

# Projectification of Doctoral Training? How Research Fields Respond to a New Funding Regime

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**Abstract** Funding is an important mechanism for exercising influence over ever more parts of academic systems. In order to do so, funding agencies attempt to export their functional and normative prerequisites for financing to new fields. One essential requirement for fundees is then to construct research processes in the form of a project beforehand, one that is limited in time, scope and content. This article demonstrates how the public funding of doctoral programs expands this model of project research from experienced academics to the socialization process for the new academic generation. This process of “projectification” underlies funding-driven institutional changes in doctoral training. A multi-level comparative study of German policies, funding mechanisms and organizational frameworks for doctoral training demonstrates the emergence of a specific model of predefined PhD projects. The investigation of doctoral training practices reveals that socio-epistemic pre-conditions regulate whether research fields adopted or rejected this demanding model. This result contradicts widespread claims about a radical change in doctoral training and suggests focusing on the actual practices of field-specific doctoral research.

**Keywords** Funding · Institutional change · Doctoral training · Projectification · Research fields

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## Introduction: Funding-Driven Institutional Change and the Projectification of Doctoral Training

For about two decades, a new powerful model of formally organized, “structured” doctoral training has evolved across the globe and now competes with the traditional concept of internal academic apprenticeship. In the traditional system, advisors, PhD students and faculty colleagues shape the process of doctoral socialization. PhD students conduct original research in order to advance knowledge and gradually become independent researchers under the supervision of experienced scholars (Laudel and Gläser 2008; Gardner 2008).

The new model of structured doctorates comprises certain elements of the US graduate school system, particularly the formation of formal organizations, competitive selection procedures, intensive coursework or collectively organized supervision, and neglects other features such as the early selection and long-term socialization of PhD students in two distinct phases or the leading role of the faculty.

Global science policy discourses promote this new model of doctoral training, justify the public funding of increased PhD production with the needs of knowledge economies, and assign universities more institutional responsibility to ensure the timely, effective and predictable completion of doctorates (Byrne et al. 2013; Nerad and Heggelund 2011; Kehm 2009). Throughout this policy discourse, the traditional apprenticeship model has been criticized and delegitimized as an outdated, non-transparent, asymmetric, irresponsible, highly individual, too loosely structured and inefficient relationship between advisors and PhD students. Long time-to-degrees, low completion and high attrition rates have come under increasing scrutiny among politicians and in the public debate worldwide (Nerad and Heggelund 2011; Gardner 2009). As a result, the purpose and meaning of doctorates has been reinterpreted from an open-ended process of internal professional socialization to a defined “third cycle” of academic training increasingly shaped by formal organizations (Kehm 2009).

In many countries, normative pressures, formal regulations and funding mechanisms implemented the model of structured doctorates (Green and Powell 2005; Byrne et al. 2013). Most studies focus on external drivers of institutional change in doctoral training and theorize it as a shift in the authority relations from individual and departmental to institutional responsibility (Kehm 2009) and trend towards neoliberal “managerialism” (Connell and Manathunga 2012) or the “industrialization of doctoral training” (Louvel 2012). Substantial claims about institutional change need to take into account that institutions as generalized expectations about adequate forms of doctoral training are shaped at different and often competing levels (Scott 2001). For this reason, the analysis of institutional change must be expanded from the levels of normative policy discourses on doctoral training, regulative funding rules and formal organizational frameworks of doctoral programs to the cognitive level of social and epistemic rules that shape field-specific doctoral training practices. Gläser et al. (2010) suggest focusing on specific social mechanisms that link multiple levels. This study considers the project form as one

crucial mechanism because it is a “basic organizing principle” (Felt 2017) of research, a “premise for decision-making” (Besio 2009) among funding agencies and underpins the belief of policymakers that the “development of a research project is the most effective way of training of research” (Ruberti 2001). The term “projectification” (Ylijoki 2016) conceptualizes the complex relationship between science policy, funding agencies, research organizations and practices as the enforcement, diffusion and adaption of a specific project mode of research in doctoral training. This mode has emerged in a long historical process, particularly in research organizations and funding environments to select, direct, coordinate and control research processes (Torka 2012). It has been argued that this mode inverts the temporal order of research (Ylijoki 2015), privileges directed over “freely roaming inquiry” (Dodds 1954) as well as collaborative team work (Vermeulen 2009) and impacts the process and content of research differently (Gläser et al. 2010; Torka 2009). These studies reveal the inherent expectation of the project form that research in general should not simply emerge over time but should be conceived in the form of a project beforehand. In order to assess, select, evaluate and monitor future research, one has to know as precisely as possible what the research will concern, how it will proceed and when it will end. Not surprisingly, many scholars criticize the consequences of predefined projects. The predictability and short-term orientation of projects run against the notion of academic freedom and the idea that science needs to be open-ended in order to embrace the unbounded creativity of the researchers. By contrast, predefined projects tend to privilege already codified over novel, uncertain knowledge; theory and application of methodology over building upon it; hypothesis testing over creation or, in short, “normal science” over revolutionary, risky or unorthodox science (Laudel 2006; Torka 2012). Empirical studies emphasize that research fields respond differently and in a creative way to this uniform expectation due to field-specific epistemic, social and temporal conditions. While some types of research fit, others cope with the project form by ending, changing, thinning, combining or using Master’s and PhD theses to continue research trajectories (Gläser et al. 2010). The transfer of the notion of predefined projects from the field of funded research to doctoral training and from experienced researchers to PhD students are a recent phenomenon. Most studies assume similar consequences at all levels of doctoral socialization. It has been argued that the selection of doable PhD projects and already advanced PhD students impacts social equality as well as the advancement of knowledge (Neumann 2007; Fochler et al. 2016) and ignores that only the progress in individually meaningful projects facilitates PhD completion (Devos et al. 2017). The focus on completion of individual PhD projects and outputs supports the “individualization” (Müller 2014) of PhD students and leads to a lack in collegiality and responsibility (White 2013). New role patterns for advisors such as “managers” and “leaders” (Vilkinas 2002) emerge and give rise to “double roles” and role conflicts in a “twin function of supervisor and project leader” (Franke and Arvidsson 2011). The preference for “fast” (Green and Usher 2003) and more “directive” (Deuchar 2008) supervision styles turns the complex supervisory relationship into a “technical process” (Connell and Manathunga 2012), thus reducing the supervisory communication from critical discourse on content to the

monitoring of outputs (Münch 2014) or from a “creative” to a “master-slave mode” (Grant 2010) of supervision.

The underlying assumption of these studies is that project-related organizational structures have a direct impact on doctoral training practices, have led to a radical “paradigm shift” and a uniform trend towards “converging practices” (Nerad 2010, 2012). These approaches tend to overestimate impacts of external regulations, ignore field-specific norms, concepts, epistemic as well as social preconditions inherent to doctoral training practices and still lack empirical evidence. Quantitative studies hardly identify systematic differences between traditional and new forms of doctoral training in terms of general expectations about supervision, exchange frequency or quality and confirm that individual relationships between advisors and PhD students remain central in structured doctorates (BUWIN 2013). Increases in more directive supervisions are limited to specific research fields such as health sciences (Wichmann-Hansen and Herrmann 2017), and significant decreases in time required to finalize a degree cannot be confirmed across research fields (Enders and Kottmann 2009; NSF 2017). Qualitative studies show how traditional and new norms, styles, roles or ways of topic and PhD candidate selection co-exist within and across fields (Neumann 2007) and conclude that “a strong interplay [exists] between continuity and change” (Louvel 2012) in current doctoral training practices. A radical shift is unlikely as long as “old” and “new” models of doctoral training overlap and compete in practice.

The analysis of projectification processes as drivers of institutional change in doctoral education needs to elaborate whether policies and funding rules promote the model of predefined projects, if different research fields implement this uniform model to a similar degree, and how advisors and PhD students respond to it in practice. This multi-level case study focuses on the German doctoral training system, specific policies and funding mechanisms for doctoral training, and analyzes training practices in the fields of social science and physics within new structured doctoral programs. The next section briefly describes the German doctorate system. The following sections outline the design, data and methods of the study and then analyze the emergence of project-related policies and funding conditions. The findings section demonstrates that research fields implement, interpret and use projects differently in organizational frameworks as well as in doctoral training practices. The conclusions emphasize the crucial role of epistemic and social preconditions and summarize implications for the analysis of funding-driven institutional change and projectification processes. In addition, suggestions for future research going beyond the empirical limitations of this case study are given.

## The German Doctoral Training System

The German chair system is a particularly interesting case to investigate the funding-driven institutional change of the traditional apprenticeship model. Burton Clark (1983) describes its structure as a combination of state regulation and professional self-governance by an “academic oligarchy” of highly autonomous

chair-holders who shaped the entire PhD process until recently. The constitutional right of freedom of teaching and research, the appointment of professors as civil servants with lifelong tenure, informal bans on university-internal promotion and norms of collegiality guarantee autonomy and restrict the control of doctoral training from departments, universities and external stakeholders. Within this system, the individual responsibility and right to select and train PhD students is an important vehicle to reproduce and run the research trajectories of chair-holders. Consequently, the traditional apprenticeship model relies on the informal relationship between individual advisors and “their” PhD students. The shift towards collective selection procedures and coursework, organizational and collegial control mechanisms in the structured doctorate has been considered as an assault on the autonomy of individual chair-holders and rejected for a long period of time. Doctoral training in the German chair system can only be changed if chair-holders benefit (Schimank 2005). German professors’ increasing dependence on project-based external funding to hire fixed-term subordinated staff contradicts their institutional autonomy and provides a byway to change the traditional training system.<sup>1</sup> For this reason, project-based funding mechanisms for structured doctoral programs have been introduced, which closely align professors’ research trajectories, PhD fellowships and the institutional aim to transform the traditional apprenticeship into the structured model. It has been argued that the economic and symbolic capital of funded doctoral programs increased the acceptance of the structured doctorates among German professors (Münch 2014).

The pathways to the doctorate are still diverse in the German system and differ particularly from the US graduate school model. German PhD students require a Master’s degree that includes coursework and practical research training in the course of a supervised Master’s thesis. They are expected to learn the practice of research already in Master’s programs and are believed to be independent early career researchers rather than students (Wissenschaftsrat 2011). German PhD students conduct their research in different organizational settings. At present, 77% work as lecturers or research fellows in funded research projects at universities, 6% in non-university research institutes and 17% in non-academic organizations. Only 16 to 23% participate in structured doctoral programs (BUWIN 2017). This means that most PhD students develop their thesis among other professional duties. Professors use different funding opportunities to pay PhD students and supervise external, internal as well as students from doctoral programs. All PhD students need the support of a supervising professor to proceed in the PhD process. Professors traditionally recommend, select, advise and even examine “their” PhD students without any formal or collegial assessment of the process. Only at the end of doctoral studies do colleagues get to examine the research-based thesis in an oral examination committee. The still common term of “doctoral father or mother” reflects the paramount role of individual professors in the socialization, examination and future careers of German PhD students. Not surprisingly, this traditional model

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<sup>1</sup> In 2014, 77% academics at universities and 93% early career researchers were on fixed-term contracts and the ratio between external and institutional funding increased from 22% to 38% between 2000 and 2014 (BUWIN 2017).

of doctoral training has come under increasing scrutiny among politicians and in the public debate because of its perceived outdated, rigid, inefficient and highly hierarchical character. The following multi-level analysis investigates whether the funding-driven introduction of structured doctoral programs led to a “transition” (Enders 2001) or even “paradigm shift” (Nerad 2012) of the traditional German doctoral training system.

## Design, Data and Methods

This article draws on an in-depth investigation of doctoral training practices within funded doctoral programs in the social sciences and physics. Studying impacts of funding mechanisms has to take different levels of analysis and the diversity of field-specific doctorates into account. I therefore analyze the *practice* of doctoral training within specific *organizational settings* and *epistemic conditions*.

Doctoral training takes place in the context of very different social and epistemic conditions that can inhibit or facilitate the adjustment to new expectations or regulations. The units of analysis are research fields within the disciplines of physics and social sciences to capture sub-disciplinary differences. The selection of cases followed the principle of maximum contrast with regard to taxonomies of field-specific epistemic and social properties provided in the literature (Gläser et al. 2010, 2015; Gläser and Laudel 2014; Kuhn 1962; Whitley 1984). The study compares research fields in the individualistic and multi-paradigmatic social sciences, with their orientation toward independent and discrete individual work, and in the rather collectivist and paradigmatic physics. Both broad disciplinary groups have a high degree of internal diversity. The sample comprises prototypical cases: Theoretical physics and social theory depend on personal capacities to cope with abstract knowledge. Experimental physics and empirical social research need to produce significant data, and observational astronomy or certain quantitative social research such as demography rely on existing data sets.

The study focuses on funded doctoral programs to investigate impacts of funding mechanisms on field-specific doctoral training practices. This statistically still exceptional and novel pathway is key for policies, funding and organizational strategies aiming to change the predominant German tradition of individual doctorates and apprentice-master relationships. Doctoral programs differ considerably in size, disciplinary composition and topical focus. The study includes three types at different universities: The large physics graduate school can be described as an umbrella organization that includes smaller structured doctoral programs known as research training groups (RTG) and all of the more than 500 PhD students, regardless of their sub-field and actual funding. The graduate school is primarily an administrative unit similar to those in the United States. By contrast, the two doctoral programs in the social sciences are smaller and more specific in content. The mid-size graduate school and small research training group (50 and 10 PhD students) build on a collaborative research program, staff and collegial networks of departments. All three doctoral programs are highly embedded in preexistent departmental and faculty structures.

Every claim about impacts or limits of institutional changes on doctoral training has to be proved at the level of *practice* (Lee and Boud 2009). The study investigates how research fields respond to funding rules in their doctoral programs and research training practices. The three doctoral programs were analyzed on the basis of five expert interviews with program directors or coordinators, funding applications, and a range of documents provided on the websites. These include self-descriptions of the program, curricula, coursework, supervision guidelines and “agreements” that ought to function like formal contracts between PhD students, advisors and program representatives. Narrative interviews with 12 advisors and 23 PhD students were used to collect information about and get access to the everyday practices of doctoral training (see Table 1). Typical interview questions were why a doctorate is being pursued at the respective program, what is the role of the program in everyday research, how advisors select, fund and supervise PhD students, which are the field-specific challenges of doctoral research, how supervisory relationships and theses emerge and evolve over time, or what the typical occasions for and challenges of supervision meetings are. After the interview phase, the question came up as to whether it would be possible to visit and/or record these meetings. It turns out that the various traditional modes—consulting hours, research team/group meetings, colloquia, workshop presentations and feedbacks as well as text, data, blackboard or lab discussions—indeed (still) make up the standard situations where field-specific doctoral training takes place in practice. In two five-month “focused ethnographies” (Knoblauch 2005) in the social sciences and physics, practices of 21 advisors and 36 PhD students were collected with different data collection methods, and in different constellations and situations. The 40 recordings of individual or group supervisions as well as numerous on-site observations in laboratories, offices, workshops or colloquia supplement the database of the study. The observations show field-specific interaction patterns between PhD students and advisors such as spontaneous encounters and discussions or the predominance of independent collective or individual work.

**Table 1** Database

	Social sciences	Physics	Total
<b>Cases</b>	35	30	65
Doctoral programs	2	1	3
Program directors/coordinators	3	2	5
Advisors	15	6	21
PhD students	15	21	36
<b>Interviews</b>	16	24	40
Program directors/coordinators	3	2	5
Advisors	6	6	12
PhD students	7	16	23
<b>Supervisory interactions</b>	21	19	40

The advisors and PhD students recorded themselves in their individual consultations to avoid disturbance of these intimate situations. During collective colloquia, workshops and working group meetings, I was present to make recordings and observations. Recording length varies greatly between five-minute spontaneous discussions, typically 30- to 60-minute individual supervision meetings, up to four-hour colloquia. All of the recordings used for this study were completely transcribed and coded in multiple rounds and stages. The purpose of the open coding process was to select relevant topics for this study and insightful segments for detailed analysis. While supervisory interactions are mostly conversations about contents, projects become explicitly or implicitly relevant if the discussion shifts to the organization of research. Sub-codes such as “milestones,” “time frames,” “completion” or “proposals” build the vocabulary for the project code. The different use of proposals turned out to be one particularly important code to distinguish field-specific doctoral training practices. They have been described as a “condition” to select PhD students in social sciences, “not possible” in experimental physics, just an “initial idea” in theoretical physics, or as “predefined from the outset” in astronomy.

The selected data was analyzed with qualitative sequence analysis (Maiwald 2005; Wernet 2014) in detail. This text interpretation method is similar to Conversation Analysis and extends the focus from generic (i.e., turn taking rules) to case-specific interaction orders such as implicit role expectations. The method provides explicit rules to grasp such background assumptions and control the process of interpretation. The interpretation starts at the beginning of interaction protocols or any other text and proceeds sequentially line-by-line in order to prevent arbitrary selections of isolated statements. It begins context-free to assess whether and when external contexts are relevant in the conversations at all and to focus on the actual responses of advisors or PhD students to external context expectations such as the idea to predefine PhD projects precisely. The method forces interpreters to take the literal meaning of texts seriously, to explore different possible meanings extensively, to make the process of interpretation explicit, and enable other interpreters to assess the validity of interpretations inter-subjectively. The data was interpreted in a team to increase the reflexivity and control the interpretation. The study only presents the results of this extensive interpretation process and provides one more detailed example in the findings section.

## **Project-Based Policies and Funding Conditions for German Doctoral Programs**

It has been argued that institutional change is only possible in the German chair system if professors benefit. For this reason, the implementation of structured doctoral programs is primarily funding-driven in Germany. Funding mechanisms emerged that promote the project form and delegate the selection, construction and monitoring of projects from funding agencies to academic organizations or networks. The following analysis traces this process of projectification from the

level of policy reforms, through funding rules to the organization and practice of doctoral training.

Since the early 1980s, all major German funding and advisory bodies have been key drivers in promoting the novel model of organizationally structured doctorates (Baldauf 1998). The German Research Foundation (DFG 2010), Council of Science and Humanities (Wissenschaftsrat 1995) and Rector's Council (HRK 1996) have advocated for this model to meet the demands of more timely and predictable doctorates. The definition of the doctorate as a "clearly time-limited qualification phase" of three years was explicitly justified with the "legitimate interests of funding agencies" to see results after a "reasonable time period" (Wissenschaftsrat 2002). In order to meet the standard scheme of a three-year project, advisory bodies recommend a focus on the thesis by offering scholarships, obligatory coursework and adjusting doctoral research methodologies, topics and exams to clarify time frames beforehand (Wissenschaftsrat 1995). The leading role of projects as the main organizing principle for funding agencies is evident and underlies the two funding schemes of "structured" doctoral programs. In the first funding scheme, established in 1985 and known as small "research training groups" (RTG), several advisors and PhD students (up to 30) form a team within a shared research and related training program. The project form was inherent from the beginning as RTGs are time-limited, programs are expected to be definite "research projects" and decomposable into smaller projects. In 1994, the projectification of doctoral research became even more explicit when the German Academic Advisory Council suggested to open research training groups to external PhD students and base the selection on "dissertation projects" (Wissenschaftsrat 1997: 18). RTGs evolved to the second funding scheme of larger multi-disciplinary "graduate schools" which integrate PhD students and advisors in less content-specific organizational frameworks. A national competitive funding scheme, known as Excellence Initiative, has established graduate schools in two rounds since 2006. Considering the structure of these two new forms of doctoral training expressed in funding guidelines, the projectification of doctoral education and research is taking shape. Graduate schools and RTGs vary considerably in size, disciplinary composition or foci of research programs but share some common features. A first crucial element is that both types of doctoral programs are fixed-term funded projects in themselves. A group of academics writes a proposal, asks for university support and applies in a "project-based ... decision process." This creates shared responsibilities and group pressure. Assessments after a fixed period of time (between 4.5 and 6 years) ensure that the promises of the proposal have been realized in order to obtain further funding. In fact, some doctoral programs have developed the same structures without or after funding has been discontinued due to negative evaluations in order to get funding in the next round. Second, a key objective of both doctoral programs is "to enable the timely completion of doctoral training." As a consequence, all obligatory elements of doctoral program proposals "must create a framework that enables doctoral researchers to produce independent research findings ... within a period of three years." Third, the basic idea of both forms of structured doctorates is to provide an ideal environment for doctoral training that consists of three main elements: a collaborative research program or priority area to stimulate cooperation

and team learning; recruitment procedures and selection criteria to attract already “specially qualified doctoral researchers”; and a structured training program that enables the timely completion of doctorates by providing monitoring measures, contract-like supervision agreements, coursework to obtain special and generic skills, and collective supervision structures. According to funding guidelines and policy documents, the project form is inherent in all these structures. Recruitment procedures use selection criteria, such as time to Master’s degree, grades and in particular future research interests or proposals, to seek out promising PhD students and projects. Proposals for PhD projects gradually differ from funded projects because it is tolerable to work on PhD proposals after acceptance due to the early career stage of PhD students. Supervision agreements transform uncertain project designs into a clearly “structured time and work schedule”; the supervisory relationship and process call for the project schedule to be assessed in regular meetings and “progress reports” that require PhD students to submit milestones and thesis chapters early on; thesis committees assess whether advisors and PhD students comply with time schedules and project plans, gradually renew scholarships or recommend the abandonment of delayed doctorates; and curricula support the individual research project by offering special workshops on project development, planning and implementation or time management. In short, all of these new organizational structures serve the projectification of research training on the level of funding policies and conditions.

### **Field-Specific Implementation of the Project Form in Doctoral Programs**

In order to analyze variations, scope, impacts and limitations of projectification processes on doctoral training, the analysis needs to be expanded from the level of formal rules to field-specific responses. This section shows how social sciences and physics implement and interpret project-related structures differently in doctoral programs.

The social science doctoral programs of this study adapt comprehensively to the formal funding rules. The self-conception of the social science graduate school as expressed in the guidelines is that “in a graduate school, doctoral researchers are free to define their own projects.” A proposal for one’s doctoral project is essential throughout the application, selection, and training process. Applicants are encouraged to write proposals in the style of grant proposals because scholarships are limited and they “need to secure doctoral funding in order to start the program.” PhD students are responsible for securing funding for individual PhD projects with the support of advisors, and the graduate school advertises successful grant applications on the homepage. Funding for this graduate school was discontinued because of poor completion rates after 3.5 years and the strong project orientation remained. The entire organizational framework of the graduate school is designed to select, fund, develop and monitor individual projects in a top-down process from the organization via membership agreements, curricula and assessments to the advisors and PhD students:

The graduate school can revert to a supervision committee ..., a supervision agreement guaranteeing binding supervision standards [and] provide support and intensive supervision for its doctoral researchers in order to ensure finalizing an excellent dissertation within three to four years. (Homepage Graduate School)

A formal agreement between advisors, PhD students and the graduate school defines supervision work as “the preparation, development and implementation of the project” in specific workshops which aim at the “Design and Implementation [of a] dissertation prospectus.” The curriculum is described as the “fulfillment” of three “milestones” as a condition for prolonging membership. Advisors approve the prospectus in the first year, two “chapters of the thesis” in the second and the submission of the first draft in the third year. The graduate school and a supervision committee assess each step and thereby the “progression of work on the doctoral project.” The social science graduate school implements the project form throughout all parts of the formal framework and interprets it as a kind of formal control over doctoral research processes.

The social science RTG provides a slightly different approach of content control to define individual PhD projects at an early stage. A focused research program outlines a shared theoretical and analytical framework, defines possible cases and questions for theses and requires PhD students to apply with a proposal for an “individual research project” that fits into the program. Doctoral training is designed as an introduction into a shared theoretical framework, training of case-specific methods, and collective support, discussion and comparison of individual case studies in the context of the framework. A three-year timeline, compulsory “progress reports” and voluntary “project management” courses supplement the doctoral training. In conclusion, both social science doctoral programs extensively apply the project-based structures outlined in the funding conditions.

In contrast, the large physics graduate school restricts the project form. It occurs explicitly only in the supervision guidelines which “were drawn up by the student representatives” in a bottom-up process and take the form of an extraordinary “conflict resolution.” The project form is designed to be a protection against powerful advisors, predefined or endless research processes:

The scientific project should be defined by the advisor and the student jointly. It should specify the main goals, suggest a timeline, but also – especially if high risk is involved – include a brief backup plan. The initial plan ... has to be submitted to the [graduate school] within six months of starting the research. It is however expected that the project plan will be periodically revised, due to the inherent unpredictability of research. Should the time originally allocated for completion of the project be expected to be exceeded by more than one year, the student, advisor and thesis committee agree on a plan for a timely completion of the project. (ibid.)

According to this account, doctorates in physics cannot entirely rely on the project form for organizational and epistemic reasons. First, PhD students in physics work in research groups for advisors and do not have their own individual projects when they start. Second, the project form cannot determine the research process due to its

**Table 2** Field-specific interpretation and impact of the project form in doctoral training

	<b>Individual work</b>	<b>Collective work</b>	
<b>Field-specific epistemic properties</b>	<i>Planning individual PhD projects</i>	<i>Providing predefined work packages for PhD students</i>	<b>Field-specific impacts of projects</b>
	Aim: Determining individual research processes	Aim: Securing timely results	
	Case: Empirical Social Sciences	Case: Observational Astronomy	
	Impact: High	Impact: High	
	<i>Developing own ideas in initial projects</i>	<i>Constructing individual PhD projects ex post</i>	
	Aim: Starting individual research processes	Aim: Attributing individual achievements	
	Case: Theoretical Physics	Case: Experimental Physics	
	Impact: Low	Impact: Low	

inherent unpredictability. This means, a project is just an “initial plan” with potentially endless revisions. Timely completion cannot be expected due to field-specific properties. For these reasons, a guarantee for timely completion can only rely on social “agreements” between all of the relevant participants.

The evidence shows that both fields have institutionalized the project form in doctoral programs differently. The social sciences are more prone to implement project-related structures than physics. This is surprising because most studies assume that the social sciences are epistemically less able to construct “doable” projects and predefined “standardized packages” (Fujimura 1987). To understand why and with what consequences research fields adopt the project form differently, this analysis has to be extended to the level of practice.

### Field-Specific Concepts and Effects of the Project Form in Doctoral Training Practices

The different ways of implementing the project form in doctoral programs indicate that projectification is less likely a process with uniform consequences. If we explore how different research fields interpret and respond to project-based doctoral programs in practice, it becomes even obvious that abstract characteristics of the project form allow for field-specific variations (Ylijoki 2015). The evidence of the in-depth study reveals four typical ways to conceptualize the project form as a technique to plan research processes beforehand, initiate new ideas, construct individual achievements ex post and provide predefined work packages (see Table 2). These concepts can be applied across disciplines and relate to epistemic as well as social properties of specific research types. While the social organizational dimension of research fields distinguishes “individual” and “collective” work, the epistemic properties are multi-

dimensional and therefore an open category. Decomposability and time requirements of research processes, the degree of codified knowledge, dependencies on data in empirical and experimental or on personal capabilities in theoretical research are relevant dimensions in my cases (Gläser et al. 2010). The study draws on prototypical cases to describe the relation between these properties and the actual use of the project form in practice. It must be emphasized that the notion of planning individual PhD projects is particularly pronounced in empirical social research. Other social science research areas of the sample such as social theory or quantitative social scientists working with large available datasets adopt the models described in theoretical physics and astronomy to some degree.

### *Planning Individual PhD Projects*

Projects are typically used to plan research processes beforehand. A research plan is important for all funding organizations and is a prerequisite for selecting and monitoring proposed projects. This strategy occurs across fields but not necessarily at the level of doctoral research, because writing proposals and raising funds for individual projects is often reserved to advanced career stages. Doctoral programs, particularly in the social sciences, mimic this approach by expecting PhD students to apply for scholarships with often sophisticated PhD project proposals. Empirical social research is a prototypical case for field-specific epistemic and social prerequisites that support and limit the promoted demand for intensified project planning at the same time.

This is because the research field lacks codified knowledge, joint research priorities, depends to a high degree on the personal selection and interpretation of research problems, and values diversity and individuality. Subsequently, PhD students are expected to work independently on topics that are already separated or should emancipate them from their advisors' research trajectories by developing distinctive individual PhD projects. If PhD projects are not embedded in shared research trajectories and knowledge, regular discussions of PhD projects are not likely to occur naturally and require explicit planning. Doctoral programs in the social sciences reinforce the plan of getting PhD students on track right from the beginning with PhD project proposals as one crucial element. Evidence from the interviews confirms that social scientists expect PhD students, in structured as well as traditional training models, to develop cogent project proposals and to be already capable for independent research before the training process starts. One graduate school director and advisor explains that he needs to know "what they do," "how they do it," whether their projects are "doable" or if they are already capable of "cutting down" projects in order to select all kinds of PhD students. According to an advisor of the research training group, his traditional model of seeking out internal PhD students among lower level students is an alternative (and in doctoral programs still possible) strategy to make sure that PhD students are "capable [of independent research] actually early on." Both social scientists nevertheless ascribe funded doctoral programs strong impacts on PhD student types and the supervision process. "If, for example, PhD students are in a structured doctoral program and obtain a scholarship," this advisor explains, "then the first basic issue we are talking about is the temporal order of the work and when they do what. This is an ongoing issue. In

the case of external [not in the program] PhD students, this is absolutely indifferent.” The first quoted advisor points out that the graduate school has changed the traditional relationship between advisors and PhD students. While in the former training system “PhD students did not come so often” and “work at the desk alone,” PhD students of the graduate school “constantly have to talk about what they are doing” and “demand more supervision. This means you have at least three to four times as much work with PhD students and that is not only because I ask them, but they want me to read chapters three, four times.”

Social science supervisors adopt the model of increased guidance although this leads to conflicts with regard to autonomy. Another advisor of the research training group is disappointed that

We have no police power over the people. That is to say, if it were up to us, the supervision would be much sharper, more regular and controlled. But even more than our students, the doctoral students naturally abhor sharp control, hard deadlines, regulations or authoritarian forms.

In this situation, advisors either wait for requested consultations or use external formal frameworks to stipulate regular meetings and progress assessments. This advisor interprets the externalization of authority as a “relief” because his active intervention would create “an asymmetry in the way we discuss the content” and would “break apart my system,” which ultimately “depends on sharp debates from the other side.” This structural autonomy-control conflict underlies supervisory interactions and advisors try in many indirect ways to keep PhD students on track (Gardner 2008; Lee 2008). They express serious concerns and threaten PhD students with interventions when delays occur; motivate students or dissuade them from other activities; unveil problems PhD students are likely to hide in order to masquerade the performance of progress and the expected capability for independent research; refine early project designs and increasingly act as editors in order to facilitate the timely completion of doctorates. However, neither of these strategies are likely to resolve the epistemic and personal uncertainties inherent in social science PhD projects, as the following interaction in a workshop for project development exemplifies.

PhD student A I’m wondering how to bring the writing process and the actual research process in line, I don’t know how you guys solved this problem?

PhD student B I’ve got some advice here. Uhm, because first I’ve done my literature review and worked on some initial concepts and I had the data collection phase and now I actually would like to drop the whole first part in the garbage and rewrite it but then I think I will never end my dissertation. ... I don’t know how to deal with that ... how to use the examples, how to actually put the data into the dissertation and to what amount of detail I have to do this ... I think the strength is in the exploratory cycle and the concept, so the validation process is, uh, over.

Advisor Ok, thank you very much.

The ambivalence of PhD student B's answer demonstrates typical limitations and risks of project proposals to plan research processes. It turns out that neither the determination of research designs nor writing processes can resolve the uncertainties inherent in the practice of research. This PhD student spells out he "would like to drop the whole first part in the garbage" and furthermore he does not "know how to deal with that" situation and with the data in general. Yet, to complete the thesis on time, he "advises" to maintain "initial concepts" and keep the "literature review." Then, despite his obvious doubts, he recommends to reduce and select supportive evidence in order to stress the strengths and hide the weaknesses of the study. The advisor did not respond to this epistemically dubious suggestion and even explicitly confirms it in the course of the workshop. Later in the session the advisor suggests to the PhD students: "simply write the structure of your book in a very early stage." Treating conceptual as editorial problems is a common strategy in text-based sciences to ensure timely completion by means of focusing on continuous writing. Other advisors in the social sciences explicitly point to the limitations of this strategy and explain to PhD candidates that all early papers will need extensive revisions because of their function as "initial ideas" to start rather than to determine research.

In the case of empirical social research, the projectification of doctoral training can be described as a paradoxical process. On the one side, the epistemic and social conditions promote the model of predefined individual PhD projects but, on the other side, they limit the precise planning of highly unpredictable research processes.

### *Developing Own Research Ideas in Initial PhD Projects*

A second understanding of projects is to find one's own ideas in the process of research, start research, engage in discussions, and launch supervisory relationships with more flexible initial tasks. This strategy deviates from the concept of predefined projects predominant in doctoral programs and occurs when the individual capacity to master a field of shared knowledge is paramount. Doctoral training in theoretical physics provides a prototypical case. In theoretical research processes, individual capacities and ways of dealing with highly codified sets of collective knowledge are crucial. For this reason, the selection of capable students is more important in theoretical physics than the development of individual projects and limits the impact of structured doctoral programs. One experienced theoretical physicist still seeks out potential doctoral students among lower level students or on the basis of collegial recommendations, even though the framework of the graduate school exerts "a certain pressure" to select PhD students from an anonymous list of applicants. He rejects this strategy as inappropriate, pretentious and even useless because in "application letter it is written I have the next Einstein in front of me, only slightly exaggerated. I cannot do anything with this. Of course, it is not true but I do not know why it is not true." In his nowadays "almost unorthodox" traditional selection process, he instead "tracks" students "for years" to examine their suitability and "watch people for how they pose questions, how they approach problems, how full of ideas they are when solving these problems." Precise and

profound knowledge of individual PhD students' capabilities as well as personal characteristics rather than pretended capabilities to conduct promising research projects independently is crucial in theoretical physics for social as well as epistemic reasons. Affinity among PhD students is important for the "team spirit" in the group and "no new ideas will emerge" without intense group discussions. For his own research, he also needs PhD students who "oppose me" rather "than just repeat the information they get from me." In order to develop this capacity in a mutual learning process, he provides doctoral students with topics merely "as a first orientation" and expects them "to develop [their] own ideas" later on.

A younger theoretical physicist is *prima facie* more prone to predefine and work with PhD students on shared projects. "One should not let PhD students work completely free from the beginning" because things can go wrong and he feels responsible for them. He explicitly uses "small," "short-term" and projects that are "doable within half a year or so" to "introduce" his PhD students to "the way of working," to develop a first "overview" of the field of study and ideally to produce a first output in order to strengthen the PhD students' self-confidence so that they will "be able to write a thesis later on." He nevertheless interprets given projects as starting points rather than predefined packages and hopes "that people start asking their own questions" and will develop "their own ideas." Trust in the students' personal capabilities is a condition to "leave ever more room" and "let them do" what they want, "get carried away" by their ideas even if they fail, because in order to learn and innovate, things "have to go wrong from time to time." As a consequence, carrying out a ready-made project is the worst-case scenario for this theoretical physicist.

If someone asks me, "please give me an idea, I don't have any," then I would give one. But I don't want to prescribe what they should be creative with. People are at their best when they are self-motivated.

In contrast to the predominant centrality of predefined individual PhD projects in the social sciences, the account "creative with" defines topics as exchangeable playing fields for learning processes. According to the first quoted physicist, not only fixed topics but also time frames and resources are secondary criteria compared to the essential aim of the doctorate to demonstrate "that somebody can research independently." In a supervision meeting with one of his PhD students whose scholarship was about to expire, he insisted on separating money, time pressure and substance. He offered to resolve the funding problem and expected the PhD student to concentrate on the content by "writing down something one day." PhD students in theoretical physics do not stick to one clear-cut project with predefined milestones and deliveries that add up to a coherent thesis. Instead, they work on different topics in the broad field of a professor and might back up highly uncertain with more certain "anchor" tasks from previous Master's thesis research. This is important because PhD projects often rely on third-party project funds. Advisors apply for project grants to enable PhD projects, suggest and tout topics that fit in already funded projects or prepare future funding proposals and PhD students change their topics if funding applications fail after all. While PhD students in theoretical physics are expected to develop capacities for independent research in

the context of given and funded fields, postdocs have to find, define, defend and increasingly fund own research themes. Contrary to social scientists, theoretical physicists reject the promoted model of predefined individual projects and reserve it for later career stages. The understanding of projects as “initial ideas” in theoretical physics deviates from the notion of planned research because it aims to start rather than determine research processes, relieves PhD students from predefining individual projects and pretending mastery at an early stage. The ways research fields conceptualize the opaque project semantics regulate the impacts of projectification processes. They are high in social research and low in theoretical physics.

### *Constructing Individual PhD Projects Ex Post*

Another interpretation of projects is to set time frames for ongoing research processes without determining tasks in detail and constructing projects ex-post after results have emerged. This strategy occurs in fields with long research periods. The daily collective work in an experimental physics research group is a prototypical case that deviates from the model of predefined individual projects in several ways. Here, it is impossible to decompose collective experimental work into clear-cut individual PhD projects. Research topics emerge from experimental results in a recursive process and time periods of experiments typically exceed the employment periods of PhD students. As a consequence, PhD students depend on unpredictable social, substantial and temporal dynamics. These are not predefined and emerge in a collective process of singling out individual achievements ex post.

The predominance of group-based collective research limits the influence of doctoral programs at all levels. According to PhD students, “the graduate school plays no role in everyday life” for several reasons. First, internal socialization processes limit the influence of formal recruitment procedures. PhD students come up in long-term experiments and research groups of advisors. Master’s theses and lab internships are common means to verify the match between new PhD students, experiments and the research team. Becoming a doctoral researcher in experimental physics is a smooth internal transition in a multigenerational group rather than a clear-cut decision and selection process. Second, daily experimental work is predominant and limits formal coursework requirements. PhD students can get mandatory coursework requirements done by attending everyday internal group meetings, weekly journal clubs, occasional public talks and an annual social event (“Graduate Day”). Third, mixed resources limit the impact of externally funded PhD fellowships. Advisors provide funding for PhD students from different sources, such as PhD fellowships from graduate schools, institutional or project funds, and combine these in budget pools. This enables research group leaders to build “protected spaces” (Whitley and Gläser 2014) for flexible experimental work and to buffer differences in income, teaching and research duties or topical and temporal discontinuities of projects. The graduate school even redistributes PhD fellowships to professors and thus provides additional funding for research group leaders to hire PhD students. As a result, PhD students perceive advisors as employers who are responsible for funding in exchange for the work they do on collective experiments

rather than on individual projects. Fourth, epistemic and social requirements of experimental work counter the model of predefined individual PhD projects predominant in doctoral programs. One candidate explains that planning individual PhD projects beforehand is impossible in experimental physics because “you cannot know what the experiment will do and what the measurements ultimately mean.”

A second problem to set clear-cut individual projects is the unclear ownership of results in collective experiments. The research group leader distinguishes three general strategies for how collective achievements are attributed to individual PhD students in experimental physics. The “communist” strategy, exemplified by multi-author papers, simply ascribes achievements to all participants. This bears a problem for doctoral students who have to exhibit individual achievements in the thesis and their future careers rely on first author papers. In the “competitive” strategy, one person in the team claims owner- and main authorship of results and takes the risk of team trouble (Müller 2014). This strategy is comparable with the proposed model to predefine individual PhD projects at an early stage but less appropriate for collective experimental work. The preferred “communitarian” strategy combines team spirit and leadership for some of the team’s research aims to claim primary ownership. The advisor thus defines a promising PhD student and “good scientist” in multiple dimensions as “social ..., organized, creative, fast” and “assertive.” PhD students are expected to discuss responsibilities and results that they want to use for their individual thesis among the team and to exhibit individual efforts by leading research group meetings. When they reach the very end of their candidature, they “write up” some of the collectively produced but individually attributed results and thereby construct individualized PhD projects *ex post*.

The research group leader’s main concern is the reduction of time periods for doctorates. He rejects policies of the graduate school to reduce funding for doctoral students after three years and expects at least four years to develop reasonable scientific findings. Nevertheless, external time pressure triggers his model of doctoral training according to his PhD students. He recently entered the lab with a “new tactic” that “everybody may leave after 3½ years and he didn’t mention any findings.” Reducing time to degree might result in a decoupling of doctorates from positive research findings, a strategy already known as ‘emergency doctorate.’ This strategy deals with the field-specific risks that former PhD students have already used results, and experiments have not yielded enough results for all. In this case, PhD students can report on different achievements, such as the construction, falsifications or failures of experiments, to finish the doctorate and presumably their academic career that still depends on promising results.

In conclusion, the predefined individual projects promoted in doctoral programs glance off the research training practice in experimental physics research groups. Here, the notion of individual projects is an *ex post* construction that occurs when candidature time expires and individual achievements have to be ascribed to PhD students. Theses emerge in the course of collective research processes, PhD students do not follow a predefined individual project and advisors assess their overall group performance along multiple social, organizational, technical and intellectual criteria. The research group, rather than doctoral programs and predefined individual projects, is what shapes PhD students’ work in experimental physics.

*Providing Predefined Work Packages for PhD Students*

A last understanding of projects in the sample is the decomposition of big data sets into prescribed work packages for individual theses. This strategy occurs in fields that rely on large data sets such as astronomy or quantitative social research. Astronomy is a case for a mutual fit between epistemic properties and institutional changes of doctoral training. It depends on the joint collection of data with large telescopes, its storage in public data archives and distributed analysis. As a result, doctoral students cannot collect their own data anymore. Advisors provide data packages and questions for doctoral theses instead. One astronomy professor explains that doctoral programs enhance this field-specific trend towards separating doctoral research from the individual development of questions and collection of data.

In the case of doctorates, topics no longer emerge, but the topic is predefined from the outset, because today the PhD period is actually limited to three years. This is a difference to previous doctorates ... In the case of observational work ... this means that the data for this work must already be available if the time limit is only three years. ... [Data collection] is ultimately a risk that can extend the three-year period. Therefore, the aim is to have the data already and to provide a topic that can be worked out without further information if necessary. Of course, this doesn't prevent PhD students from gaining more information and writing proposals for additional observations, which is desirable.

One PhD student, for example, spent his entire candidature time on the cleaning and understanding of an obscure data set and was unable to analyze the observed objects or publish "real scientific results." According to his first quoted advisor, the risk of failure for PhD projects is low if data, questions as well as methods already exist.

To say it in quotation marks, it is certain that something will come out and it is sure that you will get good results. It is not quite sure what the results will be, but actually nothing can fail unless the person who is working on it puts his hands in his lap and does nothing.

Personal capacities and characteristics are less important if a field provides "safe" work packages that can be "worked out" independently. Subsequently, the selection of PhD students from a list of applicants provided by the graduate school is appropriate in astronomy, while theoretical and experimental physics strongly oppose this model. Research and supervision processes are highly individualized in astronomy and rely to a lesser degree on personal capacities or group dynamics. The astronomer explains that topics as well as technical problems of data reduction are often too specific to discuss at group or individual supervision meetings because other PhD students "get bored," or advisors "don't know the modern programs for data reduction anymore." The model of predefined individual projects fits very well into the social and epistemic preconditions of astronomy, gives leeway to unpredictable findings and enables even less ambitious PhD students to complete their doctorates. The astronomer points out that "hopefully interesting aspects will

emerge,” and “the question may change in the course of the doctoral thesis” and there “are no objections to it.” The quest for unexpected results is still desirable in the model of predefined work packages, but no longer a condition for successful doctorates.

[PhD students] can simply say, “okay I do not do anything in addition, I just do what has been given to me and analyze it.” They can do this. A whole number of people is doing this. Especially people who don’t necessarily want to stay in astronomy afterwards don’t come up with something of their own.

This account implies that the model of predictable work packages is limited to early career stages and non-academic career tracks, while pursuing an academic career ultimately calls for taking risks and contributing to new ideas afterwards. The unintended consequence of more predictable doctorates might be that risk taking is postponed to the postdoc phase. To conclude the findings section, it is obvious that research fields interpret and use the project form according to their social and epistemic conditions and thereby respond to the funding-driven process of projectification in different ways.

## Conclusions

This study emphasizes a specific pattern of funding-driven institutional change of German doctoral training, which can be described as projectification. Funding mechanisms for doctoral programs expect advisors and PhD students to construct doctoral research in the form of an individual project, one that is limited in time, scope and content before or at a very early stage of the PhD process. It has been argued that institutional changes in doctoral training must examine different levels of analysis and should investigate the outcomes of change at the levels of normative discourses, regulatory frameworks and particularly field-specific preconditions of research training practices. This multi-level study shows that research fields respond differently to the predefined PhD project model, and field-specific epistemic and social properties regulate the influence of this model. While social scientists and astronomers adopt this model, experimental and theoretical physicists reject it. Astronomy is able to decompose shared research trajectories and data sets into predefined individual work packages and perfectly aligns epistemic preconditions and the externally promoted model of predefined individual PhD projects. The individualistic epistemic and social conditions of the social sciences, by contrast, promote the early creation of individual PhD projects but obstruct the precise planning of doctoral research. Conversely, experimental and theoretical physics deviate from this typical model. PhD theses emerge in the course of research processes and the model glances off the field-specific conditions and conceptions of the doctorate. Theoretical physics largely depends on personal capabilities, selects talents and expects them to practice, improve and demonstrate their individual capabilities in “initial projects” that aim to start rather than predict future research processes. Theoretical physicists use the project term as a metaphor for emerging tasks PhD students can be “creative with,” which do not determine the research

process, time frame or outcome in detail. Similarly, PhD theses in experimental physics also emerge in the course of ongoing collective experimental work. The construction of or decomposition into predefined individual PhD projects is not possible in this setting because experimental results are unknown and it is unclear to which team member results might be ascribed. For this reason, individual PhD projects are ex-post constructions to award a PhD on the basis of ascribed individual achievements.

The focus of this study on field-specific practices, preconditions and interpretations of a new model of doctoral research enhances the understanding of institutional change in doctoral training in three ways. First, the extension of the analysis to field-specific practices reveals the diversity of responses and contradicts claims about linear developments towards a “paradigm shift” or “converging practices” (Nerad 2010, 2012) in doctoral training. The great variety of responses demonstrates that projectification is neither uniform nor a process that can be reduced to the level of policies and organizational frameworks because advisors and PhD students do respond to it differently in practice. Both, advisors and PhD students perceive a pressure to adapt, actively resist, or cope with expectations and structures inherent to the project form by protecting or aligning doctoral research to requirements of timely output production; by focusing on continual writing; increasing guidance and planning; reducing evidence, scope or tasks and valuing multiple achievements beyond scientific results in order to complete the doctorate.

Second, the analysis of institutional change needs to take inherent structures of doctoral training practices into account. The evidence demonstrates that epistemic and social properties of research fields remain stable and regulate whether the externally promoted model of predefined PhD projects is accepted or rejected. Approaches that reduce the analysis of institutional change to publicly legitimized and formalized rules to the neglect of inherent cognitive scripts of research fields (Streeck and Thelen 2005) cannot explain why experimental and theoretical physics relate internal practices and external expectations loosely, astronomy tightly and social sciences in a fragile way. Thus the power of research fields to shape doctoral programs and training practices according to internal conditions contradicts widespread claims of a shift from professional to organizational control of “managed doctoral students” (Kehm 2009). Conversely, the evidence further confirms the findings from many other studies that advisors already select or urge PhD students to become independent researchers (Johnson et al. 2000; Gardner 2008). Advisors interpret autonomy as a precondition, constitutive problem and essential goal of doctoral training by selecting already capable talents, expecting PhD students to produce results independently, rejecting strict guidance in order to support self-directed learning processes or reduce autonomy conflicts and by providing rather tentative advice because the production of new knowledge always implies knowledge gaps. The project model of doctoral training aims to clarify unknown tasks at an early stage but tends to neglect the unpredictability of research, the importance of serendipitous findings and the transitional role of doctoral students who are neither already independent nor executors of ready-made projects. Not surprisingly, advisors criticize, adjust and deviate from this ideal project model in practice to different degrees.

Third, the investigation of projectification processes should take different understandings and drivers of the project form into account. This study has shown that some research fields deviate considerably from the promoted practice of predefining PhD proposals at an early stage. Theoretical and experimental physics do not distinguish between “project time” and “process time” (Ylijoki 2016) because individual PhD topics evolve in the course or even at the end of research processes. It can be argued that the specific temporality of a project is only set into motion and affects the research process if the content and tasks are predefined at an early stage (Torka 2009). It is an interesting question under what conditions this specific model emerges, solidifies the opaque project semantics, penetrates and possibly changes doctoral training.

This empirical study focused on field-specific preconditions that prevent or reinforce the model of predefined projects and was limited to few research fields in the unique German doctoral training system as well as to specific funding mechanisms. For this reason, more research is needed to test the generalizability of projectification processes as drivers and outcomes of institutional change. Further studies should investigate how socio-epistemic, funding and organizational conditions of different doctoral training systems promote or inhibit the model of predefined projects. The US graduate school system, for example, seems to mitigate the model of predefined PhD projects by selecting PhD students at an early stage, providing mostly internal funding and developing dissertation proposals in the course of a long-term training process. In other countries such as Australia, organizational rather than funding mechanisms promote the model of predefined projects. Organizations create preparatory phases for early skill and proposal development or introduce tuition fees aiming to reduce time-to-degree. However, if different drivers establish the model of predefined PhD projects, structural tensions between project-related expectations and inherent properties of doctoral training emerge in most research fields. It is predictable that research fields deviate from uniform concepts such as the predefined project model due to specific epistemic, social and career-stage-specific preconditions. These deviations provide valuable insights for policymakers, funding agencies, university managers, advisors and PhD students alike as they help to develop support structures that respect rather than obstruct the specific epistemic, social and temporal orders of field-specific doctoral training practices.

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