.

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2 Professionalization of Bibliometric Research Assessment. Insights from the History of the Leiden Centre for Science and Technology Studies (CWTS)*

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.

Keywords: 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 (Glänzel and Schoepflin 1994; De Rijcke and Rushforth 2015; Hicks et al. 2015). The purpose of this paper is to provide a better understanding of this ongoing process of professionalization.

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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 paper 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 paper 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 paper 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 (Yang et al. 2016; Liu et al. 2015; Zhao and Strotmann 2014; Milojevic et al. 2011). 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 paper recasts the history of CWTS as an expert organization within the Dutch science policy arena. The paper 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 paper 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 paper 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 do-

mains, 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 mono-

polies 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 instable) 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. Second, it specifies the processes by which the application of abstract knowledge to complex individual cases occur: diagnosis, inference, and treatment. Third, 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, the analysis below shows that it is still highly relevant today; 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; Heinze 2002; Bornmann and Daniel 2010; Musselin 2013; Van Leeuwen and Moed 2012). 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 labor in particular societal problem areas. Therefore, this paper 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 paper 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 paper 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 paper 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 Method

3.1 Data Sources

The paper 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 (KNAW et al. 2001; KNAW 2005; VSNU 1993; 1994; 1998; 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 paper 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 analyzed 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 evalua-

tion. 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 paper 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). Second, 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).

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 1975; 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 concomitantly 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 divison 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.

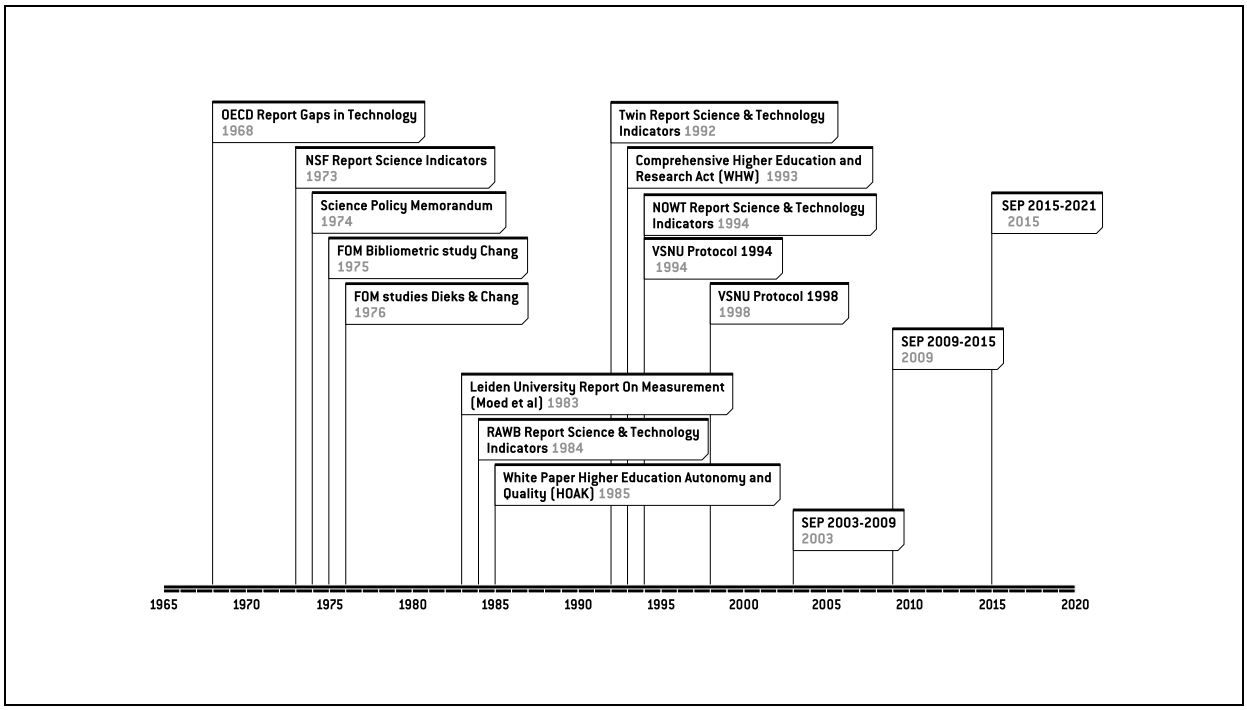
The VSNU protocol comprised a combination of self-evaluations and peer visitations from abroad (VSNU 1993; 1994; 1998). Although the standard procedure was defined by VSNU for all universities except the university hospitals who had their own procedures under the auspices of KNAW, disciplinary committees 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).

Figure 1: Science Policy Arena in the Netherlands



4.2 CWTS as an 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). Second, 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 (1973-1977) 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 Frankfort 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 the bibliometric pilot exercise at LU, two important events occurred that provided momentum for his group. First, in 1982, an evaluation report by the Verkenningscommissie 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). Second, 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). Second, 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: 1986–1993

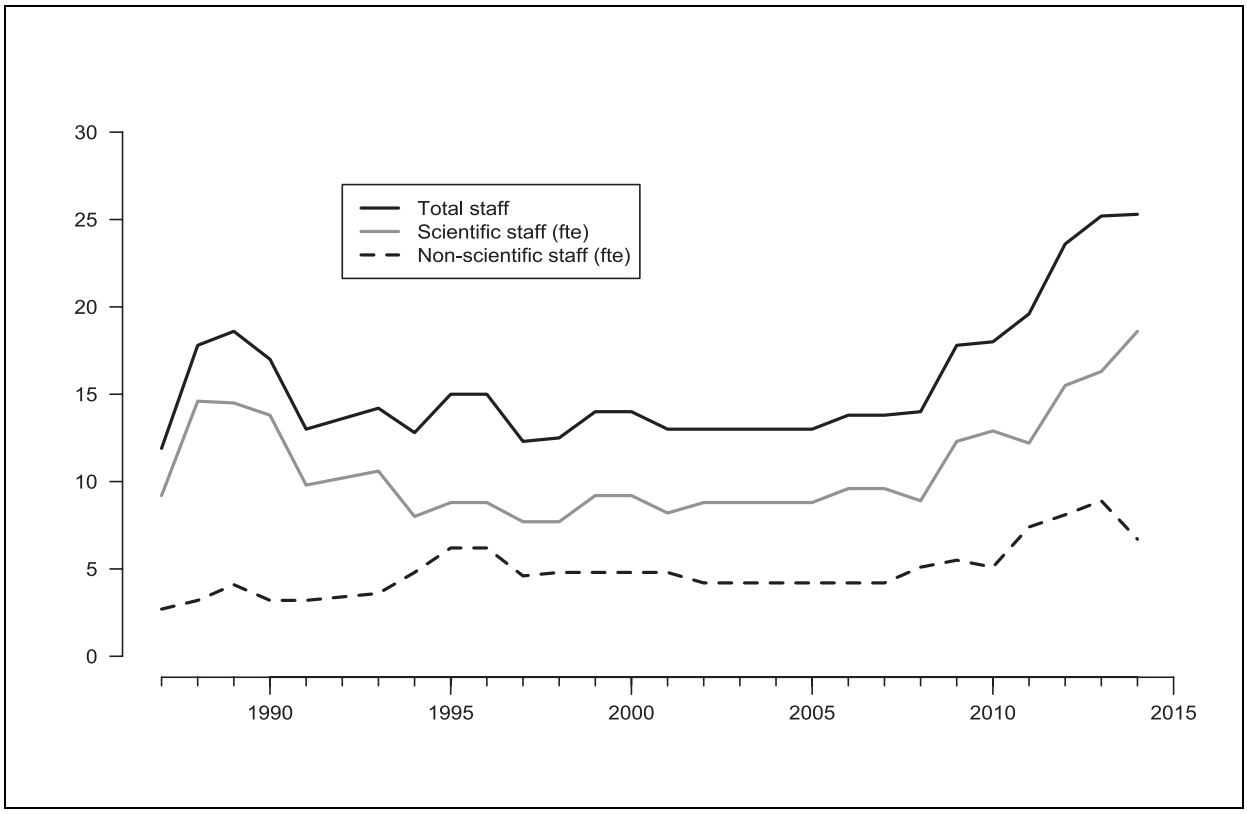
Before UL's rector left office in 1985, it was decided that van Raan's group should move to the Faculty of Social and Behavioral Sciences (FSW) and join the Leiden Institute for Policy Research. This move was no coincidence because sociology professor Mark van de Vall was interested in hosting van Raan's 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 the 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' (WTI5), 'Data-analytical methods and techniques, in particular mapping techniques' (WTIA6), and 'Role of instrumentation in the development of research fields', (WTIA7), (CWTS 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 as-

sessment of research groups within university and NWO structures and conducted strengths–weaknesses analyses on a national disciplinary level (CWTS 1990: 11).

Figure 2: Scientific and technical staff at CWTS, 1987-2014



Sources: (CWTS 1986-2010; CWTS 2008; Leiden University 2008)

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 Berghe et al. 1998). For a period of 12 years, CWTS conducted regular follow-up evaluations of Flemish universities (De Bruin et al. 1993a). 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 (1980–1985), 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% of the advanced bibliometric analyses commissioned by the universities in the first VSNU evaluation (1994–1997). 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).

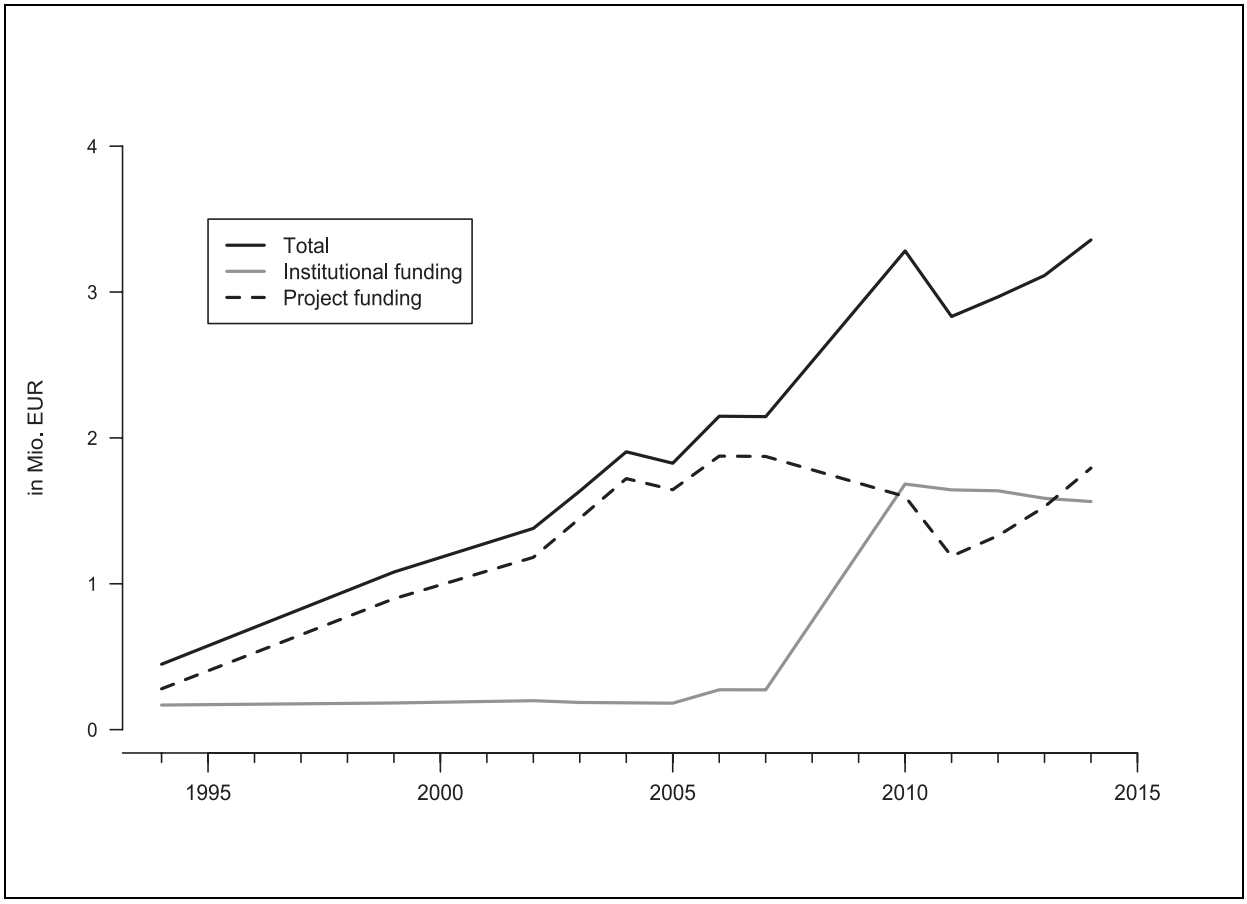
The relevance of CWTS as a provider of bibliometric analyses in the context of the Dutch university evaluation scheme was strengthened by the NOWT, in which CWTS, since 1992, and in cooperation with the Maastricht Economic and Social Research Institute, provided a national monitoring of the development of Dutch science (Interview, van Steen). CWTS assumed that role with respect to bibliometric output data, in addition to data that were gathered byc, 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 1994–2007, the inflation-adjusted amount of contract funding quadrupled (Fig. 3, see supplementary material 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 material 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% 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

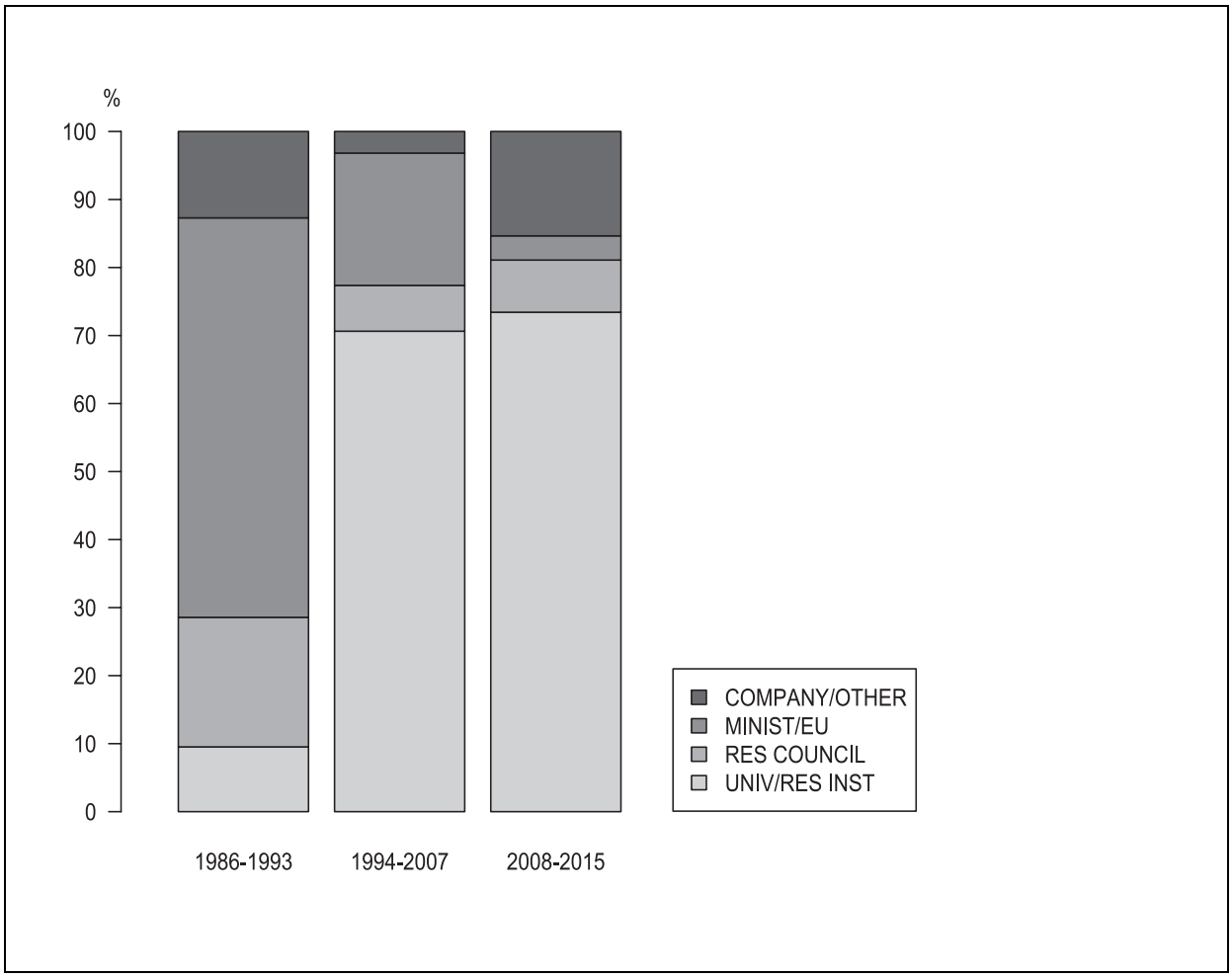
'Measuring Science and Research Performance' to students, researchers, policymakers, librarians and other professionals. Most important, by the mid-2000s, CWTS had substantially expanded its client base (Figs. 4, 5, see supplementary material tables 3, 4). This expansion became evident when, in 2007, 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).

Figure 3: Funding Sources of CWTS, 1994-2014, inflation-adjusted



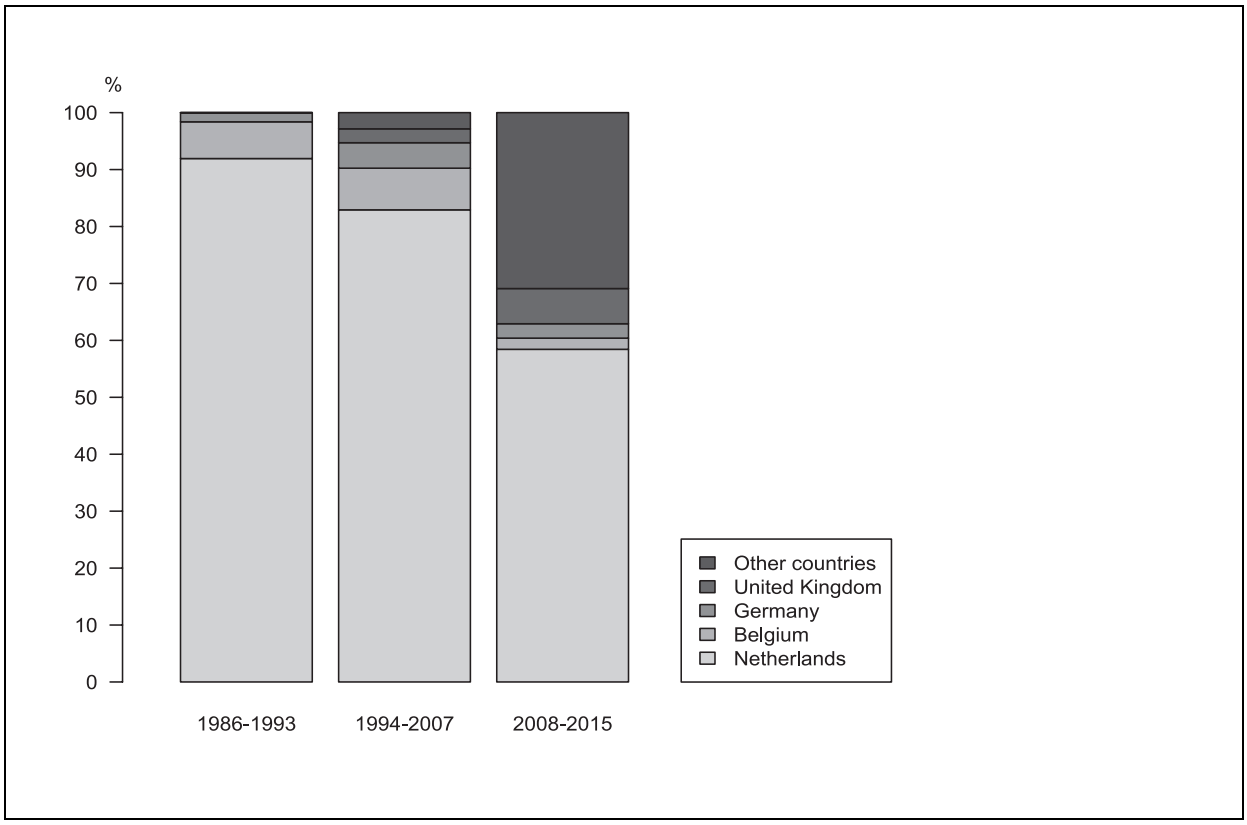
Sources: (FSW 1995; 2000; CWTS 2008; Leiden University 2008)

Figure 4: Client Types of CWTS, 1986-2015



Sources: CWTS R&D Project reports from the CWTS archive

Figure 5: Country of origin of CWTS's Clients, 1986-2015



Sources: CWTS R&D Project reports from the CWTS archive

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). 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 material: 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 nor-

malization 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).

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).

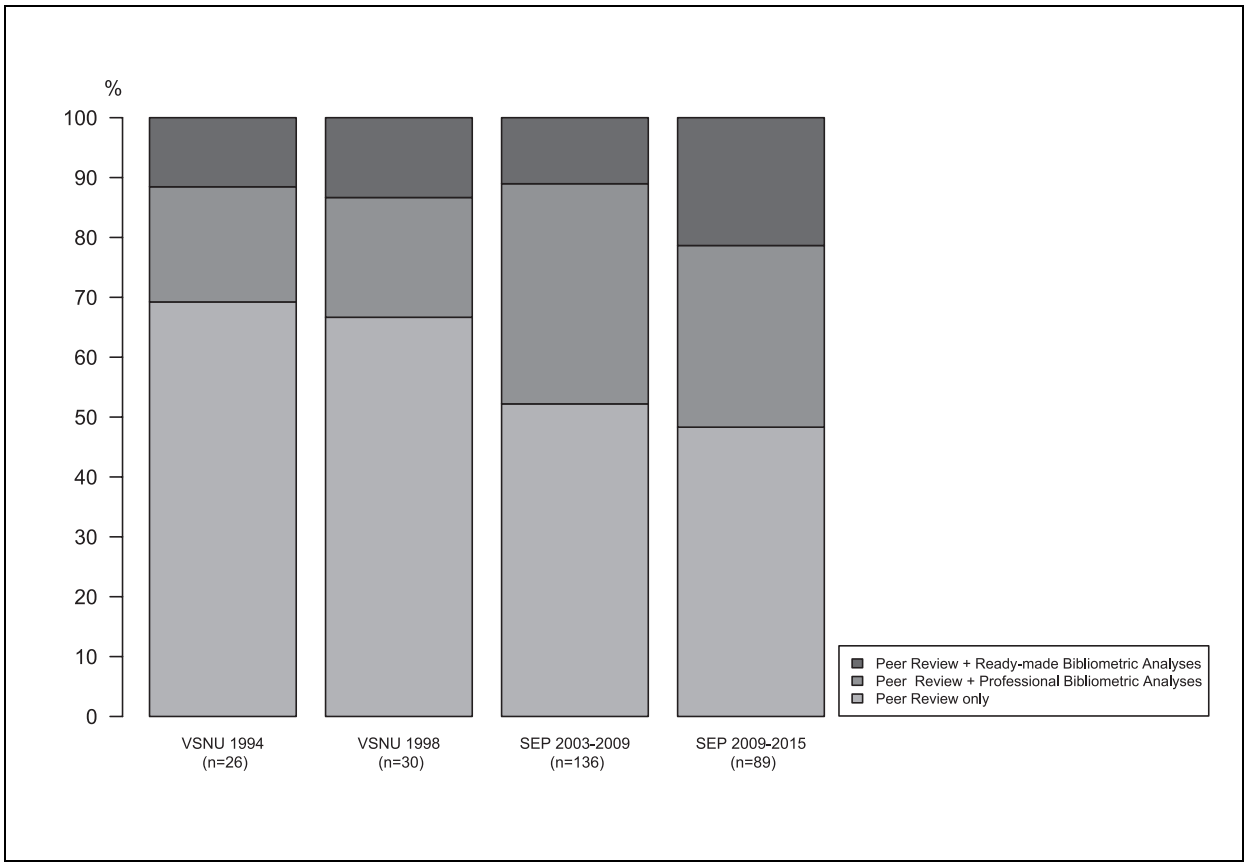
Second, the social claim: new competitors emerged, such as research groups at the Karolinska Institute in Sweden, the Scimago Lab in Spain or the contract research company Science Metrix in Canada. More important than academic competitors, however, was the fact that large database providers introduced 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 2015–2021) 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 material: 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). Ad-

vanced 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 United States (Fig. 5).

Figure 6: Share of bibliometric analyses in the Dutch national evaluation cycles



Sources: Review committee reports from VSNU and SEP evaluations (retrieved from the archives of the Rathenau Institute and CWTS and a web-search

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 paper 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 paper 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 paper 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 material: 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 VSNU 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, 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.

Figure 7: Cognitive claims to jurisdiction of quantitative research assessment by CWTS

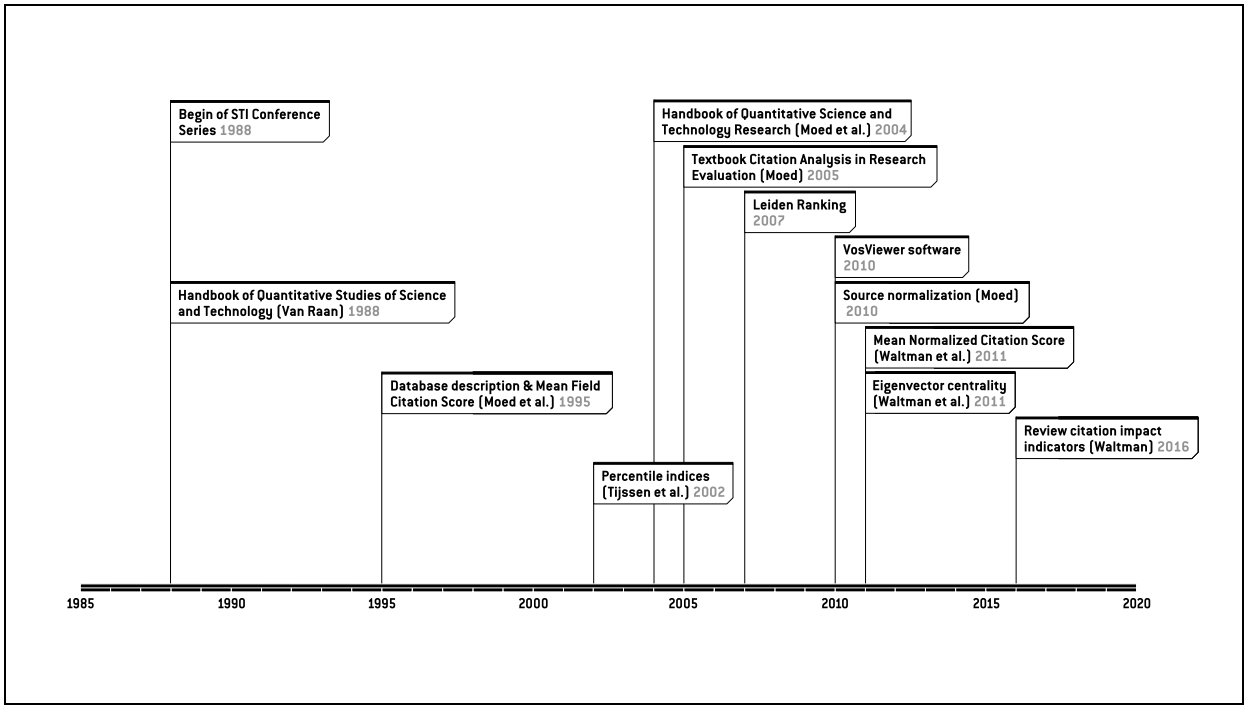
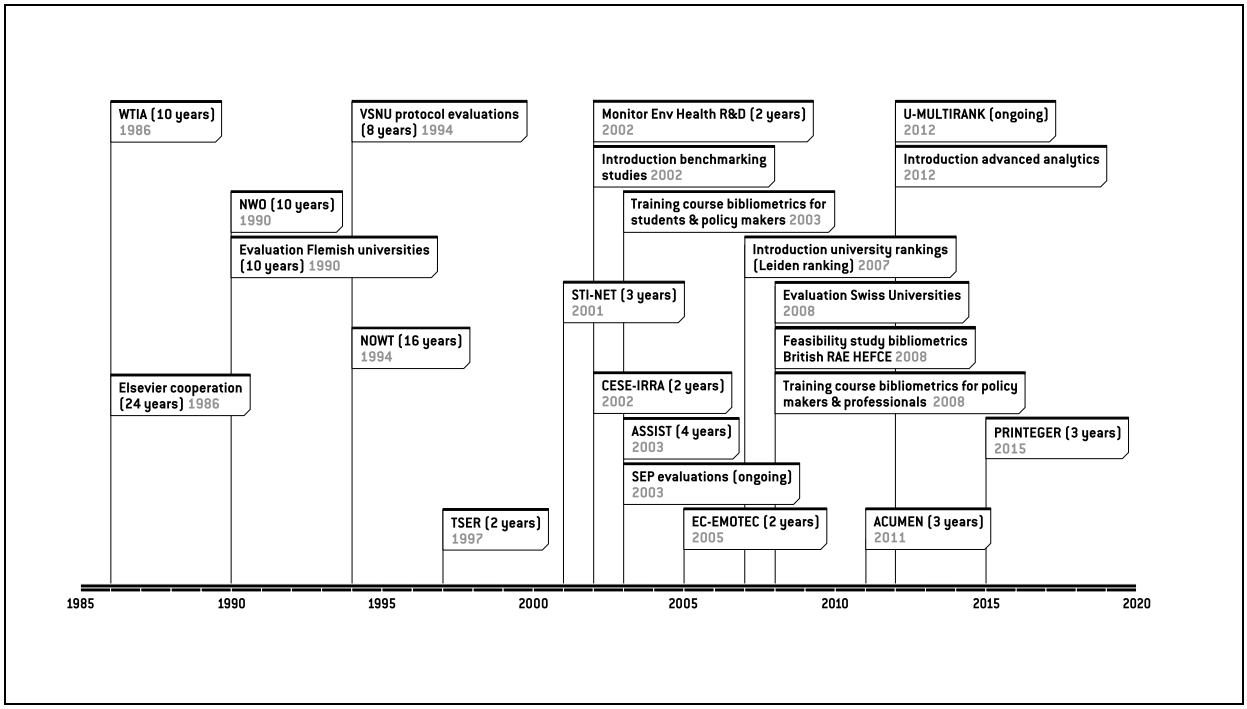


Figure 8: Social claims to the jurisdiction of quantitative research assessment by CWTS



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 paper 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 paper, 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 assess-

ment 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 paper 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 quali-

fied to deal with clients such as universities and research institutes and to arrange licence 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 subordinated 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% in the first SEP cycle (2003–2009) to 21% in the most recent SEP cycle (2009–2015). 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.

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Table 1: List of Abbreviations

Abbreviation	English-language name	Original Dutch name
AWT	Advisory Council for Science and Technology	Advisraad voor Wetenschap en Technologie
CBS	Statistics Netherlands	Centraal Bureau voor de Statistiek
CWTS	Centre for Science and Technology Studies	Centrum voor Wetenschap en Technologische Studies
DGW	Directorate General for Science Policy	Directoraat Generaal voor Wetenschapsbeleid
ECOOM	Centre for Research & Development Monitoring	Expertisecentrum Onderzoek en Ontwikkel-ingsmonitoring
FSW	Faculty of Social and Behavioural Sciences	Faculteit voor Sociale Wetenschappen
FOM	Foundation for Fundamental Research on Matter	Nederlands Fundamenteel Onderzoek de Materie
CPP/FSCm	Mean Field Citation Score	
HOAK	White Paper Higher Education Auton-omy and Quality	Hoger Onderwijs Autonomie en Kwaliteit
ISI	Institute for Scientific Information	
JIF	Journal Impact Factor	
KNAW	Royal Netherlands Academy of Arts and Sciences	Koninklijke Nederlandse Akademie van We-tenschappen
KWO	Quality Control of Scientific Research Group	Kwaliteitszorg Wetenschappelijk Onderzoek
MNCS	Mean Normalized Citation Score	
MOCW	Ministry of Education, Culture and Science	Ministerie van Onderwijs, Cultuur en Weten-schap
MW	Minister for Science Policy	Minister voor Wetenschapsbeleid
NIFU	Nordic Institute for Studies in Innova-tion, Research and Education	Nordisk institutt for studier av innovasjon, forskning og utdanning
NSF	National Science Foundation	
NOWT	Netherlands Observatory for Science and Technology	Nederlands Observatorium van Wetenschap en Technologie
NWO	Netherlands Organisation for Scientific Research	Nederlandse Organisatie voor Wetenschap-pelijk Onderzoek
OECD	Organisation for Economic-Co-operation and Development	
QANU	Quality Assurance Dutch Universities	
RAWB	Advisory Council for Science Policy	Raad van Advies voor het Wetenschapsbeleid
SEP	Standard Evaluation Protocol	
SCI	Science Citation Index	
SNIP	Source Normalized Impact per Paper	
LU	Leiden University	Universiteit Leiden
WTI	Science and Technology Indicators	Wetenschaps en Technologie Indicatoren
WTIA	Science and Technology Indicators Project	Wetenschaps en Technologie Indicatoren Advies
VK	Fact-finding committees	Verkenningscommissies

VSNU	Association of Dutch Universities	Vereniging van Samenwerkende Nederlandse Universiteiten
WHW	Comprehensive Higher Education and Research Act	Wet op Hoger onderwijs en Wetenschappelijk onderzoekcomprehensive

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Supplementary material (Appendix)

Scientific and Non-Scientific Staff at CWTS (Fig. 2)

Year	Scientific Staff	Non-Scientific Staff	Total Staff
1987	9,2	2,7	11,9
1988	14,6	3,2	17,8
1989	14,5	4,1	18,6
1990	13,8	3,2	17
1991	9,8	3,2	13
1993	10,6	3,6	14,2
1994	8	4,8	12,8
1995	8,8	6,2	15
1996	8,8	6,2	15
1997	7,7	4,6	12,3
1998	7,7	4,8	12,5
1999	9,2	4,8	14
2000	9,2	4,8	14
2001	8,2	4,8	13
2002	8,8	4,2	13
2003	8,8	4,2	13
2004	8,8	4,2	13
2005	8,8	4,2	13
2006	9,6	4,2	13,8
2007	9,6	4,2	13,8
2008	8,9	5,1	14
2009	12,3	5,5	17,8
2010	12,9	5,1	18
2011	12,2	7,4	19,6
2012	15,5	8,1	23,6
2013	16,3	8,9	25,2
2014	18,6	6,7	25,3

Sources: (CWTS 1986-2010; CWTS 2008; Leiden University 2008). Staff numbers in full times equivalents (FTE)

Funding Sources of CWTS (Fig. 3)

Year	Institutional Funding	Project Funding	Total Funding
1994	168,6	279,7	448,3
1999	182,7	897,6	1080,4
2002	198,3	1181,2	1379,6
2003	186,3	1449	1635,3
2004	183,8	1721	1904,8
2005	181,4	1644,9	1826,3
2006	273,3	1875,2	2148,5

2007	272,8	1872,8	2145,7
2010	1683,9	1598,2	3282,1
2011	1643,6	1188,6	2832,2
2012	1637,3	1329,6	2967
2013	1585,8	1527,7	3113,5
2014	1563,7	1793,5	3357,3

Sources: (FSW 1995; 2000; CWTS 2008; Leiden University 2008). Funding displayed in 1000 Euro

Client Types of CWTS (Fig. 4)

	Universities and Research Institutes	Research Councils	Ministries and European Commission	Companies and other Organizations
1986-1993	6	12	38	8
1994-2007	122	17	49	8
2007-2015	223	28	13	56

Sources: CWTS R&D Project Reports from the CWTS Archive

Country of Origin of CWTS's Clients (Fig. 5)

	Netherlands	Belgium	Germany	United Kingdom	Other Countries
1986-1993	50	4	1	0	0
1994-2007	129	14	11	6	7
2007-2015	165	7	9	22	56

Sources: CWTS R&D Project Reports from the CWTS Archive

Share of Bibliometric Analyses in the Dutch National Evaluation Cycles (Fig. 6)

Evaluation Cycle	Peer Review only	Peer Review + Professional Bibliometric Analyses	Peer Review + Ready-made Bibliometric Analyses	Total Number of Reports per Cycle
VSNU 1994	18	5	3	26
VSNU 1998	20	6	4	30
SEP 2003-2009	71	49	15	135
SEP 2009-2015	43	28	19	90

Sources: Review Committee Reports from VSNU and SEP Evaluations (retrieved from the archives of the Rathenau Institute and CWTS and a web-search

Social Claims to Jurisdiction of Quantitative Research Assessment by CWTS (Fig. 8)

Acronym	Project Title	Duration
WTIA	National Program on Science and Technology Indicators	1986-1990 1991-1995
NWO	Netherlands Science Indicators	1990-2000
NOWT	Netherlands Observatory for Science and Technology	1994-2010
TSER	The Role of Europe in World-Wide Science and Technology: Monitoring and Evaluation in a Context of Global Competition	1997-1999
STI-NET	Network Indicators: Science, Technology and Innovation	2001-2004
Monitor Env Health R&D	Monitoring Environment and Health R&D in Relation to Socio-Economic Problems; New Approach to Impact Assessment	2002-2003
CESE-IRRA	Centres of European Scientific Excellence in Industrial-Relevant Research Areas	2002-2003
ASSIST	Bibliometric Indicators for measuring scientific performance of EU universities	2003-2007
EC-EMOTEC	Identification of new emerging and converging clusters of science and technology	2005-2007
U-MULTIRANK	Global University Ranking	2012-ongoing
ACUMEN	Academic Careers Understood through Measurement and Norms	2011-2014
PRINTEGER	Promoting Integrity as an Integral Dimension of Excellence in Research	2015-2018

Sources: CWTS Annual Reports 1987-2010, Project websites

3 Professional competencies and jurisdictional claims in evaluative bibliometrics: The educational mandate of academic librarians*

Abstract

Quantitative metrics in research assessment are proliferating all over the world. The demand has led to an increase in bibliometric practitioners and service providers. Their professional roles and competencies have not yet been subject to systematic study. This paper focuses on one important service provider in evaluative bibliometrics – academic librarians – and analyzes their professional competencies from a sociology of professions perspective. To this end, expert interviews with 25 British and German information professionals and several documents have been analyzed qualitatively. Academic librarians compete with other occupations for professional jurisdiction in quantitative research assessment. The main currency in this competition is their expert knowledge. Our results show that academic librarians rely strongly on the know-how gained in their academic Library and Information Science (LIS) training and develop a specific jurisdictional claim towards research assessment, consisting primarily in training, informing and empowering users to proficiently manage the task of evaluating scientific quality themselves. Based on these findings, and informed by the theoretical framework of Andrew Abbott, our conceptual proposal is to adapt formal training in bibliometrics to the various specific professional approaches prevalent in the jurisdictional competition surrounding quantitative research assessment.

Keywords: professional jurisdiction, evaluative bibliometrics, academic libraries, Andrew Abbott, sociology of professions, academic knowledge base, professional knowledge base, bibliometrics education, claiming vacant jurisdiction

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1 Introduction

Since the early 1970s, the field of evaluative bibliometrics has been developing indicators and tools for the purpose of research evaluation. It is one of the most important research areas within bibliometrics, which is a sub-discipline of Library and Information Science (LIS) [4, 22, 60, 64, 65, 67]. The field's knowledge has become adopted rapidly by evaluation practices worldwide, and is increasingly employed to complement peer review procedures to satisfy the growing demand for accountability as part of a new governance of science [32, 59]. In Europe, the UK and the Netherlands were among the forerunners in the use of citation analyses for evaluative purposes at a national level [35, 45]. A recent study shows that quantitative metrics - ranging from simple paper counts up to complex citation analyses in national research evaluation systems – are widespread and are now employed by several countries worldwide [26]. At the level of research organizations, bibliometrics is becoming part of managerial and administrative procedures in the course of institutional evaluations on an even larger – but as yet unmeasured – scale.

The proliferation of metrics in research evaluation has given rise to increasing concerns about the misuse and uninformed use of metrics [21, 51]. While critical perspectives on unchecked bibliometric systems [18] and "mandarinates of measurement" [13] abound, one aspect has remained neglected: To date, there is no systematic empirical evidence either regarding who the external producers, clients, or users of bibliometrics outside of the research field are, or regarding how they relate to and interact with the academic field of scientometrics. The need for knowledge about the professional roles of these practitioners (be they producer, client, expert or amateur users), as well as their skills and competencies has been aptly demonstrated during the recent debates about standardization of bibliometric indicators at the recent International Conference on Scientometrics and Informetrics (ISSI) and Science and Technology Indicator (STI) conference [55, 63].

Alongside the well-established bibliometric services and consultancies developed by the commercial data base providers Thomson Reuters and Elsevier, and the contract research and services provided by the Dutch Centre for Science and Technology Studies (CWTS) [8], a diverse group of analysts at government departments or organizations specializing at the study of science and technology, university research managers, and companies is establishing itself [73, 74].

In this "crowded marketplace" [51], academic librarians have started to emerge as a professional group that actively engages in and promotes evaluative bibliometric analyses as a new service for their clients, namely the researchers and management of their research organization [6, 23, 36, 34]. However, this new service area is not covered adequately in LIS education [10, 66].

A salient question to be addressed is therefore: Which professional competencies are required for bibliometrics in research evaluation, and how can they be obtained?

We propose a conceptual answer, which is informed by a sociology of professions perspective. The sociologist Andrew Abbott defines professions broadly as exclusive occupational groups "applying somewhat abstract knowledge to particular cases" [1], thereby establishing an exclusive link between the professional and his work which Abbott calls "jurisdiction" [1]. According to Abbott, this jurisdictional link does not remain uncontested, because multiple professions and occupational groups striving for professional status exist in an interrelated system and compete for the provision of exclusive expert services in a professional work area [1]. Due to social and technological change, or to changing conceptions of societal relevance, professional problems amenable to expert services arise and disappear. In line with the need to account for public expenses in science, quantitative research evaluation can be treated as a professional field of responsibility. No professional jurisdiction has yet been claimed by competing professionals and professionalizing groups for this field.

The currency in this competition is the abstract academic knowledge on which any professional problem diagnosis and treatment is based. A central assumption we make is that bibliometrics as a research field serves as the academic knowledge base needed for a process of professionalization. Although bibliometricians have their stakes in the competition for this vacant jurisdiction if they are not primarily engaged in producing and validating new scientific knowledge, we focus on one competing professional group, namely the academic librarians who are claiming bibliometric services as a new field of responsibility.

Drawing on several documents and expert interviews, we analyze how academic librarians obtain bibliometric knowledge and the skills needed for service provision, and what kind of professional diagnosis and treatment is offered on the basis of this knowledge.

Our paper is structured as follows: First, we introduce the main theoretical concepts of Andrew Abbott's sociology of professions and then provide a brief overview of the relevant

literature, showing that the various approaches taken in the literature still lack an actor-centered perspective on the professionalization of research evaluation. After having presented the methods and data of our empirical investigation of bibliometrics in academic libraries, we present our findings on the following aspects of bibliometric practices in libraries: knowledge bases, learning strategies and needs, and the types of professional services offered based on the previous training and education. We conclude with the conceptual implications arising from this sociology of professions perspective on bibliometrics education.

2 Identifying professional competencies with Abbott's framework

Metrics-based research evaluation constitutes a societally relevant professional sphere of work [47]. This field of responsibility contains professional problems, which are amenable to expert services based on abstract knowledge.

According to Abbott, professional problems have objective features such as being grounded in natural, technical or organizational facts, and subjective features that are open to interpretation by professions [1]. It is through exclusive approaches to problem solving that professions establish a link between themselves and a task, which is called jurisdiction.

In the case of metrics-based research evaluation, the professional problem consists in the assignment of value to and measuring the quality of scientific research. At the core of this problem of finding a quantitative proxy for the qualitative notion of scientific quality [30] lies the question of what citations actually mean. What kind of inferences can we draw from citation behavior? These subjective properties of the problem are re-interpreted by a profession. Social and cultural categories of relevance and value may be attached in different ways, the construction of statistical indicators being one of them.

A jurisdictional link between this sphere of work and a specific profession is maintained by identifying a professional problem for a client, called diagnosis, then reducing the problem to its component parts and subjecting it to processes of inference, and lastly establishing a solution via treatment. Via these three professional mechanisms of diagnosis, inference, and treatment the subjective features of the problem are re-interpreted individually by each profession.

A significant objective feature of the problem of measuring scientific quality is the representation of citation behavior in citation indices. These databases as sources for citation analysis are both technological and organizational in nature, since the most important ones,

Web of Science and Scopus, are owned by the companies Thomson Reuters and Elsevier. These features are not amenable to interpretation by professions.

A prototypical professional problem solution in metrics-based research evaluation may proceed along the following lines: The clients that need expert services in bibliometrics are collective and individual actors ranging from universities and national governments and their sub-units to individual researchers. Diagnosis consists in identifying the client's needs, such as which unit is to be evaluated to which aims, and in which frame of reference.

From the data gathered in citation indices and specialized databases, it must then be inferred what the citations mean. For example:

> *"How do we know that certain citations belong to biology, to chemistry, to computer science? The answer could be that the metadata or word frequency or co-association or documentary relationships may tell us this." [16].*

The citations are symbols and thus representations of the scientific domains and the positional relationships between them.

The treatment consists in assigning value to these respective positions, captured in numerical and comparative statements in the form of indicators or rankings [16].

These three professional mechanisms - diagnosis, inference and treatment - are based on abstract academic knowledge, which formalizes the skills upon which professional work is based [1]. The abstract academic knowledge base of a profession can be located in specific worksites such as universities, research institutes, and scientific journals, and is not connected to practice but rather committed to rational and logical theorizing. While it plays a role in providing professions with new professional practices based on research, and is also fundamental in instructing both neophytes and working professionals, the abstract academic knowledge base's main function lies in the provision of a legitimate foundation for a particular professional jurisdiction [1].

The research field of evaluative bibliometrics is considered to be the main academic knowledge base for the provision of bibliometric services. The field has spawned a number of bibliometric indicators designed to measure research impact and quality. A recent study [29] has identified more than 60 indicators representing unique innovations belonging to six broad methodological groups: journal impact indicators [19], field normalized indicators [39, 54],

source normalized indicators [40, 68], Eigenfactors [7, 46], percentile indices [20], and h-type-indices [27]. Alongside science indicators, science mapping is also considered to be a valuable tool in science policy [24], and forms a growing part of the research activity within evaluative bibliometrics. Science maps are used to display the structures and dynamics of science, and can complement and validate performance analyses based on bibliometric indicators [41].

Abstract knowledge is the basis for jurisdictional contests and thus successful professionalization [1]. However, it is the degree of abstractness that matters: Not all theories and methods taught in university matter in successful professional practice. In this paper, we make use of the fact that specific professional practices – in the form of diagnoses and treatments – point, on the one hand, to the knowledge bases obtained [75] and, on the other hand, to the amount of jurisdictional control achieved, helping us to assess whether training programs should be focused more on academic objectives, or whether education should focus more on developing problem-solving skills based on standardized techniques and situations encountered in practice [76].

Professions strive for comprehensive and full claims to jurisdiction based on their ability to define and solve a set of problems, and on the social recognition of this function in the public and legal arenas. On the road to full jurisdictional claims, several jurisdictional settlements occur. Among the several forms of settlement are, for example, the case of subordination, where routine duties are delegated to a subordinate profession (a prominent example are the nursing professions, which are subordinate to medicine), or the final division of labor, which splits a jurisdiction into two equal but interdependent parts (for example, architects share the work of designing and constructing buildings with engineers) [1].

To achieve a full claim over jurisdiction or jurisdictional settlements, a rhetorical device called “reduction” is often employed. This argument states that a new task is, in principle, reducible to an already existing and secure jurisdiction held by the profession [1].

Abbott [1] proposes three analytical steps which will be broadly adhered to in this paper: The literature section presents some disturbances in the professional system of librarianship which then evoke a shift in jurisdictional claims from access to, for example, information literacy or, in our case, bibliometric literacy. The empirical section of the paper will then trace the modifications in the professional system of knowledge that are needed to bal-

ance the professional work performed in bibliometric service provision and jurisdictional claims based on this work.

3 Literature on the professionalization of research evaluation and academic librarians

A general perspective on the professionalization of evaluation as a development inherent in modern societies has been developed by House [28], and more recently by Dahler-Larsen [14], with a specific focus on organizations. The literature on research policy, higher education management, and the sociology of organization and science abounds with studies on research evaluation that explore, for instance, the characteristics of national evaluation systems (see for example [61]) and the intended and unintended consequences of research assessment on the system of science and its organizations (see for example [9]). However, an actor-centred perspective seems to be lacking. Wouters [62] maintains that existing research on the use of citation indicators in research evaluation would be enhanced by the notion of the "citation as an infrastructure" [62]. This infrastructure comprises a network of databases, publishers, consultancies, bibliometric centers, and users of citation indexes, interacting with regimes of accountability. We intend to contribute to the concept of citation infrastructure by focusing on academic librarians as selected users of citation databases.

Lindgren [33] and De Rijcke and Rushforth [51] put forward the idea of a professionalization of bibliometrics as a regulatory science. As we have stated before, we prefer to conceive of the field of evaluative bibliometrics primarily as the knowledge base for a professionalizing practice of different professional and occupational groups, rather than viewing it as an actor in the process itself. The scientific field has very permeable and open boundaries, and contributions to its main publication channels stem from scholars from a variety of disciplines [30]. A clear-cut definition of the "bibliometrician" thus remains problematic. However, evaluative bibliometrics plays a central role.

Abbott regards the knowledge base as key in the process of professionalization:

> *"Many occupations fight for turf, but only professions expand their cognitive dominion by using abstract knowledge to annex new areas, to define them as their proper work." [1].*

The body of literature applying Abbott's perspective to professional and professionalizing groups is large, and includes professions as diverse as archivists [31], environmental

scientists [38], parish diaconal workers [48], and higher education professionals [52], as well as the traditional profession of doctors [44].

It has also been frequently applied to study professional developments in librarianship [57]. Abbott himself [1, 3], as well as Danner [15] and Burnett and Bonnici [72], have studied librarianship as a profession competing for jurisdiction with other information professionals such as computer scientists.

The historical forms of library jurisdiction were influenced by the fact that the library as an organization preceded librarianship. The conception of the professional task thus centered on "maintaining physical custody of cultural capital" [1]. Librarians approached this task by focusing on access, thus providing efficient tools (cataloging, referencing etc.) for information retrieval for the user. Alongside this traditionally strong access jurisdiction, they also established and managed the library's collection to serve the users' educational and entertainment needs [1]. The access jurisdiction, especially, has come under severe threat by changes in library environments such as budget cuts, the rise of computers, the Internet, and other technological advances, as well as changes in scholarly communication and user needs. These challenges force academic libraries to engage in measures such as strengthening their educational jurisdiction by building up competency in the field of information literacy [42, 43]. They have also led to academic libraries reaching out for new jurisdictions: Verbaan and Cox [58] have identified research data management as being among the new fields of responsibility to which academic librarians lay claim. They conclude that the dynamics of competition inherent in the new field of research data management can be captured very well through the lens of Abbott's theory. Librarians have a more pro-active approach than their potential competitors – e.g. IT specialists and research managers - because they have been extending their jurisdiction in a more IT-oriented direction for some time. This is also maintained by Corrall and Cox [12] in their overview of the development of academic librarianship specialties. In their interpretation based on Abbott, the access jurisdiction of academic librarians is bound to be reinvented and extended in response to digitization. Specifically, librarians will become more firmly embedded in the scholarly research process by taking on the management and preservation of research data.

In a similar vein, bibliometric services in academic libraries may broaden the research support role of librarians. Such services are proliferating in academic libraries worldwide, as a recent survey indicates [5, 10], and are being promoted as a promising new service area by

information professionals and academic librarians alike [6, 23, 34]. Nevertheless, an understanding of the factors enabling and constraining bibliometric service delivery, and especially the competencies needed to provide it, is still lacking [12].

4 Bibliometrics in libraries: investigation of the knowledge base and the professional services

4.1 Data and method

This empirical study draws on several data sources, which give an insight into the bibliometric practices in academic libraries and the knowledge bases for these services. To account for different educational systems in librarianship as well as differing national research evaluation practices British and German information professionals and academic librarians are the focus of this study.

Publicly available data on bibliometric practices in British and German academic libraries comprise 15 conference and workshop presentations, eight opinion articles and case studies in scholarly and practitioner journals, 26 institutional library websites covering bibliometric content and promoting bibliometric services, 54 entries of the British JISC Bibliometrics mailing list, and 60 blog posts about bibliometrics and libraries. Since one of the main service areas is bibliometric training, we collected nine course presentations for scholars and university management and 16 factsheets containing information about bibliometrics. The documents were collected between October 2013 and October 2014.

The main data source is 25 semi-structured expert interviews we conducted with librarians and information professionals on bibliometric practices, training, and professional development in academic libraries. The interviews were recorded between December 2013 and April 2014, and transcribed with the aid of F4 transcription software. Transcripts were sent to the interviewees for authorization of use of selected interview passages.

The variety, richness and volume of the qualitative data —188 documents and 25 interviews— call for systematization and reduction.

Qualitative content analysis is especially suited to data of mixed types [37, 53]. It permits a theory-guided cross-section of diverse material, structured according to Abbott's theoretical framework. The categories deduced from this framework are first enhanced by inductive categories to assure a significant degree of openness, and then compiled in a cate-

gory system. This category system is the main analytical tool, and serves as a basis for interpretation. The analysis is preceded by computer-assisted coding of the relevant data after the category system is imported into MaxQDA software. This procedure is systematic and rule-guided; all the material is treated consistently. The extracted text-bundles are then analyzed - partly manually and partly by MaxQDA - for patterns and co-occurrences of professional competencies and related jurisdictional claims according to Abbott's framework.

Three qualifications should be taken into account when assessing the validity of our qualitative research results: Firstly, although the main data material consists of expert interviews with information professionals in 24 libraries, our results should not be interpreted on the institutional level. The blog entries, mailing list posts and articles or websites contain numerous references to other libraries that are out of the national scope chosen for this study. The main focus of our analysis is an Abbottonian approach to professional work, i.e. the actual and planned bibliometric practices which are tied to the profession of librarianship, but not to the library as an organization.

Secondly, we partly quantify our qualitative data in order to facilitate pattern recognition, and document our analysis [69, 70]. This does not imply that the data are one-to-one models of reality or actual distributions. The number of codes assigned to text passages can also be influenced by interview techniques, types of material, or other selective effects. Nevertheless, we maintain that we can extract more meaning from our data if we make use of numerical descriptions.

4.2 The main analytical categories

Before reporting our results, we will briefly explain how Abbott's conceptual framework is brought to bear on the empirical data in showing selected aspects of the main analytical tool, the category system.

Table 1 and 2 show the most salient categories for bibliometrics education. As a basis for bibliometric services, academic librarians need not only abstract academic knowledge (as would be expected, according to Abbott) but, as the data shows also the professional know-how acquired in LIS education. Both knowledge bases are related to the specialty of bibliometrics in differing ways. The academic knowledge base is tightly coupled to knowledge from the research area of evaluative bibliometrics, whereas the professional knowledge base develops practical know-how of bibliometrics in the application context of the library itself.

Table 2 displays categories showing what kind of knowledge was acquired and which learning strategies and needs were identified. It is not possible to directly link the knowledge content to the knowledge base it was acquired from, yet some cues can be derived from the material. The specific diagnostic approach of academic librarians, as opposed to other professionals engaged in bibliometrics, is shown in table 3. The treatment of the professional problem as visible in table 4 follows three approaches which were inductively identified. These knowledge-based professional services then lead academic librarians to jurisdictional claims, which are operationalized in table 5. These claims are very closely related to the bibliometric knowledge obtained, and thus provide important cues for improving bibliometrics education in librarianship. (For tables 1-5 please see appendix).

5 Results

5.1 Knowledge bases, learning needs and strategies

According to Zhao [66] and Corrall, Kennan and Afzal [10] the potential for acquiring knowledge in the field of bibliometrics is limited in LIS education world-wide, due to a poor representation of bibliometrics in course modules and textbooks.

Specifically for the German case, Richter [50] reports that bibliometric modules exist in most library schools and LIS university departments, although coverage varies in depth and is not especially adapted to evaluative bibliometrics as a library service. The data collected in the present study, ranging from blog entries to interview passages, also indicate that formal training in bibliometrics is virtually non-existent: "(…) and then I did an MA in Information and Library Management which didn't cover bibliometrics at all I think." (UK B9).

The education for academic librarianship differs in Germany and the UK. Germany has a dedicated educational path towards academic librarianship, which involves either taking a BA or MA degree in librarianship at a general university or a university of applied sciences, or by combining a Master's in a different subject with a two-year traineeship in a national or state library, or another post-graduate course in librarianship [49]. The UK provides no specific education for academic librarianship, most common instead being a Bachelor's degree in a potentially related subject; followed by postgraduate qualifications. There is also the option of taking a Bachelor's or Master's degree in Library and Information science (or a related subject) that is accredited by the Chartered Institute of Library and Information Professionals (CILIP) [49].

Yet although German academic librarians might formally benefit from a better coverage of bibliometrics in their LIS curricula, librarians from both countries maintain that their predominant learning strategy is training on the job (see figure 1). A statement from a British librarian thus summarizes current learning strategies in bibliometrics quite well:

> *"(...) we're sort of trained generally as librarians but the actual things, the actual specific specialties that we arrive to do at the time we take up the role we don't necessarily have formal training or we don't... we haven't previously received formal training in that particular...those particular specialist aspects we thought of as part of doing the job, and sort of pick up what we can from reading around and any training courses, which do exist - but often the sort of job comes first, or the role comes first, and then as we take on the role and as we go on through it, we sort of learn how to do the role as we are actually doing it." (UK B3).*

Librarians proactively immerse themselves in a primarily literature-based self-study:

> *"(...) Just taking a look at things, reading definitions in JCR and of course also reading critical and technical discussions of JCR in the specialist literature (...)." (GER B8, author's translation).*

A second important role is played by so-called commodity-aided learning, which refers to experimenting with software tools and databases, and consulting help files which often serve to acquaint librarians with bibliometric knowledge:

> *"You know, we are looking at these tools and it's only through looking at those during the last months or so that we are learning exactly what's possible and what kind of metrics we could use and what, you know, what the pros and cons of different metrics are." (UK B7).*

A reactive self-study takes place when library clients demand a service and the necessary knowledge is then obtained to serve these information needs:

> *"It's more sort of just trying to read journals, although I don't do as much of it as I ideally would do, so it's more of a case of, if I find that I need to know something for a particular task at work then I will look online to find out more about it." (UK B3).*

Visiting conferences or workshops and making use of professional networks are additional learning strategies.

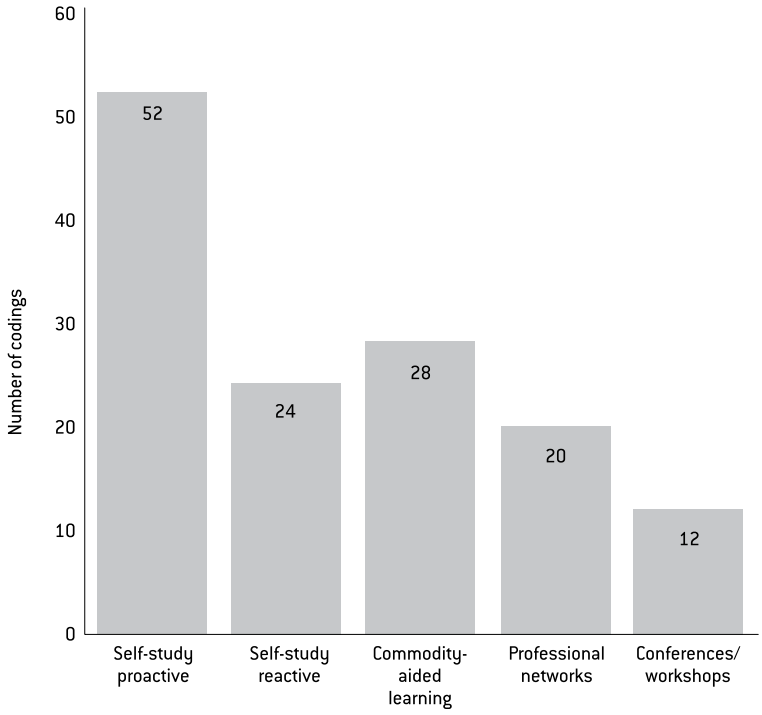

Figure 1: Learning strategies of academic librarians in bibliometric training on the job

The latter two learning strategies, in particular, are tied to two different knowledge bases that inform academic librarians' bibliometric services and their claims to jurisdiction in quantitative research assessment: the academic knowledge base and the professional knowledge base. The two differ in that the former derives its knowledge from evaluative bibliometrics as a research specialty, whereas the latter derives its knowledge from a LIS education and the day-to-day practices of academic librarianship [11]. While practical knowledge allows librarians to deal with specific situations in particular cases, scientific knowledge allows them to see specific situations as instances of general cases and to thereby explain, for example, larger mechanisms or structures. The two constitute separate and yet complementary forms of knowledge which are united in the academically trained professional [56]. The learning strategies of academic librarians are mainly tied to knowledge sources from the professional knowledge base, developed especially by networking and attending conferences.

Bibliometric practices in academic libraries are predominantly informed by the professional knowledge base. In the context of increasing demand by library users, practical bibliometric know-how is developed in practitioner conferences and workshops (such as the *Bib-*

liometrics in Libraries meetings in the UK), training by commercial vendors, and professional networks. "That workshop was just a stepping stone, I think to find out what everybody else is doing, what services were available, what were issues people were looking at." (UK B8).

Other important sources are library blogs and websites, mailing lists – such as the bibliometrics-specific *JISC* list in the UK – as well as articles in practitioner and academic journals in librarianship that deal with bibliometrics.

Next to the bibliometric knowledge developed in the application context, librarians emphasize the advantages of general LIS competencies for the delivery of bibliometric services: The skills stressed particularly include being able to handle databases as complex sources of information, and knowing about specific publication types and discipline-specific behaviors in scholarly communication. Information retrieval skills are also considered necessary:

> *"Librarians have skills and experience in evaluating the quality of information resources and these are very relevant to researchers whose work is to be evaluated, as well as to those proposing to evaluate research." [17].*

Other skills considered important are accurate and careful data cleaning and handling, as well as knowing how to correctly interpret and attribute metadata:

> *"We know exactly what descriptors are, we can distinguish them immediately from keywords, we know how to collect material in a standardized way, for instance we know the difference between a series and a journal, a normal person wouldn't know this. That's why we get questions such as: Why do these conference proceedings not have an Impact Factor?" (GER B6, author's translation).*

The academic knowledge base plays a smaller role in educating academic librarians in bibliometrics. The most important source consists in maintaining an awareness of topics covered in bibliometric core journals such as *Scientometrics, Journal of Informetrics* or *Journal of the Association for Information Science and Technology (JASIST)*. Librarians have also discovered that topics may be covered in subject-specific journals:

> *"I noticed during my research concerning bibliometrics and the Impact Factor and all those critical considerations that many articles and contributions appear in scientific journals of the respective scientific disciplines. For instance in a psychology journal I read an article about the critical aspects of the Impact Factor." (GER B13, author's translation).*

Some librarians also get the opportunity to visit bibliometrics conferences such as the bi-annual conference of the *International Society for Scientometrics and Informetrics (ISSI),* or to attend bibliometric workshops for professionals such as those offered at the Center for Science and Technology Studies (CWTS) in Leiden, the Netherlands.

The reasons for librarians' limited application of their academic knowledge in evaluative bibliometrics are, on the one hand, of a structural nature, resulting from such difficulties as time restrictions or limited funding for attending conferences. On the other hand, limitations are rooted in the perceived high abstractness of bibliometrics, for which they lack the necessary statistical and mathematical background, and the problem of transferring this knowledge from theory into practice: "I know there is the Journal of Scientometrics but I wouldn't have gone there because I know a lot of their material is so theoretical." (UK B11).

Nevertheless, academic librarians exhibit high learning motivations: "I am soaking it up like a sponge." (GER B6, author's translation).

Through their bibliometric practices and from their knowledge bases, librarians accumulate multifaceted know-how that can be broadly categorized in the following topical areas: bibliometrics as a research specialty and practical field of work; notions of what scientific quality and impact mean; knowledge of bibliometric indicators, citation databases, and commercial software tools; the ethics of bibliometrics; and caveats as to its uses.

The most well known indicators are the h-index (and variants such as g-index and A-, AR-, and e-index in Google Scholar or Publish or Perish metrics) and the Journal Impact Factor in the Thomson Reuters' Journal Citation Reports. Sometimes, field-normalized indicators such as the crown indicator, SciMago Journal Rank, Eigenfactor, and Source Normalized per Paper (SNIP) are also mentioned on blogs and websites and in interviews. Most of the knowledge accumulated on citation databases refers to Web of Science, with Scopus in second place.

Librarians are aware that single performance measures are unable to capture complex concepts such as scientific impact or quality, that context information is always necessary, and that publication and citation practices - which vary over disciplines - need to be normalized when counting citations. Problems regarding name disambiguation, different citation motivations, and field-specific database coverage are also well known.

Academic librarians are also familiar with using commodities, such as commercial software products:

> *"I've successfully used Thomson's InCites to perform publication/subject analysis for my previous employer, such as subject area strengths and citation impact against national and international benchmarks." (JISC Mailing 49).*

The main learning needs identified are improving knowledge of software, tools, techniques and indicators, and keeping track of best practices of other academic libraries with bibliometric services.

5.2 Professional problem diagnosis

The know-how acquired from academic and professional knowledge bases enables academic librarians to develop an exclusive professional approach to solving the problem of measuring scientific quality, which differs from the approaches of other professional groups competing for this vacant jurisdiction.

Certain aspects of this problem cannot be exclusively re-defined because they are objective, i.e. shaped by organizational or technical facts [1]. The measurement of scientific quality as represented by citations requires data sources such as citation databases. The library as an organization hosts institutional repositories and licenses citation databases, and is thereby well-positioned to derive some claims to bibliometric expertise from these organizational and technological problem properties: "I think there is a natural place for expertise in bibliometrics in the library if they have a repository which may be displaying these bibliometrics scores." (UK B11).

However, jurisdictional claims to expertise for solving the problem of quality measurement are mainly derived from the re-definition of the subjective problem properties. Academic librarians frame this quality measurement problem primarily as a problem of information: The application of bibliometric methods and tools by libraries or library clients can

solve these information needs. Evaluative bibliometrics thereby becomes an essential information skill for library users, be they academics or members of university management and administration.

Primarily based on the academics' demands, librarians are able to detect a need to support scientific careers and successful publication strategies by making use of bibliometric information:

> *"I've been asked if there are metrics or methodologies appropriate for measuring the impact of publications in applications for promotion, particularly at professorial level." (JISC Mailing 39).*

A deficiency regarding "bibliometric literacy" is diagnosed among academics and managers alike:

> *"(...) So it's just sort of providing training sessions for academics and administrators just to understand about bibliometrics, because I think up until recently when the university senior leadership team sort of told departments what their sort of performance is in terms of citations that hasn't... the numbers haven't necessarily meant very much to the schools or departments (...)." (UK B3).*

Academic librarians also diagnose a pronounced managerial demand for bibliometrics to help to allocate institutional funding, select new scientific staff, or strategically position the research organization in the competition for funds (category *bibliometrics as a management tool*) or in university rankings (category *benchmarking*): "I am supporting senior management with analyses on the overall position of the university and its broad citation impact." (UK B2).

These diagnoses are centered on the observation that research assessment practices are changing and becoming increasingly metrics-based. Accordingly, research support by the library as a service institution should adapt to these changes: "The research environment reconfigures the library" [34]. The differences between the decentralized, institutionally focused research evaluation practices in Germany and the regular national evaluation exercise (Research Excellence Framework, REF) in the UK [71] might suggest that German libraries are not faced with the same pressure towards establishing bibliometric services. Our data show that the REF and subsequent needs for evaluation support in universities pose a clear rationale for British librarians to engage in this service area. However, the same applies to

German librarians, especially if their library is situated in a technical university or an independent research organization with a subject focus on the natural sciences. Universities with a comprehensive spectrum of subjects and social science or humanities research organizations, as well as universities of applied science who engage in less research, mainly employ librarians who offer only a limited range of bibliometric services, if at all.

5.3 Professional problem treatment

Treatment of the information problem of academics and university managers rests on three pillars: training, information and consultancy (see figure 2).

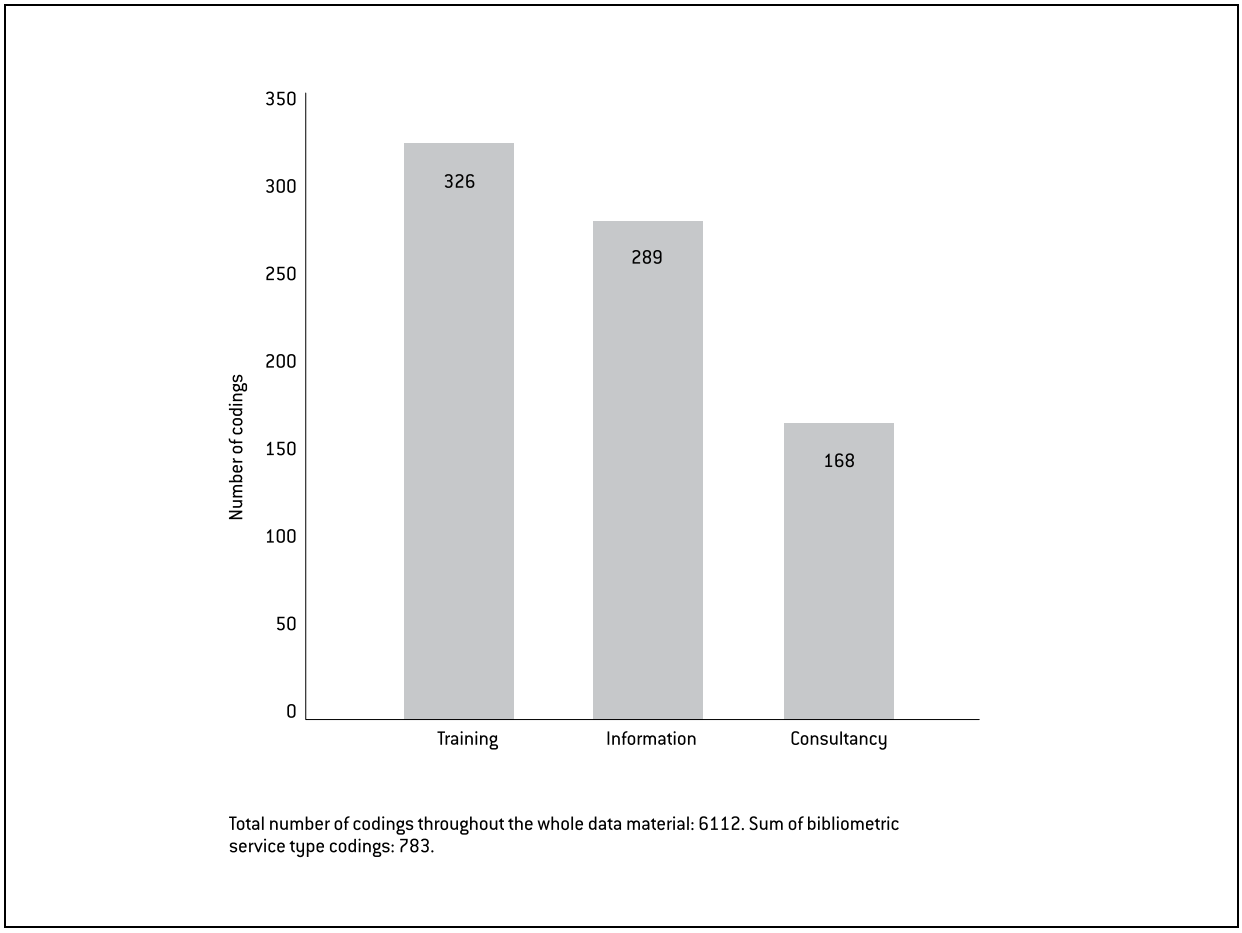

Figure 2: The three elements of bibliometric services in academic libraries

Training is the dominant method. It consists of bibliometric courses offered to academics at all career stages, as well as to administrative and management staff. These courses aim to convey knowledge on the uses, meanings, and limitations of bibliometric indicators, specifically the Journal Impact Factor and the Immediacy Index from Thomson Reuters' Journal Citation Reports; citation counts as indicators; the h-index and some of its variants

such as the m-quotient or g-index; and the SciMago Journal Rank. Other central themes are the main citation databases Web of Science, Scopus, and Google Scholar, discussing their uses and limitations. Raising awareness of caveats and limitations of bibliometric methods and tools is also an important aspect of training sessions.

The courses are generally characterized by a low level of technicality and formalism in their teaching style. For instance, bibliometric webinars often contain guided "walk-throughs" through citation databases to assist in finding JIFs or determining an h-index,[†] and indicators are presented largely without formulas.

The second treatment mechanism – academic librarians' information services – centers around the provision of definitions and assistance regarding the uses and limitations of bibliometric indicators[‡] and the main citation databases. Furthermore, librarians engage in informational activities such as "Compiling a list of the Journal Citation Reports, journals and their impact factors into one consolidated list" (UK B2). Librarians may sometimes determine - on demand - academic staff members' h-indices or provide indicators using software such as Publish or Perish, InCites, or SciVal: "Currently we look at our impact relative to subject area compared with a selection of UK and international institutions using InCites." (JISC Mailing 24).

These information activities are followed by the third treatment option, bibliometric consultancy, which represents information with prescriptive and advisory elements. The main consulting activities consist in generating reports - for example:

> *"A member of Library staff had provided a series of reports, the most recent of which was a ranking of researchers. Others have been ranking research areas by normalised citations, research strengths and collaborators." (JISC Mailing 27).*

Academic librarians also analyze various types of output, trends, and cooperations, applying network and citation analyses of differing levels of complexity. On a simple level:

> *"We are dealing primarily with simple citation analyses, for example comparing output with productivity and input, or providing the average citation rate. For journal-*

[†] For example the participants GER B3, GER B4 and UK B5 make use of webinars with step-by-step instructions.

[‡] Information was mainly conveyed about the following indicator types (listed in descending order): Journal Impact Factor, h-index, SciMago Rank, Altmetrics, Eigenfactor, and citation counts.

based indicators we look at the JIF, of course, and then the h-index when it comes to indicators concerning the individual." (GER B11, author's translation)

On a more complex level:

"The term 'perception analysis' is used to describe a direct comparison of scientific institutions. For this direct comparison, institutes must be involved in the same scientific field. If the institutes work in different disciplines then field normalization is required to relate the different fields to each other. The main subject of perception analysis is a ranking in accordance with the perception of the scientific articles." [6].

The category *exclusivity of treatment* designates the extent to which control over bibliometric work is maintained exclusively by academic librarians (see figure 3). The highest level of professional control is displayed by libraries that conduct bibliometric research and pursue bibliometric projects. For example, one librarian wrote, "What I am hoping to achieve at <university> is the creation of a research impacts repository." (JISC Mailing 28). This highest form of professional control is experienced only in a minority of cases.

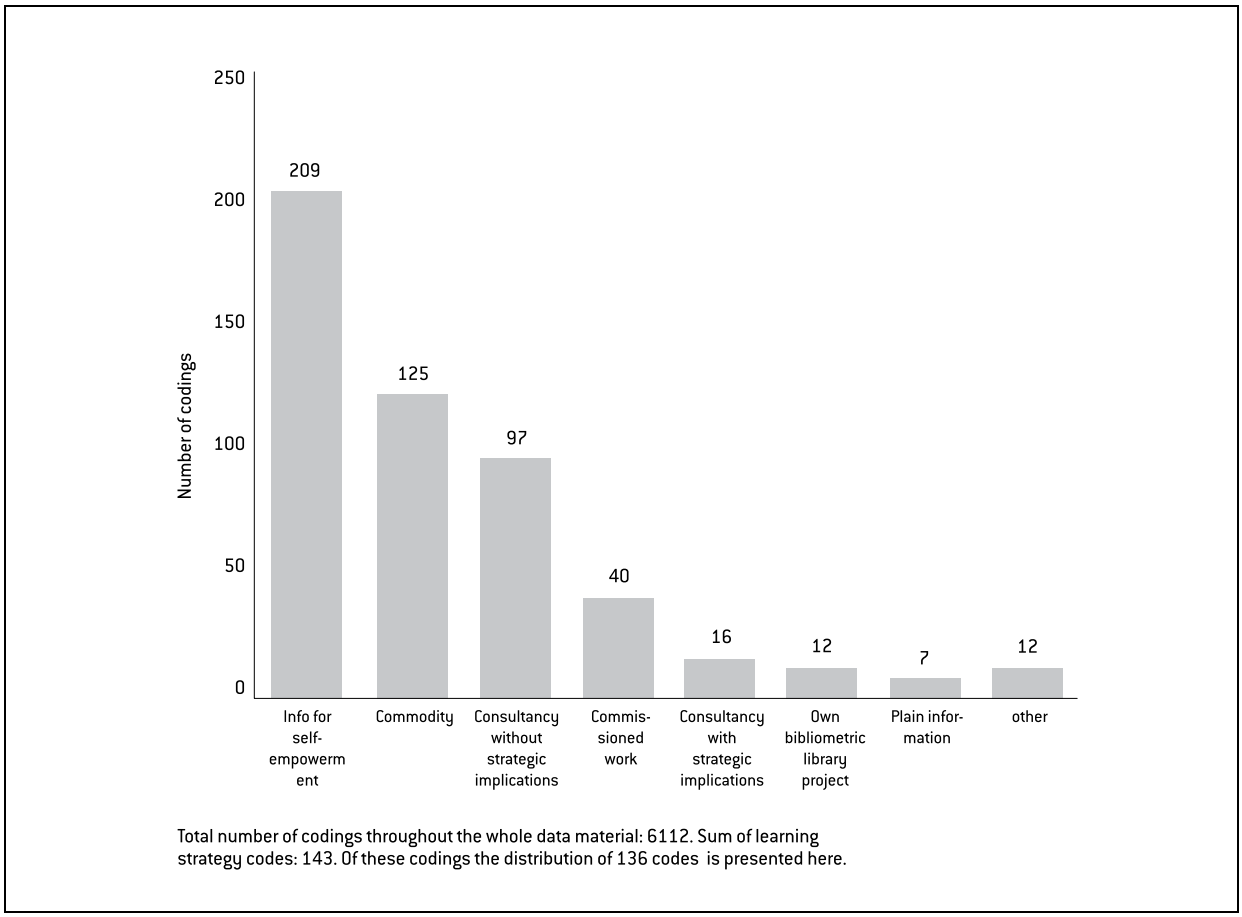

Figure 3: Exclusive professional approaches of academic librarians towards bibliometric services

Nevertheless, strong library engagement is also evident in providing *commissioned work* or *consultancy with strategic implications.* This happens when bibliometric services are delivered on demand, especially to university management, with librarians given discretion to decide on the methods, indicators, and scope of analysis, and there is also desire to influence relevant stakeholders on the basis of insights gained:

> *"We often find that demands from the client, be they academics or administrators, are attached to very different expectations; usually they completely underestimate the effort involved and overestimate the results' informative value. It has always been important for us to put these expectations back into perspective. (...)." (GER B5, author's translation)*

Smaller tasks may also be demanded, sometimes with less discretion in their implementation: "Can you repeat that twenty times? I labor through it twenty times and do whatever it is." (UK B2). Mostly though, commissioned work is tied to a strong cognitive claim on delivering comprehensive services or making an impact:

> *"There is much more interest to go and influence these people. Talk to them and see what their perspective is. Correct their misapprehensions and guess strategies that will be helpful because in the end I want the <university> to win. I can help them to win and I'll be delighted to do it." (UK B 2).*

However, more common is the professional approach of *consultancy without strategic implications*. Academic librarians position themselves as competent and yet neutral advisors who use their knowledge to serve users at the users' discretion.

> *"It is not our task to evaluate, we see ourselves rather as being in the role of the mediator and teacher of the topic. The scientists themselves need to decide how they deal with this. We can't take this responsibility from them, that's not our job." (GER B9, author's translation).*

The degree of exclusive professional control decreases in *information for self-empowerment*. The code describes a librarians' options for informing academics about the possible advantages - but also limitations - of bibliometrics, thus enabling the users to apply bibliometric methods competently themselves:

"This is connected quite closely to the fact that that I want to develop the capacity for self-help and, as a matter of fact, deliver fewer concrete numbers myself." (GER B15, author's translation) or „You know, we could get their level of expertise up, they could do it themselves and tailor the questions to answer precisely the questions they want to answer." (UK B2).

This educational approach, with the librarian as a vital partner in the learning process, is the dominant one found in the material.

Treatment exclusivity is also strongly affected by commodities such as software products. Databases and software tools are indispensable for bibliometric work:

"I mean, in order to be able to achieve anything normalized I need to use Scopus, and in fact it's not just Scopus, it's Elsevier's advanced package, which you may well know about, SciVal." (UK B3).

However, librarians' claims to bibliometric expertise can be weakened when they are mediated via the use commodities:

"I am sort of managing my own expectations', in the sense that I want to be able to do what I know that the tools will allow us to do, and if I happen to know that there is something we can't do because the tools don't allow that capability then I (---) then I tend not to look for being able to do that." (UK B3).

Bibliometric expertise is also embodied in commodities [2] which interact with the knowledge of professionals:

"I use both Web of Science and Scopus, and the more you use these things the more you realize, not they are limited, but they are controlling the amount of information that they want to give to you." (UK B2).

However, this need not be to the detriment of librarians jurisdictional claims to bibliometric expertise. They frequently combine the main professional approach of empowering library users with the use of commodified bibliometric knowledge by training library users to use databases properly.

5.4 Jurisdictional claims to bibliometric expertise

The three main aspects of treatment exclusivity - empowering users, consulting without strategic implications, and, especially, the use of commodities - point to the type of jurisdictional claims that academic librarians make in the public sphere, for example at conferences, on their websites or at their workplace, the university. The claim to jurisdiction is particularly dependent on a strong professional knowledge base.

It is most frequently maintained that bibliometrics is solely the domain of librarians:

> *"Well, I think certainly I am seen to be and I am officially the university expert on bibliometrics, and not just the bibliometrics person in the library but the library is seen and in fact is the source of bibliometric expertise." (UK B3).*

However, this claim to expertise is not an attempt to take on a new professional jurisdiction in research evaluation at academic libraries. Rather, the stakes that academic librarians have in providing bibliometric expertise are rooted in the professional jurisdictions they have already secured, namely the access- and information literacy jurisdiction. Citation and publication impact can be treated as information that needs to be collected and processed professionally in the manner of the traditional jurisdiction of access:

> *"Increasingly, assessment of research requires comprehensive information on citedness and contribution – something that no individual tool can provide today. Given the nature of such a global search – for citations or mentions in published works, acknowledgements and other potential indicators of quality – finding information has become very complex. This, however, provides a unique opportunity for librarians in these evaluation processes." [25].*

Librarians reduce the professional problem of measuring scientific quality to a problem already within their professional jurisdiction. They conceive of it as an information problem that can be solved by improving bibliometric literacy, as a variation of information literacy, and by empowering library users.

Often, the claim to bibliometric expertise is limited based on the extent of user demand, the present knowledge and skills of librarians, and potentially negative effects on the library's neutral standing at the research organization.

The reductionist professional approach also results in shared claims to bibliometric expertise. From the point of view of the library, other legitimate claimants to this professional jurisdiction are especially research managers and the academics themselves.

6 Discussion

Academic librarians in the UK and Germany pursue a distinct professional approach concerned with the provision of bibliometric literacy and user empowerment, designed to solve the problem of quality measurement in science and evaluation. This jurisdictional claim represents an extension of the professional expertise developed in academic libraries for other service areas:

> *"My own personal view is that it's one of a number of different areas that, to do with information management, that librarians are moving into. I don't think we are reducing our work in any particular area. We still have very strong library-faculty relationships, so we have our specialist librarians that deal with information literacy and materials and the usual kind of cataloging and acquisition and inter-library-loans and all that, normal library services. They are not diminishing so much but we are finding new areas that the university is interested in, because they overlap with what we are already doing, they become kind of an extension of the services that we are offering already and so research analytics or bibliometrics is one area, another is copyright." (UK B8).*

The knowledge base for bibliometric practices in libraries is predominantly professional. This means it is composed of practical knowledge derived from an academic LIS education and made relevant in the application context of the provision of bibliometric services. More importantly, there is know-how being exclusively developed with relation to evaluative bibliometrics applications in the library context, via professional exchange and learning strategies.

The specific, knowledge-based, jurisdictional approach of librarians calls for a specific educational approach in bibliometrics. Although some librarians do perform complex analyses and even engage in bibliometric research, this type of professional treatment of the problem of quantitative research assessment is not the common type of professional work that librarians perform when offering bibliometric services.

Educational elements to be strengthened should not be primarily of a technical or highly mathematical—that is, they should not aim to intensify knowledge about advanced citation analyses or bibliometric mapping techniques, models, and distributions—but should rather be of a more general and problem-solving, practical nature.

Librarians need a firm educational background in bibliometrics to be able to fulfill their educational mandate to empower their users properly. Knowledge regarding bibliometric indicators and tools should be deepened with a view to describing not only the applications, but also the limitations and caveats as well as the subject-specific citation and publication behavior and the effects of open access publishing and altmetrics on citation impact.

The vacant jurisdiction of quantitative research assessment will most likely be shared by several different professional groups, because librarians are neither extensively developing data-intensive analyses nor are they making strategic decisions in their provision of bibliometric services. Their educational and informational approach will be complemented by the more strategic and mathematically grounded approach of research managers, statisticians or IT professionals because "they have a better handle on the sort of research strategy side of things, the institutional strategy." (UK B7).

Consequently, bibliometrics education should thus be adapted to the distinct jurisdictional claims and varying types of professional work performed by each of these groups.

7 Conclusion

An Abbottonian perspective on bibliometric services in academic libraries has shown what kind of professional role librarians take in the jurisdiction of quantitative research evaluation and what skills and competencies they bring to bear in claiming this jurisdiction: "I think it's capitalizing on this position that they already have, it's because they have this position that makes them valuable in the bibliometrics role." (UK B11).

Librarians extend their access and literacy jurisdiction to the bibliometric services they offer. This approach is specific to librarianship as a profession: It is based on a specific knowledge base derived from LIS education and practical bibliometric know-how developed in the course of service provision.

Other professions or occupational groups aspiring to professional status in bibliometrics may pursue other jurisdictional claims that are more strategically and analytically oriented and more data-intensive.

Based on these findings, our proposal for improving bibliometric education for research assessment is that it should be adapted to the specific jurisdictional claims made and the professional work performed that underpins these claims. This would imply that more empirical studies on professional and occupational groups and organizations working in the area of quantitative research assessment are needed, in order to gain a better picture of the interrelated professional system of quantitative research evaluation.

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Appendix List of Tables 1-5

Table 1: Knowledge bases for bibliometric practices in academic libraries

Table 2: Bibliometric knowledge and skills and learning environment

Table 3: Diagnosis of the professional problem

Table 4: Treatment of the professional problem

Table 5: Jurisdictional claim on bibliometric expertise in academic libraries

Table 1: Knowledge bases for bibliometric practices in academic libraries

Knowledge base (KB): Refers to the knowledge obtained by information professionals in academic settings and practical work contexts, and put to use in bibliometric practices in academic libraries			
Academic KB: Refers to knowledge gained directly from the research field of evaluative bibliometrics or indirectly through the following carriers		**Professional KB:** Refers to knowledge gained in LIS education which is applied in librarianship as a professional practice, know-how embedded in routines and objects	
Closely related to Bibliometrics	*Widely related to bibliometrics*	*Closely related to bibliometrics*	*Widely related to bibliometrics*
Bibliometric conferences (conferences ISSI; STI, courses CWTS, summerschool esss)	Wider bibliometrics literature (outside the field of evaluative bibliometrics, e.g. journals in fields such as medicine, biology)	Conferences, workshops (Referring to events that deal with bibliometrics in a library context such as Bibliometrics in Libraries meetings, UK or vendor workshops on commercial database products)	Scholarly communication and publishing (knowledge of the process of scholarly communication and the types and venues used for publication, publishing industry)
Bibliometric core journals (Scientometrics, JASIST, Journal of Informetrics)	General background in mathematics/statistics	Journal articles (practitioner or scholarly journals in librarianship that thematize bibliometrics, f.e. Journal of Documentation, Journal of Academic Librarianship, Library Review, Library Quarterly, College & Research Libraries, Library Trends)	Data handling (accuracy, dealing with ambiguity, handling with care, handling large amounts, data collection, cleaning, indexing)
Own bibliometric research		Personal networks (exchange with other librarians and information practitioners about present and planned use of bibliometrics)	Metadata (structure and content of data to facilitate retrieval)
Personal networks with bibliometricians		Library/Librarians' blogs, institutional and thematic websites	Information retrieval (handling large amounts of information, obtaining information sources relevant for information needs, assessing information quality)
Books (f.e. Moed)		Mailing lists (f.e. JISC Bibliometrics in the UK, Inetbib in Germany)	Handling databases (know -how concerning database structures and function, information retrieval in these data sources)

Table 2: Bibliometric knowledge and skills and learning environment

Knowledge and skills								
Conception of bibliometrics Refers to the personal "working-hypotheses"- type conception of bibliometrics that a librarian has which is implicitly or explicitly mentioned, such as e.g. "a technical term" or "an instrument of science policy" or "statistical analysis of research output"	**Types of bibliometric analyses** Refers to varying types of citation analyses (trend, performance, collaboration etc.) and network analyses	**Databases** Technical and practical knowledge, e.g. covering aspects such as coverage of databases, document types included, transparency of selection procedure of journals to be included, caveats such as name disambiguation, field specific coverage rates	**Indicators** Technical and practical knowledge, e.g. covering aspects such as limitations of indicators, their scope and meaning, uses, contexts, interpretation	**Software** Refers to commercial or free software packages used, technical capacities, how to solve bibliometric problems with these tools and their limitations	**Field specific publication and citation behavior** Citation and publication practices in various differences (ageing of publications, citations etc.)	**Citations: Definition and motivation** Refers to the notion of citation, its function in the process of scientific communication and varying motivations to cite	**Meaning of impact/Scientific quality** Conceptual notions of quality and impact, e.g. breakthrough research or number of citations	**Applicability and ethical use, caveats** Limitations and ethical use of bibliometrics with considerations for limitations, general "health warnings"
		Web of Science Scopus Google Scholar others	Journal Impact Factor H-index Altmetrics others	Thomson Reuter's InCites Elsevier's SciVal Strata others				

Learning environment				
Learning strategies	**Learning needs**	**Learning motivation**	**Self-assessment bibliometric know- how and skills**	**Estimated level of abstraction of bibliometric knowledge**
Self-study proactive Self-study reactive Commodity-aided learning Professional networks Conferences and workshops	Bibliometric tools and techniques Bibliometric indicators General bibliometric knowledge Best practices in other libraries	high low undetermined	proficient medium low	high medium low

Table 3: Diagnosis of the professional problem

Diagnosis Refers to the professional problem that academic librarians identify exclusively which is solved using bibliometrics, part of the cognitive claim and one of the three major professional mechanisms	
Objective aspects of problem definition Refers to the aspects of the professional problem that cannot be altered, that are present because they are organizational or fundamental facts	**Subjective aspects of problem definition** Refers to the aspects of the professional problem (user needs) that are redefined by academic librarians in an exclusive way compared to other professional diagnoses
· **Library hosts institutional repository** · **Library licenses citation databases** · **Library as a neutral institution** Library as an independent, traditional, neutral service institution · **Library as a custodian of knowledge/ collection management with the aid of bibliometric analysis**	· **Bibliometrics as a management tool** Management tool for strategic organizational development, staff management, performance assessment · **Publication strategy** Researcher-oriented, which publication venue is best, improving visibility/citations · **Scientific career** Pro-active use of bibliometrics to improve career perspectives such as tenure and hiring, demonstrate capacities · **Bibliometric literacy** Improving general knowledge about bibliometrics and its limitations and uses · **Benchmarking** Performance measurements for institutional rankings and national comparisons · **Funding bids** Bibliometrics supporting bidding for grants from a management and researcher perspective

Table 4: Treatment of the professional problem

Treatment Refers to the solution the librarian has found for the problems identified. These imply the use of bibliometrics of some sort. Part of the cognitive claim and one of the three professional mechanisms		
Information Information about bibliometrics in general and provision of bibliometric information without detailed analysis or interpretation to researchers and management	**Training** Holding training sessions, workshops or providing training material such as factsheets, e-courses to researchers and management, interactive setting	**Consultancy** Activities and services with the aim of giving advice and support to researchers and management, value-added information in that data analysis and interpretation are provided
· **Databases** Informing on meaning, use and limitations of Web of Science, Scopus, Google Scholar · **Indicators** Informing on meaning, use, and limitations of H-index and variants, JIF, SciMago, Eigenfactor, publication/citation counts · **Citation reports** Provision of information on citations of the own/other institutions, research groups or individual researchers which can take the form of regular citation reports, without interpretation or further analysis · **Compilation publication output/indicators** Drawing on citation databases to compile publication lists or compile impact indicators	· **Definition and history of bibliometrics** · **Databases** Web of Science, Scopus, Google Scholar, uses and limitations · **Indicators** H-index and variants, JIF, SciMago, Eigenfactor, publication/citation counts, uses and limitations · **Caveats** Limitations and responsible application of bibliometric methods	· **Reports** Regular or one-off provision of bibliometric reports for assessment and benchmarking containing analyses on citedness, output · **Analysis** Citation analysis, network analysis, trend analysis, perception analysis, benchmarking, not part of a report · **Support** Unspecified advice, consultancy and support of researchers or management

Treatment technicality How abstract are the services in terms of technicality and formalism of the knowledge conveyed				
High	**Medium**	**Low**	**Indeterminate**	
Treatment exclusivity Indicating degree of professionalization, this category captures degree of professional control that librarians exercise over the bibliometric services they offer				
Information for self-empowerment Providing information about bibliometric methods, tools, and indicators with a view to improving the user's bibliometric literacy (educational approach), which would eventually make the library's bibliometric services obsolete in the future	**Commodity** Commercial or non-commercial tools such as databases, software products and algorithms that are needed for bibliometric services and that partly embody expertise, the librarian needs to master these commodities	**Consultancy without strategic implications** Providing advice on bibliometric methods, tools, and their capabilities as well as preparing publication lists, reports, analyses with an disinterested, neutral approach and refraining from taking strategic decisions based on these services	**Consultancy with strategic implications** Providing advice on bibliometric methods, tools, and their capabilities as well as preparing publication lists, reports, analyses with engaged, strategic approach and making strategic decisions based on these services	**Commissioned service** Providing advice on bibliometric methods, tools and their capabilities as well as preparing publication lists, reports, analyses with a consultancy-oriented approach and the desire to provide value-added service packages that are delivered to facilitate decision-making and interpretation, the library takes responsibility, sometimes the services are fee-based

Table 5: Jurisdictional claim on bibliometric expertise in academic libraries

Jurisdictional claim on bibliometric expertise Refers to jurisdictional claim on bibliometric services made in the social arena, i.e. the public sphere or the workplace, which for librarians is the university					
Bibliometrics purely a library role Library claims full jurisdiction in bibliometric service provision based on its abstract knowledge and professional mechanisms of problem solution	**Library roles shared with others (library lead)** Library takes advisory control or intellectual jurisdiction but accepts a shared practical jurisdiction	**Library roles shared with others (equal share)** The bibliometric services are divided equally between library and another organizational unit in the university or profession. The work is divided according to content and into functionally interdependent but structurally equal parts	**Library roles shared with others (library subordinated)** Library divides the labor with another organizational unit or profession and acknowledges that another profession/organizational unit is more knowledgeable and skilled in bibliometrics and therefore takes the lead, library delivers data or other resources, intellectual jurisdiction is retained by dominant profession	**Bibliometrics not a library role** Library does not claim a full or partial jurisdiction	**Limited claim** Bibliometrics is the library's responsibility, but time, funding and insufficient demand might pose restrictions for fully claiming this role
Other legitimate claimants Librarians perceive another profession/occupational group to be an equally legitimate potential claimant to bibliometric expertise					
Research manager	**Academics**	**Statistician/Mathematician**	**Bibliometrician**	**IT or computer specialist**	**Other**
Perception of other libraries' bibliometric engagement					
High	**Low**		**Changing**	**Undetermined**	

4 Competencies for bibliometrics*

Abstract

Universities are increasingly offering support services for bibliometrics, often based in the library. This paper describes work done to produce a competency model for those supporting bibliometrics. The results of a questionnaire in which current practitioners rated bibliometric tasks as entry level, core or specialist are reported. Entry level competencies identified were explaining bibliometric concepts, doing basic calculations and some professional skills. Activities identified by participants as core are outlined. Reflecting on items that were considered in scope but specialist there was less stress on evaluating scholars, work at a strategic level, working with data outside proprietary bibliometric tools and consultancy-type services as opposed to training for disintermediated use. A competency model is presented as an appendix.

Keywords: Bibliometrics; Citation analysis; Altmetrics; Research evaluation; Professional competencies; Job analysis.

1 Introduction

Bibliometrics - the statistical analysis of publications - has been practised since the 1920s (Gingras, 2016). However, bibliometric activity grew significantly with the emergence of new citation mapping tools starting with the ISI's citation indices in the 1960s (Thelwall, 2008; De Bellis, 2009). Since the turn of the century there has been a proliferation of bibliometric tools and indicators from the bibliographic database suppliers and academic researchers working in this field. In addition, the use of Altmetrics has grown in an attempt to use the social web to measure the impact of research in new ways. Such quantitative approaches to research evaluation have attracted increasing interest and controversy. Researchers are, of course, interested in evaluating their own performance. Higher Education Institutions also want to use such calculations for management purposes. Further, an interest in measuring the value and impact of publically funded research is a legitimate public and governmental concern. However, such measurement could be interpreted as an aspect of the rise of an audit culture in Higher Education, a symptom of wider trends towards the New Public Management and "neo-liberalisation" (Burrows, 2012; Fanghanel, 2012; Thornton, 2009). Metrics can be seen as a challenge to academic freedom and to the university's traditional role as a centre in

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society of critical and independent thinking, since they imply managing academics through quantifiable, even objective and universal evaluations of research quality. It is argued that they can have potentially harmful effects both on researchers and on research (Coulthard and Keller, 2016; De Rijcke et al. 2015).

More immediately, concern has been prompted by the understanding that, if applied without awareness of such factors as differing disciplinary cultures and publishing practices, quantitative metrics lack validity. Uncritical reliance on certain metrics such as the Journal Impact Factor and h-index have been strongly criticised (e.g. Lariviere et al, 2016; Curry, 2012; Barnes, 2014). Such concerns have been solidified in the last few years by a number of important publications. Thus the Declaration on Research Assessment (DORA) (2014) critiqued the use of journal metrics, in particular the Journal Impact Factor, for measuring individual researchers. The Leiden Manifesto (2015) set out ten principles for using bibliometrics in research assessment, with an emphasis on responsible use. The Metric Tide Report (Wilsdon et al., 2015) which advised against the use of bibliometrics as an alternative to peer review in the UK Research Excellence Framework (REF) also called for all stakeholders to use metrics responsibly. In this context the importance of professionally conducted and supported research evaluation, recognising the principles of responsible use, is clear.

Gumpenberger et al. (2012: 174) go so far as to label bibliometric work as “a perfect fit for academic libraries”. Indeed, there is growing evidence that university libraries are offering or planning to offer research evaluation services, aligned to the library’s increased support for research and scholarly communication (Corrall et al., 2013). Yet they are services that research administrators and HE planners could be equally well positioned to play. Indeed, Gadd (forthcoming) argues that there are roles for both groups in supporting bibliometric activities. However, there is evidence that a lack of skills and confidence can be a barrier to entry to bibliometric work (Corrall et al., 2013). As professional services begin to develop bibliometric offerings it is important for them to have a clear idea of what competencies are required in order to recruit and train staff appropriately. Professional learning and training providers, such as information schools, need to develop a clear conception of what entry level and core competencies are needed.

In this context the aim of the study was to develop a community-supported set of bibliometric competencies for those working in libraries as well as in other related services, such as research offices. In order to achieve this aim the specific objectives were:

1. To identify the tasks that practitioners working with bibliometrics currently undertake;
2. To identify which of these tasks they perceive as entry level, core and specialist;
3. To explore variations in these perceptions, for example, between the UK and other countries and between those based in libraries and those in other units, such as the research office;
4. To produce a model of bibliometric competencies and validate it with the community.

The paper is based on data from a project commissioned by the Lis-Bibliometrics forum and Elsevier's Research Intelligence Division.

The paper begins by exploring what we already know about why and how librarians and other practitioners are supporting the use of bibliometrics. It also considers the practices of job analysis and competency modelling as ways of analysing job roles. The methodology then positions the work within this continuum, and explains in detail how the current research was conducted. The findings of a questionnaire in which members of the bibliometrics community rated a list of bibliometric activities are then reported. The discussion reflects on the results and explains how a competency model was developed from this. The conclusion summarises the contribution in clarifying our understanding of the competencies for bibliometrics. A current version of the competency model is offered as an appendix.

2 Literature review

Corrall et al. (2013) found that the majority of academic libraries they surveyed in Australia, New Zealand, Ireland and the United Kingdom offered bibliometric services. The main services were training of staff, production of citation reports and measurement of research impact. Grant application support was also strong in Australia and Ireland. The UK appeared to be lagging behind with only about half of respondents currently offering bibliometric training, and only another 20% planning it. In contrast this was a service offered or planned by close to 100% of institutions in the other three countries. More patchy development in the UK was seen as reflecting uncertainties around how metrics might be involved in the national research evaluation. Nevertheless, the findings make a strong suggestion that bibliometrics is becoming a mainstream service in academic libraries. Case studies of a number of other countries support this (Aström and Hannson, 2013; Bladek, 2014; Dennie, 2010; Gumpenberger et al., 2012; Mamtora and Haddow, 2015) although not all evidence points to on-going growth (Richter, 2011). The increasing interest in bibliometrics for research evalua-

tion, and the rise of altmetrics, suggest that this trend is only likely to have intensified, though there is little data from which to draw firm conclusions.

A number of authors have presented arguments for why bibliometrics would be an appropriate new area of activity for librarians. The science of bibliometrics was developed partly as a sub-discipline of Library and Information Science (De Bellis, 2009) and from the 1970s it was extensively used in collection management (Aström and Hansson, 2013). In a survey of Swedish academic libraries, Aström and Hansson (2013) found that participants thought that librarians were the right people to offer support to bibliometrics because of competencies with bibliographic tools and metadata and because they could take a neutral positon towards the evaluation of academic work. Their respondents saw the benefit to the library in increased institutional visibility through bibliometric work.

Gumpenberger et al. (2012) give four reasons why bibliometric services are a "perfect fit" for academic libraries:

1. Librarians already use major bibliographic databases;
2. They have experience of data gathering, cleaning and analysis;
3. Librarians offer services for researchers;
4. Librarians have the opportunity to participate in a global bibliometric research community.

Not all these arguments are equally convincing. It is true that there is an evident connection between bibliometrics and library licensing and support to the use of bibliographic databases. Yet librarianship has traditionally attracted people trained in humanities and relatively few library roles involve data manipulation and analysis. Also, while a focus on information literacy implies a professional interest in guiding students to identify quality in research publication, librarianship typically positions itself as a service profession; the element of evaluating academics' research quality fits uneasily with this. Such fears were evident in Aström and Hannson's (2013) study, which found that while many Swedish libraries were developing bibliometric services, major issues were competency in advanced statistical analysis, unease about evaluating scholars and the risk of being associated with identifying underperforming departments.

Thus libraries may see bibliometrics as a natural area of work, and given the pressure on their traditional core roles might feel the need to expand into such new areas (Cox and Corrall, 2013). At the same time there are also barriers, especially in terms of skills. Further, libraries are not the only professional services in universities that might have a role in using or supporting the use of bibliometrics. In so far as bibliometrics is useful to evaluate departmental or institutional performance or support grant capture, then it would be relevant to research administrators in their roles. University planning offices that support major initiatives such as returns to national research assessment exercises might also be involved in using bibliomerics. Anecdotally it is clear that this happens, but we have no systematic data about how the role is performed. The growing literature on research management, for example, does not yet discuss roles in bibliometrics (Green and Langley, 2009; Shelley, 2010; Langley, 2012). Similarly, ARMA's professional development framework does not mention bibliometrics as such (https://www.arma.ac.uk/professional-development/PDF/explore-the-PDF).

In this context there has been relatively little work to understand what knowledge librarians or others working in this field need. Among the skills for UK liaison librarians identified by Auckland (2012) were:

- Understanding of the national and local research assessment processes, and the requirements of the REF;
- Understanding of research impact factors and performance indicators and how they will be used in the REF, and ability to advise on citation analysis, bibliometrics, etc.

However, this is a very high level summary. There are also some useful practitioner descriptions of typical activities (Delasalle, 2011).

The most substantial study in this area was produced by Petersohn (2016). Petersohn considers the cognitive and social claims made for jurisdiction over bibliometrics by librarians in the UK and Germany. She argues that if ultimately the purpose of bibliometrics is measuring the quality of science, librarians tend to interpret this from within their existing knowledge base, as an information problem. Thus she finds that their main ways of doing bibliometrics revolve around "empowering users, consulting without strategic implications, and, especially the use of commodities" (i.e. software products) (187). Thus librarians focus on training users to empower them to improve their own publication performance and impact by improving their "bibliometric literacy" as an aspect of information literacy. Such training typically explains bibliometric measures, and their limitations, but avoids technicalities. They

offer advice, but avoid more strategic aspects. They work with proprietary systems, rather than exploring manipulation of data or abstract concepts. They perceive bibliometrics as rather abstract, in line with the profession's stress on practicality. Their academic knowledge base stems mostly from their library qualification, but more important in bibliometric service delivery is their professional knowledge derived from day to day library practice, and various forms of informal learning, for example from blogs.

This is a convincing account of how bibliometrics is interpreted by librarians through their existing knowledge, values and practices. Implicit is the notion that professionals from a different background (e.g. based in research administration or university planning) would define bibliometrics in very different ways, in line with their own expertise.

3 Job analysis and competency modelling

In order to gain a clearer picture of what the current professional practice of bibliometrics actually involves there is a need for a process of job analysis or competency modelling. This is an area where there has been much work in the library field in the last few years. For example, there have been two editions of a *Competency Index for the Library Field* (Gutsche and Howe, 2009, 2014). However, neither mention bibliometrics or altmetrics. There have also been projects to develop competency models in a number of critical or highly dynamic areas such as leadership (Ammons-Stephens, 2009), electronic resource librarianship (NASIG, 2016), digital curation (DigiCurV), data science (Edison, http://edison-project.eu/), and linked data (Linked Data for Professional Educators, http://explore.dublincore.net/theory/briefing-papers/ld4peoverview/).

Job analysis and competency modelling are related practices. Both broadly seek to define the combination of knowledge, skills, abilities and other individual characteristics (KSAOs) needed to perform a particular role (Campion et al., 2011). Traditional practices of job analysis were based on asking those performing a role to identify the major tasks at the current time. Competency modelling tends to be different in a number of ways (Campion et al., 2011; Stevens, 2012; Sanchez and Levine, 2009):

- It has an orientation towards identifying the abilities that underlie exceptional performance, rather than typical performance. Thus those consulted in producing such a model are often executives with a responsibility for the job and high performers in the role.

- Rather than compiling an exhaustive listing of activities, competency modelling focuses on a refined list of qualities of individuals who can perform the task well.
- It often includes descriptions of how competencies progress at different levels.
- It is future orientated, reflecting the dynamic character of most modern jobs.
- It has a strategic purpose, seeking to link the role to organisational objectives. As such it can be seen as a management intervention and often takes a more deductive approach, rather than building up inductively from a study of current activities. A competency model may also be designed to serve the purpose of defining attributes across roles, even for the whole organisation, rather than focussing on the specifics of a particular job.
- An emphasis is placed on presentation to make the competency model easier and more likely to be used.

Competency modelling has more persuasive power and strategic value, but it may be less rigorous than job analysis (Schippmann, 2000). Certainly there is agreement that both techniques can be usefully combined (Campion et al., 2011; Sanchez and Levine, 2009).

4 Method

The approach taken to job analysis/competency modelling in this study can be seen as hybrid. In a foundational study it was considered desirable to consult broadly and build up a detailed picture of all the tasks involved in bibliometrics work, in a way more akin to job analysis. The emphasis was on discovering what people do, rather than linking through to organisational purposes. How this fits into the evolution of wider professional competencies is another piece of work. Some elements of competency modelling were employed, however. A central aspect was identifying tasks that were entry level, from core and specialist activities. There was a strong element of seeking views on how the bibliometrics role will develop in the future, recognising the dynamic character of modern roles. Presenting the final model in an easy to understand way, and with an emphasis on the main points, rather than exhaustive coverage, was also considered a priority.

Thus the bibliometrics competency model was developed in three phases. In phase one, participants at a Lis-Bibliometrics workshop in June 2016 were asked to list as many bibliometric tasks as possible that they have been asked to do, and record them on post-its. Post-its were then ordered by participants on a flip chart based on whether they were consid-

ered to require low, medium or high levels of knowledge or skill. These data were analysed to identify a comprehensive list of tasks that those working in bibliometrics undertake and place them in broad categories (Objective 1). This was achieved by combining the data from the workshop with data from the literature, job postings and interview and documentary data from Petersohn's doctoral research.

The analysis produced a list of 99 activities under 12 headings

Section heading	No. tasks
A. Awareness raising and responsible use	13
B. Applications of bibliometrics	13
C. Metrics: About scholars, academic units and institutions	14
D. Metrics: About journals	11
E. Metrics: About articles/ specific outputs	6
F. Metrics: About Impact	3
G. Bibliometric tools	5
H. General data handling and presentation tasks	7
I. Training, education and advice to users	5
J. Systems procurement and use	4
K. Policy and strategy	9
L. Professional skills	9
	Total of 99 items

Table 1: Bibliometrics tasks (see appendix for a full list of the tasks)

The headings are largely self-explanatory, but whereas most sections were specific tasks, "Section B: Applications of bibliometrics" was a question about the different purposes for which the tasks could be applied, e.g., to evaluate scholars, to evaluate a collection, etc. Conceptually there were some challenges in differentiating tasks. For example, in theory, one should differentiate calculating metrics within specific tools from calculating them manually. Similarly, the use of specific tools to calculate metrics could have been probed, but to do so would have been repetitive and added to the length of items.

This list formed the foundation for phase 2, a questionnaire designed to explore how those who performed bibliometrics perceive different tasks (Objectives 2 and 3). The questionnaire was piloted with the Lis-Bibliometrics committee, and this led to some changes in wording of task descriptions. A major change was the final choice of how to articulate different levels of competence. The final wording as used in the questionnaire was:

a) Entry level – a basic task of bibliometrics, one that a newly qualified professional should be able to perform;

b) Core – a core task of bibliometrics, one that an established professional with a responsibility for bibliometrics performs beyond entry level tasks;

c) Advanced/ Specialist – a task involving very specialist knowledge and evaluative skills;

d) Out of scope of the role.

Other approaches were possible. It was decided to differentiate these levels rather than degree of difficulty because a major objective of the project was to identify entry and core level tasks to shape training programmes. However, the concepts are clearly quite subjective. Entry level and core is different from level of difficulty: a task could be difficult but required by a new entrant or a task may be hard to do conceptually but if a tool exists to calculate it, it becomes easy. Another way of asking the questions would be to ask people whether they did them frequently, rarely or never, but this would be more about skills people used than what were perceived to be needed. Many actual activities listed in the workshop involved multiple tasks as listed. Given the length of the list of tasks in some areas it was not possible to differentiate subtly different roles in relation to a particular measure, e.g., between advising on policy and setting policy, without further adding to the length of the questionnaire.

In addition to rating tasks against these levels of competence (required fields) respondents were given the option to identify tasks in the section that they thought would grow in importance in the next five years. They were also asked for some contextual information such as the name of their institution, about their role and job title, the staffing of bibliometrics at their institution and sources of training.

The questionnaire was distributed in January 2017 to Lis-Bibliometrics (a network of bibliometric practitioners mostly based in the UK that uses Jiscmail and community events to share knowledge), sigmetrics (the ACM's special interest group on performance evaluation, https://www.sigmetrics.org/) and the Metrics Special Interest Group list for ARMA (the UK professional Association for Research Managers and Administrators, https://www.arma.ac.uk/). Such listservs remain a primary means of communication in professional library work. Attendees at a recent Lis-Bibliometrics were also directly targeted.

A total of 92 complete responses were received. Of these, 48 were from UK institutions; about half from the Russell Group of universities. There were seven UK institutions for

which more than one person responded, thus a total of around 40 UK institutions are represented in the results. It was considered that multiple responses from one institution were valid because a) institutions often have staff working in multiple services performing bibliometrics tasks and b) differences of view are of legitimate interest. Of the non-UK respondents there were 13 from the Americas, 11 from Europe, five from Australia and a number of others, including some who did not declare their national base.

Most respondents (55) were based in the library. However, 20 were in research administration, four in planning and 12 in other places including academic departments. A few people were based in more than one unit. The low number of respondents partly reflects the low development of bibliometric services across HE. With a large number of items the questionnaire was time consuming to complete, but there were few partially completed surveys. The response rate was more due to people not starting the survey than giving up part way through.

The full list of tasks and the figures for all responses can be accessed from the ORDA repository (DOI:10.15131/shef.data.5271697).

Phase 3 built on the task list to articulate required competencies and develop an effective structure within which to present them. Iterations of this were developed by the project team, with input from the Lis-Bibliometrics committee.

5 Results of the survey

5.1 Task groupings

Cronbach's Alpha is a test of internal consistency that determines the degree to which answers are consistent in a multi-item scale. It can be used to assess how consistently people respond to a particular set of questions. The threshold value is 0.7 (Tabachnick & Fidell, 2007). Table 2 reports the results for the questions in each section of the questionnaire.

Task grouping	Cronbach's alpha	No of items
A - Awareness raising and responsible use	0.773	13
B - Applications of bibliometrics	0.760	13
C - Metrics: About scholars, academic units and institutions	0.870	14
D - Metrics: About journals	0.754	11
E - Metrics: About articles/specific outputs	0.760	6
F - Metrics: About impact	0.731	3
G - Bibliometric tools	0.715	5
H - General data handling and presentation tasks	0.701	7
I - Training, education and advice to users	0.672	5
J - Systems procurement and use	0.757	4
K - Policy and strategy	0.796	9
L - Professional skills	0.881	9

Table 2: Cronbach's Alpha values for the question sections

The results support the idea that the grouping of tasks in the questionnaire made sense to respondents, although more weakly for sections I and H. The result for section I might relate to the inclusion of consultancy alongside different types of training. The designers saw consultancy as at the far end of a spectrum of types of support to users, but it is possible respondents saw consultancy as different in kind.

Section H included specialist tasks such as manipulating data, programming, running statistical tests. However, it also included more obvious practices (that everyone would think of as entry level or core) such as presenting data effectively.

5.2 Entry level tasks

Table 3 presents items that 50% or more of all respondents identified as entry level tasks.

Task	No. (%)
A1. Explains the concept of bibliometrics	74 (80%)
A2. Explains the concept of altmetrics	65 (71%)
A10. Explains and promotes author identifiers, eg ORCID	53 (58%)
A13. Explains the benefits of open access	59 (64%)
C1. Uses bibliometric tools to find metrics on a specific scholar: H-index	56 (61%)
D1. Uses bibliometric tools to find metrics on an individual journal: JIF	68 (74%)
D2. Uses bibliometric tools to find metrics on an individual journal: 5 year impact factor	61 (66%)
D3. Uses bibliometric tools to find metrics on an individual journal: SNIP	62 (67%)
D4. Uses bibliometric tools to find metrics on an individual journal: Eigenfactor	52 (57%)
D5. Uses bibliometric tools to find metrics on an individual journal: SCImago Journal Rank	61 (66%)
E1. Uses bibliometric tools to find citations for a specific article	71 (77%)

K5. Understands the key characteristics of scholarly communication	46 (50%)
L1. Works effectively within local institutional culture	48 (52%)
L6. Works effectively as part of a team with other library staff, colleagues in professional services and researchers	48 (52%)
L7. Learns to update skills	57 (62%)
L8. Works independently	47 (51%)
L9. Completes work with attention to detail	65 (71%)

Table 3: Entry level tasks

Of the 99 items offered in the questionnaire 17 were considered to be entry level. Four from section A reflected the need to explain basic concepts such as bibliometrics itself and altmetrics. An ability to use a bibliometric tool to calculate some basic metrics was also seen as important (C1, D1-D5, E1). Interestingly, most of these were journal metrics, implying less focus on evaluating scholars/institutions or individual works, more on identifying places to publish for impact. This is doubly interesting because the use of such metrics is quite controversial. However, they may have been identified as entry-level skills as their use is still commonplace in the sector. Five items were drawn from the listing of professional skills, namely, the need to work effectively with other colleagues as well as independently, and at a high level of attention to detail. Such skills may form the basis of many library and data analysis jobs, but are certainly important to bibliometric roles. The emphasis on the need to keep skills up-to-date reflects the fast moving nature of this area. Full understanding of these responses would require a comparison to respondents in other areas of library/professional work, since they could be simply generic requirements for entry level professionals.

It seems that the current expectation for a new professional is not that they have advanced skills, simply a basic understanding of key concepts sufficient to explain them to others, the ability to use basic bibliometric tools and the soft skills to operate effectively in the workplace.

5.3 Core tasks

There were 32 tasks that more than 50% of respondents saw as Core. In addition there were another 16 items that scored above 50% when combining entry level and core – excluding those that were already in the list of of items that were above 50% for entry level alone. They are all listed in Table 4.

Tasks	Entry level No. (%)	Core No. (%)	Total %
Awareness raising and responsible use			
A3. Advises on which are the appropriate tool(s) for a particular metric	12 (13%)	63 (69%)	82%
A4. Explains differences in results between metrics based on different tools	7 (8%)	62 (67%)	75%
A5. Explains responsible use as a general set of principles	37 (40%)	50 (54%)	94%
A6. Applies responsible use principles to specific requests/cases and in their own practices	11 (12%)	59 (64%)	76%
A7. Advises on the applicability of metrics to particular disciplines/metadisciplines (e.g., Arts and Humanities)	10 (11%)	47 (51%)	62%
A8. Advises on the usefulness of particular tools to particular disciplines	6 (7%)	54 (59%)	66%
A11. Explains and promotes use of the CRIS and the institutional repository	39 (42%)	38 (41%)	83%
A12. Explains use of Academic SNS such as Researchgate	32 (35%)	43 (47%)	82%
Applications of bibliometrics			
B1. Uses bibliometric knowledge to ... recommend where to publish	17 (19%)	48 (52%)	71%
B2. ... Recommend what to read	35 (38%)	28 (30%)	68%
B3. ...Increase staff bibliometric literacy	8 (9%)	67 (73%)	72%
B4. ...Support annual reporting by departments	8 (9%)	49 (53%)	62%
B9. ...Support grant applications	5 (5%)	48 (52%)	57%
B10. ...Guide library collection development	9 (10%)	52 (57%)	67%
B11. ...Evaluate repository coverage	7 (8%)	42 (46%)	54%
Metrics: About scholars, academic units and institutions			
C2. Uses bibliometric tools to find metrics on a specific scholar: G-index	39 (42%)	41 (45%)	87%
C3. Uses bibliometric tools to find metrics on a specific scholar: Full and mean citation counts	44 (48%)	36 (39%)	87%
C4. Uses bibliometric tools to find metrics on a research group or departmental metrics: description of output (e.g., quantity, type of publications)	18 (20%)	47 (51%)	71%
C9. Identifies the rate of international collaboration	12 (13%)	37 (40%)	53%
C10. Identifies current collaborations with specific other entities e.g., countries or institutions	15 (16%)	35 (38%)	54%
C11. Identifies key scholars in a particular field	15 (16%)	48 (52%)	68%
Metrics: About journals			
D6. Identifies the top journals in a field	40 (44%)	39 (42%)	86%
D7. Evaluates likely impact on citation of publishing in a specific journal	9 (10%)	50 (54%)	64%
D11. Maintains awareness of departmental recommended journal lists	21 (23%)	40 (44%)	67%
Metrics: About articles/specific outputs			
E3. Advises on how to increase citations of articles	8 (9%)	46 (50%)	59%
E4. Advises on how to use social media to increase citation	11 (12%)	52 (57%)	69%
E5. Explains metrics for books	21 (23%)	46 (50%)	73%
E6. Explains metrics for research data	16 (17%)	38 (41%)	58%
Metrics: About impact			
F1. Advises on definitions of impact	16 (17%)	40 (44%)	61%
F2. Advises on demonstrating impact	4 (4%)	48 (52%)	56%
Bibliometric tools			

G1. Maintains awareness of the functions of the main bibliometric tools	38 (41%)	48 (52%)	93%
G2. Chooses the right tool for a specific task	24 (26%)	56 (61%)	87%
G4. Checks completeness of author profiles on WoS or Scopus	25 (27%)	39 (42%)	69%
General data handling and presentation tasks			
H1. Downloads, cleans and manipulates bibliometric data	10 (11%)	42 (46%)	57%
H7. Presents data effectively	17 (19%)	51 (55%)	74%
Training, education and advice to users			
I1. Writes documentation	15 (16%)	60 (65%)	81%
I2. Designs online training	5 (5%)	63 (69%)	74%
I3. Delivers group f2f training	9 (10%)	69 (75%)	85%
I4. Delivers 1:1 training	8 (9%)	70 (76%)	85%
Systems procurement and use			
J2. Researches user needs from bibliometric tools	4 (4%)	49 (53%)	57%
Policy and strategy			
K2. Advises on decisions about what bibliometric service should be offered to staff	1 (1%)	46 (50%)	51%
K3. Explains university ranking	11 (12%)	41 (45%)	57%
K6. Keeps abreast of current developments in scholarly communication	31 (34%)	46 (50%)	84%
K7. Participates in debates about how research quality should be evaluated	4 (4%)	42 (46%)	50%
K8. Explains the likely role of bibliometrics in the next national research assessment exercise	6 (7%)	40 (44%)	51%
Professional skills			
L2. Creates and sustains professional networks inside the organisation	19 (21%)	67 (73%)	94%
L3. Creates and sustains professional networks beyond the organisation	9 (10%)	54 (59%)	69%
L5. Plans effectively in the context of a rapidly changing environment	14 (15%)	48 (52%)	67%

Table 4: Tasks considered by a majority of respondents to be core

A large part of section A was seen as core. Advising on appropriate tools and explaining the differences between results from different tools was rated as core by many respondents. Interestingly, 94% of respondents thought that explaining responsible use principles to bibliometrics was rated as core. Raising academics' "bibliometric literacy" also received strong agreement, triangulated by a strong agreement that different aspects of training such as writing documentation and delivering training were core tasks. Under professional skills, networking inside the organisation seemed to be important.

5.4 Specialist tasks

Table 5 lists tasks that more than 50% of participants rated as "Advanced/Specialist".

Task	No. (%)
A9. Understands the potential use of text mining in bibliometrics	59 (64%)
B6. Uses bibliometric knowledge to ...Evaluate departmental/research centre performance	57 (62%)
B8. ...Evaluate institutional performance	55 (60%)
B13. ...Support academic bibliometric research	56 (61%)
C5. Evaluates the quality of research group or department output	48 (52%)
C6. Analyses/benchmarks output in the context of discipline	53 (58%)
C7. Analyses collaboration patterns in a research group or department (including to compare with competitors)	59 (64%)
C8. Identifies potential strategic partnerships	53 (58%)
C13. Identifies institutional strengths	49 (53%)
C14. Examines trends in institutional performance and advises on improving its ranking	58 (63%)
D8. Identifies a journal's research strengths by key-word analyses of published articles/journal categories	46 (50%)
D10. Recommends a journal to publish in taking into account acceptance rates, turnaround time, publication speed, subscription levels etc as well as bibliometrics	47 (51%)
F3. Gathers evidence to support a national research assessment exercise impact case study	55 (60%)
G5. Connects institutional repository with WoS or Scopus to determine share of indexed articles	48 (52%)
H2. Conducts manual statistical analyses outside of proprietary tools	58 (63%)
H3. Applies statistical tests of significance to analyses	73 (79%)
H4. Undertakes programming for downloading/manipulating data	68 (74%)
H5. Undertakes Network analysis for bibliometrics	76 (83%)
H6. Undertakes text mining for bibliometric purposes	72 (78%)
I5. Undertakes charged-for consultancy	61 (66%)
J1. Evaluates systems for the purpose of procurement	52 (57%)
J3. Advises on decisions about what bibliometric tools should be subscribed to	48 (52%)
J4. Advises on decisions about how the institution should use specific tools	59 (64%)
K1. Advises on decisions about institutional KPIs	54 (59%)
K4. Monitors national policy changes around research evaluation and advising on institutional responses	48 (52%)
K9. Advises on decisions about what a responsible use policy should contain	50 (54%)
L4. Influences others, including senior departmental and institutional managers	49 (53%)

Table 5: Specialist tasks

Twenty-seven or just over a quarter of all tasks were seen as specialist or advanced. By analysing these responses we can observe that aspects that are seen as more specialist include:

- Activities that relate to the managerial use of bibliometrics to evaluate scholars (B6, B8, C5-C8, K1);

- More technical activities, including working outside proprietary bibliometric tools (A9, H2-H6) as well as keeping suppliers up-to-date with data and also system evaluation and choice (J1, J3);
- Consultancy based bibliometrics as opposed to training users (I5);
- It did not seem core to work at the policy level, e.g., to monitor wider policy change (K4), advise senior managers on responsible use (K9) or influence senior managers (L4).

A considerable number of common bibliometric activities were considered "specialist". It would be outside the usual work of librarians, for example, to be involved in the evaluation of academics' work or in high level policy making. Librarians might also be reluctant to engage in more technical roles or paid for consultancy. The majority of respondents saw the use of suppliers' bibliometric tools as a core activity, but working outside of those tools as more specialist.

5.5 Tasks rated as out of scope

There were no items identified by more than 50% of all respondents as being out of scope of the role, however a few items were seen as out of scope by over 20% of participants, namely:

B5. Uses bibliometric knowledge to promote/employ staff – 30 responses (33%)

B7. Allocate funding to departments – 43 responses (47%)

C5. Evaluates the quality of research group or department output – 20 responses (22%)

D9. Recommends a journal to publish in purely through bibliometrics – 27 responses (29%)

E2. Evaluates quality of specific article – 33 responses (36%)

I5. Undertakes charged-for consultancy – 22 responses (24%)

The rating of evaluating the quality of a specific article (E2) was interesting because roughly the same numbers rated it as core as rated it out of scope. It could be argued that rather than merely "out of scope" some of these items were considered something that should not, or could not, be done (which was not an option available for respondents). For example, many would argue that recommending a journal to publish in purely through bibliometrics (D9) is bad practice.

5.6 Differences in response between Librarians and "others"

One objective of the study was to compare the views of librarians and others undertaking bibliometrics. Unfortunately the numbers of non-librarians responding limited our ability to undertake this analysis in any depth. However, a comparison of library-based respondents (55 individuals) with those who said they were based elsewhere (excluding those based partly in the library) (34 individuals), revealed some statistically significant differences. These are listed in table 6. Means were calculated by treating 1=Advanced/Specialist; 2=Core; 3=Entry level. Thus the highest score arises where the task is seen as more of an entry level or core activity, than a specialist one. Higher scores are highlighted in bold.

Statement	**Library based**		**Non-Library based**		*t-test Library/non library*		
	Mean	sd	Mean	sd	*t*	*p*	*Effect size*
A1. Explains the concept of bibliometrics	2.68	0.59	**2.90**	0.31	3.099	0.031	**0.11**
C10. Identifies current collaborations with specific other entities eg countries or institutions	1.64	0.74	**2.00**	0.67	3.074	0.033	**0.11**
C11. Identifies key scholars in a particular field	1.69	0.62	**2.10**	0.71	3.797	0.009	**0.16**
G1. Maintains awareness of the functions of the main bibliometric tools	2.22	0.58	**2.50**	0.57	3.051	0.039	**0.10**
G5. Connects institutional repository with WoS or Scopus to determine share of indexed articles	1.32	0.52	**1.65**	0.63	3.763	0.018	**0.15**
I1. Writes documentation	1.90	0.55	**2.17**	0.60	2.901	0.043	**0.09**

Table 6: Differences in task rating by role

For all these tasks it was less likely that librarian respondents would see them as a usual practice. It is hard to fully explain these results. It does seem reasonable that librarians might have less need to identify collaborators (C10) and key scholars in a field (C11), but there are many other of the uses of bibliometrics listed in section B with which librarians may not be expected to engage where there was no statistically significant finding. It is a little surprising that librarians would see explaining bibliometrics as a less core part of their role than others. Although there seems to be ample theoretical reason to expect marked differences in how different groups involved in bibliometrics might view the task (Petersohn 2016) this was not really confirmed by the data, at least when looking for statistically significant differences.

5.7 Russell group and non- Russell group comparison

It might be anticipated that research intensive institutions might use bibliometrics a little differently from non-research intensive universities. For example, it might be anticipated that research intensive institutions with their institutionally powerful bodies of researchers

might be more able to resist imposition of metrics for evaluation, whereas non research intensive institutions might be expected to take a more managerial approach. A small number of significant differences were found between Russell group (research intensive) and non-Russell group based UK respondents. Table 7 sets these out.

Statement	**Russell group**		**non-Russell group**		*t-test Russell group/Non Russell group*		
	Mean	sd	Mean	sd	*t*	*p*	*Effect size*
A12. Explains use of Academic SNS such as ResearchGate	2.18	0.59	**2.55**	0.31	2.156	0.037	**0.10**
C11. Identifies key scholars in a particular field	1.71	0.74	**2.12**	0.67	2.374	0.022	**0.11**
C13. Identifies institutional strengths	1.32	0.62	**1.73**	0.71	2.423	0.019	**0.11**
D4. Uses bibliometric tools to find metrics on an individual journal: Eigenfactor	2.33	0.58	**2.69**	0.57	2.278	0.027	**0.10**
E4. Advises on how to use social media to increase citation	1.82	0.52	**2.17**	0.63	2.206	0.033	**0.10**
E6. Explains metrics for research data	1.70	0.55	**2.12**	0.60	2.054	0.046	**0.08**

Table 7: Comparison of Russell and non-Russell group responses

These comparisons suggest non-Russell group universities are slightly more likely to focus on Academic SNS and advise on social media use. Yet the data does not suggest a very marked difference of use between the two sets of institutions.

5.8 International differences in response

To understand whether there was a difference in bibliometric practices between UK and non-UK respondents, responses from the 48 UK respondents were compared with all others (44). Table 8 identifies the 15 tasks (about 15% of all the items) for which there was a significant difference between UK and non-UK answers.

Task	**UK based**		**non-UK based**		*t-test UK based/Non UK based*	
	Mean	sd	Mean	sd	*t*	*p*
A1. Explains the concept of bibliometrics	**2.92**	0.27	2.59	0.61	47.676	0.005
A2. Explains the concept of altmetrics	**2.86**	0.35	2.42	0.71	37.957	0.002
A5. Explains responsible use as a general set of principles	**2.49**	0.51	2.23	0.60	21.712	0.033
A7. Advises on the applicability of metrics to particular disciplines/metadisciplines (e.g. Arts and Humanities)	**1.88**	0.66	1.51	0.61	18.111	0.011
B10. ...Guide library collection development	1.73	0.59	**2.03**	0.54	8.958	0.027
B11. ...Evaluate repository coverage	1.44	0.55	**1.97**	0.61	78.457	<0.001

E3. Advises on how to increase citations of articles	**1.86**	0.58	1.52	0.63	16.321	0.015
E4. Advises on how to use social media to increase citation	**2.00**	0.56	1.72	0.63	6.121	0.047
E6. Explains metrics for research data	**1.92**	0.74	1.59	0.66	7.877	0.038
H1. Downloads, cleans and manipulates bibliometric data	1.50	0.61	**2.00**	0.65	42.012	0.001
H2. Conducts manual statistical analyses outside of proprietary tools	1.26	0.49	**1.52**	0.51	9.002	0.026
H4. Undertakes programming for downloading/manipulating data	1.00	0.09	**1.28**	0.53	43.551	0.009
I5. Undertakes charged-for consultancy	1.04	0.07	**1.32**	0.55	47.158	0.004
K7. Participates in debates about how research quality should be evaluated	**1.66**	0.63	1.39	0.50	20.741	0.035
K8. Explains the likely role of bibliometrics in the next national research assessment exercise	**1.74**	0.63	1.38	0.49	18.977	0.010

Table 8: International differences

The results suggest that UK bibliometrics practitioners see it as more central to their role to explain basic concepts like bibliometrics or altmetrics, and responsible use. They also see it as more central to advise on increasing citation in different ways (E3, E4, E6); this could be interpreted to reflect the impact of the UK's national research evaluation process; such national research assessment exercises do not exist in every country. They also see it as more core to explain how metrics for research data might operate and to participate in debates about research quality. In contrast, UK-based respondents were less likely to see it as core to use bibliometrics to evaluate the library collections and to map repository coverage. They are also less likely to rate more technical tasks such as downloading data or manipulating data as part of the role. It seems they are also less likely to do charged-for consultancy. The results do suggest bibliometrics in the UK has developed in a slightly different direction from other countries.

5.9 Growth areas

At the end of each of the twelve sections there was an open text box to allow respondents to "identify any items in this section you think will be of increased importance in the next 5 years." This question sought to gather views of the direction of bibliometric practices. It was an optional question, but respondents could select as many items as they wanted. Most respondents did not give a reply, so percentages are calculated against the total number giving any reply. Predictably the number responding fell in later sections, so figures are only given for the earlier items where a reasonable number of people did give a response. Table 9 lists

the top three tasks, as identified by participants who did respond, for the four sections where 20 or more people responded in total.

Section heading	Top three tasks
A. Awareness raising and responsible use	Author identifiers 17 (46%) Responsible use 16 (43%) Applicability of metrics to specific disciplines 16 (43%)
B. Applications of bibliometrics	National Research Assessed exercise 19 (68%) Evaluating institutional performance 12 (57%) Supporting grant applications 10 (36%)
C. Metrics: About scholars, academic units and institutions	Institutional metrics and benchmarking 15 (68%) Trends in institutional performance 15 (55%) Identifying institutional strengths 12 (68%)
E. Metrics: About articles/ specific outputs	Research data 20 (100%) Metrics for books 10 (50%) Use of social media 10 (50%)

Table 9: Areas of increasing importance in the next five years

Interestingly the use of author identifiers was the most important trend selected in section A. It was followed by responsible use and developing metrics specific to disciplines. Text mining was the fourth most important item; explaining open access was also selected by 14 participants.

One of the patterns that seemed to emerge from the data was a growing expectation that using bibliometrics to assess institutional performance would be of greater importance in the next few years. This could be simply linked to current consultations in the UK around the form of the next Research Excellence Framework. This was apparent in the growth areas for metrics about scholars, but also in the response on applications of bibliometrics. Growing areas of application of bibliometrics was for national research assessment (not surprising) but also supporting grant applications. As regards new metrics, everyone who replied (20 people) mentioned citation of research data as an important trend.

5.10 About bibliometric work

5.10.1 Job titles and locations

Predictably - since this is a pattern across professional roles across the sector - there was considerable variation in job titles reported by respondents. Table 10 lists some of the job titles recorded. The lack of standardisation in terminology and local institutional job title practices presumably determine this. The variation probably also reflects genuine differences in

role, especially as bibliometric services vary in level and some individuals combine supporting bibliometrics with other tasks.

Job titles

Faculty Librarian (Library)
Research Support Librarian (Library)
Research Analytics Librarian (Library)
Senior Institutional Support Officer (Library)
Research Repository and Information Officer (Library)
Research Officer (Library)
Research Performance Analyst (RO)
Research Policy and Governance Administrator (RO)
Research Information and Intelligence Specialist (RO)

Table 10: Job titles of respondents

5.10.2 Training in bibliometrics

55 respondents gave an answer to the question: "If you have an Library/Information Studies qualification, did it cover bibliometrics?" 37 (65%) said that their library qualification had not included bibliometrics. Only 16 (29%) said it had; three could not remember. Thus it seems that library training is often not the basis for professional practice. The next question was "Apart from on an LIS course, have you received training in bibliometrics? If so please give brief details." Answers included courses run by commercial companies such as Elsevier and by CWTS (at Leiden University), as well as individual seminars and webinars and reading the literature. A few were highly qualified with a Masters or PhD in bibliometrics.

6 Discussion

The survey confirmed that the items in the list of 99 tasks developed from the workshops are all considered to be part of the bibliometric practice of respondents. None of the items were rated as out of scope by a majority of respondents. The categories within which items were organised in the survey also seemed to make sense to participants: both the task categories and the notion of entry level and core categories. It does not follow that the list is comprehensive, indeed an important point raised by participants in a dissemination event was that ethical aspects of bibliometrics extends beyond responsible use: all aspects of the conduct of the practice should be ethical.

The data identified a rather narrow entry level set of competencies (17/99 tasks). These were about explaining basic concepts, calculating key metrics (especially journal metrics), and some aspects of professional behaviour. 48 tasks were identified as core, meaning that 65/99 items were rated as either core or entry level, together representing the main part of the role. Such tasks included providing basic explanations about relevant concepts and applying responsible use principles. Increasing staff bibliometric literacy and different forms of training also were commonly related as core which may be an effect of the large proportion of library-based respondents. The data suggests that a considerable proportion (27/99) of the bibliometric tasks were seen as specialist/advanced, as opposed to core. Specialist tasks included more managerial elements of evaluating scholars and more technical activities, such as working outside bibliometric tools, as well as influencing senior managers.

Reflecting on the difference between what was seen as core, and what specialist, the picture is largely consistent with Petersohn (2016), whilst providing a lot more detail. Respondents mainly saw bibliometrics as about empowering academics through information and training. There is an emphasis on responsible use. They see evaluation of academics' and institutional performance as a more specialist role (though not out of scope). Influencing senior managers and policy is also specialist. Their skills are in using proprietary tools, rather than advanced manipulation of data or calculations outside of them. While this picture is consistent with Petersohn (2016) in terms of how the role is defined, her explanation that this arises from the character of librarians' professional knowledge base does not seem to be supported. Comparing those who located themselves in the library only and those who did not report themselves to be based in the library, even partly, there were only a small number of statistically significant differences in perception. These do not suggest a fundamental difference of view about what bibliometrics is. An Abbottonian analysis as developed by Petersohn (2016) would expect there to be a greater difference, reflecting competing professions' attempts to define the practice in ways consistent with their own knowledge base. The lack of such a pattern may be due to the small dataset. It could also possibly reflect the current dominance of librarians in interpreting what bibliometrics means. Librarianship is a well organised profession that works collaboratively across the sector to define its role. Research administration is a newer, less formally defined group (Green and Langley, 2009; Shelley, 2010; Langley, 2012). Nevertheless, the differences are perhaps less than expected.

Similarly, we would expect differences to exist in such very different institutional contexts, such as between Russell Group and post 1992 universities in the UK and between the

UK and other countries. The data did point to a small number of statistically significant differences, however because the non-UK data was from a range of countries including USA, Australia and in Europe, these findings should be treated with caution due to the varying evaluation systems in use. For example not all countries employ national frameworks.

There was some interesting data on how people saw the practice of bibliometrics developing over the next five years. Areas of growth included author identifiers, responsible use, metrics for data, and the application of metrics for institutional benchmarking and to support funding applications. Reporting the results at professional workshops for Lis-bibliometrics and the UKSG conference produced some informal feedback that strongly supported the growing emphasis on responsible use. These discussions also suggested a widening range of bibliometrics uses. It followed that keeping up-to-date is a professional priority.

Finally the evidence suggested that the majority of staff currently working in bibliometrics did not receive any formal training during their LIS qualification. People used a wide range of sources to develop their knowledge and keep themselves up-to-date.

In phase 3 of the project, on the basis of the questionnaire results a competency model was developed (see appendix). The entry level competencies chosen were those which over 50% of all participants rated as entry level. Core were all those that scored over 50% for the sum of entry and core level, removing any that were included in the entry level listing (48 original items). Specialist tasks listed are those that scored over 50% of all respondents. In line with practices of competency modelling, the listing was simplified by merging closely related items and organised under four headings. This involves an element of interpretation. What the representation does suggest is that entry level tasks are centred around advocacy, basic technical tasks and professionalism. Core tasks include training and more technical tasks. Specialist competencies are technical and strategic.

7 Conclusion

Bibliometrics, especially citation analysis, and altmetrics have an increasingly significant place in the governance of research at international, national and institutional levels. Governments have a growing interest in seeking to measure the return on public investment in research and the performance of institutions. It is a particular concern in the UK with the evolving definition of the national research assessment exercise, the Research Excellence Framework (REF). However, as the Leiden Manifesto eloquently points out, the use of bibliometrics in research assessment is fraught with challenges. Many specific measures seem to

be significantly flawed, but remain widely used. As a result, the responsible, professional use of research metrics is important for the health of research and wellbeing of researchers.

In this context, support of bibliometrics and altmetrics has become an important area of new work for librarians and other professionals. Yet published research on their role in research metrics has huge gaps. This is the first study to examine systematically the competencies necessary to undertake bibliometric work. The study took a rigorous approach to analysing data from practitioners to produce the first listing of bibliometric competencies which differentiated entry level, core and specialist tasks. It also identified beliefs about likely growth areas. This is a significant contribution to the understanding of professional roles in supporting bibliometrics. The listing of competencies can inform institutions in recruiting and training staff; and professionals in planning their own self-development. It can also help organisations involved in the training of staff develop appropriate curricula, particularly in the context of competency based education (ACRL, 2017).

Although it is clear that it is not just librarians who are undertaking bibliometric work, the study also sheds further light on the nature and direction of development of librarianship as a profession. It reinforces our understanding of librarianship as a service profession, that focuses on empowering users through increased training, rather than building technical expertise or offering consultancy type expert services. Eschewing a more evaluative role in academic performance, librarians (and all doing bibliometrics) emphasise empowering users through information and training. This may also be seen to somewhat preclude alignment to the more ambitious hopes of Herther (2009) that librarians play a strong role strategically in developing new more reliable metrics and better tools. Yet in the light of the question marks over the validity of many bibliometric measures and the broader sense of a growing audit culture in HE, this is a judicious, even compassionate posture.

In a fast moving field, there is a need to keep the competencies model up-to-date. For this reason the list has been shared with the community under a CC-BY-NC licence, and can be downloaded from the blog “The Bibliomagician” of the LIS-Bibliometrics- Community (https://thebibliomagician.wordpress.com/competencies/). The current study is only a temporally limited snapshot of views. Earlier research (Corrall et al., 2013) suggested that the UK was a little out of line with other comparable countries in its bibliometric practices. Therefore, since most of the questionnaire responses were from the UK, further research would be useful to explore international differences in how the professional support of bibliometrics is organised. Work linking bibliometric competencies to those developing in other dynamic areas of

library practice would help us understand how the profession is developing as a whole, and how the various LIS curricula need to respond. Given the growth of metric work in librarianship, be that various library analytics (Showers, 2015) and library (data) carpentry (Baker et al., 2016) as well as bibliometrics, it may be that more quantitative data handling and statistical skills need to be made core to professional knowledge. This would have significant implications for curriculums in LIS schools. There is also an opportunity to develop an understanding of how these competencies might be rated differently among research administrators or for publishers and intermediaries, who are themselves also users of bibliometrics.

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Appendix

Competency model for bibliometric work (version 1.0; June 2017)

	ENTRY LEVEL	CORE	SPECIALIST
Applications		• Uses bibliometric knowledge to recommend where to publish and what to read; to increase academic staff bibliometric literacy; to support annual reporting by academic departments; to support grant capture; and to guide library collection and evaluate repository coverage.	• Uses bibliometric knowledge to evaluate departmental/research centre performance; to evaluate institutional performance; and to support academic bibliometric research; • May undertake charged-for consultancy.
Advocacy and training	• Explains effectively the concept, potential uses and limitations of bibliometrics to a range of stakeholders, such as, research group leaders, individual academics and PhD students; • Explains the concept, potential uses and limitations of altmetrics to stakeholders; • Explains author identifiers, such as ORCID, and promotes their wider use; • Communicates the case for open access and the impact of increased visibility on citation performance.	• Advises on which are the appropriate tools to calculate a particular metric and explains differences in results between metrics produced by different tools; • Explains responsible use as a general set of principles, and applies these principles to specific requests/cases. For example, advises on the applicability of metrics and tools to particular disciplines/metadisciplines (e.g. Arts and Humanities); • Participates in key debates about how research quality should be evaluated, including in the context of any national research assessment exercise; • Undertakes research into user needs from bibliometric tools and advises on decisions about what bibliometric service should be offered to staff; • Explains and promotes use of the CRIS, the institutional repository and the use of Academic SNS such as ResearchGate; • Writes documentation; designs and delivers online and face to face training; • Advises on how to increase citation, including through use of social media.	• Monitors national policy changes around research evaluation and advises on institutional responses; • Advises on decisions about how the institution should use specific tools and on decisions about institutional Key Performance Indicators; • Advises on decisions about what a responsible use policy should contain; • Influences others, including senior departmental and institutional managers; • Advises on decisions about what bibliometric tools should be subscribed to.
Technical knowledge	• Uses bibliometric tools to find and explain the H-index for a specific scholar including the strengths and limitations of this indicator;	• Maintains awareness of the functions of the main bibliometric tools, and is able to choose the right tool for a specific task;	• Analyses/benchmarks output in the context of discipline; • Evaluates the quality of research group or departmental output;

	• Uses bibliometric tools to find and explain metrics for an individual journal, specifically JIF, 5 year impact factor, SNIP, Eigenfactor and SCImago Journal Rank; including the strengths and limitations of these indicators; • Uses bibliometric tools to find citations and altmetrics for a specific article.	• Uses bibliometric tools to find a range of metrics on a specific scholar: such as the G-index and Full and mean citation counts; • Uses bibliometric tools to find metrics on a research group or department; to identify key scholars in a particular field and patterns of collaboration; to identify the top journals in a field; • Explains the bibliometric elements of university rankings; • Evaluates likely impact on citation of publishing in a specific journal; • Maintains awareness of departmental recommended journal lists; • Explains metrics for books, research data and other non-journal outputs; • Advises on definitions of impact and how to demonstrate the impact of research beyond academia; • Downloads, cleans and manipulates bibliographic data; • Presents data effectively.	• Analyses collaboration patterns in a research group or department (including to compare with competitors); • Identifies potential strategic partnerships; • Identifies institutional strengths and examines trends in institutional performance and advises on improving its ranking; • Identifies a journal's research strengths by keyword analyses of published articles/journal categories; • Recommends a journal to publish in taking into account acceptance rates, turnaround time, publication speed, subscription levels etc., as well as bibliometrics; • Gathers evidence to support a national research assessment exercise impact case study; • Conducts manual statistical analyses outside of proprietary tools; • Applies statistical tests of significance to analyses; • Undertakes programming for downloading/manipulating data; • Undertakes Network analysis for bibliometrics; • Understands the potential use of text mining in bibliometrics or undertakes text mining for bibliometric purposes; • Evaluates systems for the purpose of procurement; • Connects the institutional repository with WoS or Scopus to determine share of indexed articles.
Professional Conduct	• Understands the key characteristics of scholarly communication; • Works effectively within local institutional culture; • Works effectively as part of a team with other library staff, colleagues in professional services and	• Keeps abreast of current developments in scholarly communication; • Creates and sustains professional networks both inside and outside the organisation; • Plans effectively in the context of a rapidly changing environment.	

	researchers; • Continuously updates their own skills; • Works independently, showing a high level of attention to detail; • Conducts all their work in an ethical manner.		

Die Eigenständigkeitserklärung ist in der Online-Version aus Gründen des Datenschutzes nicht enthalten.

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Erklärung zum Eigenanteil im Rahmen der kumulativen Dissertation

Hiermit erkläre ich, dass es sich bei der von mir eingereichten schriftlichen Arbeit mit dem Titel:

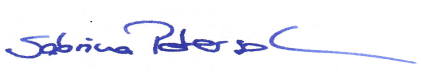
„Leistungsbewertung der Wissenschaft im Wandel: Eine professionssoziologische Analyse der Anbieter bibliometrischer Dienstleistungen im neuen Expertenfeld der quantitativen Forschungsevaluation"

um eine kumulative Dissertation handelt. Der Eigenanteil an den von mir eingereichten Abhandlungen gliedert sich wie folgt:

Aufsatz 1: *Professionalization Bibliometric Research Assessment. Insights from the History of the Leiden Centre for Science and Technology Studies (CWTS)*, online veröffentlicht am 14.12.2017 in Science and Public Policy, doi.org/10.1093/scipol/scx084, verfasst in Ko-Autorenschaft; Eigenanteil: 80% (Erstautorin); Zweitautor: Prof. Dr. Thomas Heinze, Bergische Universität Wuppertal (Anteil: 20%).

Aufsatz 2: *Professional competencies and jurisdictional claims in evaluative bibliometrics: The educational mandate of academic librarians*, veröffentlicht am 01.04.2016 in Education for Information, 32(2), 165-193, verfasst in Alleinautorenschaft; Eigenanteil: 100%.

Aufsatz 3: *„Competencies for bibliometrics"* online veröffentlicht am 31.08.2017 im Journal of Librarianship and Information Science, doi.org/10.1177%2F0961000617728111, verfasst in Ko-Autorenschaft; Eigenanteil: 25% (Drittautorin); Erstautor: Dr. Andrew Cox, University of Sheffield, UK (Anteil: 25%), Zweitautorin: Dr. Elizabeth Gadd, Loughborough University, UK (Anteil 25%), Viertautorin: Dr. Laura Sbaffi, University of Sheffield, UK (Anteil: 25%)



Wuppertal, den 14. März 2018