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School of Engineering

Leading a Well-Adjusted Research Group

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Leading a Well-Adjusted Research Group:
The philosophies of an Assistant Professor

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Structuring a research group
- Different methods/approaches

Roles of the advisor
- Defining how you manage your group

Comments from students
- Actual feedback

To be an effective manager, you must:

Have a **<u>well-defined organization</u>** (structure or chain of command) with **<u>well-defined goals</u>**.

Therefore, you should have a plan or rationale for your research group (size, hierarchy, interaction) before you start hiring students/post-docs. It is very hard to change it mid-stream.
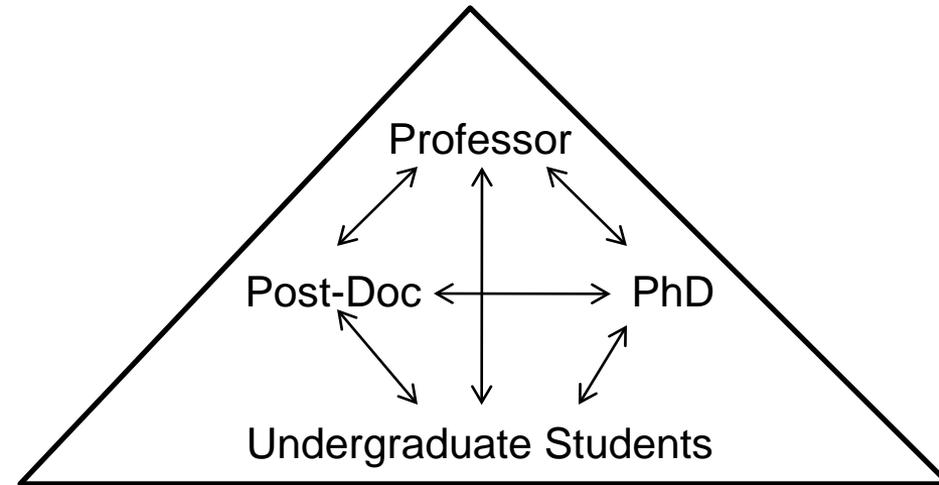
"European Model"

Professor

↕

Post-Doc

↕

Graduate Students

↕

Undergraduate Students
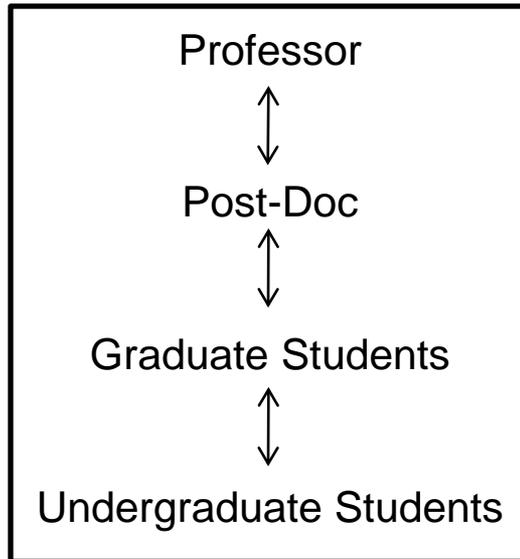
- Linear, top-down hierarchy
- Based on having all-levels
- Requires delegation of tasks

"American Model"

Professor

Post-Doc ⟷ PhD

Undergraduate Students

- Very inter-connected
- Many variations
- Very robust – not every group has all levels

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Two approaches:

Large group efforts to accomplish a single goal
Examples:
- Genome
- HIV vaccine

Main Goal

↓

Sub project 1 (thesis 1)

↓

Sub project 2 (thesis 2)

↓

Sub project 3 (thesis 3)

↓

etc
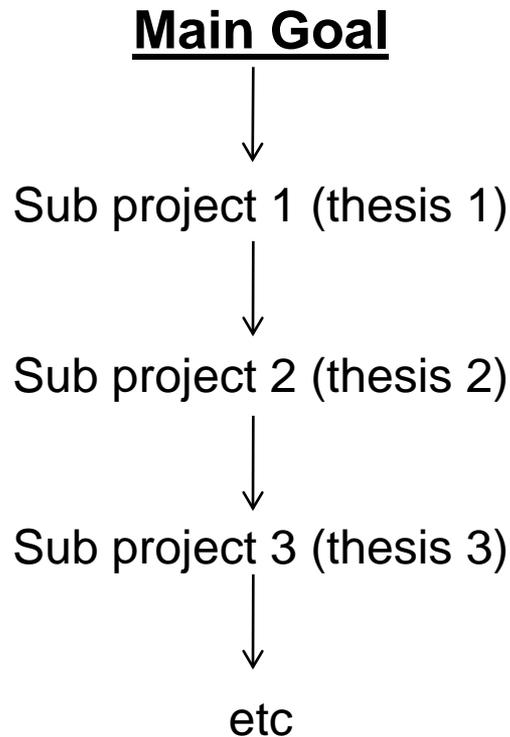
Single, independent efforts around a theme
Examples:
- Optofluidics
- Optomechanics

Sub project 1   Sub project 2

Theme/Focus of Group

Sub project 3   Sub project 4

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Three hats of the advisor
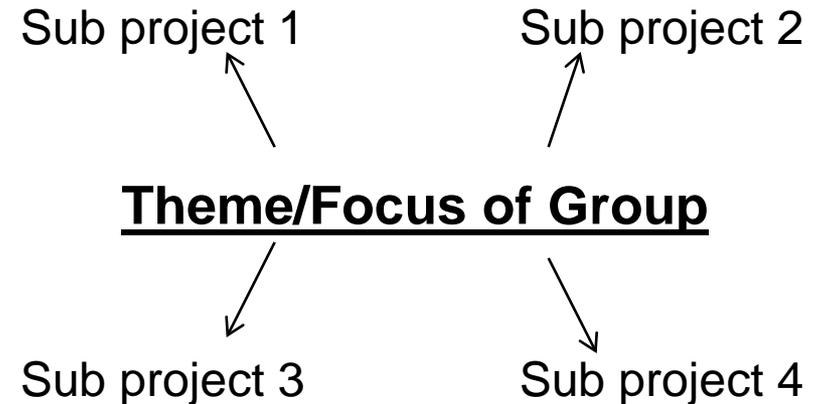
Chief Technical Officer (CTO): defines the technical and scientific focus of the research group and directs/aids in its implementation.

Chief Executive Officer (CEO): aligns the core objectives of the research group with those of external agencies and builds a sustainable organization.

Chief Operating Officer (COO): manages the day-to-day business of the research group, including ensuring efficient resource allocation.

The balance between these roles is ever-evolving.

"CTO": defines the technical and scientific focus of the research group and directs/aids in its implementation.

In the transition from grad student or post-doc to faculty member, the role of CTO is the easiest to assume.

Many senior students/post-docs have already begun acting in this role.

However, as a student/post-doc, you performed all of the research. As a professor, your students and post-docs will perform the research. **Learning to delegate is a crucial skill.**

It is important to realize that, while you are capable of doing everything, you are not able to do everything. There are only 24hrs is a day.

Balancing your role as a CTO:

Actively to moderately involved in research: aid in performing research, guide research of students, develop new ideas, develop theory

Time ───▶

Actively involved in research: perform research (take and analyze data), guide research of students, develop new ideas, develop theory

Moderately involved in research: guide research of students, develop new ideas, develop theory

Transition from active to moderate involvement in research is dependent on many factors, including personality (yours), funding, availability of students, and type of research.

Also relates to your management style.

Micro-management
A style where a manager closely observes or controls the work of the employees. Because micromanagement can give the impression that a manager does not trust an employee, it often leads to resentment between the employee and the manager.

"Macro"-management *(not a real term)*
A style where the manager is somewhat detached from the daily work of the employees, and focuses on the over-all goal of the organization. Because macro-management can give the impression that the manager is disinterested in the project, it often leads to the researchers being un-motivated about their work.
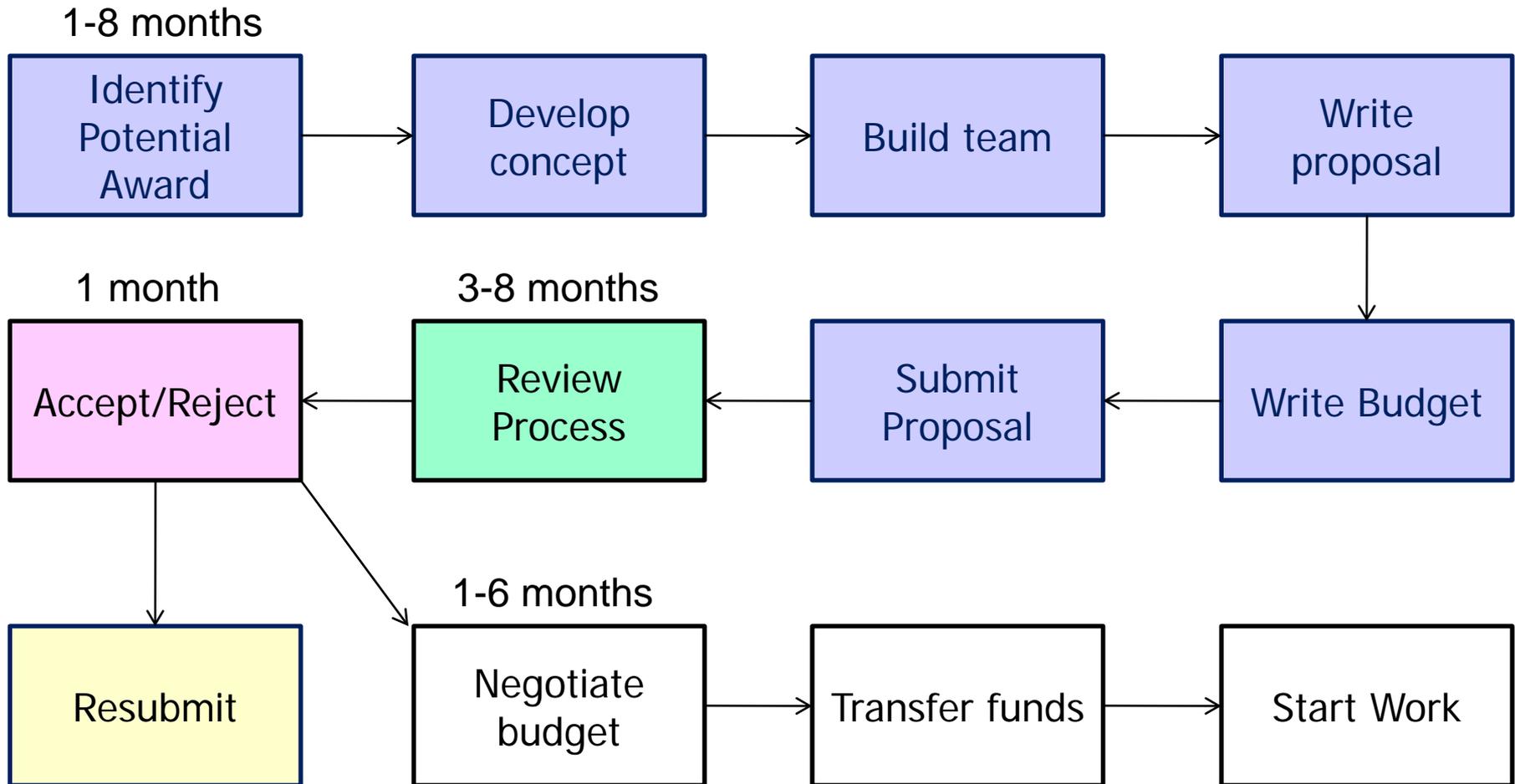
It is clearly ideal to fall somewhere in the middle. However, this is not a static behavior - how you manage your group, or a given student, will evolve as that student matures.

Chief Executive Officer

While you may think your ideas are incredible, you must convince someone to fund them and you must convince your research group to work on them. You also must create an environment which is conducive to performing research.

This is your job as the CEO –
• align your research objectives with those of a funding agency
• interface with the general public on behalf of your research group
• inspire your research group – ie be a leader worthy of following

Funding (Cliff notes version)

1-8 months

Identify Potential Award	→	Develop concept	→	Build team	→	Write proposal

1 month   3-8 months

Accept/Reject	←	Review Process	←	Submit Proposal	←	Write Budget

1-6 months

Resubmit		Negotiate budget	→	Transfer funds	→	Start Work

→ You need to start writing proposals as soon as possible.

The advisor: advisee relationship is symbiotic. I've posted a Science article on my website which has a very good discussion about this concept.

I share it with my students when they join.

If they see you working hard, they will work hard. If you are sleeping in until noon and leaving at 4pm, they will as well…

Manages the day-to-day business of the research group, including ensuring efficient resource allocation. Examples of issues which can arise in the first couple years:

Managing people
• Personality conflicts in the lab
• Firing a student
• Student "crushes"

Managing finances
• Hiring grad students vs. post-docs
• When to hire students
• What to budget for

Managing resources
• Fighting over equipment
• Poor use of equipment
• Poor use of space

Many conflicts between people are the result of confusion.

Companies have contracts and rules; your lab shouldn't be any different.

One way to remove confusion or perception of favoritism is by establishing "best operating procedures" or a guidebook to the lab. You can put all relevant information in there and give it to all new group members upon joining the lab and post it online for easy reference.

For example:

Table of contents (from mine)
- Purpose of lab
- "To do list" upon joining
- Overview of research/funding
- Overview of resources
- Progress Reports
- Experimental Protocols
- Equipment
- Software
- Vacation policy
- Lab rules/duties/contacts
- Advice (writing papers, giving presentations)

The two biggest expenses are salary/tuition and overhead.

Because your salary commitment is known (for existing graduate students at least), it is possible to create budget/expense projections, so that you will know if you can afford additional students or not.

These projections should include (at a minimum): your known/committed expenses with any anticipated salary/overhead increases and your active awards/grants.

These types of projections are very helpful when writing proposals – and when trying to determine how many proposals you should be writing.

The most fought over resource is space – don't wait until you **<u>need</u>** it, to ask for it.

However, make sure that you have a well-thought out rationale for your space request and be somewhat flexible. Key points/questions to ask:

Lab:
What is the average $/sqft of lab space? ($ in indirect costs) This is typically a known number and is calculated on a rolling 5-yr average. For example, Prof. X has brought in $1M in indirects over the last 5yrs and has 2000sqft of lab space ($500/sqft). If the av$/sqft at Prof. X's school is $300/sqft, then Prof. X should request more lab space.

Office:
How many grad students are typically in an office and how many do you have in your current offices? Is there office space which could be shared among faculty?

Are you currently housing students in the lab because you do not have enough office space (poor resource allocation)?

Identify what you **need** vs. what you **want**.

Example: Lab
Need
400sqft
Fume hood
Cabinetry

Want
800sqft
Two fume hoods with sinks and built in gas/vacuum lines
Cabinetry
DI water system

Approximate cost of a lab rehab ~$800/sqft + equipment costs

Request lab space with duct work for second fume hood in place. Depending on availability of funds, request second fume hood/DI system.

Identify what you **need** vs. what you **want**.

Example: office
Need
300sqft
Furniture (new or otherwise)

Want
600sqft
New paint/floor/ceiling/etc
New furniture

Request rehab of office space, offer to pay some of the bill –eg furniture.

<u>Lab/Research Level</u>

<u>Establishing fixed protocols</u>
•Methods/protocols for synthesis, fabrication, and testing is detailed in manuals, so everyone does everything the same way.

<u>Equipment</u>
• Every piece of equipment (purchased or built) has a manual – both online and next to the equipment
• To use a piece of equipment, the student must be trained. This is verified by the super-user of the equipment and the student both signing an equipment-specific form, which is given to me. Requiring the trainer to also sign the form, thereby taking responsibility, significantly improves the training.

<u>Lab duties</u>
• Every student has responsibilities in the lab, to ensure that the lab is always operating and that no single student is doing everything. Responsibilities increase with time in group

<u>State of the Group Talk</u>
• Every fall, I give a "state of the group" talk which discusses our funding (present and future), projected expenditures, and pending proposals. I also discuss any large changes – eg addition of lab/office space or new students

Individual Student

Making students aware of grant deadlines

• Discuss specific grant which is funding PhD work, and goals/milestones/metrics which must be met

Maintaining connection with student's goals

• Yearly surveys about student's goals. As their goal's change (eg industry to academia), my mentoring must also change.

• Similarly, I try to promote my students to those who can best help them in the future in their chosen career path. eg meeting with seminar speakers and program managers or meeting with industry colleagues.

Assigned mentors for new students

• Every new student is assigned a mentor who is responsible for training and integrating the student into the lab

• Every new student is given a "starter" project which will guide them through the equipment of the lab, while still exploring new research

• Every new student who joins is given "homework" – a sheet with ~ 30 questions along with about ~50 journal articles which contain the answers. The questions are meant to guide the students through the reading and reinforce the important concepts.

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Individual Student cont.

Research projects

• Monitoring a student's progress without being over-bearing. Checking in frequently enough so that they know I care, without it being too frequent.

• Supporting/enabling collaborations with other professors – making sure that they always have everything (tools/equipment) they need.

• Letting them "flounder" just long enough

• Encouraging them to pursue their own ideas – even when I know (or am fairly sure) that they won't work

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Group Level

Group Activities
• Group parties at the end of every semester with spouses/significant others. Everyone is invited and everyone comes. These really build a sense of community within the group.

New Members
• When possible, I involve the current members of the group in interviewing and in choosing new graduate (PhD) students.

Celebrate achievements
• No matter how big or small, all achievements and accomplishments are recognized on our webpage and all papers/press are posted on our bulletin board in the hallway.
• For those achievements which may not be widely known, I email the group and announce them. A success for an individual member of the group is a success for the group.

Acknowledgements

http://armani.usc.edu