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Professionalising Doctoral Education: Institutional Diversity and Changing Regimes of Knowledge Production

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Article

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Abstract

Professionalisation of doctoral education is often associated with employability, innovation and closer university–industry relations, but these objectives do not imply equivalent changes in doctoral work. This article compares selected programmes, qualification routes and reforms in Europe, Australia, China and other national settings to examine how professional involvement reshapes research organisation, criteria of contribution and doctoral certification. A qualitative, case-oriented comparison distinguishes formal programme rules and policy intentions from empirical evidence on candidates' experiences and research practices. Three dimensions emerge: organisational hybridisation of employment, funding and supervision; epistemic negotiation of scientific originality and professional usefulness; and certificative variation in admissible outputs and assessment. These dimensions do not necessarily evolve together. Employer participation may extend to problem definition and research conditions while universities retain thesis assessment and degree-awarding authority. Distinct professional routes, such as British professional doctorates and the Dutch engineering qualification, cannot be assimilated to a single model. China's recent engineering reform permits specified practical achievements as degree evidence, but available implementation data do not establish its prevalence at doctoral level. Institutional layering, qualification differentiation, programme-level design and regulatory redesign account for contrasting responses to comparable policy pressures. The findings identify a selective redistribution of influence rather than a uniform transfer of academic authority or evidence of an established new knowledge regime.

1. Introduction

The relationship between doctoral education, professional practice and society has become a prominent concern in higher education and research policy. For more than a decade, international policy frameworks have called for a reorientation of doctoral training beyond its traditional academic purposes. The European Commission's *Principles for Innovative Doctoral Training* explicitly advocated "Exposure to industry and other relevant employment sectors" (European Commission, 2011, p. 1). A decade later, an OECD investigation recorded a research funder's demand that "Doctoral education needs to include more practical work, including in Arts, Humanities, and Social Sciences" (OECD, 2021, p. 38). The Council of the European Union subsequently observed that doctoral training still "does not sufficiently take into consideration the wider range of occupations across relevant sectors" (Council of the European Union, 2023, recital 27). These statements reflect increasingly explicit expectations concerning employability, innovation, the economic and social contribution of knowledge, and closer relationships between universities and professional organisations. Yet the convergence of such policy expectations leaves open a more fundamental question: whether, and to what extent, they transform the organisation of doctoral research, the recognition of its contributions and the authority responsible for their validation.

This orientation also raises a longstanding tension between the scientific purposes of research training and the relevance of doctorates to societal needs (Sarrico, 2022, p. 1310). Yet the professionalisation of doctoral education cannot be understood simply as the growing participation of non-academic

organisations in research. It also concerns the purposes, forms and institutional recognition of doctoral knowledge.

Comparable policy expectations have not produced a single doctoral model. In some arrangements, professional organisations employ candidates, participate in defining research problems and provide resources while conventional university assessment remains in place. Other arrangements create separate professional qualifications or recognise practice-based outputs through alternative assessment procedures. The distinctions are consequential: influence over research priorities, conditions of inquiry, criteria of relevance and degree certification are not equivalent forms of authority and need not change together.

This article asks how pressures to connect doctoral education with professional practice and innovation are translated into varied institutional configurations, and what these configurations reveal about the production and legitimation of knowledge. The central issue is not whether professionalisation displaces an academic doctorate, but where, how and by whom the conditions and standards of doctoral work are negotiated. A shared language of employability and innovation may coexist with heterogeneous rules governing what constitutes a doctoral contribution and who has authority to assess it.

Three analytical dimensions guide the comparison. Organisational hybridisation concerns employment, financing, research settings, supervision and the distribution of responsibilities for conducting research. Epistemic hybridisation concerns how scientific originality, methodological rigour, technical performance and practical usefulness shape research problems and the value attributed to contributions. Certificative hybridisation concerns admissible evidence, procedures of examination and the authority to confer a degree. Distinguishing these dimensions makes it possible to examine their combinations without assuming a progression from an academic to an industrial or professional model.

The analysis combines historical contextualisation with a qualitative, case-oriented comparison of identifiable schemes, programmes and qualification routes. The principal cases include France's CIFRE, the Danish Industrial PhD, British Engineering and other professional doctorates, the Dutch 4TU Engineering Doctorate, Australian professional doctorates and the National Industry PhD Program, and China's recent practical-achievement pathway. Selected initiatives from the United States, South Korea, Japan, India, Indonesia and Russia provide contrasts. The sources comprise scholarly analyses, empirical investigations, legislative and policy texts, and programme documentation. Institutional prescriptions and stated objectives are distinguished from observed implementation and doctoral experiences; the cases are analytically selected, not statistically representative of national systems.

The comparison identifies contrasting institutional responses to common pressures and a selective redistribution of influence across doctoral work. It does not presume that institutional change is uniform, that professional participation necessarily transfers certification authority, or that a new knowledge regime has already emerged. By locating change in the operations through which doctoral research is organised, valued and validated, the article offers a basis for assessing whether—and under what conditions—professionalisation transforms the authority attached to doctoral knowledge. The following

section first places these configurations in a longer history of doctoral diversification before the corpus, comparative results, institutional mechanisms and theoretical implications are examined.

2. Historical trajectories and the diversification of doctoral education

2.1. Professional qualifications and doctoral research: historical foundations (1880s–1940s)

Professional and professionally oriented doctorates cannot be understood as products of a single historical sequence or as recent departures from an originally homogeneous academic model. Medieval doctoral degrees were associated with learned professions, notably law, medicine and theology, whereas the research doctorate developed through heterogeneous nineteenth-century transformations of universities, disciplinary research and academic careers (Ruano-Borbalan, 2022). The opposition between academic and professional doctorates is thus an inadequate starting point for interpreting their longer institutional history.

The expansion of engineering education and industrial research raised a specific question: which institutions and forms of technical knowledge could legitimately claim doctoral status? In Germany, doctoral-awarding powers granted to the Technische Hochschulen in 1899, including the Doktor-Ingenieur (Dr.-Ing.), followed disputes over the academic standing of technical higher education. This was not a professional doctorate in the contemporary sense. It extended recognition to research pursued in institutions closely associated with industrial development while retaining the requirement of an original contribution. The boundary between academic science and technological knowledge was thus already subject to institutional negotiation (Technische Universität Berlin, 2024).

Industrial research also generated forms of training outside doctoral certification. The Mellon Institute, founded in Pittsburgh in 1913, developed company-sponsored fellowships organised around specified industrial problems. Research contracts governed access to resources, rights over discoveries and publication, while fellows varied in prior qualifications and some pursued advanced degrees separately. It is accordingly an example of contractual organisation of industrial research, not an early industrial doctorate (American Chemical Society, 2013). Its relevance here is limited but instructive: industrial actors could shape research conditions without acquiring university degree-awarding authority.

In the United States, the Doctor of Education (EdD), introduced at Harvard in 1920, sought to strengthen advanced preparation for educational leadership while also addressing the academic standing of education as a university field. Its distinction from the PhD was neither consistently defined nor uniformly implemented; similar dissertation and research requirements often persisted across institutions. The EdD accordingly exemplifies the contested institutional differentiation of educational and professional inquiry, rather than a stable prototype of the contemporary professional doctorate (Perry, 2012).

French efforts to connect engineering and university research provide another contrast. The ingénieur-docteur title, established by decree in 1924, was designed to provide engineers with research training in university science laboratories and to strengthen the scientific capacity of industry. Its requirements, academic recognition and professional significance were debated, while subsequent investigations disclosed a discrepancy between intended industrial careers and graduates' actual destinations (Fonteneau, 2020). It exemplifies the uncertain consequences of creating a differentiated scientific qualification not a direct institutional ancestor of CIFRE.

Business doctorates add a further, non-industrial trajectory. Harvard Business School was authorised to award the Doctor of Commercial Science in 1922, conferred the first such doctorate in 1928 and renamed it Doctor of Business Administration (DBA) in 1953. This programme was conceived as scholarly doctoral work, not as a credential for executives purchased through a contemporary management-education market; indeed, Harvard replaced its DBA designation with an interfaculty PhD beginning in 2018–2019 (Harvard Business School, n.d.). The subsequent development of practice-oriented DBAs elsewhere cannot be projected backwards onto the origins of the qualification.

2.2. The expansion of research training and university–industry relations (1945–1980)

After 1945, the growth of public research systems, universities and scientific employment transformed doctoral education more substantially than a chronology of new degree titles alone would suggest. In the United States, federal support for university research was accompanied by a major expansion of science and engineering doctoral training. This development increased the supply of researchers for universities, government and industry, but did not amount to the simple subordination of universities to industrial demand: publicly financed research could also reinforce disciplinary organisation and university autonomy (National Center for Science and Engineering Statistics, 2024).

The French trajectory likewise involved the reconstruction and differentiation of research training within higher education. The creation of a third cycle in science faculties in 1954 (French Republic, 1954), followed by further reforms of doctoral preparation and engineering-related qualifications in the 1960s and 1970s, broadened routes into research without consistently requiring employer participation. These reforms consequently belong to the history of doctoral professionalisation in a broad sense but should not be conflated with contractual industrial doctoral arrangements.

In Britain, the relationship between advanced scientific training and industrial employment became an explicit policy issue by the late 1960s. The Swann Report (The Flow into Employment of Scientists, Engineers and Technologists, 1968), prepared for the British government by a working group chaired by Michael Swann, examined the employment prospects of scientists, engineers and technologists and their relationship to industrial needs (Great Britain, Committee on Manpower Resources for Science and Technology, 1968).

The subsequent parliamentary debate also addressed scientific career opportunities beyond universities. These discussions preceded later European innovation policy, but do not establish that a uniform form of industry doctorate existed (United Kingdom, House of Lords, 1969).

Denmark offers an especially significant early institutional precedent. Innovation Fund Denmark retrospectively dates the Industrial PhD programme to 1970, while the Danish Agency for Science, Technology and Innovation described it as introduced in 1971 and adapted in 1988 to the form subsequently evaluated (Innovation Fund Denmark, 2018; Danish Agency for Science, Technology and Innovation, 2013). These accounts are consistent in locating the origins before the French CIFRE scheme, but differ on the inception year and do not, by themselves, document an identical degree structure throughout the period. The historically defensible claim is the early establishment and subsequent redesign of a programme linking employer-oriented research and doctoral training; later rules should not be projected unchanged onto its beginnings.

These post-war developments should not be read as successive stages in a transition from academic to industrial doctorates. Expansion of publicly supported science, specialised professional qualifications, labour-market diversification and organised cooperation with employers followed partly independent trajectories. The shift is best understood as a widening range of institutional settings in which doctoral work could be financed, conducted and valued.

[Table 1 **about here]**

Table 1
Selected historical transformations of doctoral qualifications and research training

Period	Case	Institutional transformation	Interpretative limit
1899	Germany: Technische Hochschulen	Research-degree authority for technical institutions	Recognition of engineering research; not a modern professional doctorate
1913	United States: Mellon Institute	Contracted industrial research fellowships	Research training and control of results, not a doctoral qualification
1920	United States: Harvard EdD	Distinct educational doctorate	Differences from the PhD varied across institutions
1922–1953	United States: HBS DCS/DBA	Business research doctorate authorised, awarded and renamed	Original DBA was scholarly; later executive orientation not implied
1924	France: ingénieur-docteur	University research qualification for engineers	Professional destination and academic status contested
1945–1970	United States: science and engineering doctorates	Large-scale expansion with federal research support	Growth in research training, not proof of industrial control
1954–1970s	France: postgraduate research reforms	Third cycle and differentiated research qualifications	Institutional restructuring without necessary industry partnership
Late 1960s	United Kingdom: Swann debate	Industrial careers and postgraduate science on policy agenda	Policy concern, not a single doctoral programme
1970/1971; 1988	Denmark: Industrial PhD	Early programme, subsequent reorganisation	Historical continuity with changed rules; dates differ by source

Note. The entries cover heterogeneous analytical objects: degrees, industrial research fellowships, research-system expansion, policy debates and partnership programmes. They are neither a ranking nor stages in a common evolution. Dates indicate selected institutional milestones, not uniform implementation.

2.3. Professional and industry-linked doctoral routes since the 1980s

The more visible diversification of professional and employer-linked doctoral routes from the 1980s took place within these already transformed research systems. It involved at least two arrangements that should be distinguished: establishing professional qualifications alongside the research PhD, and reorganising employment, funding and supervision within an existing university doctorate.

In France, the Conventions industrielles de formation par la recherche (CIFRE), established in 1981, combine doctoral employment by an organisation with a university laboratory partnership and preparation for the national doctorate. Employers may influence research problems and working conditions, but thesis examination remains under academic rules. More than 30,000 doctoral researchers had participated since the scheme's inception, and 1,857 new agreements were awarded in 2024 (ANRT, 2025). The Danish Industrial PhD similarly combines employer participation and university certification, albeit through contrasting funding arrangements. Neither case should be interpreted as establishing that industrial priorities determine doctoral judgements in practice.

Professional doctoral qualifications followed another trajectory. Australia saw an expansion in the 1990s, from 48 programmes recorded in 1996 to 105 in 2000 and 202 in 2011; a 2023 study identified 129 in 2022. Because counts were assembled from university offerings and are not a harmonised time series, the apparent contraction should be interpreted cautiously. In 2022, health, education and law accounted for substantially more programmes than engineering (Maxwell & Shanahan, 2001; Wang & Liu, 2023). In England, 320 programmes were identified across 86 institutions in 2015; the approximately 2,600 enrolled students reported for 2013–2014 came from a sample of 100 programmes and cannot be compared directly with Australian programme counts (Mellors-Bourne et al., 2016). Recognition at doctoral qualification level has consequently coexisted with differentiated purposes and assessment arrangements.

The international development of the DBA is particularly revealing of the tensions between academic recognition, professional relevance and the value of credentials within management education. From the 1990s, practice-oriented offerings for experienced managers developed within an increasingly competitive business-school environment, but neither executive orientation nor tuition-based provision demonstrates a for-profit institution or weak research requirements. In Australia, DBA enrolments rose from nine in 1993 to 1,505 in 2004, before falling to 869 in 2013; the decline has been linked to changes in programme provision and the management of international cohorts not a proven collapse of demand (Kortt et al., 2016). Studies of Australian programmes also document changing accreditation expectations and uncertainty over equivalence with research PhDs (Wallace et al., 2015). This trajectory is relevant to the political economy of doctoral credentials, but DBAs remain too heterogeneous in recognition and assessment to be treated as a single comparable case in the present corpus.

At the European level, the 2011 Principles for Innovative Doctoral Training brought greater policy visibility to intersectoral cooperation, professional relevance and transferable skills (European Commission, 2011). Yet these orientations largely postdated the establishment of national arrangements such as the French CIFRE and the Danish Industrial PhD. Their significance lay less in initiating doctoral professionalisation than in articulating common expectations across historically differentiated higher education systems, without determining how individual qualifications or assessment procedures would evolve.

China's trajectory adds a further, historically distinct form of differentiation. Professional doctoral degrees were introduced incrementally between 1998 and 2014, while research doctorates continued to dominate qualifications awarded. Professional doctorates represented 2% of doctoral degrees in 2009 and 3.5% in 2013, a scale characterised as still limited in relation to research doctorates (Bao et al., 2018, pp. 535–536). This slow early expansion matters: the professional route did not emerge fully formed from recent industrial policy, nor did it immediately displace the established expectation of an original research contribution. The national plan for professional graduate education (2020–2025) subsequently sought to expand professional doctoral training and strengthen industry-linked preparation and evaluation (Academic Degrees Committee of the State Council & Ministry of Education of the People's Republic of China, 2020).

The Degree Law adopted in 2024 and effective from January 2025, followed by specific requirements for professional engineering degrees, marked a more direct intervention in certification. Eligible candidates may submit and defend specified practical achievements instead of a conventional dissertation, under conditions defined by the relevant regulations; degree-awarding authority remains with authorised institutions (National People's Congress of the People's Republic of China, 2024, art. 21; Office of the Academic Degrees Committee of the State Council, 2024). An October 2026 report counted more than 400 engineering degree recipients through this route, but combined master's and doctoral graduates and supplied neither a doctoral denominator nor evidence of routine practice. Proposals to extend category-specific requirements to further fields likewise document policy direction rather than generalised implementation (Ministry of Education of the People's Republic of China, 2026; Office of the Academic Degrees Committee of the State Council, 2026). The case thus marks a change in the legally admissible forms of evidence, whose practical scope remains to be established.

2.4. Historical diversity as a problem of institutional and epistemic authority

The historical trajectories examined above challenge the assumption that doctoral professionalisation constitutes a recent, coherent or unidirectional transformation of higher education. Relations between advanced research training, professional activity and industrial development have long been embedded in doctoral institutions, but their purposes and institutional forms have varied considerably. The recognition of technical research in Germany, the differentiation of educational and business doctorates in the United States, the development of engineering research qualifications in France and the post-war expansion of publicly funded doctoral training did not address the same problems. Nor did they establish equivalent relationships between scientific inquiry, professional competence and academic certification. Contemporary policies promoting employability, innovation and university–industry collaboration thus intervene in historically differentiated institutional settings rather than transforming a previously homogeneous doctoral model.

The opposition between academic and professional doctorates obscures important distinctions. Professionally oriented qualifications may retain conventional expectations of originality and academic

assessment, while industrially embedded PhDs may preserve existing certification rules. CIFRE and Denmark's Industrial PhD exemplify participation within research degrees; British and Australian professional doctorates and DBAs involve qualification differentiation; Chinese reforms extend admissible contributions for some professional degrees. What varies is not simply professional orientation, but the institutional location of authority over research problems, resources and assessment.

Nor does industrial participation straightforwardly diminish academic autonomy. Public funding can reinforce university capacity while directing research towards public objectives; employers may provide research settings and resources without determining conclusions or degree decisions. Equally, distinct professional qualifications need not relax research requirements. The analytical question concerns how authority is distributed across the formulation, conduct, evaluation and certification of doctoral inquiry, rather than whether external actors have entered an otherwise autonomous academic sphere.

Shared policy objectives should not be mistaken for convergent practice. Professional doctorates, partnership schemes and alternative forms of doctoral contribution can coexist within one system, reflecting varied combinations of funding, professional organisation and university regulation. Nor does formal institutionalisation show how rules are applied, expectations negotiated or candidates' careers affected.

Doctoral professionalisation is best understood as historically situated institutional differentiation than as diffusion of a single model. Historical diversity alone, cannot explain why configurations arise or whether they alter the standards through which knowledge is authorised. The following comparison examines organisational arrangements, epistemic expectations and certification procedures, distinguishing institutional prescriptions from observed practice to identify where—and with what evidential support—authority over doctoral knowledge may be changing.

3. Corpus and scope of sources

The comparative approach distinguishes national qualification frameworks from the rules governing individual doctoral programmes. The United Kingdom provides an illustration: research PhDs, Engineering Doctorates and other professional doctorates coexist within the same higher education system but differ in organisation and assessment. At Warwick, for example, the Engineering Doctorate combines industry-based research and joint academic–industrial supervision with assessment through a portfolio and oral examination. Such differences cannot be inferred from general policy objectives concerning employability or innovation; they must be established through programme regulations and institutional documentation, supplemented where possible by empirical studies. The comparison accordingly applies common analytical questions to specific institutional arrangements, without assuming that similar features have equivalent implications across cases.

The CIFRE scheme and China's 2024 reform, outlined in Section 2, illustrate two contrasting transformations: company participation in a thesis-based doctorate and the recognition of practical

achievements as doctoral evidence. Empirical research provides a complementary perspective on how such arrangements operate and affect doctoral work.

A systematic review of 54 publications from 2002 to 2023 (38 journal articles and 16 conference papers) documents a research field that expanded after 2015 but remains geographically concentrated, with 45 publications concerning Europe. Evidence remains insufficient regarding three categories of outcomes: doctoral research and graduates' careers, participating firms, and local entrepreneurship and innovation ecosystems. The review identifies "limited quantitative evidence about the impacts of industrial doctorates" (Compagnucci & Spigarelli, 2025, p. 1086). Only five studies use quantitative methods and six mixed methods; the quantitative studies are cross-sectional, with none adopting a longitudinal design. The resulting "lack of longitudinal studies on the impact of industrial PhD programmes" (p. 1095) limits conclusions about long-term outcomes and comparisons of programme effectiveness.

Industrial doctoral education in Sweden has been examined through the experiences of doctoral candidates at University West, across three doctoral fields: informatics specialising in work-integrated learning (WIL; five participants), production technology (six), and WIL as a distinct doctoral field (eight). Participants were employed in public- and private-sector organisations. Reported benefits include "proximity and access to data, project and networks" (Bernhard & Olsson, 2023, p. 506), alongside difficulties concerning employers' understanding of doctoral workloads, multiple roles, institutional belonging, collaboration agreements and ethical issues. The empirical material requires some caution: the abstract mentions 19 semi-structured interviews, whereas the methods describe 19 participants, including two written email responses and one interview involving two students. This inconsistency warrants precision concerning data collection, without invalidating the findings. The study documents experiences within one institutional setting, not their prevalence across Sweden.

Industry-linked engineering research has also been investigated at an unidentified UK public research university, within an engineering department associated with a Centre for Doctoral Training (CDT), a specialised structure providing research training and coordinating industrial collaboration. At the time of data collection, the centre included approximately 90 postgraduate researchers and collaborated with around 40 industrial organisations. The investigation involved 13 participants with heterogeneous academic trajectories and forms of industrial involvement: one was enrolled in a research-based master's programme (MSc by Research), two were pursuing doctorates without industrial involvement after undertaking industry-linked research at master's level, and another had experienced the termination of an industrial partnership after the first year (Wint, 2026).

The findings document tensions concerning research objectives, timescales and responsibilities. Some industrial supervisors expected operational solutions or short-term commercial benefits, while candidates sought exploratory research and original scientific contributions. Divergent academic and industrial expectations also generated uncertainty over supervision and accountability. Participants tended to prioritise academic requirements, reflecting university supervisors' influence over progression, thesis submission and publication. One participant stated: "my loyalties lay with my academic

supervisor" (Wint, 2026, p. 13). Industrial involvement could provide resources, applied experience and career opportunities while imposing additional obligations or constraining independent inquiry. Differences also emerged in how practical application, scientific originality and benefits beyond the sponsoring company were valued. These findings illustrate how organisational integration may introduce competing criteria of research relevance and asymmetrical relationships of authority without necessarily displacing academic control over doctoral progression and certification. Their significance concerns the mechanisms identified within this particular institutional setting, not their prevalence across UK industrial doctorates (Wint, 2026).

Programme documents specify formal requirements, funding arrangements and institutional objectives; empirical research examines how they operate. Thus, the CIFRE and Danish frameworks document company participation alongside university certification, but cannot determine whether candidates experience comparable research time, confidentiality restrictions or supervision. Such differences require evidence from doctoral practice.

To organise this comparison, a case-oriented analytical matrix is used to examine the selected schemes, programmes and qualification routes according to common criteria. Its structure follows the organisational, epistemic and certificative dimensions introduced in the Introduction, distinguishing research arrangements, the roles of academic and professional actors, recognised contributions, and assessment and certification procedures. It is designed to identify where professional involvement affects the conditions of research, the criteria through which contributions acquire value, or the authority responsible for their evaluation. The matrix provides the analytical basis for the cross-case comparison developed in Section 4, whose main results are synthesised in Table 2. This table presents the documented institutional configurations and the corresponding limits of the available evidence, rather than a complete variable-by-variable dataset.

The evidential scope of claims is assessed through five distinctions: R denotes a rule or prescription; I, formal institutionalisation by a university or programme; M, documented implementation involving actual candidates, cohorts or assessments; E, empirically documented practice based on interviews, observations, surveys, case files or comparable evidence; and D, repeated, institutionally stable practice sufficient to establish routinisation. These categories guide the assessment of sources rather than constituting a numerical scale or a coding system reproduced in Table 2. Thus, regulations may substantiate R or I without demonstrating implementation, while qualitative interviews may document E for their participants without establishing prevalence. Initial implementation likewise cannot be equated with routinisation.

The evidence differs considerably across cases. Established schemes in France, the United Kingdom and Scandinavia can be examined through both institutional regulations and empirical studies of research orientations, working conditions, supervision and doctoral experiences, although these findings cannot be generalised across industrial doctorates. More recent initiatives offer a less developed empirical basis. For China's 2024 reform and Australia's National Industry PhD Program, official

documents specify regulatory frameworks and programme arrangements, but provide little evidence of established practices or long-term outcomes. In Indonesia, Regulation No. 39/2025, amended in 2026, allows doctoral final assignments to include dissertations, prototypes and projects. Politeknik Negeri Malang (Polinema) has offered an applied doctorate in mechanical design optimisation since 2024–2025, but available documentation does not confirm whether alternative forms of assessment are actually used. In Russia, emerging workplace-oriented postgraduate initiatives and proposals for joint academic–industrial supervision remain insufficiently documented to verify their implementation or any change in doctoral certification. These differences require distinguishing established institutional arrangements from demonstrated practices and outcomes, particularly where reforms are recent or empirical evidence remains limited (Office of the Academic Degrees Committee of the State Council, 2024, 2026; You, 2026; Southeast University, 2026; Australian Government Department of Education, 2026; Republic of Indonesia, 2025; Ministry of Higher Education, Science and Technology of Indonesia, 2026; Politeknik Negeri Malang, 2026; Ministry of Science and Higher Education of the Russian Federation, 2026; Nefedova et al., 2026).

The empirical record is thus asymmetrical: established schemes offer some evidence of practice, whereas newer configurations often remain accessible mainly through policy and programme documentation. The comparison identifies institutional possibilities without equating them with demonstrated outcomes.

4. Results: What changes in doctoral work?

The comparison of doctoral configurations raises a question that cannot be resolved through programme regulations alone: to what extent does professional involvement actually transform the conduct, purposes and recognition of doctoral research? Employment arrangements, joint supervision and industry-oriented objectives create opportunities for collaboration, but do not determine how candidates experience their work, how research findings are mobilised or how competing expectations are negotiated. Empirical investigations provide contrasting evidence on these issues, suggesting that organisational integration, professional relevance and academic authority do not necessarily evolve together.

The Danish experience first challenges the assumption that industrial participation invariably produces distinctive doctoral working conditions. A survey of engineering doctoral candidates and supervisors at Aalborg University obtained 269 responses from 399 invited candidates and 113 from 173 invited supervisors; industrial PhD candidates represented approximately 15% of doctoral respondents. No statistically significant differences were identified between industrial and university-based candidates on the measured dimensions (Kolmos et al., 2008). This finding does not imply equivalent experiences, particularly given the limited industrial subgroup. The average workload of nearly 46 hours per week and reported pressures concerned respondents overall, rather than industrial candidates specifically. Nevertheless, the absence of measured differences within this institutional setting questions any straightforward association between employer participation and a distinct doctoral experience.

The significance of professional involvement may lie less in formally differentiated working conditions than in what doctoral inquiry makes possible within professional settings. A collaborative enquiry involving alumni of two part-time, work-based Doctor of Professional Studies programmes offers a complementary perspective. Of ten initial participants, seven remained active through the final stage; five reported mobilising research findings or related insights to initiate or influence workplace changes, while four described broader community or cultural effects (Boud et al., 2021, author-accepted manuscript, p. 8). These accounts suggest that professional relevance cannot be reduced to the immediate application of research results. It may also emerge through capabilities developed during doctoral inquiry, including the capacity to investigate, question and reinterpret professional practices. Yet these reported changes cannot demonstrate causal effects or their wider prevalence.

Such possibilities must nevertheless be considered alongside the institutional tensions created by participation in separate professional and academic communities. The Swedish investigation discussed in Section 3 documents this ambivalence particularly clearly. Access to workplace problems, professional networks and research resources coexisted with workload pressures, competing responsibilities and uncertain institutional belonging. As the study observes, “Most industrial PhD students accentuate feeling alone during PhD education” (Bernhard & Olsson, 2023, p. 514). Organisational proximity between universities and workplaces does not automatically produce intellectual or social integration. The experience of occupying two institutional settings may entail access to additional resources without securing recognition or support within either.

The question becomes still more consequential when academic and professional expectations diverge over what constitutes worthwhile research. In the heterogeneous UK postgraduate sample examined in Section 3, tensions concerned research objectives, timescales, accountability and the respective expectations of academic and industrial supervisors. Participants tended to privilege academic requirements when disagreements arose, reflecting the university's continuing influence over doctoral progression, submission and publication (Wint, 2026). Although the sample included master's researchers and cannot characterise UK industrial doctorates generally, it reveals a possible asymmetry: professional organisations may contribute substantially to the conditions and direction of inquiry while academic actors retain decisive influence over its formal recognition.

These studies neither measure a common effect nor permit direct comparison of outcomes: their populations, methods and institutional settings differ. Together, however, they show that limited measured differences in working conditions can coexist with professional capabilities, contested research priorities and unequal recognition. Expanded professional participation need not change how doctoral contributions are assessed.

These findings provide the basis for examining three dimensions of hybridisation introduced earlier: organisational arrangements governing employment, resources, research settings and supervision; epistemic negotiations over originality, rigour, technical performance and practical usefulness; and certificative rules determining admissible evidence, examination and degree-awarding authority. The

distinction between breadth and depth is particularly important. Breadth refers to the range of doctoral activities in which professional actors or criteria are involved, whereas depth concerns the extent to which their influence reaches the definition and evaluation of doctoral contributions. Neither implies an ordered progression towards a more professional doctorate. The central comparative question is how these dimensions combine, diverge or remain institutionally separated across the configurations examined below.

4.1. Organisational breadth without certificative depth

The distinction between professional involvement in doctoral research and authority over certification is particularly evident in workplace-based research conducted within existing university degrees. The French CIFRE scheme exemplifies this configuration: employers participate in defining research problems and providing resources, while thesis examination remains under university authority. Research conditions accordingly depend on negotiations among candidates, employers and academic laboratories (Perrin-Joly, 2010; Renault-Tinacci, 2020; de Féraudy et al., 2024).

Employer participation does not automatically orient research towards immediate application. Two complementary analyses of the same 631 CIFRE projects completed in 2018—not independent replications—show that basic research predominates, while the less frequent category of user-inspired fundamental research generates the highest scientific and inventive yield (Plantec et al., 2023). Basic research accounts for 61% of projects, independently of discipline, company size or university type (Cabanes et al., 2025). These findings challenge the opposition between academic and industrial research, without revealing how priorities were negotiated or whose expectations prevailed.

Research orientation must also be distinguished from doctoral working conditions. A separate survey of 391 respondents in the humanities and social sciences—267 current CIFRE candidates, 118 doctorate holders and six who discontinued their doctorate—documents unequal access to resources and differences in workplace supervision (de Féraudy et al., 2024). Weaker academic socialisation is associated with some graduates' trajectories towards positions at the margins of teaching and research. Fundamental research within industrial partnerships does not guarantee equivalent opportunities for academic integration or professional development, although these findings remain specific to the populations examined.

Comparable arrangements distribute responsibilities differently while preserving academic certification. The Danish Industrial PhD combines company employment, university enrolment and dual supervision. Projects must demonstrate research and business relevance, but dissertations remain subject to university assessment and defence (Innovation Fund Denmark, 2026). In the USA, at Northeastern University, industry advisers may participate in dissertation committees without altering PhD requirements. IIT Madras similarly permits employer-based co-guides within its External PhD route, while retaining external academic examination and a viva (Northeastern University, n.d.; Indian Institute of

Technology Madras, 2024; University Grants Commission, 2022). Professional participation thus extends into supervision and examination without transferring degree-awarding authority.

Other configurations reinforce this distinction. In South Korea, the Sungkyunkwan University (SKKU)–Samsung partnership coexists with current dissertation-centred doctoral rules, although their continuity throughout the collaboration remains undocumented (Sungkyunkwan University, College of Information and Communication Engineering, n.d.; Sungkyunkwan University, Office of International Student Services, n.d.). Japanese policies promoting industry engagement, employee doctorates and career diversification do not demonstrate changes in admissible doctoral evidence (Ministry of Education, Culture, Sports, Science and Technology of Japan, 2024). Australia's National Industry PhD Program formally incorporates industry co-design, workplace research and joint supervision while retaining university thesis assessment and degree award (Australian Government Department of Education, 2026).

These configurations distinguish formal certification authority from the potentially unequal influence exercised over research problems, resources, working conditions and supervision. Retaining university examination does not guarantee academic autonomy throughout the research process: professional actors may shape the production of doctoral knowledge without controlling its final certification.

4.2. Epistemic hybridisation: from coexistence to arbitration

Epistemic hybridisation concerns more than the coexistence of scientific originality, methodological rigour and practical usefulness. It raises a question about the distribution of authority: how do academic and professional criteria enter the research process, how are they articulated or negotiated, and who determines their relative importance? Addressing this question requires distinguishing the orientation of research, the influence exercised over its conduct and the criteria through which its contributions are recognised.

The CIFRE evidence first demonstrates why research orientation cannot be taken as a measure of institutional influence. Two complementary analyses of the same 631 projects completed in 2018 show that basic research accounts for 61% of projects, while the less frequent category of user-inspired fundamental research is associated with the highest scientific and inventive yield (Plantec et al., 2023; Cabanes et al., 2025). These findings challenge the assumption that employer involvement invariably redirects doctoral research towards immediate application. They do not, however, reveal who defined research problems, negotiated priorities or resolved disagreements. Fundamental research can thus coexist with substantial employer influence over the conditions and direction of inquiry.

The question then shifts from the scientific orientation of projects to the negotiation of research priorities. The UK interviews document tensions over objectives, timescales and accountability, with candidates navigating academic and industrial expectations while university supervisors retained considerable influence over doctoral progression and publication (Wint, 2026). This suggests an asymmetrical distribution of authority: professional actors may shape research priorities without always

controlling the recognition of scientific contributions. Yet the evidence does not show that such tensions are systematic or that academic criteria invariably prevail.

A further distinction is necessary, however, between negotiating competing expectations and articulating multiple forms of knowledge. The Norwegian architectural case shows how professional design practice may contribute to an ordinary doctoral research process without invariably conflicting with scholarly requirements (Schlegel & Keitsch, 2016). Professional and academic criteria may thus become mutually productive rather than competing claims to legitimacy.

These cases trace a progression from the coexistence of diverse research orientations to the negotiation of expectations and their possible articulation within inquiry. They also identify the limits of the available evidence: neither professional participation nor observed tensions demonstrate how conflicting criteria are ultimately arbitrated. Establishing a redistribution of epistemic authority requires examining the decisions through which research problems are defined and contributions recognised, rather than inferring it from programme objectives or research classifications.

4.3. Certificative hybridisation: changing what can count as doctoral contribution

Certificative hybridisation raises a question separate from professional participation in doctoral research: under what conditions can contributions other than a conventional dissertation acquire doctoral legitimacy? The issue concerns not only acceptable research outputs, but also the relationship between their recognition, assessment criteria and degree-awarding authority. Comparing institutional configurations reveals how these dimensions may be modified separately.

In the United Kingdom, the Warwick Manufacturing Group (WMG) Engineering Doctorate shows how assessment can accommodate industry-based research within an academically governed qualification. Candidates submit a portfolio for oral examination, developed through projects involving academic and industrial supervision (University of Warwick, n.d.). Other British professional and practice-based doctorates combine written work, portfolios, practical outputs and commentary through varied arrangements. The national quality framework accommodates this diversity without prescribing a uniform assessment model (Quality Assurance Agency for Higher Education, 2020). Recognition at doctoral level does not imply identical forms of contribution.

This distinction also applies to Australia, where the Qualifications Framework places Professional Doctorates at the same level as research doctorates while associating original contributions with professional practice. However, recognition of a qualification type does not determine how individual programmes assess those contributions (Australian Qualifications Framework, n.d.; Maxwell, 2003). The Dutch 4TU Engineering Doctorate represents an alternative institutional choice: technological design and validated solutions to industrial or public-sector problems underpin a separate professional third-cycle qualification, rather than an alternative assessment route within the research PhD (4TU.School for

Technological Design, 2022). The contrast concerns not simply assessment formats, but the differentiation of qualifications themselves.

China's 2024 reform introduces another configuration by permitting specified practical achievements to be defended instead of dissertations within eligible professional engineering doctorates. Assessment requirements explicitly connect doctoral contributions to engineering problems, practical effectiveness and technological innovation (National People's Congress of the People's Republic of China, 2024; Office of the Academic Degrees Committee of the State Council, 2024). Unlike the Dutch route, this changes admissible contributions within an authorised degree framework. Documented defences establish initial implementation, but not how routinely alternative outputs are accepted or how examiners reconcile practical effectiveness with scientific requirements. Degree-awarding authority remains with authorised institutions (You, 2026; Southeast University, 2026; Office of the Academic Degrees Committee of the State Council, 2026).

Indonesia exposes a related distinction between regulatory change and assessment practice. Regulation No. 39/2025, amended in 2026, permits doctoral and applied-doctoral final assignments including dissertations, prototypes and projects, while Polinema operates an applied doctoral programme. Neither establishes how frequently alternative outputs are accepted (Republic of Indonesia, 2025; Ministry of Higher Education, Science and Technology of Indonesia, 2026; Politeknik Negeri Malang, 2026).

Across these configurations, changing what may count as a doctoral contribution need not redistribute degree-awarding authority. The more consequential question is how alternative contributions acquire legitimacy through actual assessment decisions, a process that formal recognition alone cannot demonstrate.

4.4. Hybridisation as variable geometry

These configurations do not form a continuum from academic to professional doctorates. Employment and supervision may change without altering dissertation rules; alternative contributions may be recognised while degree authority remains academic. The relevant question is where change occurs and who decides.

Table 2 synthesises the selected schemes and programmes alongside qualification routes, policy frameworks and pilots. Rather than ranking cases, it distinguishes documented research arrangements, recognised contributions, assessment procedures and evidential limits.

Table 2
Comparison of selected doctoral programmes and routes

Case and level of evidence	Organisation of research	Recognised doctoral contributions and assessment requirements	What the sources support
France: CIFRE national scheme	Company employment; research involving a company and an academic laboratory; shared supervision and negotiated project conditions.	Thesis examined under university procedures; the university awards the degree.	Project and candidate studies document orientations, working conditions and trajectories (Perrin-Joly, 2010; Renault-Tinacci, 2020; Plantec et al., 2023; Cabanes et al., 2025; de Féraudy et al., 2024). Company involvement does not itself change the formal thesis requirement.
Denmark: Industrial PhD programme	Candidate is a company employee and university student; research takes place across the two settings with company and academic supervision.	Dissertation assessed and defended under university procedures.	Programme rules and one university survey document the model (Innovation Fund Denmark, 2026; Kolmos et al., 2008); the survey is not a national estimate.
UK: Warwick WMG Engineering Doctorate, a named programme	Industry-based projects; academic and industrial supervisors; taught modules.	Portfolio submitted for oral examination.	The programme's official description documents this assessment route (University of Warwick, n.d.).
UK: professional and practice-based doctorates, a heterogeneous qualification family	Varies by programme and professional setting.	May combine dissertation, portfolio, practice outputs and critical commentary.	The framework recognises variation, not a single assessment model (Quality Assurance Agency for Higher Education, 2020).
Netherlands: 4TU Engineering Doctorate, a named qualification route	Technological design work addressing an industrial or public-sector problem.	Design-based contribution and validated solution within a professional third-cycle qualification.	A distinct qualification route, not a research PhD with another thesis format (4TU.School for Technological Design, 2022).
Australia: Professional Doctorate, qualification type and varied programmes	Varies by programme; professional practice is central to the route.	Original contribution is situated in relation to professional practice; programmes specify evidence and assessment.	The framework establishes a qualification type, not uniform procedures (Australian Qualifications Framework, n.d.; Maxwell, 2003).

Case and level of evidence	Organisation of research	Recognised doctoral contributions and assessment requirements	What the sources support
Australia: National Industry PhD Program	Industry co-design, workplace research and joint supervision.	PhD thesis and university award procedures retained.	Official documents establish programme design; early documentation does not establish routine practice or long-term outcomes (Australian Government Department of Education, 2026).
China: practical-achievement route for specified professional engineering doctorates	University–enterprise training centred on real engineering problems; engineering expertise may enter evaluation.	A dissertation or defined practical achievement may be accepted under specified conditions; the authorised university awards the degree.	Law, requirements and early defences establish authorisation and implementation, not routine use (National People's Congress of the People's Republic of China, 2024; Office of the Academic Degrees Committee of the State Council, 2024, 2026; You, 2026; Southeast University, 2026).
United States: Northeastern University Industry PhD, a named institutional programme	Industry employment and workplace research; an industry adviser may participate in the dissertation committee.	University PhD requirements and dissertation procedures govern the degree.	Institutional documentation distinguishes employer participation from university authority over certification (Northeastern University, n.d.).
South Korea: SKKU–Samsung collaboration	Long-standing university–industry collaboration.	Current doctoral regulations remain dissertation-centred.	The sources show collaboration alongside current thesis-based rules, not continuity since the collaboration began (Sungkyunkwan University, College of Information and Communication Engineering, n.d.; Sungkyunkwan University, Office of International Student Services, n.d.).
India: IIT Madras External PhD, a named institutional route	Workplace research may be supported by an employer-based co-guide alongside an IIT guide.	Thesis, academic external examination and viva.	Programme rules show workplace participation within academic assessment procedures (Indian Institute of Technology Madras, 2024; University Grants Commission, 2022).
Japan: policy contrast, not a distinct programme case	Policies promote industry engagement, employee	The reviewed sources do not establish a corresponding	Policy contrast only; the reviewed sources do not identify a separate scheme or assessment reform (Ministry

Case and level of evidence	Organisation of research	Recognised doctoral contributions and assessment requirements	What the sources support
	doctorates and career diversity.	change in recognised outputs or assessment.	of Education, Culture, Sports, Science and Technology of Japan, 2024).
Indonesia: national regulation and Polinema applied doctorate	Rules permit applied doctoral work; programme materials confirm an applied doctorate is operating.	Dissertation, prototype, project or comparable final assignment may be permitted.	The sources establish formal permission and programme existence, not the frequency of alternative assessment (Republic of Indonesia, 2025; Ministry of Higher Education, Science and Technology of Indonesia, 2026; Politeknik Negeri Malang, 2026).
Russia: production-oriented aspirantura initiatives and proposals	Policy sources describe workplace-oriented postgraduate training; comparative research recommends dual academic–industrial supervision.	Available sources do not establish routine dual supervision or that industrial results replace dissertations or modify degree decisions.	Policy description and research recommendations must be distinguished from verified implementation (Ministry of Science and Higher Education of the Russian Federation, 2026; Nefedova et al., 2026).

Note. The table compares several types of institutional arrangements, including specific doctoral programmes, distinct qualification routes, national policy frameworks and experimental initiatives.*They are not rankings. Where the available sources establish only formal permission or early implementation, the table states that limit.*

Table 2 shows that professional influence over research conditions need not entail authority over assessment, while changes to admissible contributions need not transfer degree-awarding powers.

Organisational, epistemic and certificative changes need not coincide. Section 5 examines the institutional mechanisms behind these combinations.

5. Institutional mechanisms shaping doctoral configurations

The diversity documented in Table 2 raises an explanatory question: why do comparable demands for professionally relevant research produce contrasting doctoral configurations? Four mechanisms can be distinguished by the institutional level at which change occurs: layering new employment and funding arrangements onto existing doctorates; differentiating professional qualifications from research PhDs; redesigning doctoral programmes to incorporate professional participation; and modifying the criteria

for recognising doctoral contributions. These mechanisms differ in how they redistribute responsibilities and authority over research and certification.

Similar policy pressures do not operate independently of institutional history. Comparative institutionalism highlights how established relationships among universities, employers and public authorities shape the funding, organisation and recognition of advanced research training (Hall & Soskice, 2001; Busemeyer & Trampusch, 2012). This perspective helps explain institutional diversity without assigning countries to homogeneous national models: multiple mechanisms may coexist within the same higher education system.

The first mechanism, institutional layering, adds employment, funding and partnership arrangements to an existing doctorate while preserving its certification rules. In France, CIFRE combines employment by a partner organisation, public support and university laboratory supervision, while retaining the national doctorate (ANRT, n.d.). Denmark's Industrial PhD similarly links company employment and university research through joint applications and funding for salaries, supervision, equipment and training (Innovation Fund Denmark, 2026). Both extend professional involvement without transferring degree-awarding authority. Their differences concern how cooperation is organised and financed, while the effects of unequal resources and bargaining positions on research autonomy remain empirically open.

A second mechanism, qualification differentiation, establishes professional or technological routes alongside the research PhD. British professional doctorates operate within a common doctoral-level quality framework but retain programme-specific assessment requirements, as illustrated by the Warwick EngD (Quality Assurance Agency for Higher Education, 2020; University of Warwick, n.d.). The Dutch 4TU Engineering Doctorate instead constitutes a separate post-master's qualification centred on technological design and industrial problem-solving (4TU.School for Technological Design, 2022). These routes are not equivalent awards. What they share is the institutional differentiation of qualifications not the incorporation of employers into an otherwise unchanged PhD.

The third mechanism concerns programme-level integration: professional participation is organised within an existing PhD through specific research, supervision and funding requirements, without creating a separate qualification. Australia's National Industry PhD Program organises this through two streams. Industry Linked candidates undertake jointly designed projects and spend 20–50% of their candidature with an industry partner; Industry Researchers pursue doctoral research while remaining employed (Australian Government Department of Education, 2026). Northeastern University's Industry PhD similarly integrates employer participation within university doctoral requirements (Northeastern University, n.d.). Unlike qualification differentiation, these arrangements preserve the PhD; unlike layering alone, they specify how professional involvement is incorporated into the doctoral programme. Neither industry relevance nor employer participation independently changes thesis examination requirements.

The fourth mechanism, coordinated regulatory redesign, modifies what may be recognised for degree certification. China's 2024 legislation and subsequent engineering requirements permit specified practical achievements to replace conventional dissertations under defined conditions, while authorised

institutions retain degree-awarding powers (National People's Congress of the People's Republic of China, 2024, art. 21; Office of the Academic Degrees Committee of the State Council, 2024). An October 2026 ministry announcement reported more than 400 engineering degree recipients through this route, combining master's and doctoral levels without specifying the doctoral share or institutional distribution (Ministry of Education of the People's Republic of China, 2026). Proposals to extend category-specific requirements to further fields indicate regulatory ambitions, not established practice (Office of the Academic Degrees Committee of the State Council, 2026). The distinctive change thus concerns admissible doctoral contributions, while its implementation and effects remain insufficiently documented.

Japan provides a contrasting case of reform directed primarily towards doctoral conditions and careers. Its 2024 action plan promotes broader employment opportunities, including outside academia, without demonstrating changes to the criteria for awarding doctorates (Ministry of Education, Culture, Sports, Science and Technology of Japan, 2024). Professionalisation policies need not activate any of the same certification mechanisms.

The four mechanisms are neither mutually exclusive nor stages of a common transition. They identify several institutional levers through which professional priorities may affect doctoral work, from employment and programme organisation to qualification structures and assessment criteria. Their comparison reveals why changes in research conditions need not coincide with changes in academic authority. Table 3 summarises these distinctions and the limits of the available documentation.

Table 3
Institutional mechanisms shaping doctoral configurations

Mechanism	Institutional lever	Illustrative case	What the evidence supports
Layering	Adds employment or partnership funding around an existing PhD.	France: CIFRE; Denmark: Industrial PhD.	Employer participation and funding are reorganised; the university retains doctoral certification (ANRT, n.d.; Innovation Fund Denmark, 2026).
Differentiation	Creates a qualification route alongside the research PhD.	UK: Warwick EngD; Netherlands: 4TU EngD.	Professional or technological work is recognised through distinct programme or qualification rules; formats vary by programme (University of Warwick, n.d.; 4TU.School for Technological Design, 2022; Quality Assurance Agency for Higher Education, 2020).
University-level programme design	A university organises employer participation within its existing PhD authority.	United States: Northeastern Industry PhD.	An employer can participate in supervision and committee work; this is one programme leading to the university PhD, not a national model (Northeastern University, n.d.).
Coordinated redesign	Legal authority is translated into field-specific evidence and assessment requirements.	China: professional engineering doctorate; 2026 staged policy expansion.	More than 400 engineering graduates at master's and doctoral levels reportedly received degrees through practical achievements, counted together; the doctoral total, prevalence and uniformity remain unknown (National People's Congress of the People's Republic of China, 2024; Office of the Academic Degrees Committee of the State Council, 2026; Ministry of Education of the People's Republic of China, 2026).

The comparison redirects attention from the common rhetoric of professionalisation to the asymmetric distribution of institutional authority. Employers and funders may gain influence over research agendas, resources and working conditions while universities retain certification; changes to admissible evidence may occur without transferring degree-awarding powers. Whether these formal configurations alter doctoral researchers' autonomy and the validation of knowledge remains an empirical question, not an effect that can be inferred from programme design alone.

6. Discussion: Doctoral authority and knowledge regimes

The diversification of doctoral configurations raises a question extending beyond the professionalisation of research training: does it signal a transformation of contemporary knowledge regimes, or the adaptation of doctoral institutions to changing expectations within established social and epistemic orders? Three influential approaches offer alternative interpretations of these transformations. The distinction between Mode 1 and Mode 2 contrasts two forms of knowledge production: Mode 1,

organised primarily within universities and academic disciplines, where research problems and standards of validity are defined by scientific communities; and Mode 2, in which knowledge is produced across institutional and disciplinary boundaries, in contexts of application, with more diverse actors participating in the definition of research problems and criteria of relevance (Gibbons et al., 1994). The concept of academic capitalism describes how universities increasingly engage in market-oriented activities, competing for funding, commercialising research and developing closer relationships with economic actors. It examines how these practices reshape institutional priorities and academic work, rather than simply suggesting that universities become commercial enterprises (Slaughter & Rhoades, 2004). From another historical perspective, the institutionalisation of innovation-oriented science policy shows how universities and scientific research came to be increasingly valued and governed according to their expected contributions to technological development and economic growth (Popp Berman, 2012). While both approaches examine the growing economic orientation of research, they address specific institutional processes, not a uniform transformation of knowledge production. This distinction also calls for caution towards the presumed historical succession of Mode 1 and Mode 2: “contrasts between ‘Mode 1’ and ‘Mode 2’ are not compelling in historical terms” (Pestre, 2003, p. 245).

A knowledge regime is understood here not as a successive mode of research production, but as a historically constituted configuration of institutions, practices, resources, relations of authority and principles of legitimacy through which knowledge and social order are jointly organised. This conception draws on neo-institutionalist analyses of historically embedded institutional relationships and their transformations (Hall & Soskice, 2001; Busemeyer & Trampusch, 2012), together with the STS perspective on the co-production of knowledge and social order (Jasanoff, 2004). It also encompasses the collective beliefs through which particular purposes of knowledge acquire legitimacy. Innovation, in this perspective, operates not merely as an economic objective but as an organising belief that shapes institutional priorities, justifies reforms and sustains expectations of societal progress (Ruano-Borbalan, 2024). Historical transformations of scientific practices and their political organisation further caution against treating such orientations as entirely new or institutionally uniform (Jasanoff, 2004, pp. 1–12).

The comparison exposes a tension between concentrated academic certification and more distributed control over research production. Decisions about problems, resources, methods and usefulness shape what can be known before examination. Conversely, recognising alternative contributions may alter legitimate outputs without shifting institutional authority. A change in knowledge regimes would involve more than new programme structures: it would concern how scientific validity, professional relevance and institutional legitimacy are negotiated and stabilised.

University degree-awarding powers do not guarantee autonomy throughout inquiry, just as recognition of practice-based work does not demonstrate the displacement of scientific standards. Formal authority and effective influence must be examined together.

Candidate-level investigations in Sweden and France make these tensions observable through supervision, coordination and working conditions (Bernhard & Olsson, 2023; de Féraudy et al., 2024).

They reveal how doctoral researchers negotiate institutional expectations, although their limited scope precludes generalisation about completion, wellbeing or careers. More broadly, common policy objectives do not imply comparable practices or outcomes. Japan's emphasis on careers beyond academia (Ministry of Education, Culture, Sports, Science and Technology of Japan, 2024) and China's recognition of specified practical achievements in doctoral assessment (National People's Congress of the People's Republic of China, 2024, art. 21; Office of the Academic Degrees Committee of the State Council, 2024) illustrate contrasting institutional translations of professional relevance. Neither establishes innovation outcomes or how scientific originality and practical usefulness are reconciled in actual assessment. The prominence of innovation as a legitimating doctrine must be distinguished from its demonstrated institutional consequences (Ruano-Borbalan, 2024).

The findings support selective and differentiated reconfigurations, not an established new knowledge regime. Innovation-oriented expectations coexist with persistent institutional and epistemic diversity. Whether these changes become durable depends on actual decisions concerning research priorities, assessment, the uses of doctoral contributions and subsequent careers; policy convergence or new qualification rules alone cannot establish such a transformation.

7. Conclusion

Professionalisation does not lead to a single institutional transformation. Employment and supervision can change while thesis assessment remains intact; professional qualifications can recognise other contributions while retaining degree authority. The question is how influence is distributed across inquiry, valuation and certification.

Historically established qualifications, funding instruments and relationships among universities, employers and public authorities shape these differences. Layering, differentiated qualifications, university-level arrangements and regulatory redesign are distinct, potentially coexisting responses to demands for relevance. Shared objectives should not be mistaken for convergent doctoral practice.

Programme documents identify formal requirements, while candidate-level studies document tensions over research time, supervision, autonomy and professional resources without demonstrating prevalence or causal effects on completion, employment or innovation. Doctoral policy assessment must consider working conditions and subsequent careers, not merely partnership counts or declared employability objectives.

These configurations raise, but do not settle, questions about knowledge regimes. Employers may influence research agendas while universities retain certification; revised admissibility rules do not demonstrate how examinations operate. Longitudinal evidence on decisions, doctoral outputs, their uses and careers is necessary to assess durable transformations in knowledge production and legitimation.

Declarations

Ethics declaration

Not applicable. The study did not recruit human participants or use identifiable personal data; it analyses published research and public institutional and policy materials.

Competing Interests

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Author Contribution

Jean-Claude Ruano-Borbalan was solely responsible for the conceptualisation of the study, development of the theoretical and comparative framework, methodology, investigation, collection and analysis of documentary sources, interpretation of findings, and preparation and revision of the manuscript. He reviewed and approved the final version and accepts full responsibility for its content.

Data Availability

This study is based exclusively on published research, legislation, policy documents and institutional programme materials, all identified in the article and its references. No original participant-level dataset was generated. The sources underpinning the comparative analysis are publicly available through the cited publications and institutional sources.

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