

Chapter 7

The Research Ecosystem

Framing the chapter

Everything this course has described so far is the substance of research: what was discovered, by whom, in what institutional setting, and how credit for it was assigned or withheld. This chapter and the next turn to a different question, one this course has left implicit until now: what does it actually take, today, to become and remain a researcher in Europe, and what does the machinery that makes research possible actually look like once you step behind the two figures a student normally sees – the lecturer at the front of the room and the pedagogical secretariat that manages enrolment? Those two are the visible tip of a much larger structure. This chapter maps that structure in two stages: first, the sequence of statuses – doctoral student, postdoctoral researcher, permanent position – that a career in research typically passes through, and how differently that sequence is organised from one European country to the next; second, the ecosystem of people, workshops, and shared national and international facilities that a working laboratory actually depends on, of which the synchrotron light source is used here as a detailed, worked example.

7.1 Becoming a researcher: doctoral training around Europe

A doctorate is the near-universal entry credential for a research career, but the institution that awards it, and the conditions under which candidates work toward it, vary substantially across Europe and beyond – more than the shared label “PhD” or “doctorat” suggests. The portrait that follows sketches a few illustrative national patterns; it does not attempt to catalogue every system, and hybrid arrangements (a candidate registered in one country while working day-to-day in another, joint or “co-tutelle” degrees between two universities) are increasingly common precisely because the national models differ enough to make coordination worth the paperwork.

France formally expects a thesis to take three years, funded, in the sciences, most often by a *contrat doctoral* – a fixed-term employment contract with the doctoral candidate’s home institution – or, for projects run jointly with a company, a CIFRE convention that splits supervision and funding between the academic laboratory and the industrial partner. In practice a three-year science thesis is a target more than a guarantee, and extensions of some months are common. Supervision is nominally the responsibility of a single *directeur* or *directrice de thèse*, though a co-supervision arrangement (*co-encadrement*) with a second, often more

junior, researcher is routine in experimental groups; every candidate is registered with a doctoral school (*école doctorale*) and, since a 2016 reform, is followed by an individual monitoring committee (*comité de suivi individuel*) that meets at least once a year, independently of the supervisor, partly in response to long-standing concerns about supervisory power imbalance.

Germany has no single doctoral model at all: a candidate can be an informally arranged *Doktorand* attached to a professor's chair, with no fixed programme duration and no guarantee of a work contract (some doctoral candidates in this arrangement are paid via a research or teaching assistant position, others via an external scholarship, and a nominally "self-funded" doctorate without any salary is not unheard of); or a candidate can be enrolled in one of the structured graduate schools and research training groups – often modelled on, or directly funded by, programmes such as the Max Planck Society's International Max Planck Research Schools – that impose a defined curriculum, cohort structure, and typically a three- to four-year target duration much closer to the French or British norm. The absence of a single national doctoral framework is itself a legacy of the same academic tradition, discussed further below, in which the professor's chair (*Lehrstuhl*) has historically held very wide discretion over how research training under it is organised.

The United Kingdom funds most science doctorates through UK Research and Innovation (UKRI) studentships awarded to doctoral training partnerships or centres, typically covering three to four years, with a supervisory team of a first and second supervisor rather than a single director, and an annual progress review built into the funding requirement.

The United States runs on a noticeably longer timeline: five to six years is typical in the sciences, because the first one to two years are normally spent on coursework and qualifying or preliminary examinations before a candidate advances to full-time dissertation research, a structure closer to a taught master's degree folded into the doctorate than to the more purely research-focused European models above. Funding is usually a research or teaching assistantship tied to a specific grant or department, which links a student's financial security quite directly to their advisor's own funding success – a dependency this course will return to in the next chapter's discussion of grants.

Historiographical note

The four sketches above are illustrative, not a survey: they were chosen because they show real structural variation – in duration, in funding instrument, and in whether supervision is by one person or a team – not because they exhaust the systems in use across Europe. Structured doctoral programmes funded directly by the European Union, such as the Marie Skłodowska-Curie Actions Doctoral Networks discussed below for the postdoctoral stage, increasingly cut across all four national patterns by placing candidates in industry as well as academic hosts and requiring international mobility as a condition of the funding itself, which is one of several forces gradually narrowing – without eliminating – the national differences this section describes.

7.2 The postdoctoral stage: fellowships and a structurally precarious interval

Almost everywhere in Europe, a doctorate is followed by one or more fixed-term postdoctoral positions before – if a candidate obtains one at all – a permanent post. The defining European funding instrument for this stage is the **Marie Skłodowska-Curie Actions (MSCA)** Postdoctoral Fellowship, part of the European Union’s Horizon Europe programme: a competitive, individually held grant that funds a researcher, of any nationality, to spend one to two years at a host institution in an EU member state or associated country, on a project the fellow largely designs themselves in collaboration with a host supervisor. A “Global Fellowship” variant allows an initial period outside Europe followed by a mandatory return phase at a European host, explicitly designed to bring internationally trained researchers back into the European system rather than losing them to it permanently. National funding agencies run parallel postdoctoral schemes of their own, and many postdoctoral positions are simply funded as line items within a supervisor’s own project grant rather than through any dedicated fellowship at all.

Historiographical note

The postdoctoral interval is also, and increasingly explicitly, discussed in the research-policy literature as a structurally precarious one: a sequence of short fixed-term contracts, often requiring relocation between contracts (sometimes across countries), during precisely the years in which many researchers are also making major personal decisions about long-term residence and family. This is not a peripheral complaint; French and European Union bodies have both, in different contexts, formally acknowledged rising average postdoctoral duration and the retention and well-being costs associated with it. This course flags the pattern rather than treating it as background noise, because it materially shapes who can sustain a research career through to a permanent position and who cannot.

7.3 Permanent positions: a few national portraits

What comes after the postdoctoral stage, and how it is obtained, again differs sharply by country; the sketches below cover only a handful of illustrative career types, not every position title in use.

France runs two parallel permanent tracks. A university career passes through *maître de conférences* (associate lecturer-researcher, roughly half teaching and half research), reached by a national qualification process (the *Conseil national des universités*, or CNU) followed by a competitive recruitment procedure (*concours*) at an individual university; promotion to *professeur des universités* requires, first, the *habilitation à diriger des recherches* (HDR), a further qualification (distinct from, and additional to, the doctorate) attesting the right to supervise doctoral students independently, and then a fresh competitive recruitment at a university – there is no automatic internal promotion from one rank to the other. A parallel, research-only track runs through the national research organisations, chief among them the CNRS: a *chargé de recherche* and, after a further national competition, a *directeur*

de recherche hold permanent research positions with no formal teaching duty at all. In both tracks, appointment itself confers French civil-servant (*fonctionnaire*) status essentially immediately, rather than after a multi-year probationary period – a structural difference from the tenure-track model described next that shapes how early-career risk is distributed in the French system compared with others.

The United States (and, increasingly, several European systems that have explicitly adopted comparable structures) instead runs a **tenure-track** model: a newly appointed *Assistant Professor* holds a position that is, by design, not yet permanent, and is evaluated – typically five to seven years in, drawing on external letters from researchers at other institutions – for promotion to a permanent, tenured *Associate Professor* position; a further, later promotion to *Full Professor* follows a comparable, though usually less binary, review. Failure at the tenure review, rather than triggering a further attempt, typically ends the appointment at that institution altogether (the colloquial “up or out” rule), which concentrates career risk into a single, well-defined multi-year evaluation window rather than distributing it, as the French system does, mainly into the recruitment competition itself.

Germany historically tied the equivalent of a full professorship (a W3-level chair, or *Lehrstuhl*) to completion of the Habilitation, a qualification that could itself take five to fifteen years beyond the doctorate to complete, typically while holding an unsalaried or semi-salaried *Privatdozent* status; a chair itself, once available, is filled by open national and international competition, with no internal promotion route from within the same department. Since a 2002 federal reform, an alternative *Juniorprofessur* (W1) route allows a researcher to hold an independent junior professorship without first completing the Habilitation, evaluated after several years for progression toward a permanent chair – a deliberate attempt to shorten a path that critics had long argued left researchers dependent on a single senior professor’s goodwill for a decade or more. Research-only permanent positions, for instance group leaderships at a Max Planck Institute, have historically not required the Habilitation at all, giving Germany, like France, two structurally distinct tracks running in parallel.

Historiographical note

These three portraits illustrate three different ways of allocating career risk – concentrated in a single tenure decision (United States), distributed across a recruitment competition with immediate permanence on success (France), or gated by a lengthy separate qualification before the decisive competition is even entered (Germany’s traditional Habilitation route) – rather than ranking the systems against one another. Several other European countries, including Switzerland and the Netherlands, have adopted tenure-track models closer to the American pattern in recent decades, which is one respect in which the historically sharp differences sketched here are narrowing, without having disappeared.

7.4 Beyond the lectern: the laboratory ecosystem

The two people a student typically encounters directly – the lecturer delivering a course and the pedagogical secretariat administering it – represent only the visible tip of the structure that makes their own research possible, let alone the institution’s. A working laboratory of

any size depends on a range of roles that rarely appear in front of a lecture hall at all.

Administrative and financial staff manage the laboratory's grant contracts once they are awarded (tracking spending against a budget line, handling the institution's own procurement rules for equipment purchases), and process the paperwork – travel authorisation, expense claims, sometimes visa support – behind every conference trip or beamtime experiment a researcher in the lab undertakes; this administrative layer is frequently invisible to students precisely because its whole function is to let the researcher-facing side of the laboratory operate without having to think about it.

Engineers and technicians design, build, and maintain the instruments a laboratory actually uses to do experimental work: a design office (*bureau d'études*) that turns an experimental requirement into detailed mechanical or electronic drawings, and a workshop (*atelier*) – mechanical, and increasingly also electronic or software – that machines, assembles, and repairs the resulting parts, often on a much faster turnaround than any external supplier could offer. Larger laboratories add dedicated instrumentation engineers, cryogenics or vacuum specialists, safety officers responsible for radiological, chemical, or laser hazards, and information-technology staff maintaining everything from data-acquisition software to the local computing cluster.

Research-adjacent professional roles complete the picture: librarians and data stewards who manage the laboratory's or institution's publications and datasets; communication officers; and, particularly relevant to the funding questions the next chapter takes up, technology-transfer or valorisation officers – in France, often employed by a dedicated regional structure called a SATT (*société d'accélération du transfert de technologie*) – whose job is to help a laboratory patent, licence, or spin out commercially useful results.

Historiographical note

None of this is unique to any one country or discipline, but the ratio of visible to invisible roles is worth stating plainly because it is easy to lose sight of as a student: a functioning experimental laboratory typically employs several support staff – administrative, technical, or both – for every researcher whose name appears on the resulting papers, and the laboratory's actual scientific output depends on all of these roles working together, not on the researchers alone.

7.5 Large-scale research infrastructures: the synchrotron as a worked example

Not all research happens inside a single laboratory's own walls. A large share of experimental work in physics, chemistry, biology, and materials science instead depends on shared national or international large-scale facilities – synchrotron light sources, neutron sources, high-field magnet laboratories, free-electron lasers, and high-performance computing centres among them – that no single laboratory could build or operate on its own, and that are consequently made available to outside research teams through a competitive, peer-reviewed access process rather than simple ownership. The synchrotron – a particle accelerator that produces extremely bright, tunable X-ray beams used to probe the atomic and electronic structure of

everything from proteins to battery electrodes – is one of the clearest examples of how that access process actually works, and is used here as a detailed illustration of a pattern that recurs, with variations, across essentially all such facilities.

A synchrotron such as the French national facility SOLEIL, near Paris, or the European Synchrotron Radiation Facility (ESRF) in Grenoble, opens a call for beamtime proposals roughly twice a year – at SOLEIL, one call in the autumn with results before the year’s end and a second in late winter with results in late spring – rather than accepting applications continuously. Each proposal is assessed by a discipline-specific peer-review committee (SOLEIL runs several, organised by broad scientific area such as condensed matter, chemistry and soft matter, or structural biology), made up of ten to twenty researchers external to the facility, appointed for a fixed, renewable term of a few years, who meet at fixed points in the yearly cycle to score every proposal submitted to their area against criteria that typically include scientific merit, the appropriateness of the technique to the scientific question, and the team’s demonstrated capacity to carry the experiment out; a separate technical review by the beamline’s own scientific staff checks feasibility and safety before any accepted proposal is actually scheduled. Because demand for beamtime substantially exceeds the hours available on any given instrument, proposals are effectively ranked by score and granted time from the top down until the beamline’s allocation for that period is exhausted, which means a genuinely good proposal can still fail to be funded with beamtime purely because of oversubscription in a particular cycle. Research groups with a long-term, recurring need for the same instrument can instead apply for a multi-year Block Allocation Group award, which grants a fixed annual time budget the group itself then distributes among its own experiments, subject to periodic renewal review rather than a fresh competitive proposal every single cycle.

Historiographical note

The same basic logic – a periodic call, external peer review by a standing committee, competitive ranking against a hard capacity limit – governs access to most other large-scale research infrastructures this section does not describe in the same detail: neutron sources such as the Institut Laue–Langevin in Grenoble, free-electron lasers such as the European XFEL near Hamburg, high-field magnet facilities such as the LNCMI in France, and national or European supercomputing allocations (through, for instance, GENCI in France or the EuroHPC Joint Undertaking at European level). The details of call frequency, scoring criteria, and committee structure differ from one facility to the next, and a full inventory is well beyond this course’s scope; the synchrotron example above is meant to make the general shape of that access model concrete, not to suggest every facility runs on an identical calendar.

Looking ahead

This chapter has described the people and structures research depends on: the sequence of career statuses a researcher typically passes through, which differs sharply from one European country to the next even as EU-level programmes gradually narrow some of those differences; and the wider ecosystem, human and institutional, that a working laboratory needs in order to function at all, from its own technical and administrative staff to the shared national and

international infrastructures exemplified here by the synchrotron. The next chapter turns from who does research and where, to how research is actually funded, judged honest, evaluated once published, and shared – the practical machinery, in other words, that the careers and institutions described here actually run on day to day.

Further reading

- European Commission, *Marie Skłodowska-Curie Actions: Guide for Applicants – Post-doctoral Fellowships*, Horizon Europe (updated annually).
- Mary Frank Fox and Catherine Mavriplis, eds., *Handbook of Academic Careers in Science and Engineering*, for cross-national comparisons of academic career structures.
- Synchrotron SOLEIL, *User Guide and Call for Proposals* (current cycle), synchrotron-soleil.fr.
- European Synchrotron Radiation Facility, *Users and Science: Proposal Submission Guidelines*, esrf.fr.
- Deutsche Forschungsgemeinschaft (DFG) and Hochschulrektorenkonferenz (HRK), joint guidance on the Habilitation and Juniorprofessur reforms (2002 federal framework law and subsequent amendments).