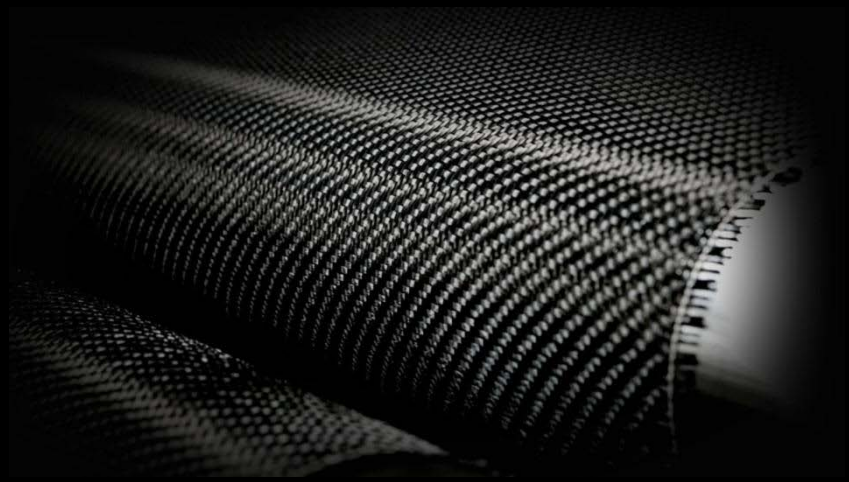
Industry-Academia Collaboration
Toward the Establishment of a Global Innovation Cluster

Paolo Feraboli, Ph.D.
Director and Research Professor

AUTOMOBILI LAMBORGHINI
ADVANCED COMPOSITE STRUCTURES LABORATORY
UNIVERSITY OF WASHINGTON

President and CEO

GEMINI COMPOSITES LLC.



What is industry??

- Ferruccio → Tractors → Supercars
- Industry is the realization of ideas of single entrepreneurs
- Identify need, provide a solution → a product

FUNDAMENTAL DIFFERENCE

- For industry research is a tool to make the product better - more competitive. It is a means, not an end. The end is to sell the product and make a profit.
- For University research is the end, industry is a means.

IN BOTH CASES THERE ARE OTHER MEANS TO THE SAME END

- For industry, other means can be marketing, lower costs, etc.
- For university, it can be other funding sources.

- *Therefore it is not NECESSARY for either one to work together to achieve the respective GOAL (end). It has to be desired.*

Some thoughts
on
Industry-Academia Collaboration

- Research
- Education
- Training

Research

- Most US universities receive bulk of their funding through Government grants (94-70%), and only small portion through Industry contracts (6-30%)
- Government funding is typically “trendy”: the “hot topics” come in waves.
- These topics represent the future of technology (10-20 years ahead)
  - Controls and Robotics >1975, Composites >1985, Nano technologies >1995, Bio and Molecular >2005
- Universities go after these funds and gear up by hiring faculty in these fields
- As a consequence, they:

  1. the faculty’s relevance is high at the time of hiring, then risks to decrease over the years when the topics are not “hot” anymore.

  2. the institution loses continuity in knowledge base for traditional fields (example wood, steel)
- If the topic reaches a level of maturity sufficient to be explored commercially, it transitions to mainstream industry. By the time it does, a new wave of “hot topics” reaches the universities, and the resources available to industry at the university dry up.

Example of composites

- In the early 1980's composites were a hot topic for US Government organizations
- Air Force, Navy, NASA were investing heavily in understanding composite materials
- Universities across the US hired faculty in the field to pursue funding opportunities
- Dozens of then-young faculty built entire career based on such research
- By late 1990's the funding dried up. Composite materials were deemed to be then a mature technology. The industry was ready to implement composite technology into production.
- By the early 2000's we assisted to the mainstream introduction of carbon fiber technology into commercial products.
- In the meantime the focus of Government funding had shifted to other fields, in particular nanotechnologies and biotechnologies. Universities shifted the hiring focus to these new fields.
- Currently very limited Government funding available for "traditional" composites research.
- Faculty that was previously very active is either inactive, or has converted to other fields.
- At the same time composites are finding more and more range of applications across different industrial fields. Industry is "thirsty" for composite knowledge, expertise, employees. Yet universities are focusing on other topics.
- This cycle repeats over and over and across different fields.

Research

- College of Engineering is typically standalone entity, separate from College of Sciences
- Yet, the main and most prestigious funding organization for US Colleges of Engineering is the National Science Foundation (NSF)…..Engineering is NOT A SCIENCE
- To be relevant to industry, Engineering should be seen as a professional discipline such as Medical School, Law School, Business School and College of Architecture
  - Faculty usually are successful professionals with ongoing professional practices
  - Often they do not even have a PhD but only a Master's degree in their discipline
- *People do what they know how to do best*: Faculty PhD train future faculties and PhD's
- Since Colleges of Engineering use as performance metric peer-reviewed funding and scholarly publications, these typically go hand-in-hand with PhD student production. Focus for Engineering departments is not on undergraduates and typically not on master's degrees either.
- On the other hand, industry pursues undergraduate employees first and foremost, followed by Master's degrees. PhD are rarely sought after, and typically only by very large corporations (see later).

Research

- Difference between basic (fundamental) vs applied research
- Traditional model is University develops a technology based on simple ideas and using simple tools. Then industry takes it and brings it to maturity and commercialization.
- This was true when the level of progress of each technology was so low that relatively small discoveries would lead to relatively major breakthroughs.
- Academia can contribute more or less depending on level of maturity of technology. Academia cannot - and arrogantly does not want to - get involved when the level of technology is mature enough for being widely utilized by industry.
- Different industries have different needs: fields of activity significant (size and complexity of product sold)
- For composites, basic research is NOT of interest – neither now – nor was in the past (with exception of very large and highly specialized corporations, like Boeing)
- Difference between large corporations and small companies. Size of R&D division is the useful metric, not overall company size

Education

- Universities need to develop curriculum that is suitable for Industrial approach and needs
- Complementary to traditional degree systems
- Certificate Programs
- Stackable modules

Training

- Industry reps stages 2 days – 6 weeks in university
- Summer camps for students in industry 2-3 months
- Future graduates become employees of industry
  - 90% bachelor
  - 9% master
  - 1% PhD
- Train students – that is the future workforce - on the real needs of industry.

Education and Research

- Current bachelor degrees lack many of fundamental skills required to be useful right out of college: FEA, CAD, machining/testing.
- Teaching of fundamentals (not interesting/ current research topics) left to non-tenured faculty. Better at community colleges or tier-2 university?
- Large companies can retrain, but small companies are left with inadequate workforce.
- Large companies like Boeing nowadays pay little attention to details of education of new hires (prospective employees) because regardless they will have to re-train them.

Example 1

- Finite Element Analysis (FEA) course: Senior elective and/or graduate course
- Somewhat service course: FEA is rarely a field of research in itself, so no tenure faculty teach it because it's research area.
- Everywhere in the US – instructors claim their version of course and textbook to be more or less applied
- In reality, at least 50% is pure theory (shape functions, energy methods, etc) and 50% is very, very simplistic applications from 1D problems up to 3D
- Reason is that:
  - 1. Universities train engineers, not technicians
  - 2. FEA as pushing buttons of software program is pure technician work
  - 3. If fundamentals and theory are understood, then utilization will be simpler .
  - 4. code used is often a simple one, because they are all similar anyway
- In the end, the industry receives employees that CANNOT run FEA with any of the major software programs and for any complex problem
- In reality they are referring to two different issues: the tool vs the mathematics!!

Example 2

- 3D design – CAD; often offered as senior elective
- Nearly always seen as a service course. Virtually not field of research in itself, so no tenure faculty teach it. Though by either staff or industry visiting affiliate professors.
- Treated as a secondary and unimportant course. At UW it has been removed from required set of courses.
- Content is usually very watered-down and typically part of some other course, such as technical drawing, computer tools in engineering, a design capstone course.
- In the end, the industry receives employees that CANNOT run CAD with a the major software program and for any complex problem

- BOTH FEA AND CAD ARE EXTREMELY IMPORTANT TO INDUSTRY!!!!

What could the University do to accommodate Industry better

- Note: University to accommodate industry, not viceversa. Universities are service providers, Industry is the customer. Universities need to be more humble
- Lower the overhead: indirect costs in the US can be as high as 60% per dollar spent, which means as much as 35% of a total award can be withheld by the university
- IP policy scares industry away: if funded research leads to discoveries, they belong to the University
- Long term vs short term funding: need to sustain and commit to Phd. Industry typically focuses on 1-year projects. Shift focus to research being conducted by undergraduates and master's students, and only some by PhD students

What could the University do to accommodate Industry better

- Universities need to change perspective toward industry research. Currently they see industry funding less prestigious and competitive compared to Government (peer-reviewed) funding which is held as the standard. Faculty focusing on industry research are penalized (the so-called color of money), while they should be rewarded.
- Need to understand industry needs, approach and language. Need to help and accommodate their needs, then expand. Not antagonize and expect to convince otherwise. Need to understand deliverables, milestones. Need to focus on cost, time, product.
- Need of trust: only if previous part of specific industry. Best solution is to have person/persons detached from industry to university. Also to have periodic summer camps both ways industry to academia and vice versa.