

#### **RSC 4: IAMT PhD Expectations and Process**

PhD expectations differ – between disciplines, supervisors and candidates. A PhD is much more individual than coursework, which *RSC2 HOW TO WRITE A PHD PROPOSAL* has already highlighted. The aim of this document is to explain the expectations of PhD training at IAMT and to encourage discussion about those goals which are designed to i) enable effective research training and ii) a successful research career. PhD application process and some basics can also be found on the IAMT website. It is after all important to align expectations and find the right match between supervisor and candidate!

#### **PhD @ IAMT – What is offered?**

IAMT is a very young and small institute of about 20 researchers. The 500 m<sup>2</sup> laboratories are custom-built and new (2019) with state-of-the-art equipment. Much of the equipment is custom-designed and built. Membrane filtration systems mostly have Labview data acquisition, filtration protocols have been developed and processes in place to ascertain the highest quality of results while new team members contribute continuously to improving facilities with new designs. Analytical instruments are equally new, most analytical tools for water quality analysis and membrane material characterization are available at IAMT. These tools are very complex in nature and tend to challenge technical limits of detection. A vast amount of additional instruments can be accessed across KIT ranging from the Karlsruhe Nano Mikro Facility (KNMF) through to the Test Facility and Synchrotron Radiation Source at KIT. The IAMT team is operating the laboratories independently with each team member taking on roles and taking care of one of the instruments. This teaches systematic problem-solving and dealing with suppliers. The international IAMT team engages collaboratively and skills such as giving and receiving feedback are developed in monthly group meetings, self-management and communication are trained through bimonthly progress reports, while social skills and 'soft skills' are supported through social events and team days. Personal meetings take place as required i) with the supervising postdoctoral researcher and ii) the professor together with the postdoc involved. The IAMT team language is English.

#### **PhD @ IAMT – Application process**

Selection of PhD candidates is an ongoing process at IAMT with admission possible throughout the year. The first step, after compiling the usual required documents, is the preparation of a research proposal. Little guidance is provided as this is a selection process, but instructions can be found in previous research career coaching (RSC 2) and key requirements are three focused research questions built on a solid literature review and a realistic work plan for a 4 year PhD. If the topic and quality are appropriate then an interview is scheduled (typically *via* skype/teams/zoom). If this is positive then the candidate is either supported to apply for scholarships or is offered a contract (funding dependent) by the personnel department (PSE). Contracts at IAMT are initially of a 1-year duration, with no one being admitted unless a full 4 years of funding is available. Continuation is performance dependent. Applicants who are moving from PhDs are required to declare such intentions openly and an oral or written reference from the previous supervisor will be requested. The aim of the admission process is to identify if a PhD is a match with IAMT in terms of skills as well as attitude and personality, and that can in the IAMT environment achieve success. Important to reflect on is the motivation for doing a PhD and examine repeatedly 'what do I really want?'. There are easier paths to an income than to engage in the gruelling journey of a PhD, which ought to be driven by a genuine interest in research fueled by curiosity.

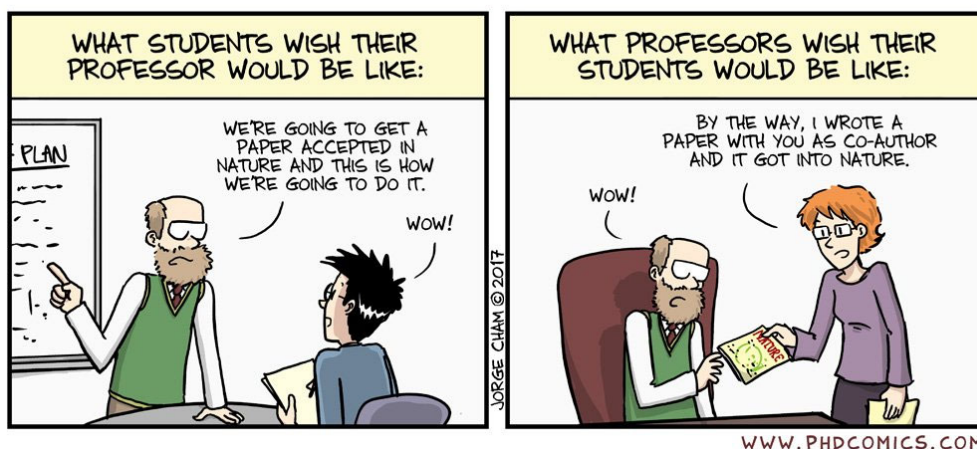
#### **PhD @ IAMT – PhD Admission and registration**

The admission to start a PhD at IAMT is done with i) an invitation letter by the IAMT Director (that allows obtaining a visa if required), and ii) an employment contract OR scholarship award through a funding body that requires an 'Infrastrukturnutzungsvertrag ISNV' at IAMT. This contract allows access to infrastructure.

The admission to PhD in a Faculty (in our case the Faculty for Process & Chemical Engineering) is independent of admission to IAMT and employment. At the end of the PhD the candidate submits a thesis when ready and, again, this process is independent of employment or scholarship. Note that delays in completion may result if progress is not adequate and this is to be managed by the candidate with the supervisor. This document clearly explains the expectations at IAMT.

### PhD @ IAMT – Publication requirements

Publication is important to i) communicate work, ii) collect performance indicators for a future career and iii) learn to structure and write (see *RSC 3: WHY PUBLISH RESEARCH...AND WHY IS THIS SO HARD IN OUR FIELD?!*) . ‘Publish or Perish’ is a common phrase in research training with all its pros and cons [1]. PhDs at IAMT are structured such that the research results in 4 main publications where the PhD candidate is the main author and that will be (in rewritten form) the main chapters of the PhD thesis (cumulative theses are currently not supported at IAMT). If a master student (supervised by the PhD candidate) carries out an experimental project, contributes scientifically and writes the paper (this is rare), this may mean second authorship for the PhD, otherwise the PhD candidate would be expected to write the manuscripts and be the first author. The work can be used in the PhD if the concept idea is that of the PhD candidate and he/she supervises the work. Additional collaborative papers may be written but these are not counted as part of the required 4 core PhD papers. Collaborative papers require careful discussion about scientific contribution and arrangements upfront as the same results cannot be used in two different PhD theses. The contributions of others (masters students through to supervisors) are always to be duly acknowledged, where the discussion of what is scientific contribution is discussed in a transparent manner within the framework of the DFG Kodex that KIT and IAMT adhere to.



### PhD @ IAMT – Supervision

IAMT supervision is very structured yet reliant on effective self-management, aiming to give all PhD students the tools required to succeed. This takes the form of many templates that are available, resources on research planning/skills and regular group and individual meetings. Very poor students may find this too demanding, brilliant students may find this restrictive, yet manage to adapt. However, a ‘laissez faire’ approach that many first-class institutions can afford (some brilliant students may not need supervision) to adopt in supervision will result in failures that this process can pick up early. A PhD will go through ups and downs and there are some good resources available to assist and well worth looking at [2, 3]. Going with it and trusting that everyone will be challenged at their level is key. Even the most brilliant of students can still learn a lot. Accepting feedback with an ability to learn and a resilience to not take criticism personally is the path to maturity. Very importantly, IAMT is a team and team members help each other. In research people come, stay for a while and then move on – this means the skill in the team fluctuates and everyone leaves a

legacy that was their contribution in their time. This builds a strong peer network in addition to supervisor expertise and experience.

### PhD @ IAMT – Evolution of expectations along a 4-year PhD

The below table summarizes a typical progression through a 4-year PhD at IAMT and this can help to set deadlines and notice early that things are taking longer and correct delays with faster progress.

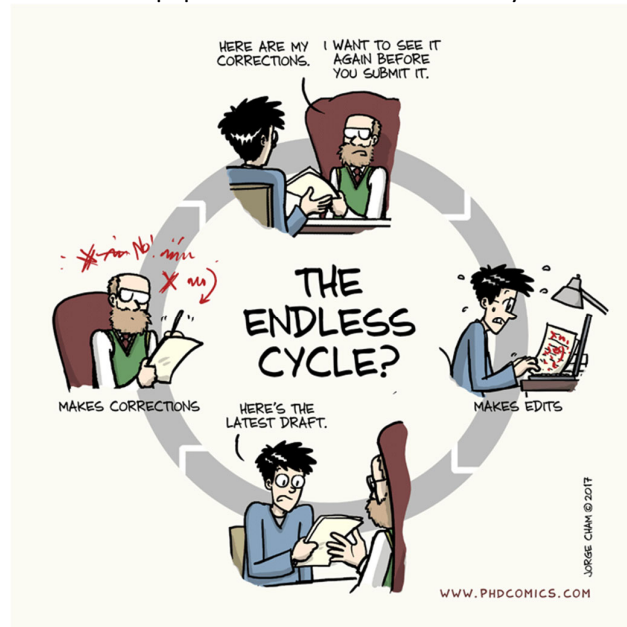
Year	Expectations	Comments
	<ul style="list-style-type: none"> <li>◆ Research Proposal with literature review, research questions and work plan</li> <li>◆ Assess novelty, focus, feasibility and fit to IAMT</li> </ul>	The research proposal aims to i) assess the candidate ability to conceptualize research (admission), ii) select a suitable (general) topic, iii) apply for scholarships
1	<ul style="list-style-type: none"> <li>◆ Refine PhD topic on the opportunities at IAMT at the time of arrival and make a plan for the first concept note (CON), ideally something that is feasible</li> <li>◆ CON 1 from planning through to data and error analysis, data management, making graphs, paper writing</li> <li>◆ Major literature review (Endnote, structure, prepare for review chapter; topic overview and depth; set up alerts for new papers on the topic)</li> <li>◆ Set up methods (filtration system &amp; protocol, analysis, risk assessment); naturally very new research topics will take time</li> <li>◆ Take on a laboratory responsibility (typically care of an analytical instrument)</li> <li>◆ Effective reporting, self-management, presentation and writing; participation in group meetings and discussions; team integration</li> <li>◆ SUBMIT FIRST PAPER (after many rounds of revision and prompt/complete incorporation of feedback)</li> </ul>	<p>Literature review is ongoing throughout PhD</p> <p>Risk assessments need updating every time a new method or chemical is used throughout the PhD</p> <p>CON1 is often predominantly the idea of the supervisor to allow a reasonably fast start</p> <p>Progress reports are an important tool to demonstrate communication skills and reliability (on-time delivery) to your supervisor(s)</p> <p>Submission of a first paper in the first year of PhD is an ambitious goal but it is worth striving towards as the first paper is the most challenging and difficult task in the PhD. No progress towards this goal will put PhD progression in question</p> <p>Novel method development may (depending on degree of challenges) result in a separate paper</p> <p>Administrative admission to PhD in Faculty should be completed within 6 months of commencement – this is the responsibility of the PhD candidate</p>
2	<ul style="list-style-type: none"> <li>◆ CON2 (new scientific challenges) from planning through to submission</li> <li>◆ Revisions of first paper reviews (careful: learning goal to deal with critique)</li> <li>◆ First conference (with all the admin; write abstract for oral presentation (of first submitted paper), funding applications, travel forms)</li> <li>◆ Supervision skills (supervising 2-3 master projects in a PhD is expected, more is always possible)</li> </ul>	<p>Conference participation requires the first paper to be submitted</p> <p>The more students are supervised the more results can be generated, which will result in opportunities for additional publications (for very good PhD candidates)</p> <p><b>Note that it is normal that things go wrong, don't work, need resilience, time to figure out,... this is part of PhD training!</b></p>
3	<ul style="list-style-type: none"> <li>◆ CON3 (new scientific challenges) from planning through to submission</li> <li>◆ Second conference</li> <li>◆ Participate in collaborations (in discussion with supervisor opportunities may become available that may result in further publications)</li> <li>◆ Beginning of grant writing and project management research skills</li> <li>◆ OPTIONAL: Research sabbatical at another institution</li> </ul>	<p>Build network (conferences, collaborations, peers)</p> <p>Funding for research sabbaticals elsewhere is available and can be applied for if this is of interest (it is good to experience different research environments)</p> <p>In the last phase, it is a good time to now publish a literature review on the topic. This is a really big effort but is usually rewarded with many citations and quite fast. Now you have the expertise to write such a review on your topic and you will need it for the thesis anyhow.</p>
4	<ul style="list-style-type: none"> <li>◆ CON4 (new scientific challenges) from planning through to submission</li> <li>◆ Thesis writing</li> <li>◆ Thesis examination</li> <li>◆ Celebrate (we do like parties)!</li> </ul>	<p>Build network (conferences, collaborations, peers)</p> <p>Complying with Faculty processes of thesis submission is the responsibility of the candidate.</p> <p>PhD examination is not about failing or passing, it is to pass a ritual, hopefully with experts in your field (this depends very much on institutions but I recommend courage and confidence!).</p>

### What is a 'successful' PhD?

In a nutshell, the transition to an 'independent' researcher who can conceptualize, execute and publish research. Hence CON 4 should normally require relatively little contribution from the supervisor(s), neither in direction, nor problem solving or revision of a publication. Further, at the end of a successful PhD one is known in the field for one's expertise that is communicated with the papers and hence internationally visible. Ideally, this skill will result in amazing job offers from places that would like someone to bring exactly your skill. You get to know the researcher who invented this device or developed that technique. Naturally, this depends a lot on the abilities of a PhD candidate, the environment in the host laboratory (facilities, team culture and supervision) and the hours of effective work put into the project.

Typically, the bigger the challenges (and the higher the frustration potential), the better the learning opportunities, but not all are able to grow on large challenges. Success is about getting up after falling, turning failures into learning and frustration into resilience. It can be a rocky road!

An interesting analogy may be the description of the effort required for mastery of a topic that was generalized to amount to an investment of about 10,000 effective hours [4]. This was the time Bill Gates required to become a master in programming or a musician to be a master of his instrument. If applied to a PhD of 4 years this equates to 50 weeks of 50 hours per year. This is probably a realistic effort for a successful PhD. Naturally, there are weeks where we achieve little, and there are weeks (often due to deadlines) where the effort is way more and the outcome enormous. If one learns in a PhD how to work effectively then this is a great outcome, wouldn't we all like to be in constant 'flow' free of unhelpful distractions and procrastinations!?



### Relevant IAMT Documents

- ◆ PhD Outline
- ◆ PhD Workplan
- ◆ PhD Budget
- ◆ Risk Assessment Template
- ◆ Concept Note (CON) Template
- ◆ Manuscript outline Template (with formatting instructions)
- ◆ Progress Report Template
- ◆ Group Meeting Template
- ◆ Performance & development review

### References

- [1] M. De Rond, A.N. Miller, Publish or perish: bane or boon of academic life?, *Journal of Management Inquiry*, 14 (2005) 321-329.
- [2] M. Petre, *The unwritten rules of PhD research*, McGraw-Hill Education (UK), 2010.
- [3] E. Phillips, D. Pugh, *How to get a PhD: A handbook for students and their supervisors*, McGraw-Hill Education (UK), 2010.
- [4] M. Caldwell, *Outliers The story of success*, in, New York: Hachette Book Group, 2008.