Entrepreneurship and Technology Transfer (Taking Inventions to Market)

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ET Cube (ET^3) International
Advanced Fluidics LLC

NMIST, Arusha, Tanzania
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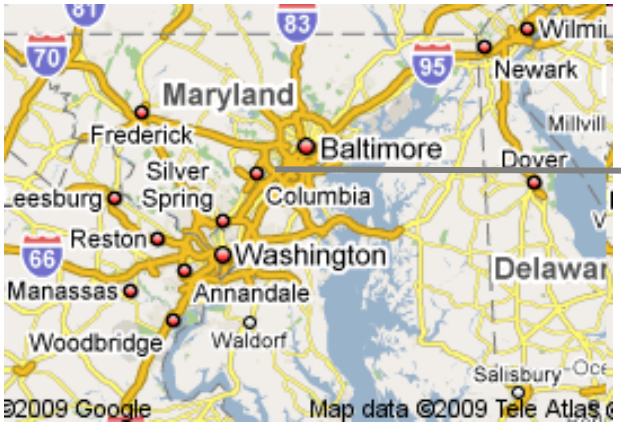


About ET Cube International and Advanced Fluidics

ET Cube International: Entrepreneurship, IP, Tech. Transfer Training and Capacity Building in Developing Countries

Argentina, Ethiopia, Ghana, India, Indonesia, Italy, Jordan, Mexico, Morocco, Pakistan, Philippines, South Africa

Advanced Fluidics LLC

Research and Product Development in

1. Aerospace Sciences – Aerodynamics, combustion
2. Micro/Nanofluidics/nanotech-based biosensors
3. Electrochemical Sensors (corrosion sensors)
4. Medical Instrumentation
5. Technology Roadmap Development and Training

Work with Universities, Small Companies, Big Companies and Govt. Research Labs.

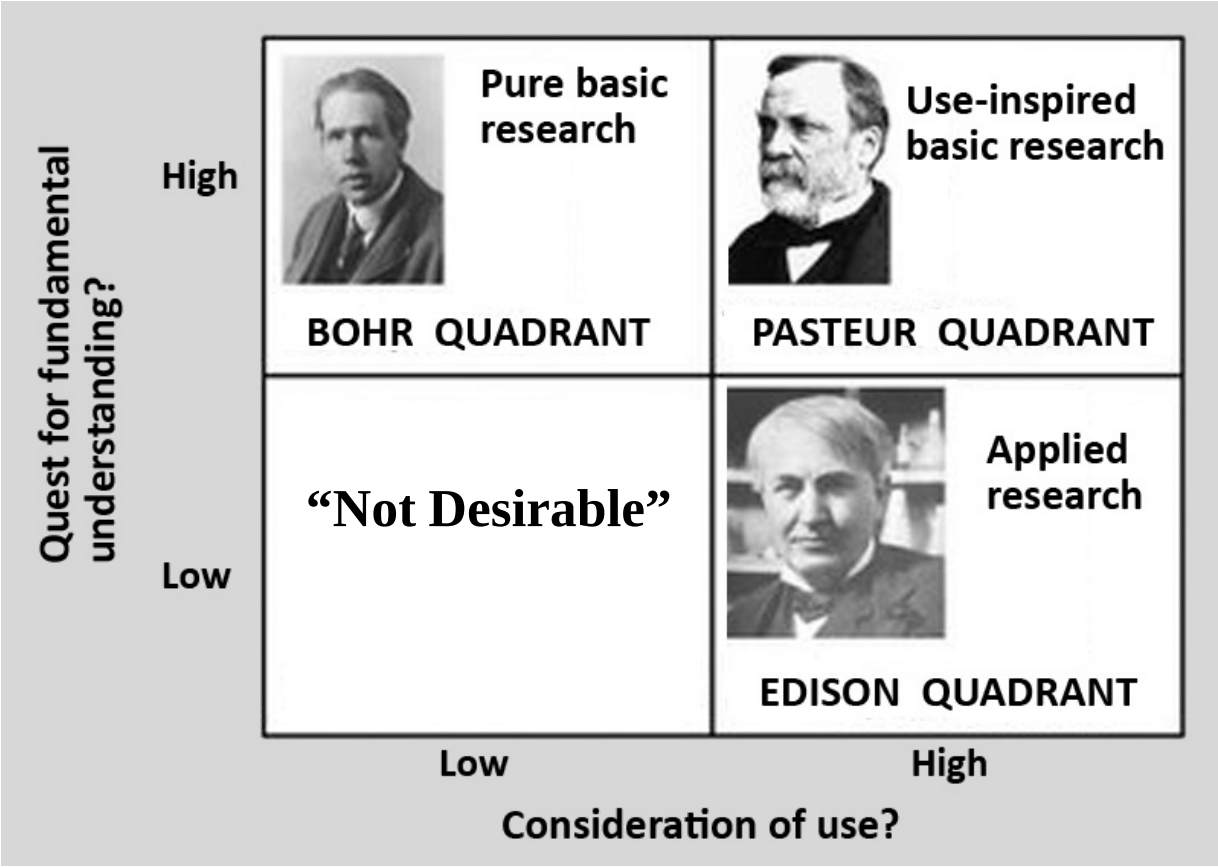
OUTLINE

Discussions of the questionnaire:

1. **What kind of research to take up?**
2. **Ideas, Inventions and IP**
3. **Technology Development and TRLs**
4. **Timelines for Product Development**
5. **Example of Invention to Product**
6. **Pitfalls to commercialization**
7. **Conclusions**

University - The Intellectual Capital

1. What Type of Research?



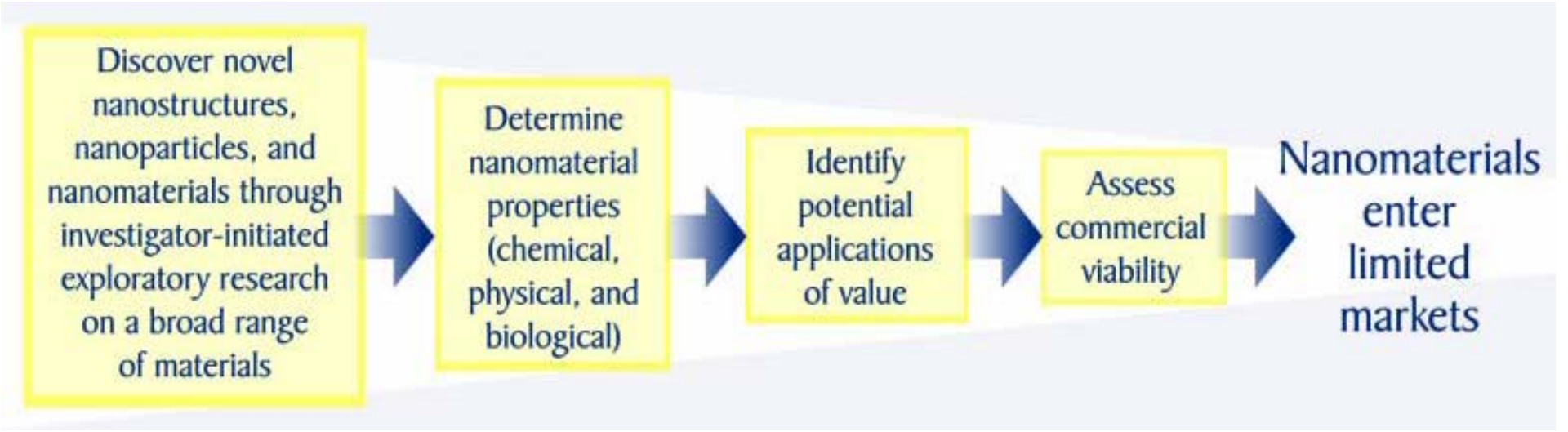
Donald Stokes - Pasteur's Quadrant: Basic Science and Technological Innovation

"Lots of Research but for What Purpose?"

THE AIM OF EDUCATION AND RESEARCH IS NOT SIMPLY THE GENERATION OF RESULTS FOR THEIR OWN SAKES BUT, IN ENGINEERING IN PARTICULAR, THEY ARE SUPPOSED TO FULFILL SOME SIGNIFICANT PURPOSE.

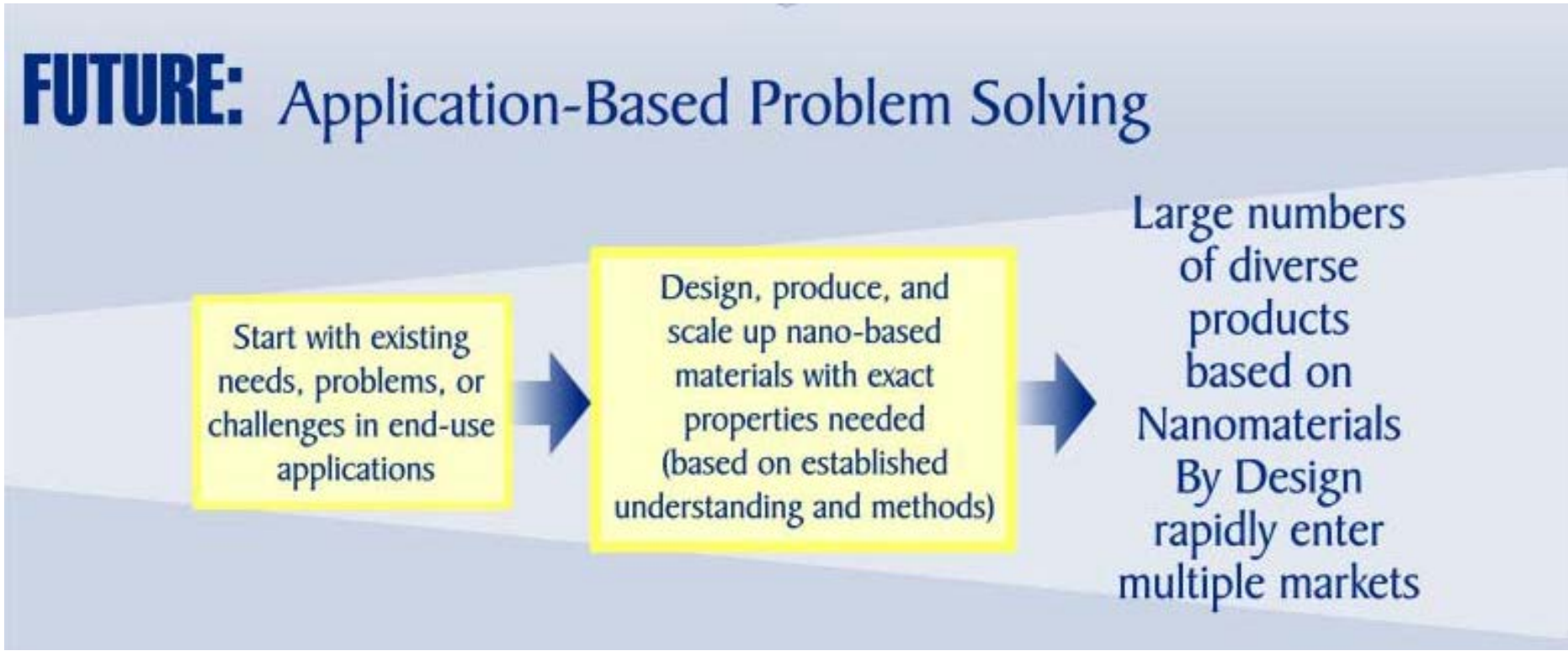
Mechanical Engineering, Sept. 2013)

The Tradition – Basic Research



Ref.: Chemical Industry Vision 2020
Technology Partnership Energetics, Incorporated, 2003

The New Model



Ref.: Chemical Industry Vision2020
Technology Partnership Energetics, Incorporated, 2003

2. Technology Transfer and IP Office

Benefits of Tech Transfer

New products and services for public good

Employment generation in hi-tech industry

Growth of regional economies

Replace poverty with prosperity

3. IP Policies in your Institutions

Invention Disclosures

Who owns the IP

Rewards/Recognitions for Patents

Share of income on patents through royalties/sale of invention

4. Intellectual Property Training

5. Can your Idea be Patented?

Research, Discovery and Inventions

Applied or Commercial or Use/Context-based Research
Example: New plastics in plastics industry, new cancer drugs in pharmaceutical industry. Objectives are somewhat known.

Basic Research (Context-free research)
Typically University Research/Research Institutions
Example: Research on Properties of fluids or matter

Generally, we have faster development of products from Applied or Commercial Research

What are you inventing?

New Technology? (Method and Apparatus or Process)

"Technology is a capability that can be used in a product."

Example: Laser – Ted Maiman (1960)

"a solution looking for a problem?"

(http://spie.org/x39920.xml)

OR

A New Product? (Apparatus)

"makes use of existing or new technologies"

Optical readers, scanners, laser pointer, laser-based eye surgery systems, golf trainer, laser machining, …….

A new product has a customer and a market in mind

Publications vs. Patents

Publications

Academics – publications are recognized as a product of scholarly academic activity and the author is recognized in his field of specialization. Recognition such as fellowships and prizes, distinguished lectures and invited speeches in Professional organizations.

Recognition in only the academic community for your number of papers.

Quality of papers also count.

Publications vs. Patents

Patents

Patents are more valuable and encouraged in industry.

Patents are recognized by their *value* to a *product.*

Inventor *may or may not* be recognized publicly.

The inventor is recognized in a different way – plaques, promotions and monetary benefits.

Inventor is, in general, recognized by the impact it has on a product – not the number of patents.

6. Who Will Be The Potential User/Customer Of Your Idea?

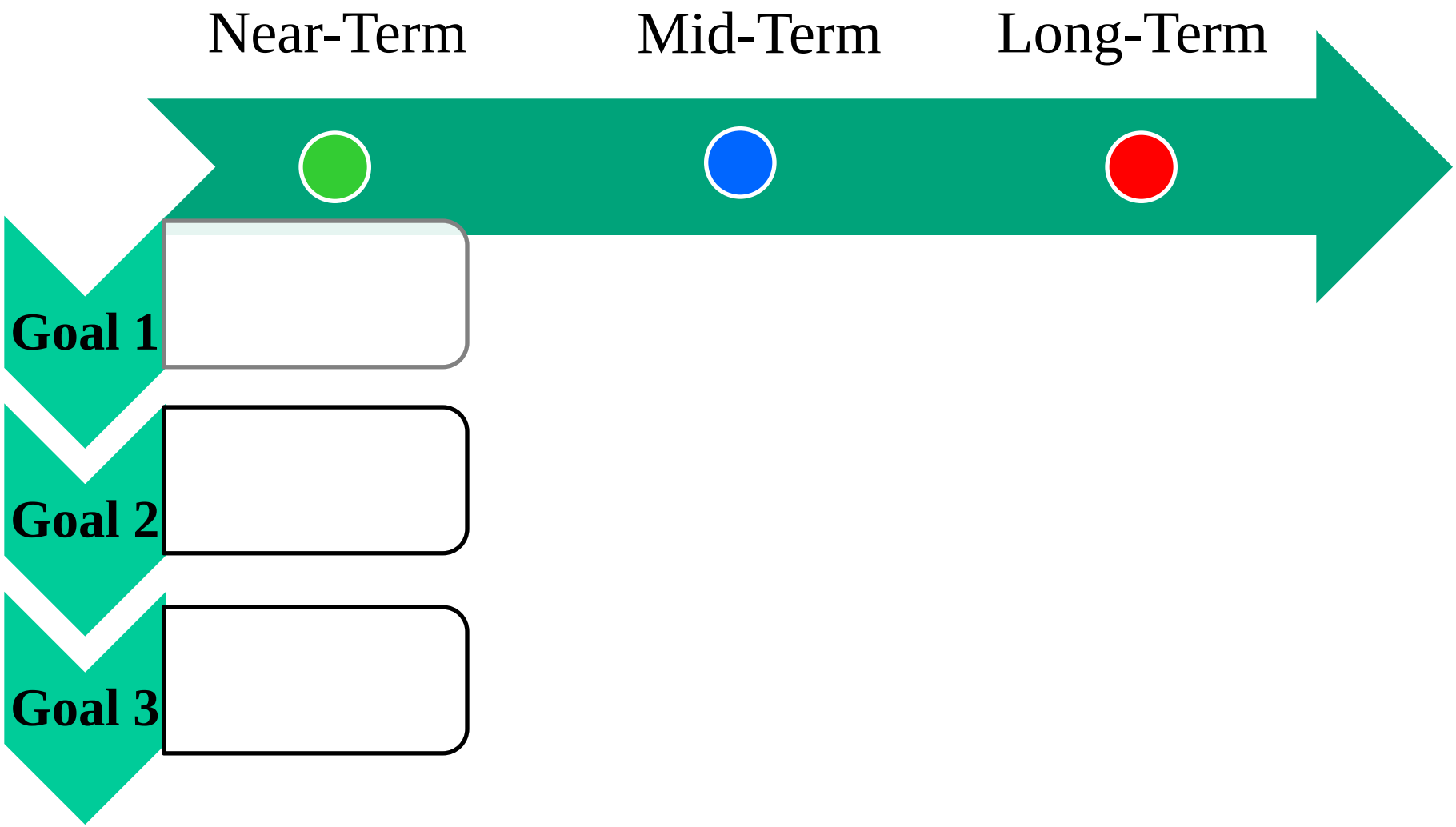
Looking for ideas

- **Technology Road Maps**
- **Technology Mind Maps**
- **Technology Intersect Maps**
- **Looking through a crystal ball?**

Technology Roadmaps

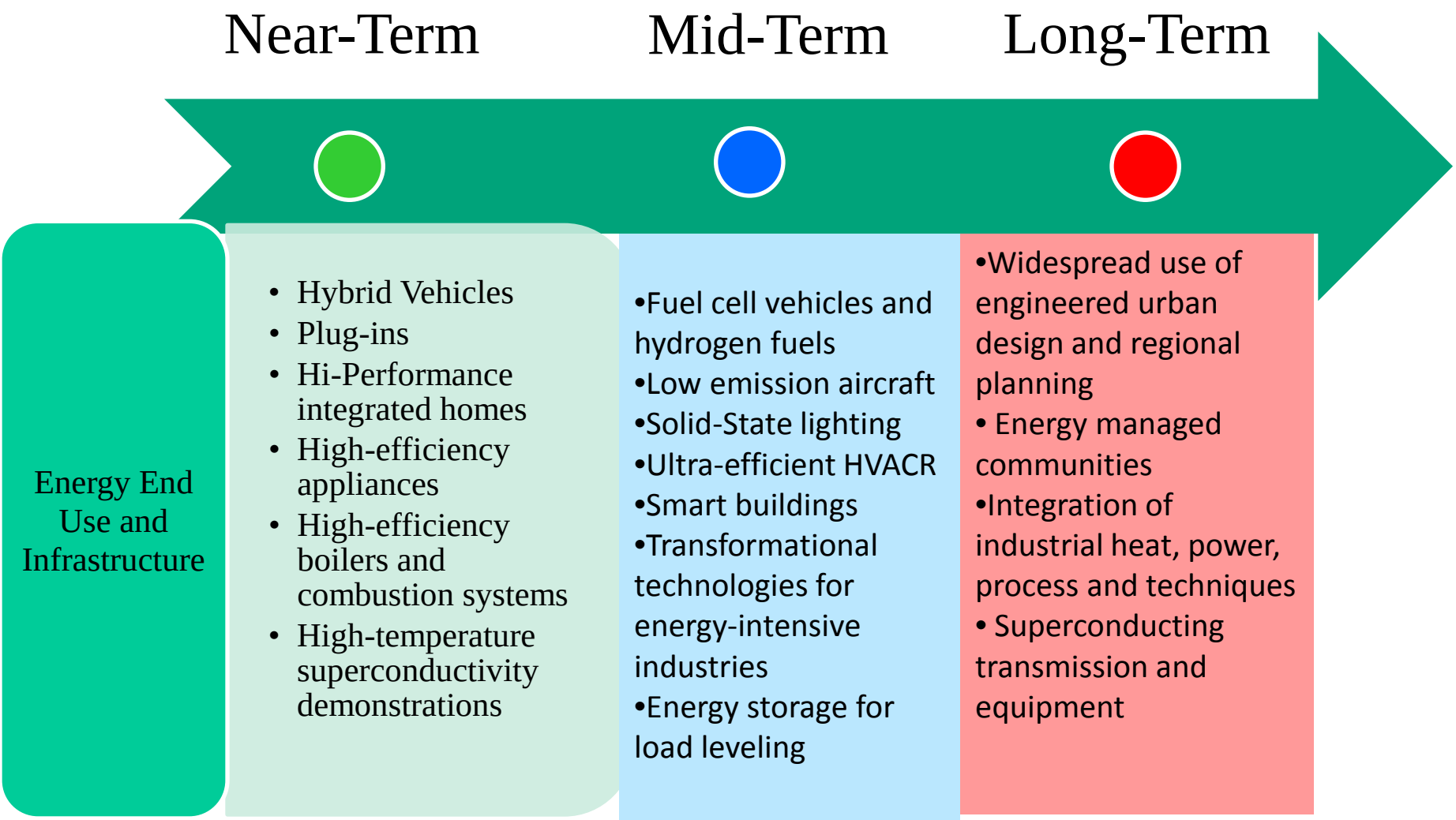
Developed to show us opportunity for inventions and products based on market evolution

Technology Road Map



Technology Road Map

http://www.climatetechnology.gov/library/2006/testimony20sep2006.htm

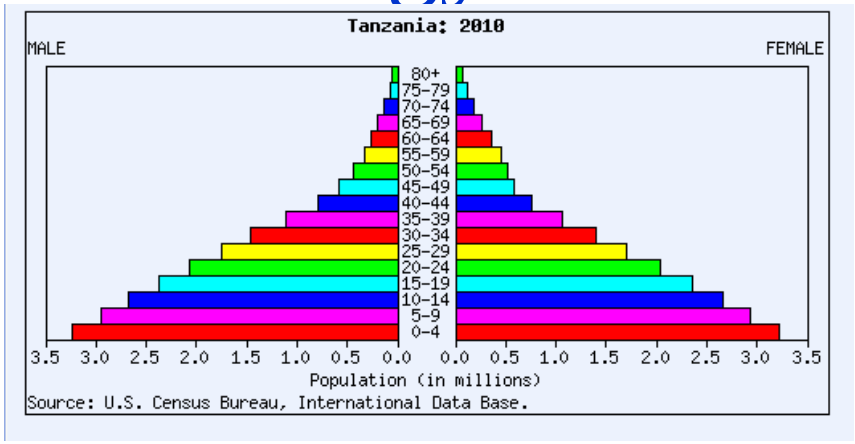


Connecting the Dots

Points to consider for forecasting

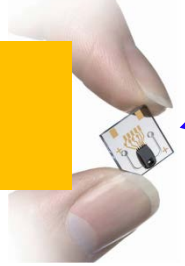
- Observing/Studying Trends
- Economic factors
- Societal factors
- Technological Advances
- Political Action/Regulatory statutes

Technology Forecasting



www.afran.info/

Micro-sensors



Health Monitoring

Generation-2 Internet

24-hour medical care

http://www.i-micronews.com/

Market for your Ideas and Inventions

7. Have You Estimated The Potential Market Size (# Of Customers) For Your Idea Or Product?
Yes No

8. Are There Competing Technologies In The Market?

9. If So, What Is The Advantage Of Your Idea/Invention Over The Competition?

From an Idea to a Successful Product

An idea is not an invention

An invention is not a product

Not done before ≠ Necessarily useful invention!

Innovation

Useful Invention → $succe$$ful Product *only* if marketed well

10. Stage of Your Research Project

Technology Readiness Level

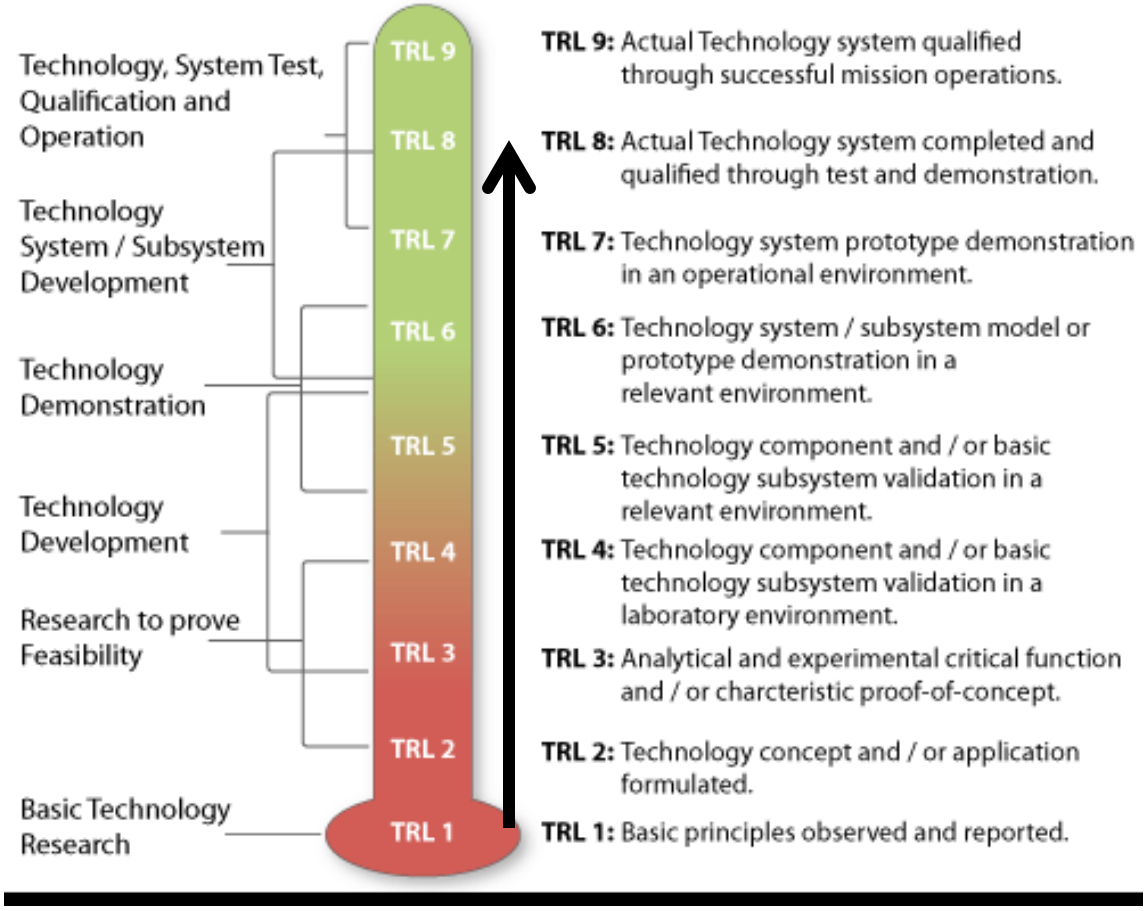
Technology Development and Technology Readiness Levels (TRL)

TRL Table: Developed by NASA and commonly used in the US (and more recently in Europe) for technology development programs to measure the maturity of a technology. Also important in the valuation of the product/company.

9 Stages of Technology Readiness Levels – TRL 1-9

(Ref: John C. Mankins (1995), http://www.hq.nasa.gov/office/codeq/trl/trl.pdf)

Technology Readiness Levels (TRL)



TTO can use this TRL concept to evaluate the stage of invention in the Institution for both internal evaluation and external marketing - Technology Push by the institution.

http://www.aof.mod.uk/aofcontent/tactical/techman/content/trl_applying.htm

11. TIME-LINE

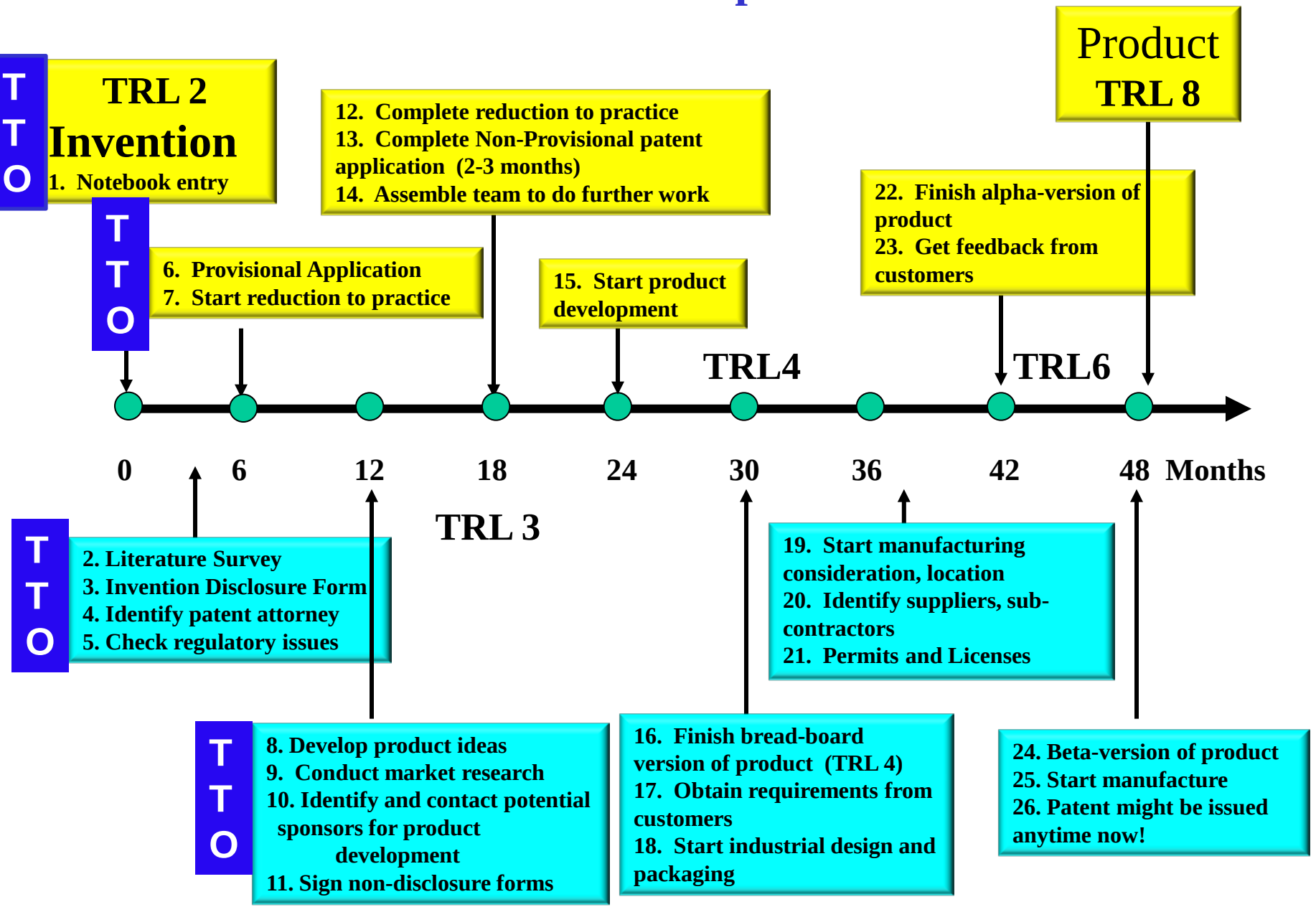
How long does it take to get from TRL1 to TRL9?
(what is your estimate?)

12. Idea to Market

Various aspects of taking an invention to a product

1. Technology Development
2. Securing Intellectual Property
3. Manufacturing Process
4. Company aspects – Legal, Financial and HR
5. Business Development

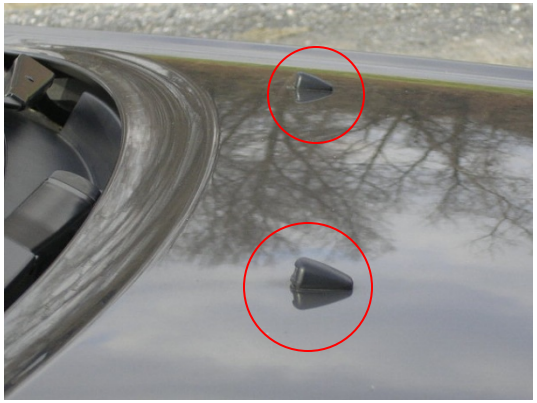
Invention to Product: Steps and Time-Line



Lots of decisions to be made with incomplete information!

Examples of Timelines for Products

Example: Windshield washer nozzles based on hydrodynamic instabilities (Market pull)



Example 1. Windshield washer nozzles based on hydrodynamic instabilities

Inventor: Surya Raghu, USA

Invention process: August-October 1998

US Provisional application: October 1998

Non-Provisional Application: October 1999

Patent issued: July 2001 (US, Europe, Japan, Brazil, Mexico, India, China, S. Korea, etc.)

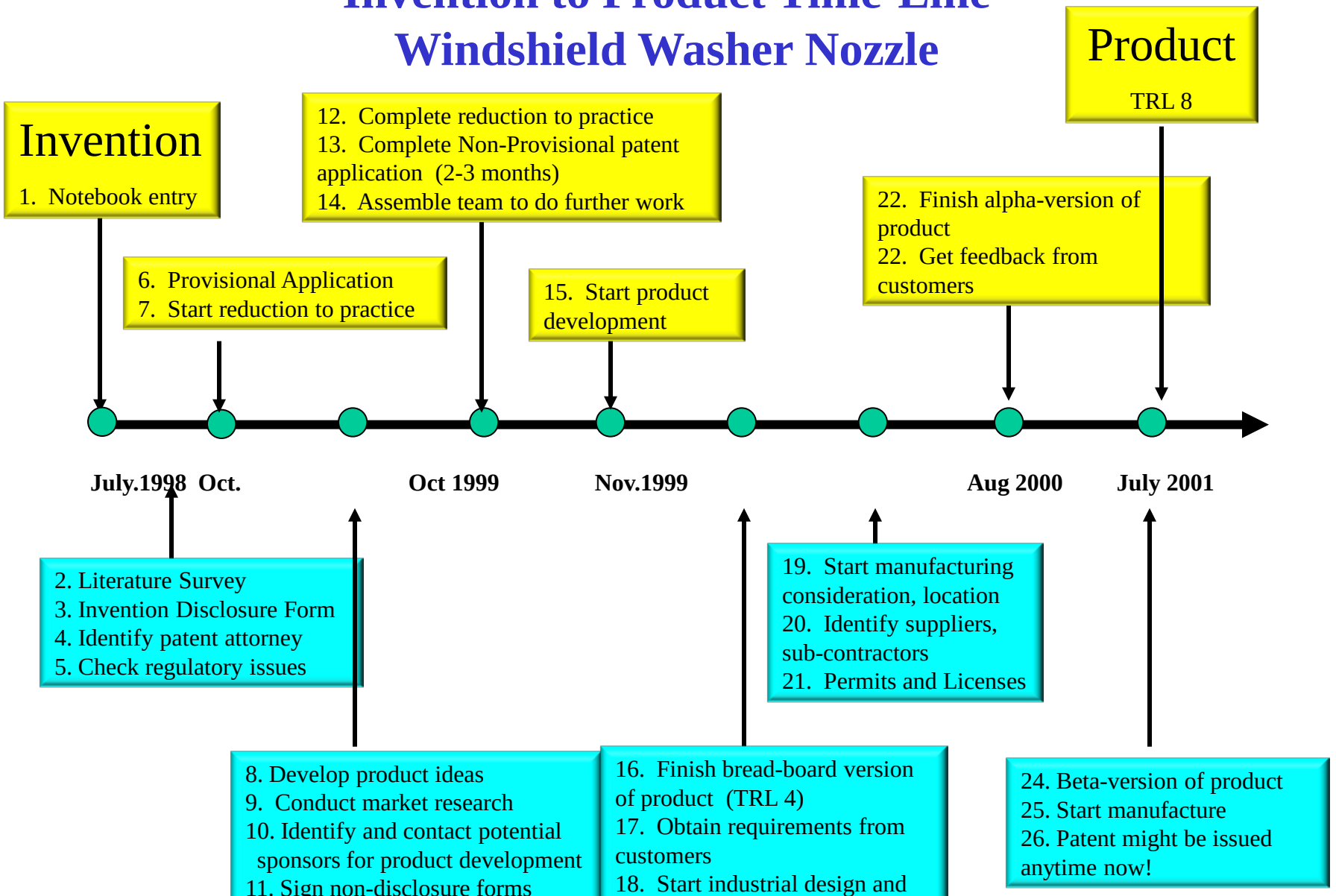
Development:

Currently an automotive product in use from 2001

- 40 million nozzles/year
- Used in GM, Ford, Chrysler, Volkswagon, Mercedes, Saab, Jaguar

Toyota, Honda and Subaru

Invention to Product Time-Line
Windshield Washer Nozzle



The Issued Patent

US006253782B1

(12) **United States Patent**
Raghu

(10) **Patent No.: US 6,253,782 B1**
(45) **Date of Patent: Jul. 3, 2001**

(54) **FEEDBACK-FREE FLUIDIC OSCILLATOR AND METHOD**

(75) Inventor: **Surya Raghu**, Ellicott City, MD (US)

(73) Assignee: **Bowles Fluidics Corporation**, Columbia, MD (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/417,899**

(22) Filed: **Oct. 14, 1999**

Related U.S. Application Data

(60) Provisional application No. 60/104,511, filed on Oct. 16, 1998.

(51) **Int. Cl.**[7] **F15C 1/06**

(52) **U.S. Cl.** **137/14**; 137/809; 137/810; 137/811; 137/813; 137/826; 137/833; 137/835

(58) **Field of Search** 137/826, 833, 137/835, 808, 809, 810, 811, 812, 813, 14

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,208,462	*	9/1965	Fox et al.	137/811
3,452,772	*	7/1969	Zaloudek	137/809
4,151,955		5/1979	Stouffer	239/11
4,184,636		1/1980	Bauer	239/11
4,463,904		8/1984	Bray, Jr.	239/284 R
4,508,267		4/1985	Stouffer	239/11
4,854,176	*	8/1989	Okabayashi	73/861.19
4,976,155	*	12/1990	Challandes	73/861.19
5,213,269		5/1993	Srinath et al.	239/589.1
5,213,270		5/1993	Stouffer et al.	239/589.1
5,396,808	*	3/1995	Huang et al.	73/861.19
5,638,867	*	6/1997	Huang	137/826

FOREIGN PATENT DOCUMENTS

1550510	*	3/1970	(DE)	137/812

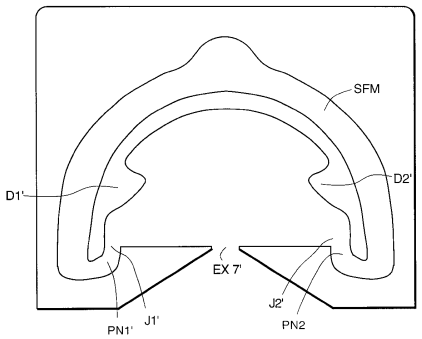
* cited by examiner

Primary Examiner—A. Michael Chambers
(74) *Attorney, Agent, or Firm*—Jim Zegeer

(57) **ABSTRACT**

A fluidic oscillator includes a member having an oscillation inducing chamber, at least one source of fluid under pressure, at least a pair of power nozzles connected to the at least one source of fluid under pressure for projecting at least a pair of fluid jets into the oscillation chamber, and at least one outlet from the oscillation chamber for issuing a pulsating or oscillating jet of fluid to a point of utilization or ambient. A common fluid manifold connected to said at least a pair of power nozzles. The shape of the power nozzle manifold forms one of the walls of the interaction or oscillation chamber. In some of the fluidic circuits, the length can be matched to fit existing housings. The power nozzle can have offsets which produce yaw angles in a liquid spray fan angle to the left or right depending on the direction desired. In some embodiments, the exit throat is off axis (off the central axis of the symmetry) by a small fraction to the left or right to move the leftward or rightward yaw angles in the spray. The outlet throat may be offset along the longitudinal axis by a small amount to produce a yaw angle of predetermined degree to the left or right depending on what is desired. Thus, one can construct circuits for yaw using a combination of the techniques described above which suits most applications.

25 Claims, 15 Drawing Sheets



12. Do You Have Plans To Take The Idea To Market?

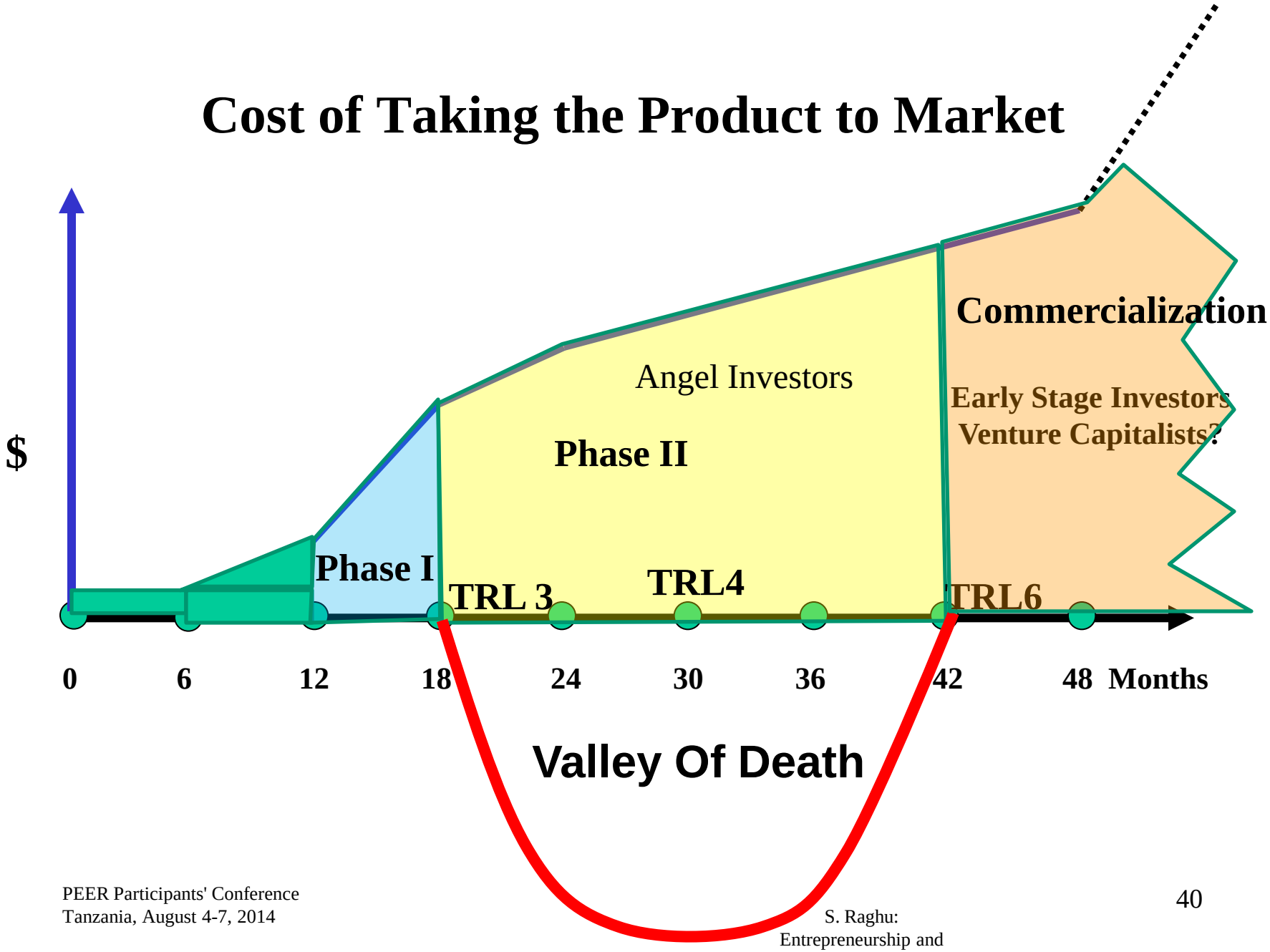
Entrepreneurship is a career option

Inventor as an entrepreneur

Alternate career for Masters and Ph.Ds
(Large percentage of those employed in science are in Universities)

Faculty on sabbatical/leave of absence

Cost of Taking the Product to Market



“PITFALLS IN COMMERCIALIZATION”

1. Reinventing the wheel

“PITFALLS IN COMMERCIALIZATION”

2. Ideas that did not work in reality – not really an invention

   - Do not stand the test of science!

"PITFALLS IN COMMERCIALIZATION"

3. Ideas worked and ***even patented*** but limited or no applications (no products)

"PITFALLS IN COMMERCIALIZATION"

4. Found applications but products not successful in market
   too expensive, too complicated, too big, too small, "crazy" …

“PITFALLS IN COMMERCIALIZATION”

5. Products successful only for a short time or technology outdated

TTO can help a great deal in avoiding these pitfalls!

CONCLUSIONS

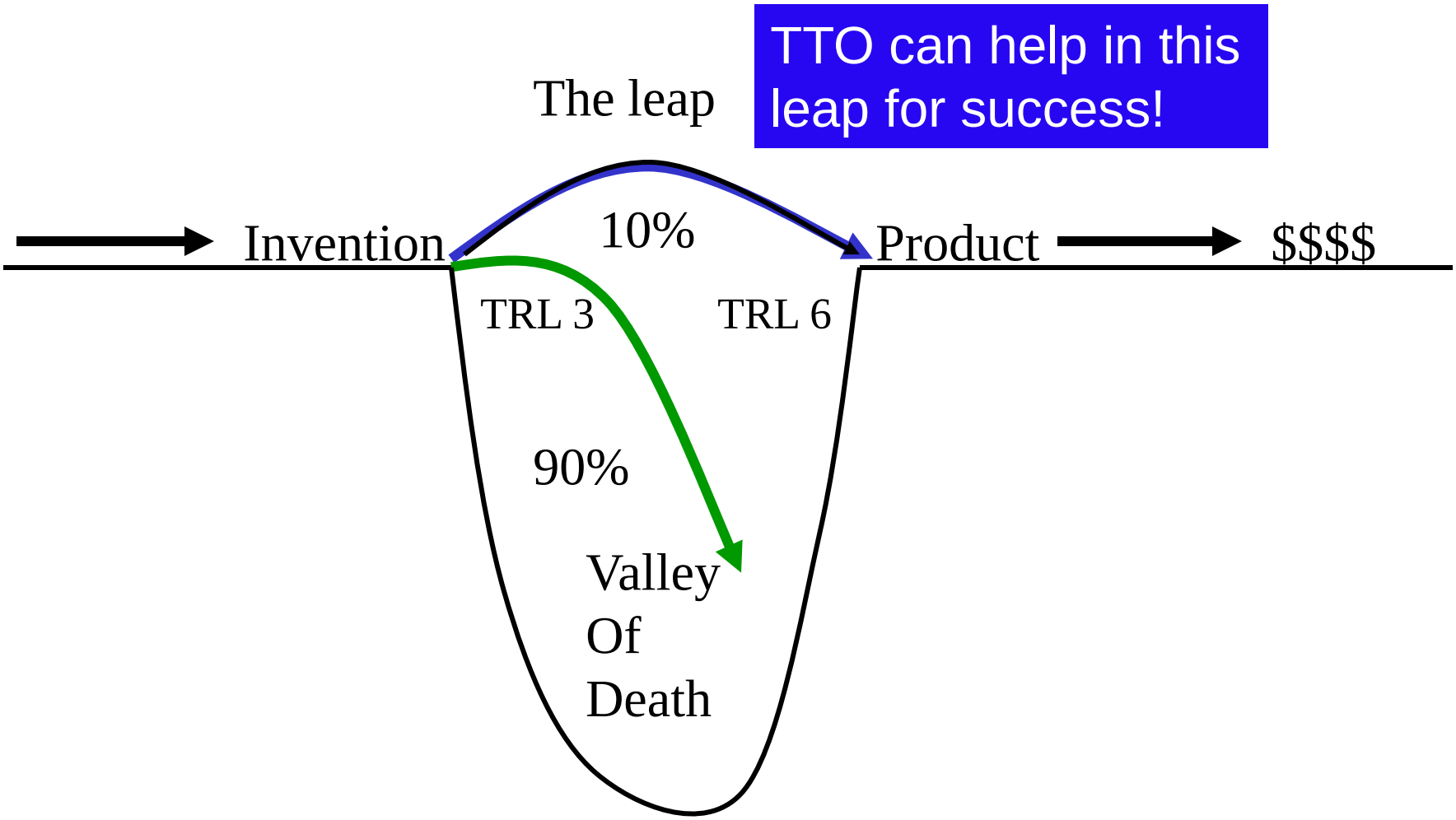
The Research Quadrants

Looking for ideas – potential areas of research

Invention to a Product involves quite a few steps and processes

Technology Readiness Level (TRL) is a good metric for determining the stage of the invention/product.

CONCLUSIONS



CONCLUSIONS

Watch out for pitfalls!

Encourage risk taking by students and faculty at the University

Accept failures as part of the entrepreneurial spirit

How do we promote Inventions and Entrepreneurship at Universities

Faculty

Selection of Research topics

Link and promote industrial interaction reward systems for faculty inventors,

Promotion policies

Students

Introduce projects with content of innovation

Master's thesis with industrial projects,

Student entrepreneurship competition that is cross-departmental and interdisciplinary

Current Educational System

"the educational system (*for scientists and engineers?*) is still rather traditional, which means that it teaches young people to obey, reproduce facts and to engage in wage-employment after finishing their education"

(Ref: The Long Road to the Entrepreneurial Society - Global Entrepreneurship Monitor 2001, The Netherlands)

One-Semester Course in Entrepreneurship

Course Title: Introduction to Entrepreneurship for Scientists and Engineers

In this course we deal with scientific and technological innovation and entrepreneurship.

THANK YOU

How do we promote inventions and innovation in scientific and educational institutions?

1. University-Industry interaction.

   Examples:

   - Presentation of Industrial R&D needs to Universities so that researchers will see the market needs.
   - Industrial visits

2. Industry sponsored projects to students and faculty

3. Industrial internships for students and faculty

4. Encouragement – it is OK to fail!

Example 2. ATRIAL FIBRILLATION MONITOR

(Market push)

UK: MELYS DIAGNOSTICS

USA: ADVANCED FLUIDICS

ATRIAL FIBRILLATION MONITOR

Inventor: Dr. Dawood Parker, UK

Invention process: 2003-2006

European Patent application: May 2006

Complete Specification: May 2007

Patent issued (date): To be issued

Development:

1. Proof of concept

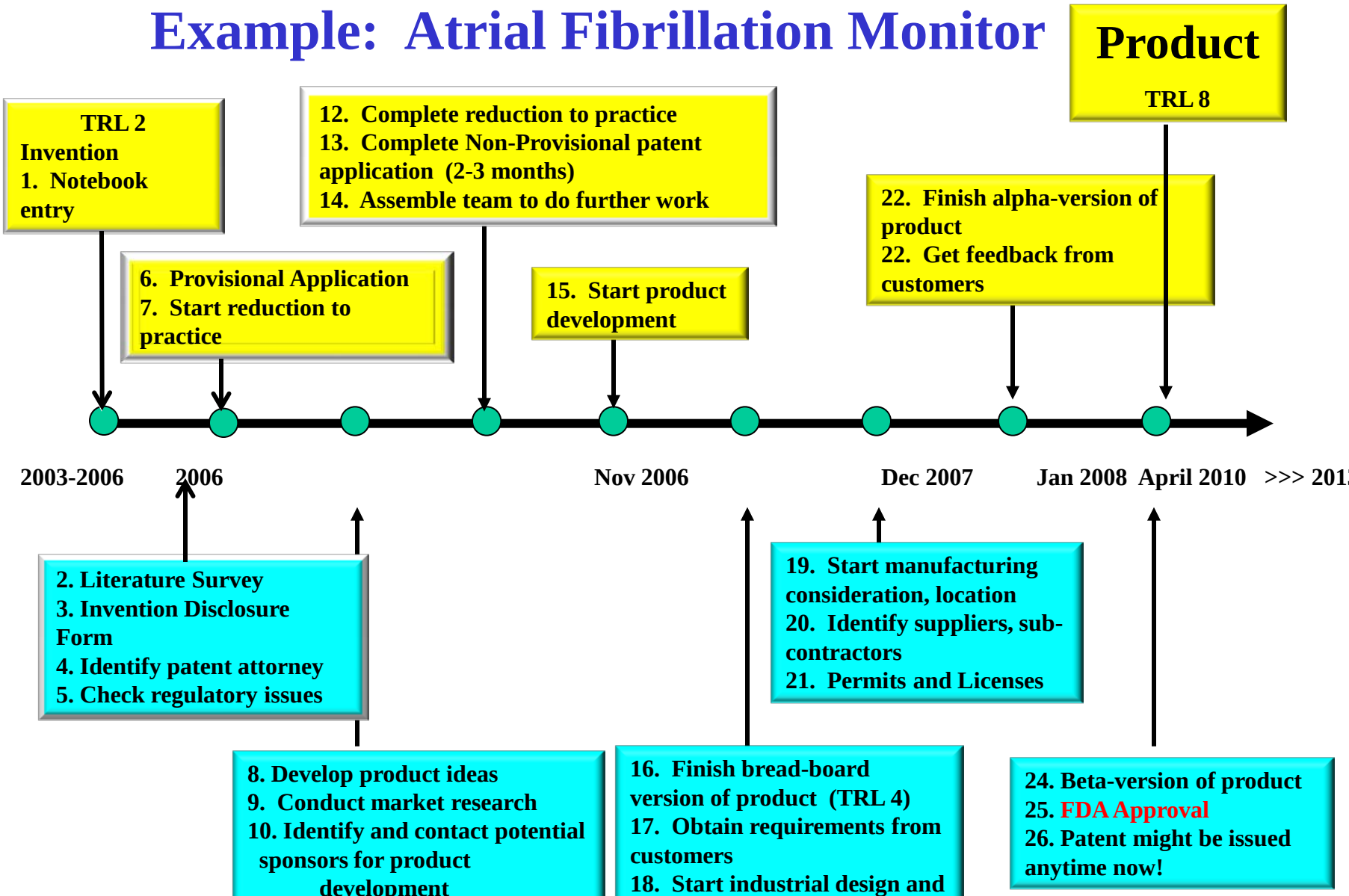
2. Validation with EKG (UK &US)

3. Pre-production (Alpha) Prototype ready in November 2007

4. Manufacturing prototype Version 1 2008

5. FDA Approval Process and Redesign for Manufacture (2009)

Example: Atrial Fibrillation Monitor



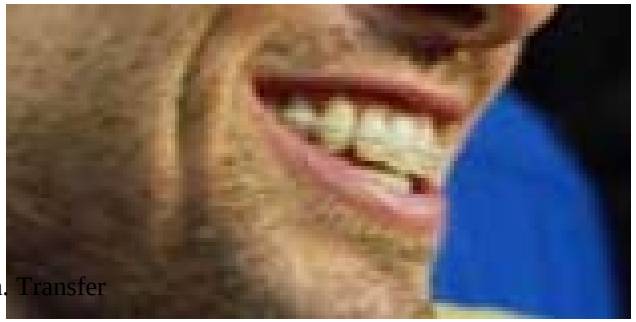
Examples of inventions from research institutions
NASA's top inventions – "spin-off"s

Digital ear thermometers (infra-red sensors)

Aural thermometers use an infrared sensor to measure the temperature of energy radiating from your ear drum.

Dental braces (translucent polycrystalline alumina (TPA)

Invisible ceramic braces



NASA's top inventions – "spin-off"s

Scratch resistant glasses

A process NASA developed while refining helmet visors for astronauts led to scratch-resistant lenses for eyeglasses and sunglasses.

Insoles (cushions for astronauts)

Space boot technology in athletic shoes is meant to put more spring in your step.