Universidad Politecnica de Valencia
SPAIN

Seminar
15 MAY 2009
pm

College of Electrical Engg & Computer Science

Research Quality, Impact, & World Class Institutions

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"Research Quality, Impact & World Class Institutions"
Seminar at Politecnica Valencia, SPAIN

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Acknowledgements

Seminar Outline – 3 Parts

1. Intro to Research
2. Research Quality, Measure, & Impact
3. World-class Universities
4. Conclusion

Time Management

P1	10 mins	P2	30 mins	P3	10 mins

Part 1 – 15 slides

What is Research ?

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Research is not about the Paper-cranking Machine!

Pg 5

What is Research ?

Dark Tunnels, Unknowns, Solutions

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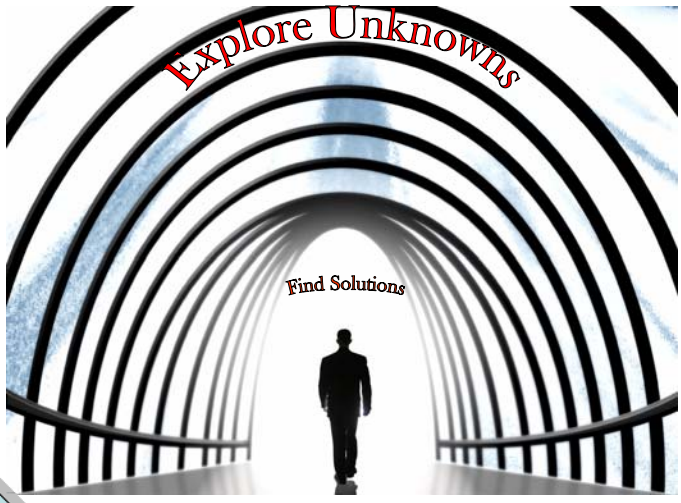

Research is like..

You picked a Tunnel ("problem").

You walk in this dark tunnel.

You do not see light until you walk to the end of the tunnel!

Research involves exploring the "unknowns"and "finding solutions".

Pg 6

About Research

What is Good Research?

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1. When Research is **Focused**
2. When Research addresses and solves **important problems**
3. When Research creates **Impact**
4. Research is **problem**-oriented.

Pg 7

Research Cycle

essence

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Research in Essence:

"Research excellence" can be buried if outcome has no disclosure.

Research entails *understanding and appreciation by others* and *recognizing the importance of the discovery and outcome*.

Professor

Student

Ideas

Pg 8

Research Cycle

Initial, Execution, Final

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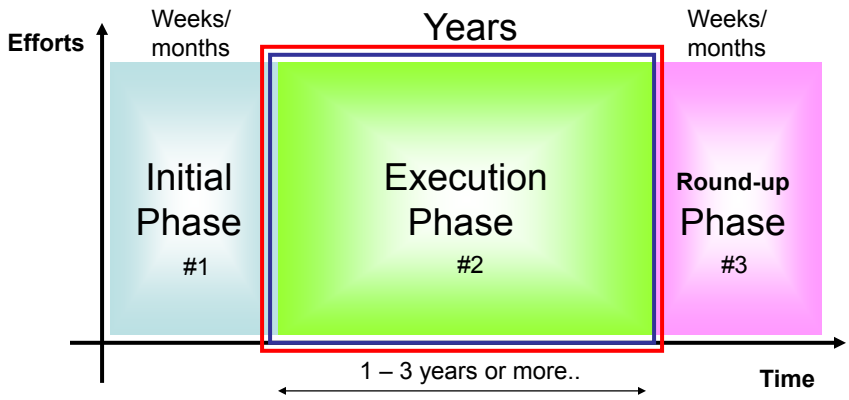

Emphasis should be on the "execution" phase.

Pg 9

Research Cycle 1

Initial Phase

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Proposal **P**reparation:

Too much time and emphasis on proposal preparation is detrimental to on-going research.

A **good proposal** has **no guarantee** of **good research output** or outcome.

A **highly funded proposal** indicates **high cost** and **large scale** BUT does not necessarily imply research quality nor excellence.

Pg 10

Research Cycle 1

The Dilemma

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Risk of Initial Phase:

Vs.

No funded proposals → limited resources → **crippled research**

Too much funded proposals → overwhelmed → **quality affected**

Too much efforts in writing proposals → **little time for research**…

&

Pg 11

Research Cycle 2

Research Execution

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Research **E**xecution:

This is the most important part of your research. Doing and investigating on unsolved or undefined problems enhances "creativity" and "novelty". There are many researchers out there, competition is fierce.

time

+

Talent
Creativity
Ideas

+

Professor

+

Students,
Postdocs,
etc

Pg 12

Research Cycle 2

Duration of Research Execution

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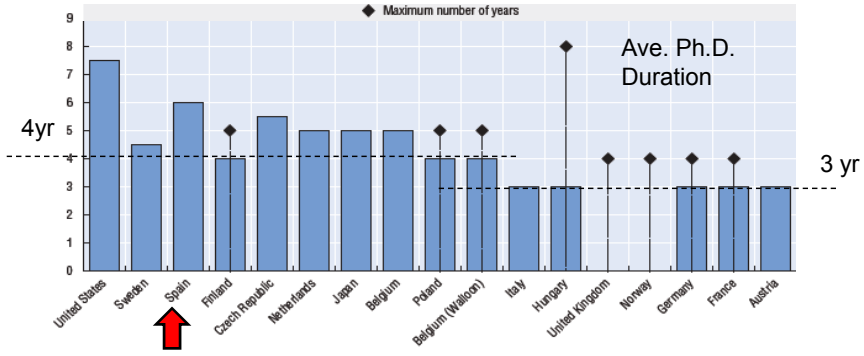
Research **E**xecution:



1. Defined as the average duration of full-time PhD study from the point of admission into a doctoral programme to completion of degree, excluding any period spent on prior university level studies. For the United States, data is the effective average duration based on surveys of actual graduates.

Pg 13

Research Cycle 3

Risk of outcome

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Risk of **R**esearch **O**utcome:

No ideas → **no** creativity → **no** solutions → **no** contributions

Poor research → no good results → little significance → **no publications** → **no impact**

Very hard problem → no solution → **failure**

Pg 14

Types of Research
Positive

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"Positive Research"

- Work on "**new problems**"
- Find **new solutions**

- Or work on **existing unsolved problems**
- Find solutions

- Move the field forward (i.e., beyond the current state-of-the-art)

- Create the "wave"
- Create the "impact"

Pg 15

Types of Research
Negative

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"Negative Research"

- Prove existing or past work or solution is **wrong!**
- Undo and Redo
- Re-learn from mistakes made by community
- Impact the community and impact the field !!

Pg 16

Types of Research
Incremental

"Incremental Research"

- **Improve on an existing solution**
  - say by 5-10%
  - produce tons of papers,,,
  - big deal or no big deal?
  - ask yourself

- Don't sweat the small stuff !
- Take your time to find impt topics to do.
- Leap, not drag!!

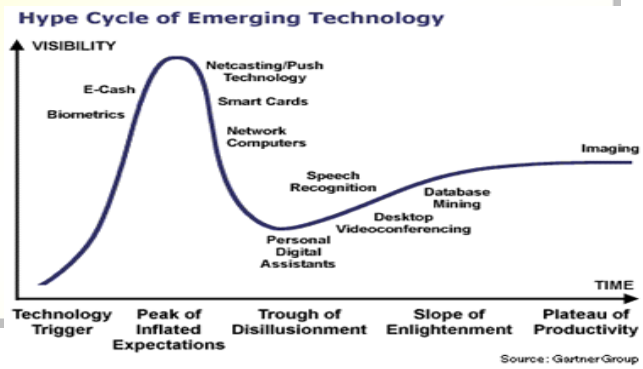
Pg 17

Types of Research
Myth or Hype

"Myth or Hype Research"

- **Hype** – just saying (frenzy publicity, over enthusiasm)
- **Myth** – A belief that is widely thought as false

- High Risk
- High Gain
- No Gain



Pg 18

Types of Research

In Summary

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Summarizing: Choosing the right topic is KEY!!

"Positive" Research	→	**Major Contributions** (new solution)
"Negative" Research	→	**Major Contributions** (rewrite history) ..it takes a lot of guts and evidence to… ...prove something is wrong…
"Incremental" Research	→	**Incremental Contributions** (avoid…) (5-10% improvement on existing solutions)
"Myth or Hype" Research	→	**Solving a problem way ahead of time** ..when needs are not yet recognized… ..when problem takes time to gain

1

Pg 19

Part 2 – 30 Slides

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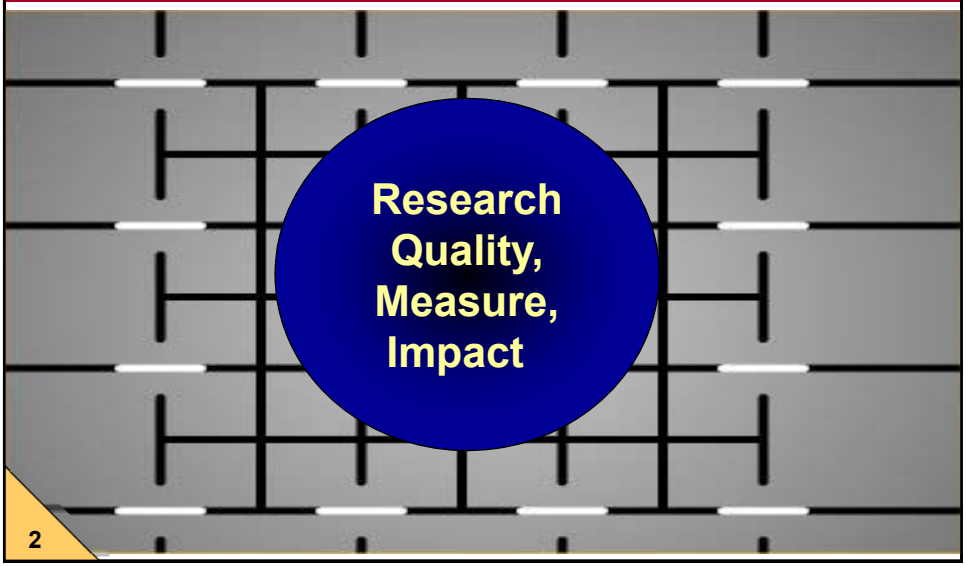

2

Research Quality

What is it?

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How can we know we are doing "Quality" Research?

Quality is NOT Quantity!

Quality Metrics

1. Novelty
2. Originality
3. Technical Correctness
4. Significance
5. Timeliness
6. Impact

JUDGE by peers?

JUDGE based on impact?

Pg 21

Research Quality

Quality vs. Quantity

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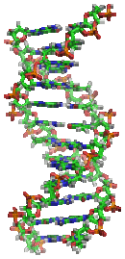
Point # 1

I have published over 3000 papers in my lifetime!

So What?

Point # 2

I published **1** and **1st** paper on DNA that rocks the world!



Now that is something!!..

Pg 22

Research Measures

What are we measuring?

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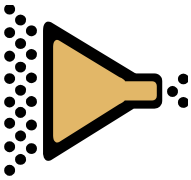
What are we measuring?? Input ? Output ? Or what?

Research Input
- proposals
- $$ (matching)
- researchers
- time



Research Output
- Number of Citations
- Number of Publications
- Number of Patents (Inventions)
- Recognition (Awards,,,)
- Attention (Follow-on work,,wave,,)
- **IMPACT**

Research Proposal Outcome
- $$
- resources

Which Carries More Weights?

Pg 23

Research Measures

Examples from Purdue University

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1. Journal Paper Approach

- Formally reviewed and archived
- No. of papers = productivity, not quality!

2. Rate of Publications = "Speed"….

- N/T (total papers to time)
- Productivity, not quality!

Source: Prof. Doug Comer, ex-VP Research, CISCO (USA)

Pg 24

Research Measures

Examples from Purdue University

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3. Direct Funding Approach

- Amount of $$ is not always = quality of research

4. Profit Generated by Patents, etc

- Revenue is a terrible measure of research quality !

Source: Prof. Doug Comer, VP Research, CISCO (USA)

Pg 25

Research Measures

Examples from Purdue University

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5. I/R

- Ratio of **Impact** vs. amount of **Resources** used.
  - ►Large funding BUT poor impact = looks bad
  - ►Small funding BUT large impact = looks good
  - Individual PI is concerned with “impact”
  - Administrators might prefer resources

Source: Prof. Doug Comer, VP Research, CISCO (USA)

Pg 26

Research Measures

THOMSON Essential Science Indicators

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Thomson ISI

THOMSON

6. No. of Citations on each paper / author / institution

Total citations / H-index / G-index / etc

Etc.

Web of Science® - Access to current and retrospective multidisciplinary information, author abstracts, and cited references from approximately 8,500 of the most prestigious, high impact research journals in the world.

Journal Citation Reports® - Provides a systematic, objective way to evaluate the world's leading journals.

Essential Science Indicators℠ - Offers data for ranking scientists, institutions, countries, and journals.

International Pharmaceutical Abstracts - IPA adds approximately 18,000 records annually and draws from a global selection of health care journals.

ISI Web of Knowledge℠ - Powerful Web-based platform that integrates the Web of Science and Current Contents Connect.

Research Services Group - Provides customized citation datasets and bibliometric analyses to science policy agencies, government laboratories, universities, libraries, independent research institutes and other research organizations for monitoring and assessing scientific activity and performance.

Pg 27

Research Measures

Journal Impact Factor vs. Citations

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Bad Things About Journal Impact Factor (JIF),,,,

Education and debate

Why the impact factor of journals should not be used for evaluating research

Per O Seglen, *professor* [a]
[a] Institute for Studies in Research and Higher Education (NIFU) Hegdehaugsveien 31 N-0352 Oslo Norway

Journal impact factors are not statistically representative of individual journal articles!!

Journal impact factors correlate poorly with actual citations of individual articles

Assumption: ✗ Publication in a High Impact Journal will enhance the impact of an article.

Answer: ✓ Journals do not offer any free ride. **Citation rates of articles determine the journal impact factor, not vice versa!!**

Pg 28

Research Outlets

Where to publish?

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- Publish in "International" Outlets
  - Especially by major professional bodies
  - Engineering: IEEE, IET
  - Computer Science: ACM/IEEE/BCS
  - BUT: don't get stuck with "brand"
    - A "Gucci" bag may be empty inside.
  - Focus on your significance of "work".

Pg 29

Research Impact

What does it mean?

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What do we mean by "Research Impact" ?

How can we quantify "Research Impact" ?

Source: Research Global Feb 2007.

Pg 30

Research Impact

What does it mean?

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- 3 Prime Elements of IMPACT

New knowledge Creation
Advances current State-of-the-art
Open new field Breakthrough

Society;
Research community;
Industries;
Follow-on work;
Create a "wave"

Wealth creation
Jobs creation
Benefit the country

Pg 31

Research Impact

How to create high impact?

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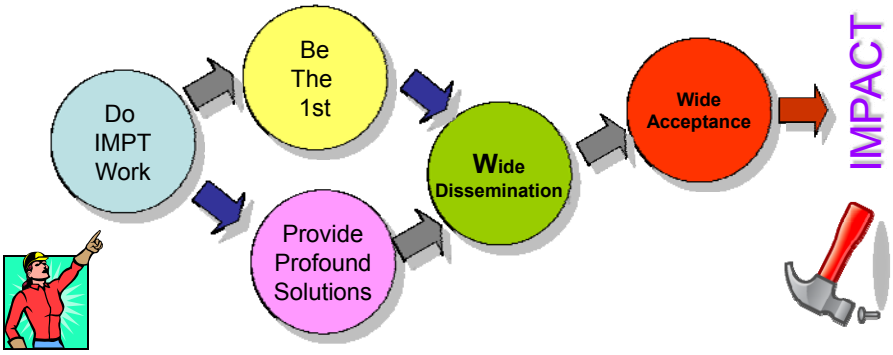

Do it well,,,,,

It takes **TIME** to see the impact (especially for new fields)

It takes **LESS TIME** to see the impact if it immediately solves an existing issue..

Pg 32

Research Impact

Short vs. Long Impact?

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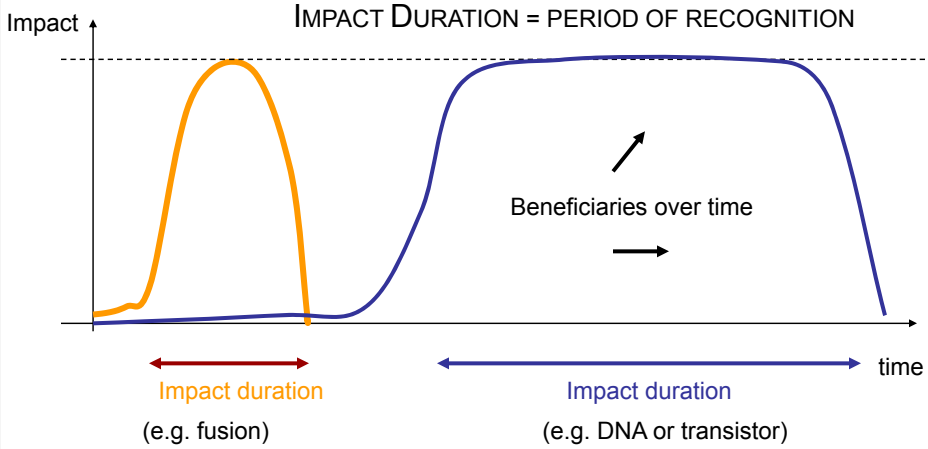

Research Recognition

An aftermath of Impact

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- Reputation
- Awards / Prizes

- Recognized as Research Leader / Topic Guru
- International Recognition – Benefit of Doubt!

Bottom line: Multiple "signs" of success and recognition leave others # No Doubt # of your research excellences

Critics left at bay…!!

Research Recognition
The Peak in Engineering Research

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Specifically, there isn't a Nobel Prize for Computer Science!

So what other international recognitions?

Computing: IEEE – IEEE Fellow

Engineering: ACM – ACM Fellow

AAAS Fellow

IEEE Medals

ACM Turing Award

Kyoto Prize

Marconi Prize/Fellow

►Fellowships are also given for leadership and education but that Is not the point…

Pg 35

Research Recognition
The Peak in Engineering Research

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IEEE Bell

IEEE Edison

IEEE Noyce

IEEE Neumann

IEEE Hamming

IEEE Medal of Honor

Pg 36

Research Recognition

Peak in Engg. & Science Research

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Excellence in Research results in election to National Academy

- UK Royal Academy of Engineering (FREng)
- UK Royal Society of London (FRS)
- US National Academy of Engineering (NAE)
- US National Academy of Sciences (NAS)
- US Presidential National Medal of Technology
- US Presidential National Medal of Science

- Holders of *Distinguished Chair Professorships*
- Chair professors report to Dean or Vice Presidents

Pg 37

Research Evaluation

Others judge your work!

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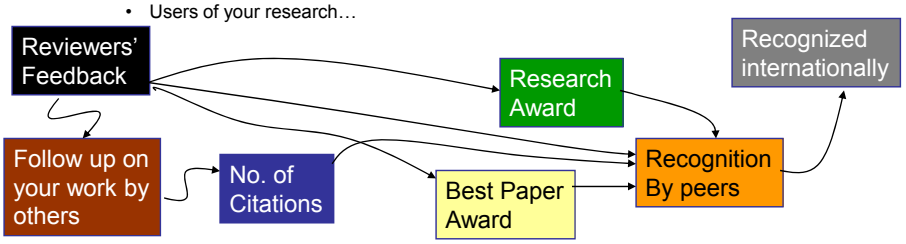
- Let others judge your work
  - Include "international peers"
  - Peers include:
    - Researchers from industries
    - Academic professors, postdocs, etc
    - Users of your research…



Pg 38

Research Evaluation
The Swiss Way

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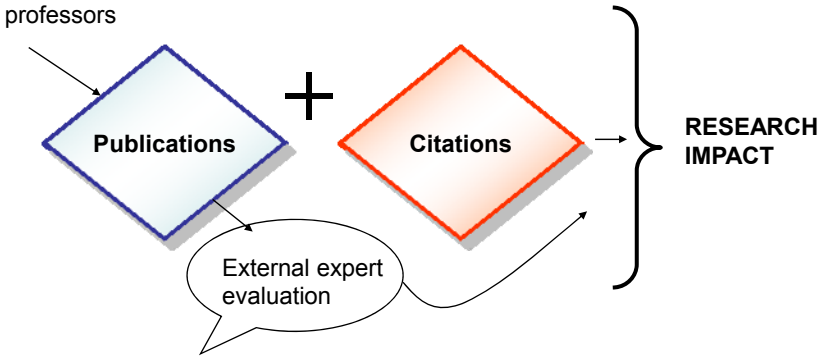
SWISS MEASURE OF PROFESSORS

Example from ETHZ ,,,,,,



Pg 39

Research Evaluation
The Swedish Way

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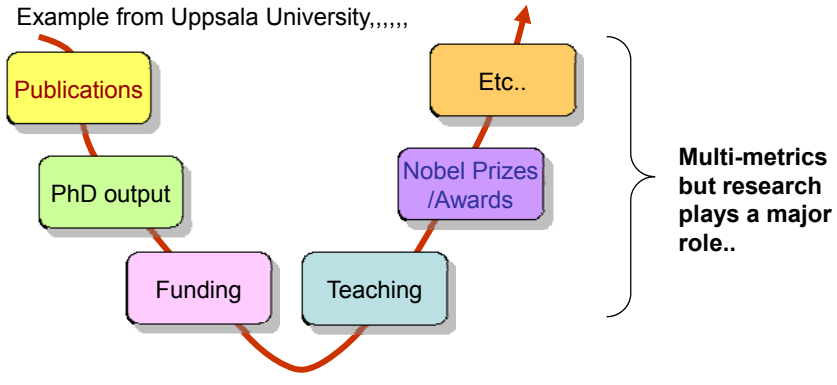
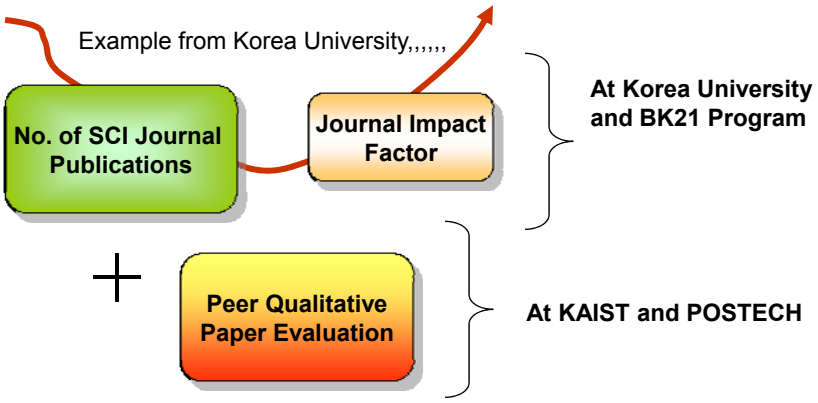
SWEDISH MEASURE OF PROFESSORS

Example from Uppsala University,,,,,,



Pg 40

KOREAN MEASURE OF PROFESSORS



Pg 41

NATIONAL SCIENCE FOUNDATION

Quote from Dr. Jeannette Wing, Asst. Director, NSF and President's Professor at Carnegie Mellon University (CMU):

> "It's the same difficult problem that all universities in the US have in evaluating "impact" when considering promotion and tenure of faculty. There are no easy measures, no easy counts."

In USA, attaining FIEEE/FACM and NAE/NAS represents highest academic excellence

Pg 42

Research Evaluation

University-wide evaluations

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Uppsala KoD07 Project Organization

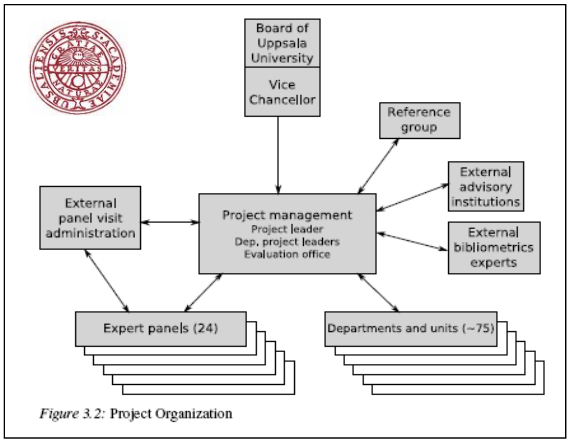

Figure 3.2: Project Organization

Aim

1. **Evaluate "strength" of university's research**
2. **Understand its "national" and "international" standing**
3. **Help formulate strategic plan**
4. **Process took 1 year**

Pg 43

Research Evaluation

University-wide evaluations

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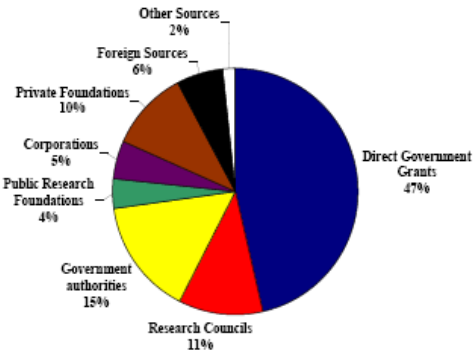
The Swedish System

- Uppsala (1477) & Lund (1688) : Oldest
- Stockholm, Gothenburg: 19th Century



Recruitment differs from USA system. Departments are NOT expected to take an active role in the selection of candidates. Mostly appointments are made at university level based on evaluation by external experts.

Pg 44

Research Evaluation

University-wide evaluations

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Uppsala KoD07 Project

Information Technology, Information Science, Signals and Systems (panel 18)

Jeffrey D. Ullman
Professor of Computer Science at Stanford University (Emeritus 2003-).
Research interests include database theory, database integration, data mining, and education using the information infrastructure.
Founder and CEO of Gradiance Corporation, whose goal is to provide better, cheaper homework and programming-lab support for college courses.

ullman[-at-]cs.stanford.edu
http://infolab.stanford.edu/~ullman/

Qualitative **E**valuation using Panels

Evaluation Material

Panel Members

Evaluation Report

About the panel – panels members requirements

Panels
Chairperson
1 swedish panelist
4-8 International panel experts

Requirements
Chair – distinguished scientist with high integrity
Not active in Sweden

Swedish Panelists
Active in fields
Integrity
Not from Uppsala

International Panelists
Distinguished scientists
Active outside Sweden
Gender balance

Pg 45

Research Evaluation

University-wide evaluations

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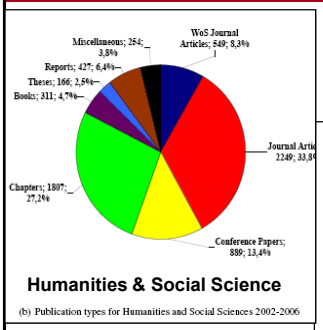
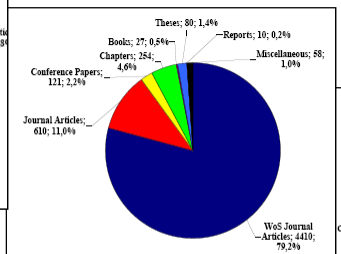
Research output across different schools/disciplines

Publication is the KEY.



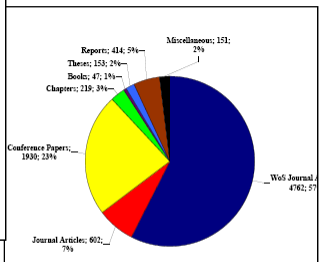
Humanities & Social Science

(b) Publication types for Humanities and Social Sciences 2002-2006



Medicine & Pharmacy

(a) Publication types for Medicine and Pharmacy 2002-2006



Science & Technology

(c) Publication types for Science and Technology 2002-2006

Uppsala KoD07 Project

Pg 46

Research Evaluation

University-wide evaluations

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30. External Report from Leiden University

Bibliometric Study of the
Uppsala University,
Sweden,
2002 - 2006

For a more complete evaluation,,

Qualitative **E**valuation

+

Bibliometric **E**valuation

Bibliometrics = Quantitative study of written work in research.

Pg 47

Research Evaluation

University-wide evaluations

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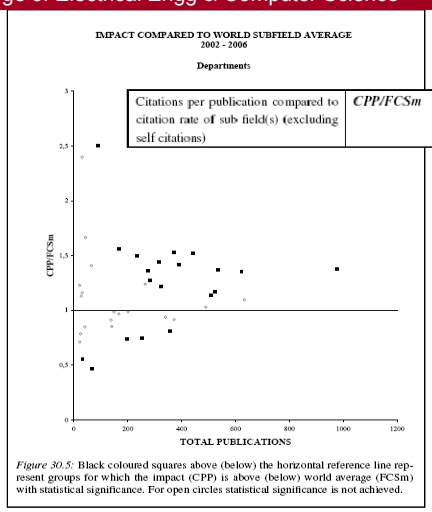
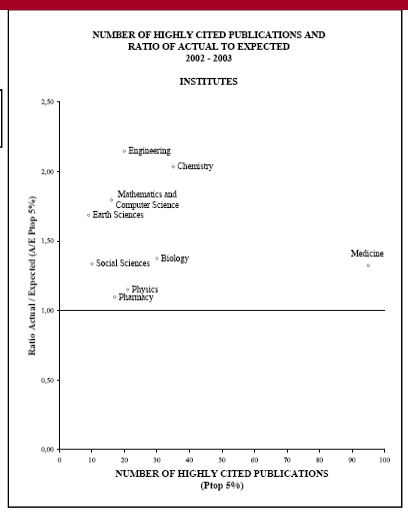


Figure 30.5: Black coloured squares above (below) the horizontal reference line represent groups for which the impact (CPP) is above (below) world average (FCSm) with statistical significance. For open circles statistical significance is not achieved.



Pg 48

Research Evaluation

University-wide evaluations

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Table 30.4: *Indicators of publication output and citation impact for Uppsala University 2002 - 2006*

Indicator	Symbol	Score 2002 – 2006
Number of publications in Web Of Science	*P*	8,502
Total number of citations received	*C+sc*	60,031
Citations received excluding self citations	*C*	45,209
Citations per publications, self citations not included	*CPP*	5.32
% Publications not cited, self citations not included	*Pnc*	34%
Citations per publication compared to citation rate of journal packet (excluding self citations)	*CPP/JCSm*	1.06+
Citations per publication compared to citation rate of sub field(s) (excluding self citations)	*CPP/FCSm*	1.25+
Citation rate journal packet compared to citation rate of subfields (excluding self citations)	*JCSm/FCSm*	1.17
Percentage self citations	*Self Citations*	25%
Number of papers that are highly cited in their subfield(s) (excluding self-citations)	*Ptop 5%*	228
Number of highly cited papers compared to total publication output	*A/E Ptop 5%*	1.43

Bottomline is still:

CITATIONS (numbers)

And

EVALUATION of work by outside experts.

Pg 49

Part 3 – 15 Slides

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World Class

Why the need for World Class?

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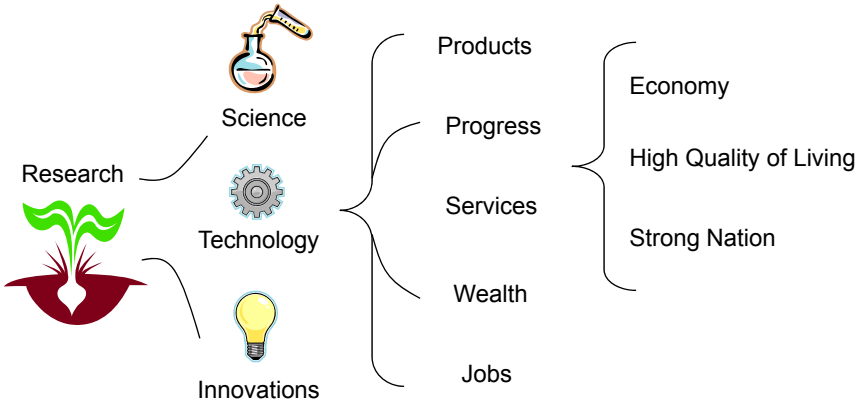
Why World Class?



Pg 51

World Class

Where we stand among others?

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THE QS TOPUNIVERSITIES

2008 World Universities Ranking
Top 10 (all fields)

1. Harvard, USA
2. Yale, USA
3. Cambridge, UK
4. Oxford, UK
5. Caltech, USA
6. Imperial, UK
7. UCL, UK
8. Chicago, USA
9. MIT, USA
10. Columbia, USA

Asian Universities

19. University of Tokyo	JP
26. University of Hong Kong	HK
30. University of Singapore	SG

SPAIN - Universities

186. University of BARCELONA
Universidad Autónoma de MADRID
Universidad Autónoma de BARCELONA
University Complutense MADRID
University of NAVARRA
University of SALAMANCA
Universitat de VALENCIA
University of GRANADA
University of MURCIA
Universidade de SANTIAGO DE COMPOSTELA
Universidad de SEVILLA
Universidad Politecnica de VALENCIA
Universidad de ZARAGOZA

Pg 52

World Class

Many countries want world class

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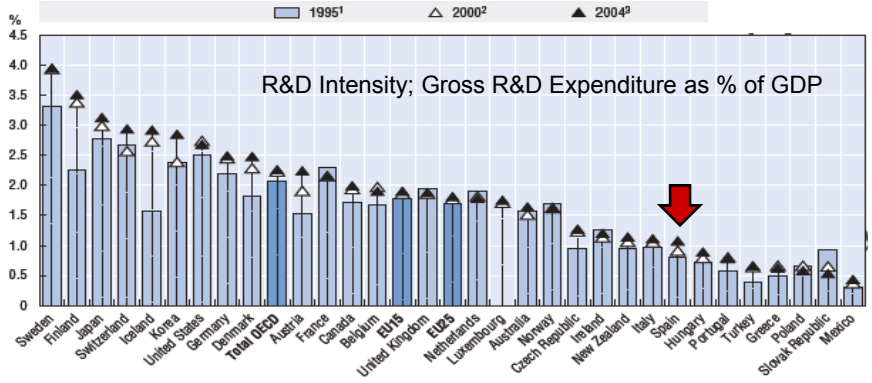
Many Countries want to be world class,,,,,,



1. 1996 instead of 1995 for Japan and Switzerland.
2. 1999 instead of 2000 for Denmark, Greece, New Zealand, Norway and Sweden.
3. 2002 for Australia and Turkey, 2003 for Greece, Iceland, Italy, Mexico, New Zealand, Portugal, Sweden, United Kingdom, EU-15 and EU-25.

Pg 53

World Class

Many countries want world class

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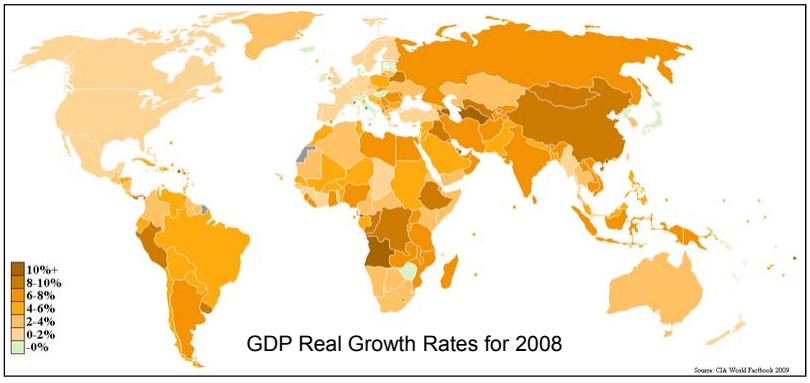
GDP = Consumption + Investment + Government Spending + (Exports-Imports)



Pg 54

World Class

Many countries want world class

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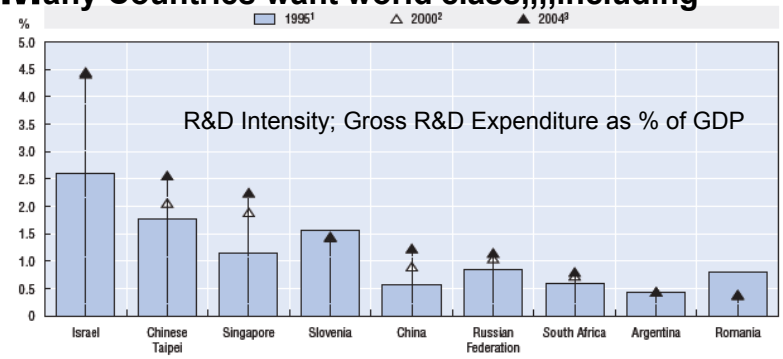
Many Countries want world class,,,,including



1. 1996 instead of 1995 for Argentina, 1997 for South Africa.
2. 2001 instead of 2000 for South Africa.
3. 2003 instead of 2004 for South Africa.

Pg 55

World Class

Global R&D $$ Manpower

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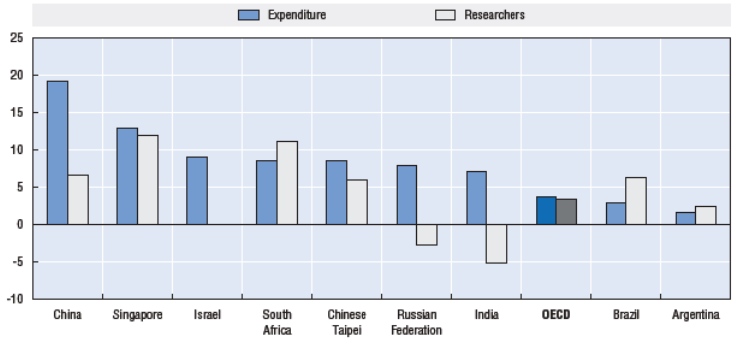
Most countries trying to grow R&D $$ and manpower,,,,

Figure 1.20. **Average annual growth rates of R&D expenditure and R&D personnel, 1995-2004 (%)**



Note: Growth rates are based on data in constant prices. For expenditure: Argentina 1996-2004, South Africa 1997-2004,

Pg 56

World Class

Research Intensive Countries

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World's Most Research Intensive Countries

The Numbers:

Research & development, as share of national and state GDP:

New Mexico:	*8.72%*
Massachusetts:	*5.26%*
Israel:	4.90%
Maryland:	*4.77%*
Sweden:	4.27%
Japan:	3.15%
United States:	2.67%
South Korea:	2.64%
EU Total:	1.86%
China:	1.22%

Source: Trade Pact of the Week, Jan 2007

Ranking (in terms of spending)

USA accounts for 1/3 of world's spending on scientific R&D.

Second is Japan

Third is EU (27 members combined)

Ranking (relative to GDP)

- **Israel** is Top
- **Sweden**/Finland/Iceland is 2nd
- **Japan** is 3rd
- **USA** 4th
- **Korea** 5th

Pg 57

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Publish or Perish

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Publish or Perish?

Table 1.2. **Scientific articles by geographic region and field of science and technology**

	Total number of articles[1]		Life sciences (%)		Physical sciences (%)		Engineering, technology and mathematics (%)		Social and behavioural sciences (%)	
	1996	2003	1996	2003	1996	2003	1996	2003	1996	2003
United States	201 798	211 233	54.1	54.1	22.4	22.2	8.0	10.7	8.8	6.4
EU15	193 172	220 002	54.3	52.1	31.6	30.1	7.5	9.6	4.4	5.5
Japan	50 392	60 067	50.1	46.8	38.3	38.6	10.4	12.5	1.0	1.8
Total OECD	516 043	583 913	53.2	51.8	28.7	28.2	8.1	10.7	6.1	5.4
World	593 568	698 726	50.8	48.7	31.4	31.3	8.7	11.2	5.7	5.3

1. Includes health sciences and professional fields which are not shown here (see annex).

Source: US National Science Foundation, *Science and Engineering Indicators*, 2006.

Pg 58

World Class

Common Misunderstanding

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Quote from a Member of US National Academy of Sciences

Professor X-H Cho, Professor of Radiological Science, U C Irvine

> A fundamental problem is the lack of understanding of just what is meant by a world-class research institution. As epitomized by Nobel science prizes, it is the "originality" and "major impact and contributions" that define truly world-class science!! World-class buildings, offices, and lab spaces do not make world-class institutions..

Pg 59

World Class

Attributes of WC Universities

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What Constitutes a World Class University?

Characteristics

1. Research Excellence
   - Significant research achievements/impact
2. Top Faculty
   - Each faculty is a "star" in his field
3. World-Wide Reputation
   - University *must* be world famous in something..

Pg 60

World Class

What it Entails?

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What it Entails?

- **Personal Development**
  - Promote excellence in research
  - Develop "Stars" Culture
  - Intensify research quality and output
  - Learn from others! (don't hate or envy)
- **Change – Yes we can! "Obama"**
  - Change in emphasis and in recognition
  - Shift from "power struggle" to "research excellence"
  - Get the "right people" to do the "right things"…
  - Enpower star researchers to lead by example…

Pg 61

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Top Faculty A Must Have

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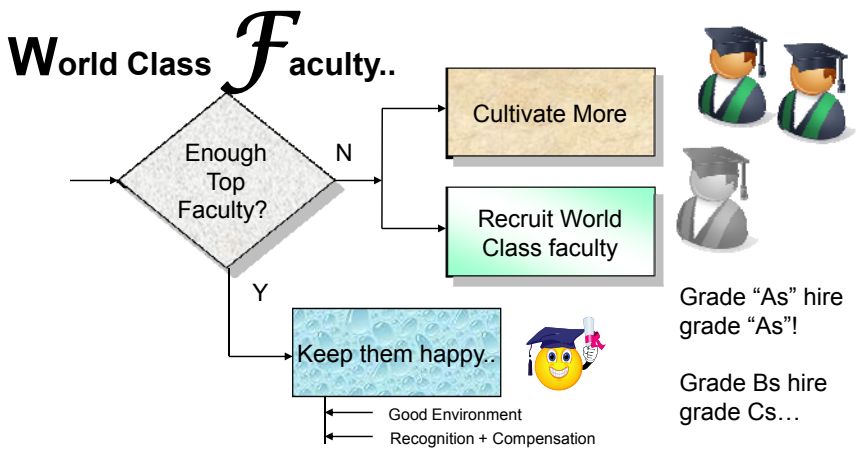

Pg 62

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Clear Faculty Structure

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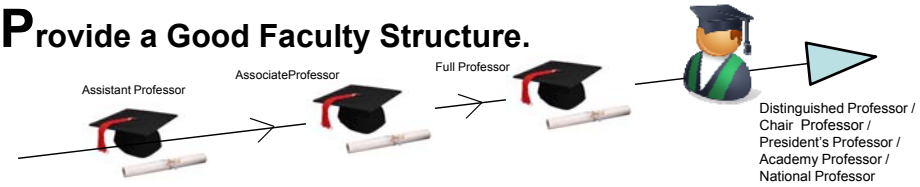
Provide a Good Faculty Structure.



- Create "The Hierarchy of Excellence" (based on merit)
- Assistant professors work on building up their prestige, contributions, and research excellence
- Associate professors proceed to perform greater significance in their research with more teaming up
- Full/Chair/Distinguished professors lead their fields and provide research insights, teaming and excellence.
- Build "Respect and Recognition" within schools/colleges

Pg 63

World Class

Build World Wide Reputation

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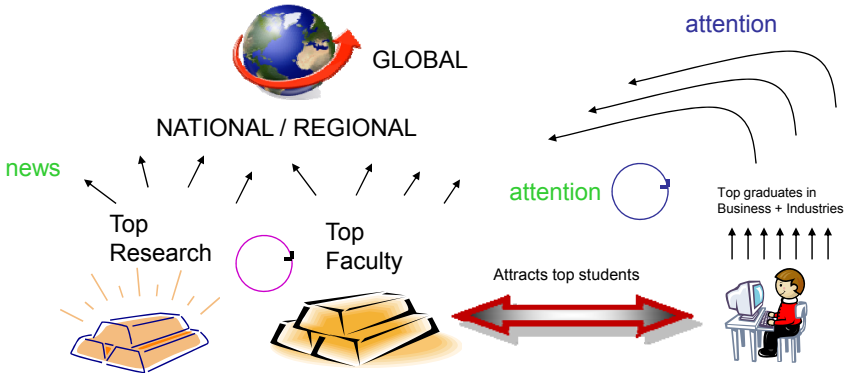
Build World-wide Reputation...



Pg 64

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Important Things to Do..

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Approach ??

- Divide & Conquer: Best in the Country
- Strive for Best in the Region
- Best in the World
- Hire the best – A's quality
- Form stars team
- Focus research impact
- Form research alliance
- Produce!!
- Reference: YALE professors / YALE setup

Pg 65

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Pave to World Class University

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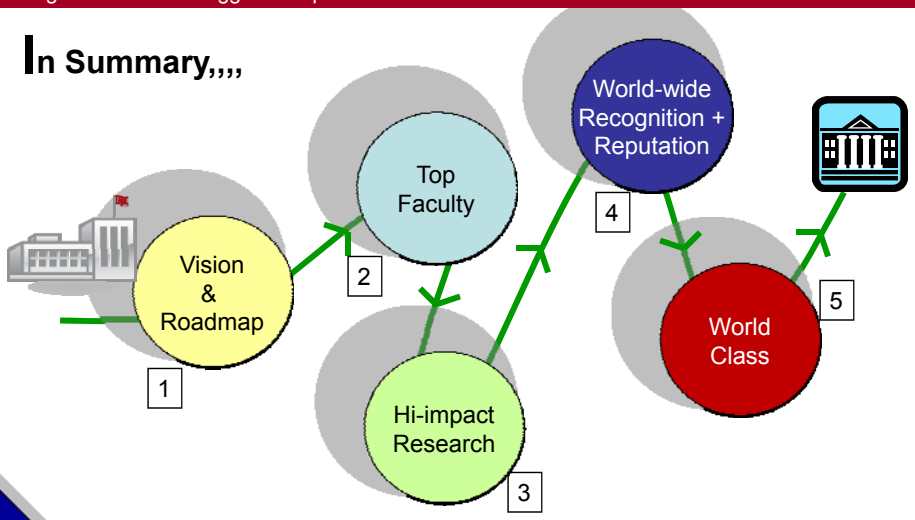
In Summary,,,,



Pg 66

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High Impact Research

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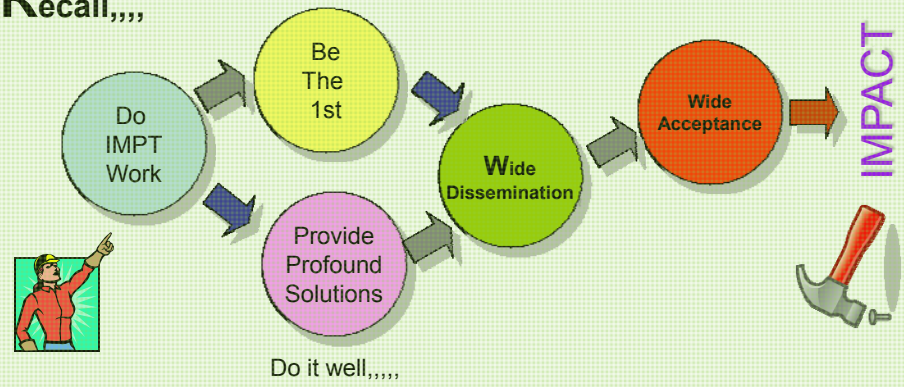
Recall,,,,



Conclusion

World Class

We build it. They will come.

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Essentially,,,,,

1. The Roadway to "world class university" cannot be done overnight!!
2. You do require "total efforts"
3. You do need a clear direction and goals
4. Recruit /Compete for Many Top Faculty
5. Do "High Impact Work"
6. Need to be "famous for something"..
7. Achieve WWR: World Wide Reputation
8. Then,

you are on your way to building a World Class Institution!

9. End.