SCIENTIFIC RESEARCH METHODOLOGIES AND TECHNIQUES

Unit 6: RESEARCH IN COLLABORATION

Luis M. Camarinha-Matos
cam@uninova.pt

PhD PROGRAM IN ELECTRICAL AND COMPUTER ENGINEERING

1. WHY

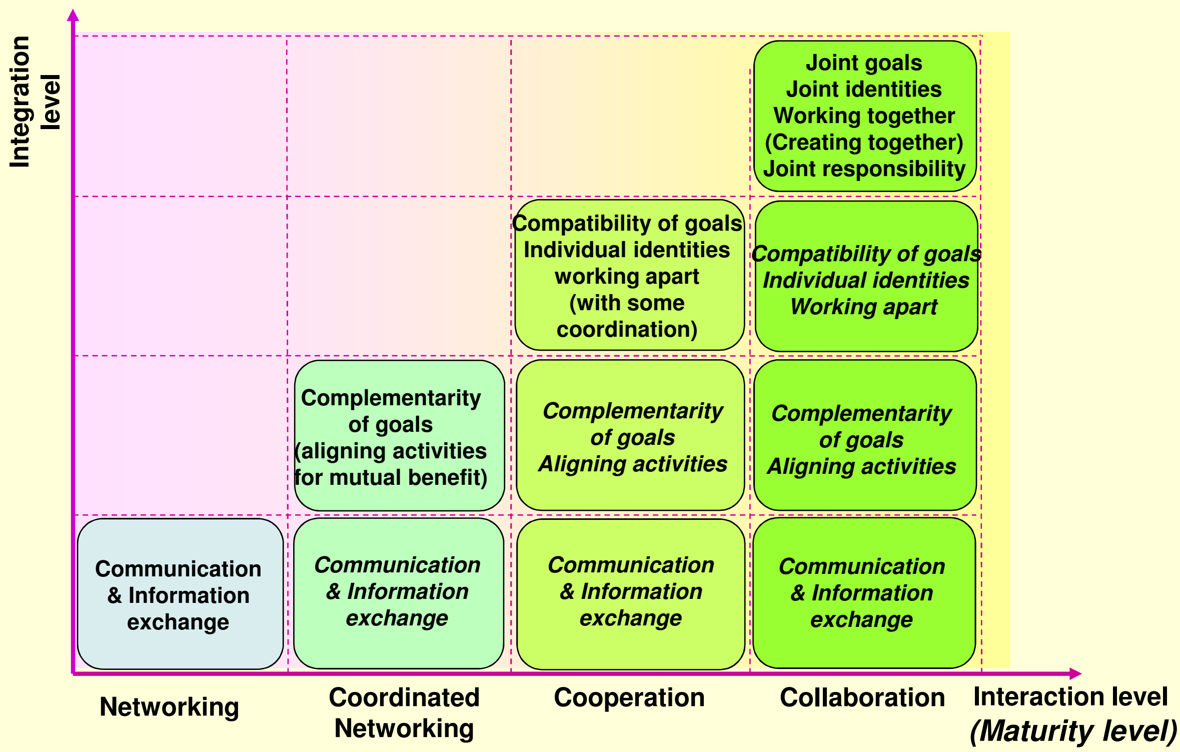
Basics

Research collaboration – researchers working together to achieve the common goal of producing new scientific knowledge.

Collaboration consists of two or more individuals or companies working together to achieve a common goal or create mutual value.

Assumption: As research addresses more complex and inter-related problems, no single individual could possess all the knowledge required to contribute to all aspects of a particularly complex piece of research, an interdisciplinary project or a 'big science' experiment.

Basics ...



Research collaborators

Weak definition - a 'collaborator' is anyone providing an input to a particular piece of research … *useless definition, as it could include a too wide group.*

Strong(er) definition – 'research collaborators' are

a) those who work together on the research project throughout its duration or for a large part of it, or who make frequent or substantial contributions;
b) those whose names or posts appear in the original research proposal;
c) those responsible for one or more of the main elements of the research (e.g. the experimental design, construction of research equipment, execution of the experiment, analysis and interpretation of the data, writing up the results in a paper).

In some cases, the list of collaborators may also include

a) those responsible for a key step (e.g. the original idea or hypothesis, the theoretical interpretation);
b) the original project proposer and/or fund raiser, even if his or her main contribution subsequently is to the management of the research rather than research *per se.*

[Katz, Martin,1997]

Why Collaborate ?

1. **Each of the partners will be more competitive for external funding.**
2. **Shared risks / cost.**
3. **The partnership will lead to synergy in discovery.**
4. **Stakeholders (researchers, departments, schools, society) will benefit.**
5. **Access to new research ahead of competitors**
6. **Access to (complementary) expertise / facilities**
7. **It can be fun.**
   - **New people, new cultures, new ways of work, new places**

Benefits

"

Sharing of knowledge, skills and techniques.

Transfer of knowledge or skills e.g. timely access to tacit knowledge (not documented)

Stimulation of innovation and creativity - collaboration may bring about a clash of views, a cross-fertilization of ideas which may in turn generate new insights or perspectives that individuals, working on their own, would not have grasped (or grasped as quickly)

Intellectual companionship – research can be a lonely occupation, probing the frontiers of knowledge where few, if any, investigators have been before. An individual can partly overcome that intellectual isolation through collaborating with others, forming working and perhaps also personal relationships with them

'**Plugging**' the researcher into a wider network of contacts in the scientific community. By collaborating with others in another institution or country, the individual can greatly extend that network.

Enhance the potential **visibility** of the work. "

[Katz, Martin,1997]

Why Collaborate ? ...

1. **changing patterns or levels of funding;**
2. **the desire of researchers to increase their scientific popularity, visibility and recognition;**
3. **escalating demands for the rationalisation of scientific manpower;**
4. **the requirements of ever more complex (and often large-scale) instrumentation;**
5. **increasing specialisation in science;**
6. **the advancement of scientific disciplines which means that a researcher requires more and more knowledge in order to make significant advances, a demand which often can only be met by pooling one's knowledge with others;**
7. **the growing professionalisation of science, a factor which was probably more important in earlier years than now;**
8. **the need to gain experience or to train apprentice researchers in the most effective way possible ;**
9. **the increasing desire to obtain cross-fertilisation across disciplines;**
10. **the need to work in close physical proximity with others in order to benefit from their skills and tacit knowledge.**

[Katz, Martin,1997]

Collaboration, but ...

Three Simple Realities

1. Silence is not golden. Tension, debate, and conflicts are expected.

2. Some collaborations fail. If some don't, you are not taking enough risks.

3. Collaborations are not forever. They end when a simple rule is violated.

www.iupui.edu/research/research_collaboration.pdf

... There are also some risks:

1. **Loosing your original ideas / results (before publishing them)**
2. **Extra overheads**
3. **Less productivity in the case of straightforward activities**
4. **Win-loose vs win-win mentality**
5. **Critical dependencies**

Collaboration costs

Travel and subsistence costs are incurred as researchers move from one location to another

- During project proposal preparation (not included in project budget)
- During project execution
  - Consortium meeting, review meetings, bi-lateral meetings
  - Short stays for joint developments / integration activities
  - Transport of equipment

Time

- Preparation of joint proposal
- Keeping all the collaborators fully informed of progress as well as deciding who is to do what next
- To amicably resolve differences of opinion and undertsand different perspectives / approaches / work methods
- Writing joint reports
- Recovering from effects of traveling (e.g. Jet lag), working in an unfamiliar environment, and developing new working and personal relationships with one's collaborators

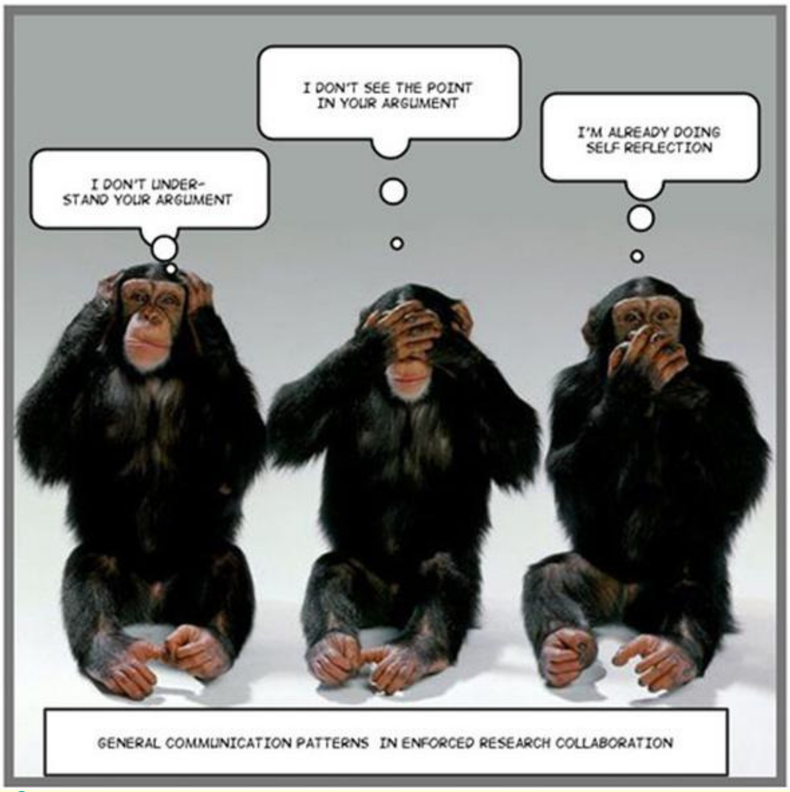
Collaboration costs ...

Increased administration

- More formal management & reporting methods
- Joint reporting to sponsors / reviewers

Reconciling efforts

- different management cultures
- different financial systems
- different rules on intellectual property rights
- different reward systems, promotion criteria
- different time-scales and even different notions of time
- different values
- different opinions on what is the most important research to pursue, how to carry it out, or over commercial or ethical implications
- etc



Reaching mutual understanding is a base requirement for successful collaboration

... but mutual respect is a pre-condition !!!

Collaboration, when?

In some cases work in collaboration is not very effective
... Additional overheads with coordination
... Decision-making can take longer
... Development productivity is lower

For projects that are mainly "development" and for which most knowledge is available, collaboration is perhaps not the most effective approach !
... Unless the reason is sharing resources, risks, getting higher visibility, etc
... Purely in terms of development, a "local team" could be more effective

Research in collaboration is more appropriate when addressing long-term, high-risk, complex problems, requiring multi-disciplinary approach.

Collaboration, some hard issues

Collaboration or cooperation?

Team building

IPR and Ethics

Management of Expectations

Mutual respect, trust building

2. TYPES OF PROJECTS AND PARTNERSHIPS

Types of initiatives

- Co-authorship of papers
  ... Although this does not necessarily mean working together
- Inter-individual collaboration
- Inter-group collaboration
- Academic consortium
- Mixed academic-industry consortium

  National
  International

Co-authorship of papers

Collaboration with high-productivity scientists tends to increase personal productivity
Collaboration with low productivity scientists generally decreases it.

Some studies show that acceptance levels of multiple authorship papers submitted to a leading journals is higher than single author / group papers

Overlap of specialized competences leads to enhancement
Better cross-checking / internal refereeing

Other research suggested that the total credit given by the scientific community to all the authors of a jointly authored paper is greater on average than the credit allocated to the author of a single-author paper

Another study demonstrated that, as the number of authors per paper increases, the proportion of high-impact papers (i.e. papers earning a high number of citations) also increases …. and that research by larger groups tends to be more influential

Another study has found evidence that internationally co-authored papers are cited up to twice as frequently as single-country papers

[Katz, Martin,1997]

Collaboration between individuals / groups

Bi-lateral collaboration is often informal (or supported by a simple Memorandum of Understanding (MoU) between organizations.

It is frequently motivated by genuinely scientific interests such as exchanging / sharing knowledge, experiences, resources

Collaboration typically spans over a long period of time (not limited to a single project) and often leveraged by personal friendship

During this period several joint initiatives may be undertaken:

- organization of scientific events
- project proposals
- seminars
- exchange of PhD students
- etc.

"Your social (professional) network"

Research in consortium

Frequently motivated by access to resources
e.g. Access to European Commission research funds

A consortium is organized for a single project
... and dissolved after project completion.
... Frequently acting as a virtual organization
(using ICT to support collaboration)
... Most consortia have a fixed structure during its operation
... In a few cases the structure may change

The consortium is bound together by a formal contract (with the sponsor) and/or consortium agreement
Defining roles, duties, rights, financial conditions, IPR

Research in consortium ...

Minimum number of participants[31] as set out in the Rules for Participation

Funding scheme	Minimum conditions
Collaborative project	At least 3 independent legal entities, each of which is established in a MS or AC, and no two of which are established in the same MS or AC.
Collaborative project for specific cooperation actions dedicated to international cooperation partner countries (SICAs)	At least 4 independent legal entities. Of these, 2 must be established in different MS or AC. The other two must be established in different international cooperation partner countries
Network of excellence	At least 3 independent legal entities, each of which is established in a MS or AC, and no two of which are established in the same MS or AC.
Co-ordination action	At least 3 independent legal entities, each of which is established in a MS or AC, and no two of which are established in the same MS or AC.
Support action	At least 1 independent legal entity

MS = Member States of the EU; AC = Associated Country

STREP = Small or medium-scale focused research actions
IP = Large-scale integrated project

The ICT program of the European Commission requires research in consortium in most of its actions.

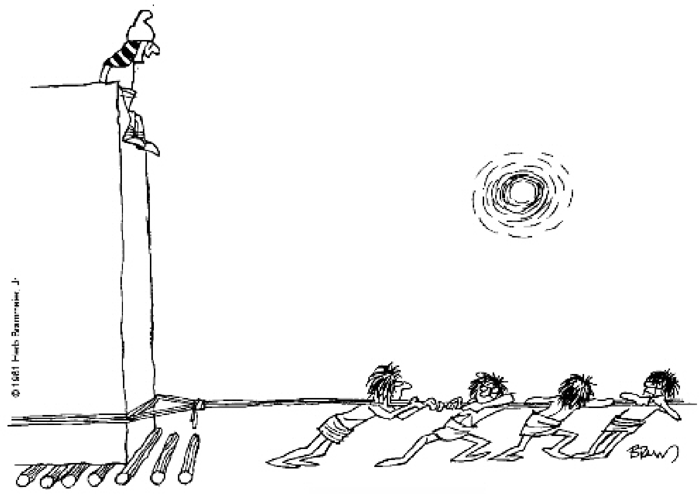
During Framework Program 6 / 7:

STREPS:
participants:6 to 15
EC contribution:1 - 4 M€,
(average around 2 M€)

IPs:
#participants:10–30
EC contribution:4 - 25 M€
(average around 10 M€)

Roles

- Coordinator
  - Scientific coordinator
  - Project manager
- Partners
  - Core partners
- Sub-contractors
- 3rd parties
- External experts
- *Reviewers*



University – Industry collaboration

A bit counter-nature ?

- University-Business research collaboration is fundamentally a marriage against nature
  - Business wants short term results and to appropriate the profits
  - Universities and their researchers are basically curiosity-driven and consider their discoveries as a public good (this is their main reward)
- However,
  - it is a public responsibility for universities to transfer knowledge
  - a commercial necessity for business to remain competitive!

[Webber, 2005]

University – Industry collaboration ...

A bit counter-nature ?

- **In addition to new knowledge, universities develop prototypes / proof of concept.**
  But universities do not have the human resources (and culture) to productize their research results.
  - Researchers need to prepare publications, theses, etc.
  - The innovation level required by publications and theses does not leave much "space" for the engineering effort required for productization.

- **Industry often expects "products" and deals with short term objectives**
  - The fact that universities cannot act as normal engineering sub-contractors may fail the industry expectations
  - Universities often follow a 3 or 4-year life cycle in their projects; companies talk about months.

University – Industry collaboration ...

But it happens ...

In the past:
Industry mainly sought partnerships with universities as a means to identify and train future employees

Nowadays:
Globalization as well as scientific and technological progress brought a tough competition climate to both industry and universities.
Both have to
- **React and adapt faster**
- **Cope with tougher accountability mechanisms**
- **Be more cost-effective** (business margins are very tight and university funding of research is hard)

Industry success requires continuous innovation and even introduction of disruptive technologies … what requires access to cutting-edge knowledge

University – Industry collaboration ...

But it happens ...

While companies rely on university researchers for product innovations, faculty gain prestige through increased external research funds.

- Industry needs innovative ideas to ensure profits; researchers need additional research funds to sustain faculty productivity.
- High-tech companies have their own research labs ... mostly focused on incremental research and product development; for breakthrough discoveries, industry needs to maintain close alliances with university researchers so that they can gain a better understanding of the science that underlies the discovery

The access to most research funds from the European Commission require mixed University-Industry consortia.

University – Industry collaboration ...

Benefits for all...

University-Business research collaboration can and should be a Win-Win situation!

- **Businesses**
  - **gain access to the knowledge frontier and to the network of (top) scientists**
  - **can outsource research activities for which they have a comparative disadvantage**
- **Universities and their laboratories**
  - **receive funding to employ additional researchers and buy scientific equipments**
  - **may hope to gain a permanent source of additional funding in commercializing their intellectual property (patents and licenses)**
  - **may gain access to original statistical information and to sophisticated equipments they cannot afford**

[Webber, 2005]

- **Society benefits from university-industry research relationships through innovative products and technologies.**
- **University-industry partnerships may lead to new industries that enhance the competitive advantage of their region.**

University – Industry collaboration ...

Potential problems (when industry sub-contracts research) ...

- Strong disagreement may crop up in defining the ownership of the intellectual property (prior and newly gained) and turn into a "bloody" legal dispute
- Business may be upset if the contracted research doesn't bring the expected results
- Universities may…
  - be upset if their IP doesn't produce as much additional funds as expected or "dreamed",
  - observe that some of their best research teams are involved in "second class" research and/or do not contribute anymore to the reputation of the institution within university circles (rankings)
  - suffer from the penetration into some spheres of the academia of a mercantilist spirit and observe increasing tensions between those "who have access" and those "who have not" to "juicy" contracts

[Webber, 2005]

University – Industry collaboration ...

Potential problems (when both do research funded by a 3rd entity) ...

- **Disappointments**
  - **Academics may be disappointed with the level of the industry participants and their low interest in very advanced aspects**
    - Some companies do not bring their best people and most challenging issues to a consortium
  - **Industry may be disappointed with the "finalization" of the academic prototypes (robustness, interfaces)**
    - ... Although in some cases academic researchers produce sounder prototypes than industry
- **Disagreements on exploitation plans and intellectual property**
- **Disagreements on dissemination strategy**
  - **Academics need to publish**
  - **Industry wants to protect knowledge**
- **Not being able to understand the different value systems**
  - **Money vs prestige, recognition ...**

University – Industry collaboration …

Some issues for good partnership:

- **Identifying the right partner(s)**
  - Competencies, values, strategic goals?
- **Aligning interests**
  - Which complementarities? and common goals?
- **Treating collaboration strategically**
  - A simple sub-contract / opportunistic access to funds or a long-term partnership?
- **Identification of responsibilities**
  - Decision-making? Roles?
- **Organizing for lasting relationships**
  - Which long-term goals? Structures? Key people?
- **Establishing clear intent (description of the collaboration)**
  - MoU, common research proposal, identified inputs and outcomes
- **Achieving effective intellectual property protection**
  - Which mechanisms? Ownership? Incentives / compensation forms?
- **Finding a fair compromise re. publications and confidentiality**
  - Which levels? Compensation? Affecting PhD students' work?

3. REQUIREMENTS

Potential partners – Good qualities

1. Shared vision for a specific research project.
2. Complementary (synergistic) resources.
3. Scientific expertise, leadership, or maven *.
4. Research infrastructure, including professional staff.
5. Research population, samples, database, or toys (technologies, equipment).
6. Extramural funding.
7. Intermediary to research resources.
8. Enjoyable personality is a plus but not a requirement.
9. Mutual respect is a requirement.

www.iupui.edu/research/research_collaboration.pdf

** accumulator of knowledge*

Potential partners – Good qualities ...

Strength—A good collaborator should of course be a strong researcher in my area of interest.

Compatibility of Strengths—The strengths should complement each other nicely. Good collaborators know their areas well and can quickly focus the inherently difficult parts of a problem and have different tools and approaches they can bring to the table.

Respect—Good collaborators need to trust and respect each others ability and judgment.

Philosophy—Long-Term collaborators need to share beliefs on what problems are important and worth working on.

Personality—You need to have a friendly relationship outside of work.

Luck—Finding the right problems to work on together at the right time. You need a good first collaboration before you start making time for further collaborations.

Distance—This seems counterintuitive but two people in the same geographical area rarely have a long history of collaboration. It's hard to make time for working together when you are in close proximity. Also two people who see each other constantly get tired of working with each other no matter how compatible they are. Better to keep in email contact and have several short and long visits where one can allocate time for the other.

http://weblog.fortnow.com/2005/03/what-makes-good-collaborator.html

Potential partners – Poor qualities

1. Non-overlapping research focus.
2. Good will but no specific research project.
3. Incompatible or conflicting work style.
4. Ineffective finisher.
5. Inability to recognize and deal with differences in work style and dynamics.
6. Questionable integrity.
7. Functions at a different speed.
8. Working with incompatible goals.

www.iupui.edu/research/research_collaboration.pdf

Steps to successful collaboration

1. Define the goals of the project and expected outcomes.
2. Communicate face-to-face at the outset.
3. Communicate often and regularly.
4. Choose a leader or leadership structure.
5. Define roles and responsibilities of each participant.
6. Discuss administration of the budget.
7. Discuss administration of data.
8. Identify intellectual property issues.
9. Discuss publication and authorship plans.
10. Identify when the project is expected to end.

http://www.iupui.edu/research/research_collaboration.pdf

Issues in cross-disciplinary research

Cross-disciplinary / multi-disciplinary research comes from the need to understand and solve complex real world problems.

A broad range of competencies is required to deal with these technically and socially complex issues.

In this context misunderstandings, and mismatched expectations easily arise.

Each scientific (sub-)discipline orients its attention (*focus*) to certain phenomena, and takes a specific approach to conceptualize and study these phenomena.

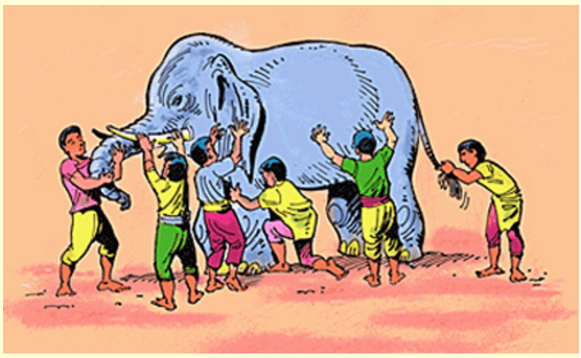
Each discipline thus maps a specific area, and maps it in a specific way (highlighting specific features of the area, using certain kinds of symbols, etc.) (*no common ontology, no common language*)

[Dewulf et al, 2007]

Issues in cross-disciplinary research ...

And yet ...

- **It is in the borderline between different disciplines that important research challenges can be found!**
- **Also confrontation of diverse frames of reference, with mutual respect, can lead to innovation !**



... It is therefore important to make it work !

Some challenges in mutual understanding and coordination:

1. ***Very few concepts are self-evident to all participants***
2. ***Considerable confusion about concepts emerges in project meetings***
3. ***The different concepts and meanings are not neutral***

   (people often feel strongly about which concept to use)

[Dewulf et al, 2007]

Recommendations in cross-disciplinary research

1. *Get to know each other's frames.*
   A first step **is to be confronted with the different kinds of knowledge others contribute.**
2. *Acknowledge differences.*
   This requires paying attention to differences and not acting as if there were none.
3. *Incorporate other concepts into your own framing.*
   A first and perhaps inevitable step in understanding other frames is to translate them into your own terms. This does not do justice to the full richness of the knowledge, but is probably necessary as first approximation (just as translating words is often a necessary intermediary step when learning a foreign language).
4. *Explore and work with the differences.*
   A further step is to mutually explore the different views so that each can understand the other's view in its own terms, and thus find out where the frames are incompatible and where they provide complementary contributions.
5. *Forge new frames.*
   As a way of integrating different frames, often a new vocabulary has to be created that is able to carry the new and jointly created meanings and knowledge.

[Dewulf et al, 2007]

4. FINDING PARTNERS

Finding partners

Ideal-IST http://www.ideal-ist.net/

At starting ....

Some tools

e.g. Ideal-IST
CORDIS

... Not so effective though

Face-to-face

e.g. Conferences
Special networking events

... Much more effective

Finding partners ...

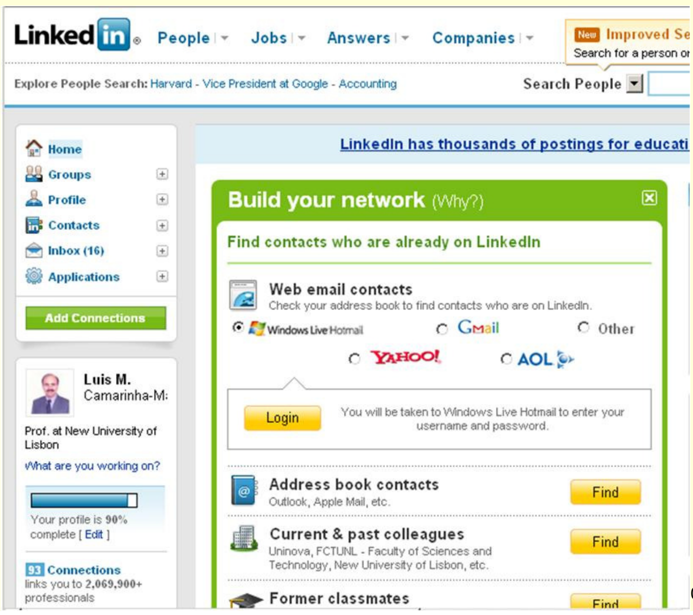
Keeping your social networks

Building trust and sound collaboration habits take time ....
Nourish your network of reliable partners

Some tools might help

e.g.
LinkedIn
Facebook ?

Create your own Professional Virtual Community



Social networks

Some open-source social networking tools:

www.vivalogo.com/vl-resources/open-source-social-networking-software.htm

AROUNDME

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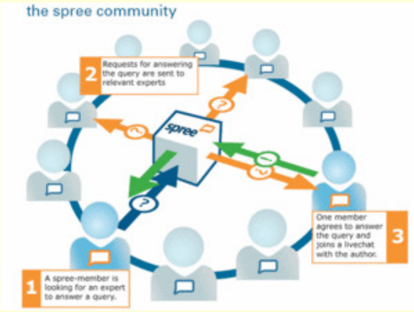
mahara



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