Everything about PhD: Requirements, application process and the value of degree

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About me/bio

Educational Background

- BEng in Petroleum Engineering, Baku Higher Oil School / Heriot Watt University, 2013 – 2018
- MSc in Reservoir Evaluation and Management, Baku Higher Oil School / Heriot Watt University, 2018 – 2020
- PhD in Petroleum Engineering, University of Southern California, 2021-

Industry experience

- Summer intern, SOCAR, 2015
- Summer intern, SOCAR, 2016
- Summer camp participant, Schlumberger, 2016
- Geoscience intern, BP AGT, 2017
- Reservoir Engineering intern, BP AGT, 2019

Involvement in SPE Azerbaijan

- Young Talents program, 2016-2018
- Student Symposium, 2017
- Petrobowl Finals, BHOS team lead, 2019

1. Requirements

Formal requirements

1. Research (the most important one)

- High quality and novel work validated by published peer-reviewed journal and conference paper(s)
- Presentation of the research results in a (written) dissertation and (oral) defense

2. Coursework

- Successful completion of core and elective courses
- Electives should not necessarily be from your department
- Extra courses can be taken from other departments, and you can even earn MSs degree in your/another major during PhD
- Grades/GPA are not that important (3.0/B average grade is enough)

3. Teaching requirement (Optional)

- You may be asked to do TA based on funding limitations or PhD degree requirements

Informal requirements

1. Academic ability

- *Above average (not necessarily exceptional) intellectual ability (for understanding of research papers, conducting research and satisfactory completion of non-trivial demanding graduate courses)*

2. Curiosity and passion for research

- *Research is major component of PhD degree, and it is the thing you spend most of your time on*
- *A lack thereof would make it very hard to persist through such long (4-5 years) period of time*

3. Hard work, persistence and time management

- *Research is hard, slow, lonely and very low return on investment activity – enough said*
- *There will always be something interesting going on, especially during hard times (Murphy's law)*

4. Motivation and ambition

- *The thing (s) that will help you to wake up in the morning, do hard work every day and persist during hard times*

5. Creativity and independence

- *You should independently come up with novel research ideas and independently execute them*

Informal requirements (continued)

6. Communication skills

- *Not just IELTS band 7 or band 8*
- *(oral) You will be communicating a lot with your peers, advisor, committee and giving presentations*
- *(written) Emails / abstracts / paper / dissertation writing*
- *Also, very useful for outside of PhD activities: job application process (CV writing, cover letters, interviews) and personal life*

7. Teamwork/Collaboration

- *Put your ego aside as soon as possible*
- *Group projects in courses, joint research projects, coauthoring papers, research discussions, mentoring younger PhDs*

8. Ethics / good intentions (Optional)

- *Original rationale behind PhD: Expanding the boundary of human knowledge- Ideally, PhD is not just about slogging your way through it asap, publishing a sequence of papers and landing a high-paying job and posting a success story in social media (e.g., Ian Goodfellow – GAN)*
- *Doing things that contribute little on paper/ others don't do but should (e.g., mentorship/outreach, helping professor, taking on non-trivial risky research projects)*

You should not have it all before applying or while doing PhD, but the more you have, the better

2. Application process to the US graduate programs

Do you really need a graduate degree from US university?

Some Pros

- *High-quality education, recognized in every part of the world*
- *Learning how to learn/research*
- *Learning to be independent in many respects*
- *International, highly-intellectual environment*
- *Better employment opportunities (maximizing future choice)*
- *It is just cool (exclusivity, status, expertise, personal growth)*

Some Cons

- *Time-consuming and costly application process (~ 80-100 USD per each application)*
- *Statistically low chance (~ 10-20%) to get into top US school*
- *Demanding graduate programs (long hours, working on weekends, difficult courses, difficult research)*
- *Opportunity cost (what you could achieve otherwise in 4-5 years)*

So, it is important to have some valid reason for pursing graduate degree in US

- *http://karpathy.github.io/2016/09/07/phd/*

Know your options

MSc with thesis

- *Funded by RA/TA, Azerbaijan government scholarship, US government scholarships (e.g Fullbright), fellowships (university-specific or general)*
- *2-3 years*
- *Requirement for graduation: coursework and MSc thesis (research project)*

PhD program

- *Could be applied to without MSc degree*
- *Funded by RA/TA, government scholarship, US scholarships, fellowships (university-specific or general)*
- *4-5 years on average*
- *Requirement for graduation: coursework, dissertation (~3 research projects), journal/conference publications*

Selection of universities

Criteria for selection

1. General ranking and quality of the program

- *Reputation of university: brand name, better career options, top talent (faculty, students)*
- *Quality of program: degree structure, courses, facilities*

2. Faculty

- *Presence of one or several faculty whom you want to work with*
- *Things to consider: research interests and work habit/personality of advisor, students in the lab*

3. Physical location

- *Culture, weather, fun stuff/student life, career options (e.g. Stanford vs MIT)*

Things to keep in mind

- *Generally, it is better to apply for 3 type of universities: 1) dream/top schools 2) about your caliber 3) safety schools*
- *Naturally, the more universities you apply, the higher your chances for acceptance, but keep in mind that application process is costly both financially (~ 80-100 USD per each university) and timewise (1) researching and contacting professors, 2) application forms, 3) tailoring your applications)*

It is almost always possible to achieve great things at non-top schools

Application items and timeline

Applications items

- *BSc (and MSc) diploma*
- *Research/Industry experience*
- *SOP (statement of purpose)*
- *Recommendation letters*
- *Test scores (IELTS/TOEFL and GRE)*
- *CV*
- *Fees: application fee (~50-125$), GRE sending fee (27$), IELTS/TOELF sending fee*

Timeline

- *Application deadline: Dec-Jan*
- *Contacting professors (if any): Dec-Jan*
- *Interviews (if any): Jan-Feb*
- *Application outcome: Feb-March*

BSc/MSc diploma

- Perfect GPA is not expected
- Usually around 3.5-3.7 is competitive
- A in core/important/relevant courses does not have equal weight compared to other less relevant courses
- I had F in MSc transcript (retook, got B), still got accepted; there are few more cases like mine
- For concrete data check university/department website

Research/industry experience

- *For good schools – impossible without some research experience*
- *You do not necessarily need a published paper*
- *Ideal cases: 1) first-authored or coathored paper at known venue 2) recommendation letter from a known professor/researcher 3) internship experience in meaningful role at a known company*
- *Still possible without research experience: other application items should be very strong (very strong GPA, test scores, SOP (clear indication of research direction , right attitude, knowledge of the field), some industry experience)*

How can you get research experience??

1) *Your university*
2) *Research centers/universities in Azerbaijan*
3) *International research internship programs*
4) *Contacting professors at good schools and asking for research internship*
5) *Personal projects*
6) *Quality thesis work (but usually, you do not have a thesis while applying)*
7) *Internship project and its extension*

SOP (statement of purpose)

- Important application item – only item for self-expression
- Concise and compelling story involving 1) how you started out 2) why you did all the Xs in your CV, demonstrating maturity and purpose in every decision 3) demonstration of strong technical and research ability/qualifications 4) demonstration of a very strong passion, interest and a clear direction for the future research, potentially mentioning your target advisor(s)
- Basically, you can think of it as writing narrative for your CV
- Customize little bit for each university/program
- Confident, humble, respectful, ambitious, mature tone; ideally from the depths of your heart
- 1-1.5 pages
- Proofread and ask experienced people to review

Avoid

- Narrating your life story (life was very harsh, you are from small town, everything was bad, but you won)
- Overselling yourself, you need to have a humble tone

SOP (statement of purpose)

Approximate structure

- ***1st paragraph*** *(very important and hardest to write) – eye catching 1st sentence; potential ideas: some relevant insight/fact, problem statement, followed by its elaboration through the rest of the paragraph;*
- ***2nd paragraph****: smoothly shift the story to yourself; introduce yourself: how you started out, reason behind your college major selection etc*
- ***3rd -4/5th paragraphs*** *– walk through significant achievements in your CV; pick the ones that are the most relevant to the research; describe your experience/what your learned, what unique insights you got, potentially demonstrating your critical thinking ability and passion for problem solving and research; all with humble tone, without overselling*
- ***5/6th paragraph*** *– summarize your experience and skills; state your research directions for MSc/PhD degree; mention the name(s) of potential people you want to work with while including some unique/personal information about faculty and school and explain why (avoid mentioning professors with completely different research agenda!); end with ambitious and confident tone*
- ***Significant part of your SOP should be about research****: what you have done, what insights you got while doing, what you would like to do next*
- ***https://www.quora.com/What-was-your-Statement-of-Purpose-SOP-for-entering-into-a-PhD-program***
- ***https://grad.ucsd.edu/admissions/requirements/statement-of-purpose.html***

Recommendation letters

- *3 letters are required*
- *At least two from academia (unless you are coming from industry)*
- *Ideally, from a person who worked with you, knows you well and can write a unique letter*
- *Examples: academic advisor(s), Prof for the class you served as TA, internship supervisor/TL*
- *Ideal scenario: from someone who is involved with research actively, has published papers/ some name in the field and can write a good letter for you – perfect contribution to your admission result*
- *Not more than a page, mostly about your research/teaching skills and little bit about personality*

Test scores

IELTS/TOEFL

- *Usually, 7.0 IELTS is acceptable for most engineering schools*
- *High/perfect IELTS/TOEFL score won't put you in advantage, so don't waste your time*
- *Most universities accept IELTS*
- *For concrete data check university/department website*

GRE

- *3 parts: 1) Quantitative 2) Verbal 3) Analytical writing*
- *Quantitative : Basic math skills, mostly school math; aim for 165+; the most important one for engineering*
- *Verbal: type of questions: 1) reading comprehension (similar to IELTS), 2)text completion (fill words/phrases into gaps), 3) sentence equivalence (fill 2 synonymous words into gaps); learning lots gre-specific vocabulary is the key for verbal section; for engineering schools – aim for around 150*
- *Analytical writing: 2 essays: 1) analyze an issue (similar to IELTS) 2) analyze an argument; require more words than in IELTS: 400-500; for engineering schools aim for 3.5-4*
- *For concrete data check university/department website*

Contacting professors

- *Unless you have something unique/meaningful to say, do not contact*
- *Contacting to a professor with strongly tailored email with some unique insights can be advantageous for your application*
- *Your email should be concise (2-3 paragraphs): 1) I am X 2) I did Y, (better for Y to be relevant to professor's research interests or past work) 3) I want to do Z – must be relevant to professor's work*
- *Attach your CV, paper(s) (if any), and maybe credentials (GRE/IELTS scores and GPA)*

How to write strongly tailored email with some unique insights?

1) *Go through Prof's webpage or lab webpage very carefully*
2) *Try to detect something interest / relevant to your past work/future research interest*
3) *Try to come up with interesting questions after going through Prof's webpage and reading 1-2 of his/her latest research paper (read the one you find the most interesting/relevant/easiest – you do not need to understand it completely)*
4) *Do not ask something you are not confident about/ do not completely understand; he may invite you for an interview*

Interview

- *Not every university/department conducts an interview*
- *Interview structure varies depending on professor*
- *Usually, not very long (15-20 min)*

Potential questions:

1. Your background/research/internships projects (the most likely question)

2. something on your CV

3. technical questions

4. your future research interests and why you would like to work with him/her

- *Google for interview questions if invited for interview*

CV

- *You should not limit to 1 page, as for job applications*

Sections to have:

1) ***Education****: years attended, major, GPA*

2) ***Research Experience*** *(if any): – briefly describe each project with few bullet points*

3) ***Research Interests****: – pick few areas (not 1 and not too many) – relevant to Prof's area*

4) ***Work/Internship experience*** *(if any): - briefly describe each experience with few bullet points*

5) ***Personal projects*** *- briefly describe each project with few bullet points*

6) ***Skills*** *: programming languages, relevant software, languages, etc*

7) ***Test results: IELTS/TOELF, GRE***

8) ***Conferences attended*** *(if any)*

9) ***Extracurricular activities*** *(e.g. SPE section involvement, or something non-academic such as sports)*

10) ***Relevant online courses*** *(if any) (link to certificates if any)*

- *Do not include unnecessary/not relevant certificates/info*

Final thoughts

- *Try to figure out whether the Profs you target are accepting graduate students/have funding - by contacting professors/graduate students (better to do before applying)*
- *Planning ahead: start early (GRE score is valid for 5 years, IELTS for 2 years, documents preparation will take 1-2 months)*
- *Get your SOP reviewed*
- *Apply to several schools (top, your caliber, safety)*
- *Application may not end with submit button (emails, interviews)*
- *Google, quora, reddit, linkedin are your friends*

A Five-Minute Guide to Ph.D. Program Applications

- ***https://pg.ucsd.edu/PhD-application-tips.html***

3. Career options in Petroleum engineering: pre and post-PhD

Two things to bear in mind

Before diving into concrete career options, let's think about 2 things:

1. Degree is not defined by its name: what actually matters are:

- *courses you took and how you did on them/what your learned;*
- *conferences, trainings, seminars, webinars or any technical sessions you attended*
- *extra technical/non-technical courses/projects you completed*
- *extracurricular/volunteer activities (degree-related or not) you involved in*
- *your network/people you interacted with*

2. Think of finding job a from an economic perspective:

- *whenever there is match between your skills and the skills required by a job, you can find a job (less true in Azerbaijan)*

So, 1) there will be a significant variability in skillset among graduates from the same university and degree 2) unless you define yourself, you are not defined by your degree

Pre-PhD (after BSc) - preliminaries

What skills you should/can have after completion of BSc in PE:

- ***Technical:*** *mathematics, physics/mechanical engineering (exposure), geology (exposure), process engineering (exposure), petroleum engineering, economics (some slight exposure), programming (exposure)*
- ***Non-technical:*** *general communication skills (pure communication, presentation, public speaking), English (oral and verbal), teamwork, leadership, project management, work ethic/time management*
- ***Research/self study/problem solving ability*** *– ability to independently find and learn what is needed (if you took all the reports from senior students, copied solutions from your friends, crammed before exams – then you do not have those skills); these skills develop slowly, bit by bit, with time and usually more when you are stuck*

So, there are lots of jobs, that you can be a match, depending on:

1) your level of mastery of above skills and how you navigated through your undergraduate degree

2) your persuasion/presentation/selling ability

3) open-mindedness of employer

Pre-PhD (after BSc) – usual tracks

1. Operator companies (BP, SOCAR, UBOC etc) – the most relevant to your education

- *Roles: Engineering (Reservoir, Production, Drilling), Geoscience (Geology, Geophysics, Petrophysics)*
- *Features: good salary, (mostly) office environment, good work-life balance, higher job security, guaranteed career progression (though not fastest)*

2. Services (Schlumberger, Baker Hughes, Halliburton, SOCAR AQS, KBR etc)

- *Roles: lots of roles (drilling, completion, wireline, cementing etc)*
- *Features: higher salary, usually field/offshore environment, relatively poorer work-life balance (not structured), lower job security, faster (usually) career progression, not very relevant to what you studied*

3. Academic (MSc/PhD, teaching, research) – pick this if you have a valid reason and/or some passion

- *Options: local/international*
- *Features: salary (depends, but usually lower), work-life balance (depends, but usually much more flexibility), not the best option for industry-oriented people, career progression (depends on your future decisions, usually late start high momentum)*

Pre-PhD (after BSc) – not usual tracks

4. Other close engineering roles (not technically hard to shift):

- *Chemical/process (Petkim, SOCAR Polymer, Technip, Azerkimya etc)*
- *Mechanical/subsea/offshore – (SOCAR Polymer, Saipem etc)*

5. Tech (tehnically harder to shift, also you need passion):

- *Software engineering (web/mobile/front/backend development) – (ATL tech, banks, telecom, IDRAK etc)*
- *Data science (software, telecom, banks etc)*
- *Product management (ATL tech, banks, telecom etc) –less technical job*

6. Non-technical (not technically hard to shift, though stronger soft skills needed)

- *Marketing/sales*
- *Consulting/finance/audit (Mckinsey, EY/Deloitte/KPMG, banks etc)*
- *Tutoring -non-petroleum (university entrance exam, SAT/GRE, IELTS/TOEFL etc)*
- *Project management*
- *HR*
- *and other roles*

Pre-PhD (after MSc)

More or less same career options as after BSc

- *Have a good reason/clear goal for doing MSc, if unsure it is better to find a job (even the one not related to your degree) and work for some time and figure out things / discover yourself*

Some valid reasons for doing MSc

- *Advancing your knowledge in the field / PhD / academic career*
- *Career change (though MSc is not the only option for that)*
- *Access to foreign market/immigration*
- *International exposure/experience/soul-searching*

Some not very valid reasons for not doing MSc

- *You do not know what to do / you have free time*
- *Everybody else / your friends are doing MSc*
- *MSc degree at some point will help you with your career progression (a bit debatable)*

Post-PhD

- *Depending on your 1) research topic/advisor/funding constraints 2) program structure (its flexibility) 3) how you structure your PhD (choice and sequencing of research projects and courses) 4) internships while doing PhD 5) ranking and location of your university, you may end up at very different places by completion of PhD*

- Skills you can acquire while doing PhD:

1) *Problem solving/Analysis/ Research skills - ability to think clearly, identify problems, critically review existing literature, come up with new idea(s), implement prototype, test it and communicate properly*
2) *Technical skills (depends on major/research project/your course selections) – at bare minimum for STEM PhD you will have non-trivial math and programming background*
3) *Independence and superb self-learning ability and creativity*
4) *Leadership, project management/organization, time management, mentorship*
5) *Communication skills (more on written side) – ability to communicate clearly and succinctly*

Post-PhD career options

- *Academia (Postdoc, Professor): teaching/research career*
- *Industrial/governmental research labs: research scientist*
- *Engineer at your/different field*
- *Consultant: independent or at a technical consulting company*
- *Entrepreneurship: build product based on your research projects/acquired knowledge/insights*
- *Quantitative finance / Management Consulting / Investment bank – hire PhDs very actively*
- *Software development/Data Science – hire PhDs very actively*
- *Whatever you wish*

4. General advice / concluding remarks

General advice

- Do not overthink (or do not be very picky) the available choices/opportunities, try many different things, especially early on
- Do overoptimize for grades, study hard but also smart (e.g., 1) 80-90 vs 90-100 equal difference in points, but not in effort) 2) no need for all A's (even in major-related subjects) 3) neglect non-relevant/boring courses
- Resist procrastination/laziness/cheating as much as possible (copying homework / reports / projects, cramming few days before exams)
- Enjoy life – trips, friendships, intellectual games, societies, volunteering, sports, non-academic stuff
- Be flexible, take risks, do not fear of failure (if you do you will fear even more in the future), do not only try to connect dots looking forward, do some things just because you like/find interesting without expecting anything
- Be creative – posts, personal projects, mentorship, outreach, blogs, teaching, seminars
- Try many different things early on, but try to eliminate stuff you do not like quickly, learn to say no to good opportunities for the sake of expected great opportunities after some point

General advice (continued)

- Do not procrastinate in disguise (e.g., doing/learning easy stuff / stuff you already know over and over)
- Work hard and play hard: non-academic / fun extracurriculars, trips, friendships, volunteering, sports – so that when you graduate you do have only diploma and good grades, but good friends and memories
- Don't do stuff for social media posts, tick marks, another line at CV
- Do not rely just on university, self-study heavily – online/physical courses, trainings , seminars, textbooks – but with time be cautious of your time and be picky
- Network – but meaningfully, networking is two-way street, meaning you also need to contribute and help; invite people experienced people for a coffee/lunch meeting
- Avoid unhealthy competition/comparisons, instead collaborate heavily (1+1=3)
- Avoid perfectionism disease, good enough is almost always is enough: almost nothing in this world is perfect (for reference: lots of problems in science are also solved approximately, optimized sub optimally)
- Your best friends: Google, Quora, Reddit, Linkedin, Youtube, kind and helpful professionals/academics and BHOS alumni

Acknowledgements

- Elshan Rzayev, BP/SPE
- Quora
- Google
- Linkedin

Sources

Everything about PhD:

- http://karpathy.github.io/2016/09/07/phd/

SOP samples:

- https://www.quora.com/What-was-your-Statement-of-Purpose-SOP-for-entering-into-a-PhD-program

SOP info:

- https://grad.ucsd.edu/admissions/requirements/statement-of-purpose.html

5-min guide for PhD applications:

- https://pg.ucsd.edu/PhD-application-tips.html

Thanks!

Stay tuned!

Possible future sessions

- Learning how to learn / Learning effectively
- Presentation about some aspects of doing PhD / doing research
- Presentation about some aspects of Machine Learning and Data Science

5. QA