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GE105: Introduction to Engineering Design

The Engineering Profession

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What is Engineering?

Engineering is a profession like medicine, law, etc. that aspires to high standards of conduct and recognizes its responsibility to the general public.

Scientist Vs Engineer

Scientist

- Like an engineer, but a primary goal is the **expansion of knowledge** and understanding physical processes.



Engineer

- **Applies knowledge** of math and the physical sciences **to the efficient design** and construction of usable devices, structures and processes.



Professionalism

Is an aspirational standard,
the essential elements of
which are:

1. Competence
2. Personal integrity, responsibility and accountability
3. Public obligation



Professionalism

1. Competence:

- Relevant, up-to-date skills and capabilities appropriate to the particular task
- Including appropriate non-technical competences - communication, business, leadership and management competences.
- A broader foundation of relevant experience, knowledge and understanding
- Supported with relevant qualifications
- Maintained through Continuing Professional Development

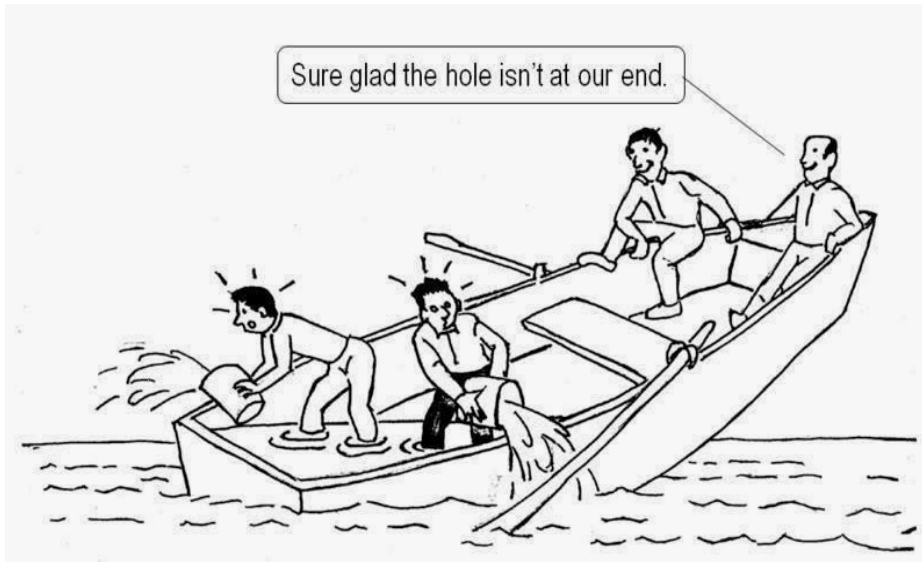
Professionalism

2. Integrity

Responsibility and Accountability

- A clear commitment to abide by a code of ethics which is recognized and administered by the professional community.

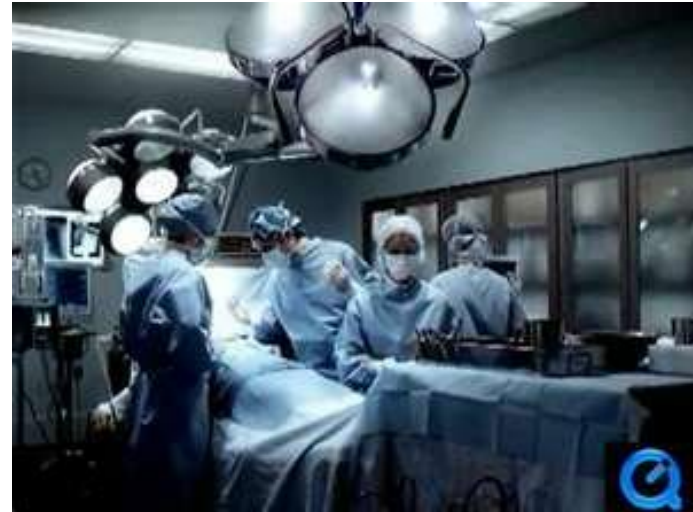
- A set of personal obligations and responsibilities which sit alongside the contractual obligation to an employer or client.
- A matching accountability which is also separate from that of an employer.



Professionalism

3. Public Obligation

- Regard for and contribution to the public good - protect the public interest
 - Social responsibility
- Commitment and contribution to the professional community and support from that community



What is a Profession?

1. Requires specialized and highly skilled knowledge.
2. Requires academic training.
3. Is regulated by professional bodies.
4. Examination of competence.
5. Function of professional work is vital to society.
6. Professionals enjoy higher social status.
7. Compensation is higher than other occupations
8. Professionals must perform under a standard of professional behavior that requires adherence to the highest principles of legal and ethical conduct.



Engineer



Medical Specialist

The Engineering Profession

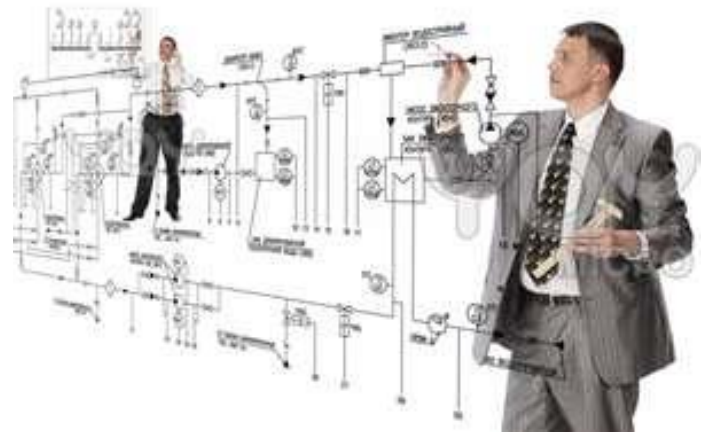
Training, Qualifications, Advancements, Licensure

- BS is required for all entry level engineering Jobs.
- Engineers trained in one field, may also work in a related field of engineering:

Civil Eng. Surveying Eng. M Eng.
E Eng. Gas & Oil Eng.
Chem Eng. Industrial Eng.

The Engineering Profession

- Whether the end result is a product, a process, a system or service, engineers need to consider safety, reliability, and cost-effectiveness.
- Engineering is a career based on logical, systematic problem solving, generally in high-tech, industrial, or scientific fields.



So Does Engineering Qualify as a Profession?

- Engineering possesses (owns) those attributes that typically characterize a profession.
- Satisfies an indispensable and beneficial need.
- Requires the exercise of carefulness and judgment.
- Involves activities that require knowledge and skill not commonly possessed by the general public.
- Has group awareness for the promotion of knowledge and professional ideas and for execution social services.
- Has a legal status and requires well-formulated standards of admission.

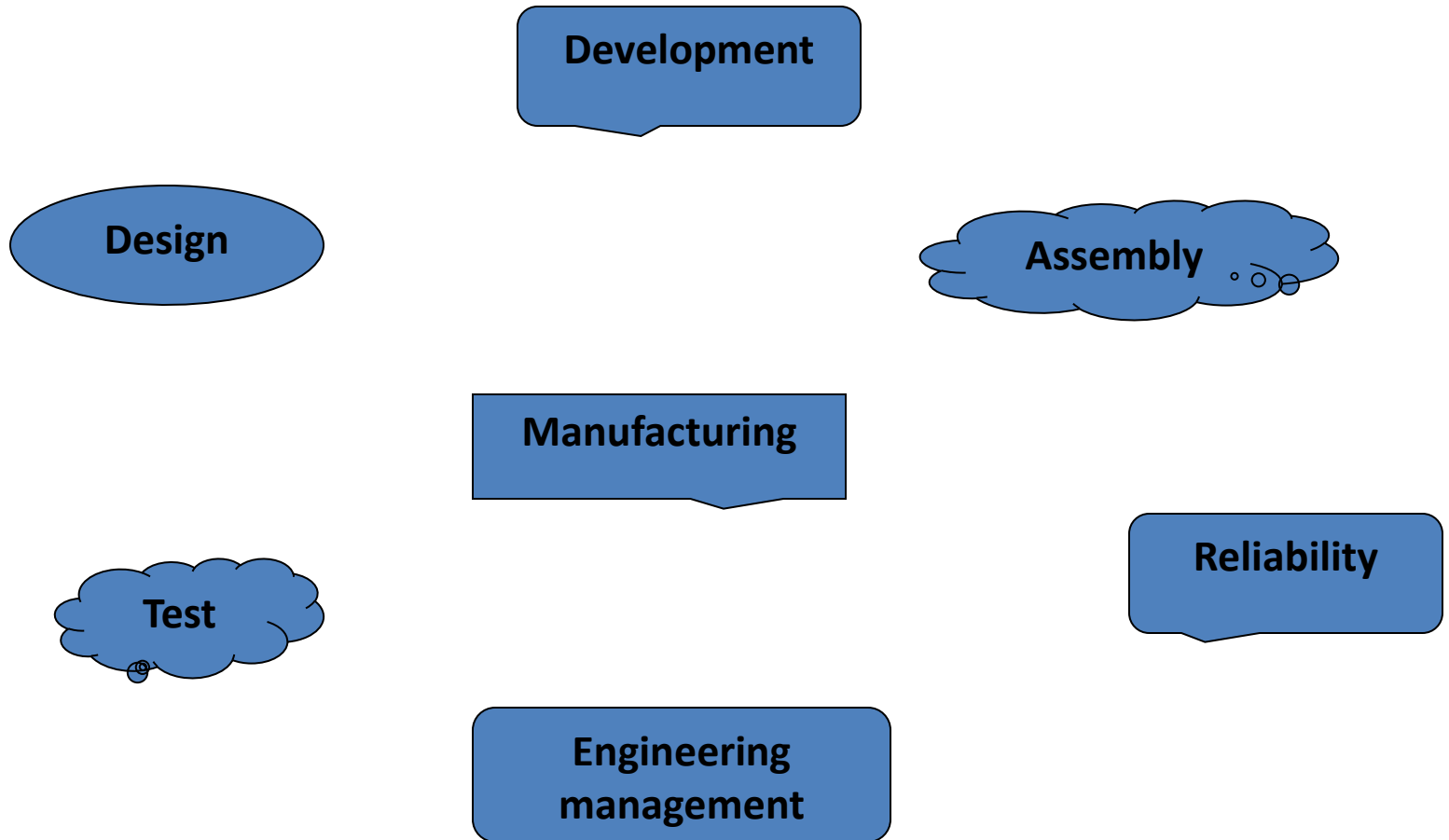


What Engineers Do? (a review)



1. **Design** products.
2. **Design** machinery to **build** and **test** these products.
3. **Design** Plants in which those products are made.
4. **Design** the systems that ensure the quality and efficiency of the manufacturing process.
5. **Design, plan** and **supervise** the construction of buildings, highways, transit systems.
6. **Develop** and **implement** ways to extract, process and use raw materials such as Petroleum and Natural Gas.
7. Utilize the power of the **sun**, and **wind** to satisfy the nations power needs.

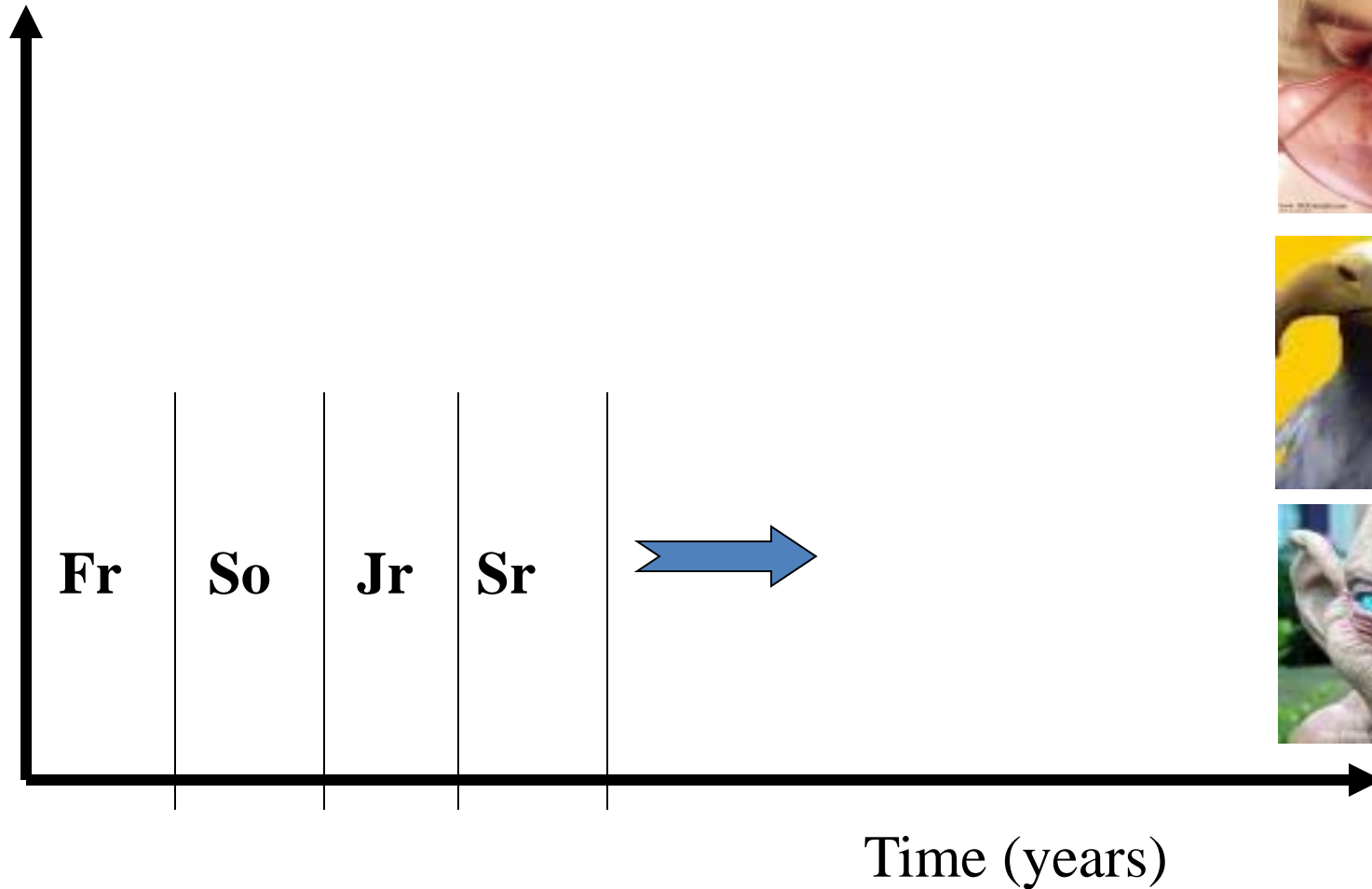
What kind of a pattern do we see from this list?



**Where do you see
yourself
5-10 years from now?**



Timeline to Engineering Education



From Student to Professional Engineer

Step 1

BS/MS

Majors

**ME,
EE,
CE
PNGE,
CHE,
IE ...**

Specialization



CE

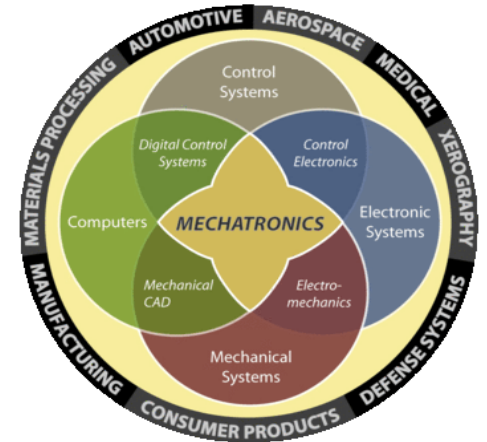
Construction

Structural

Transportation

Geothermal

Environmental



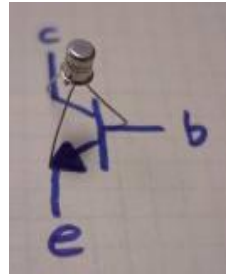
ME

Fluid
Dynamics

Thermo-
dynamics

Mechanical
Design

Mechatronics



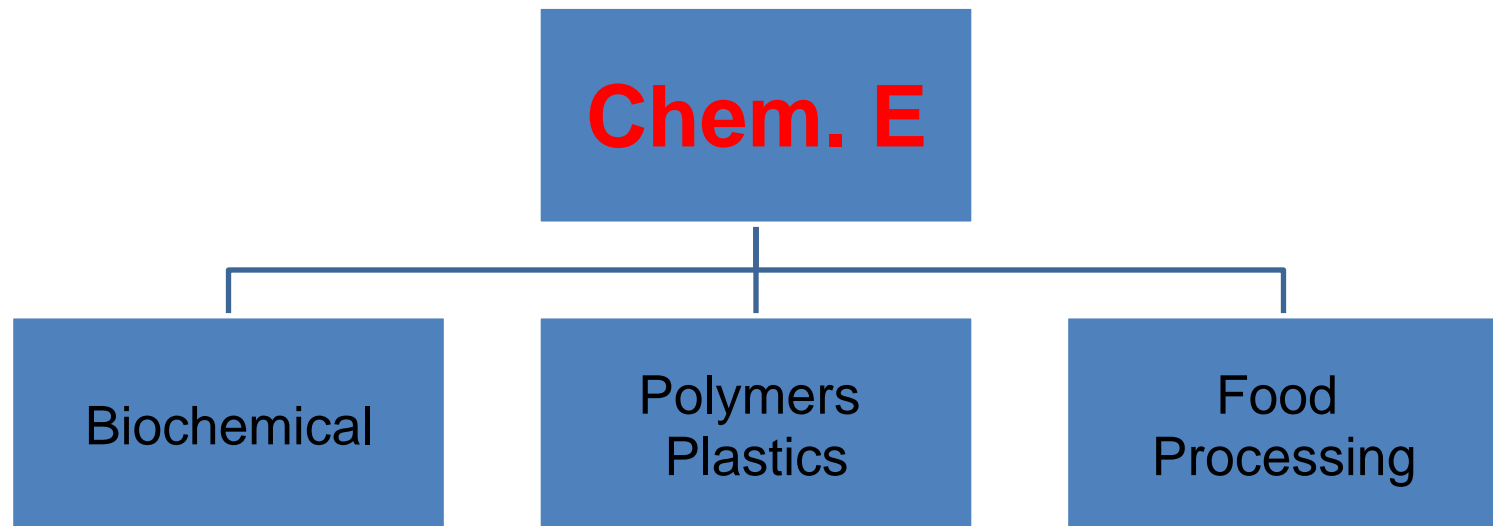
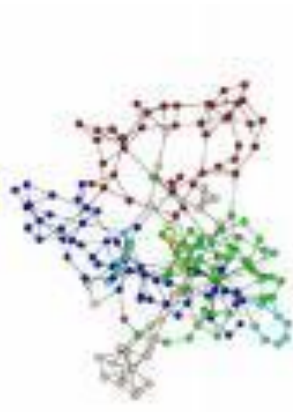
EE

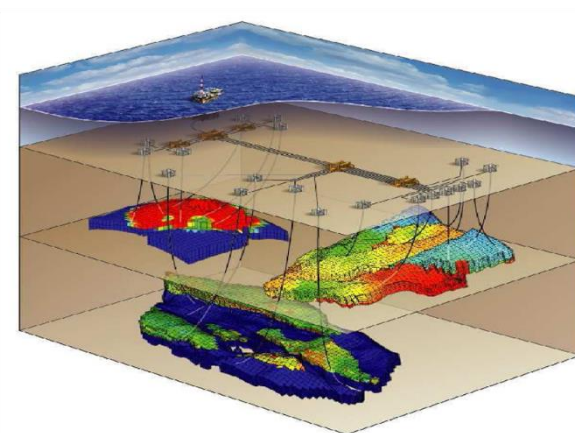
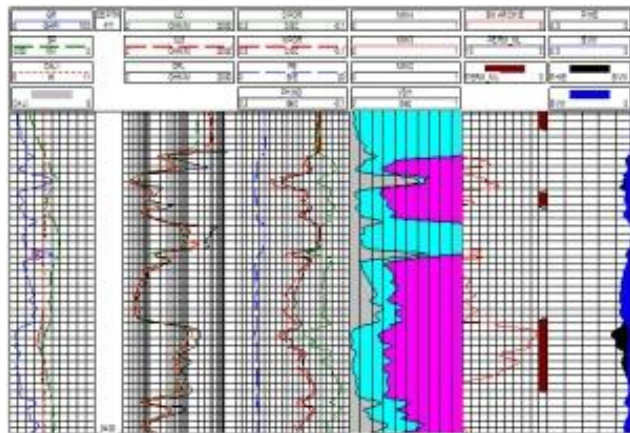
Power
Generation

Communication
Systems

LSI
(Large scale Integration)

Electronics





PNG E

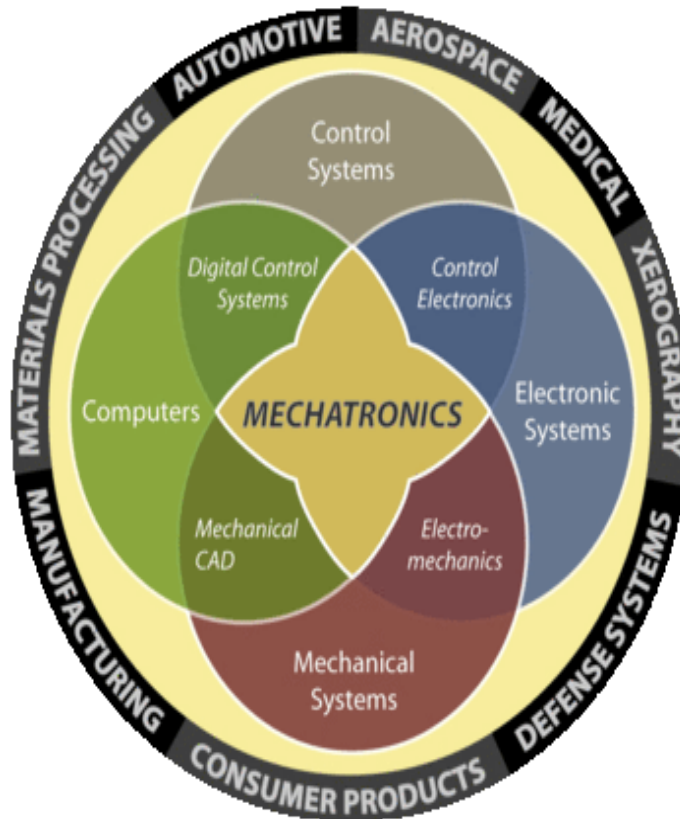
Drilling

Logging

Reservoir
Simulation

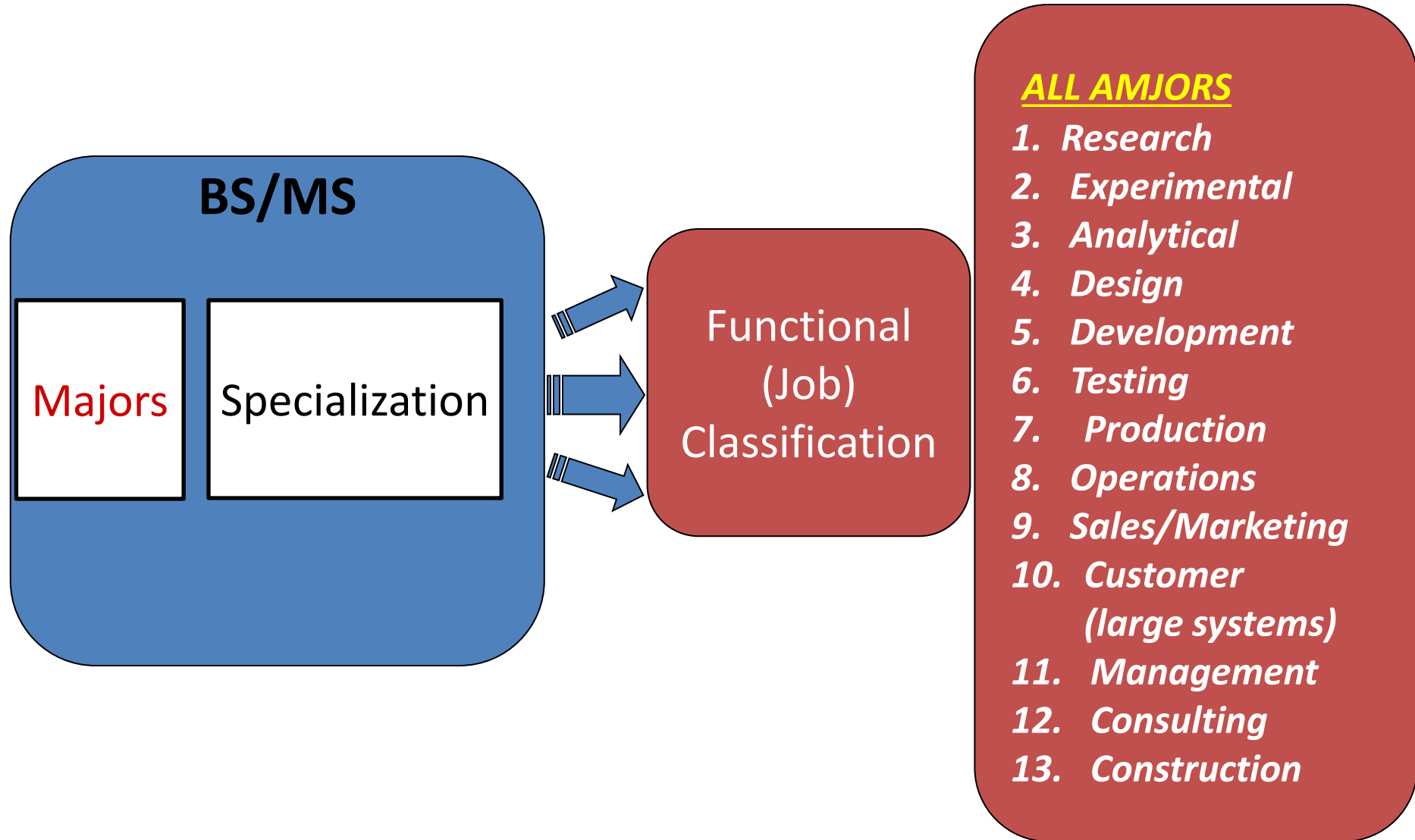
Mechatronics

Mechanical, Electronic, Control and Computing systems.

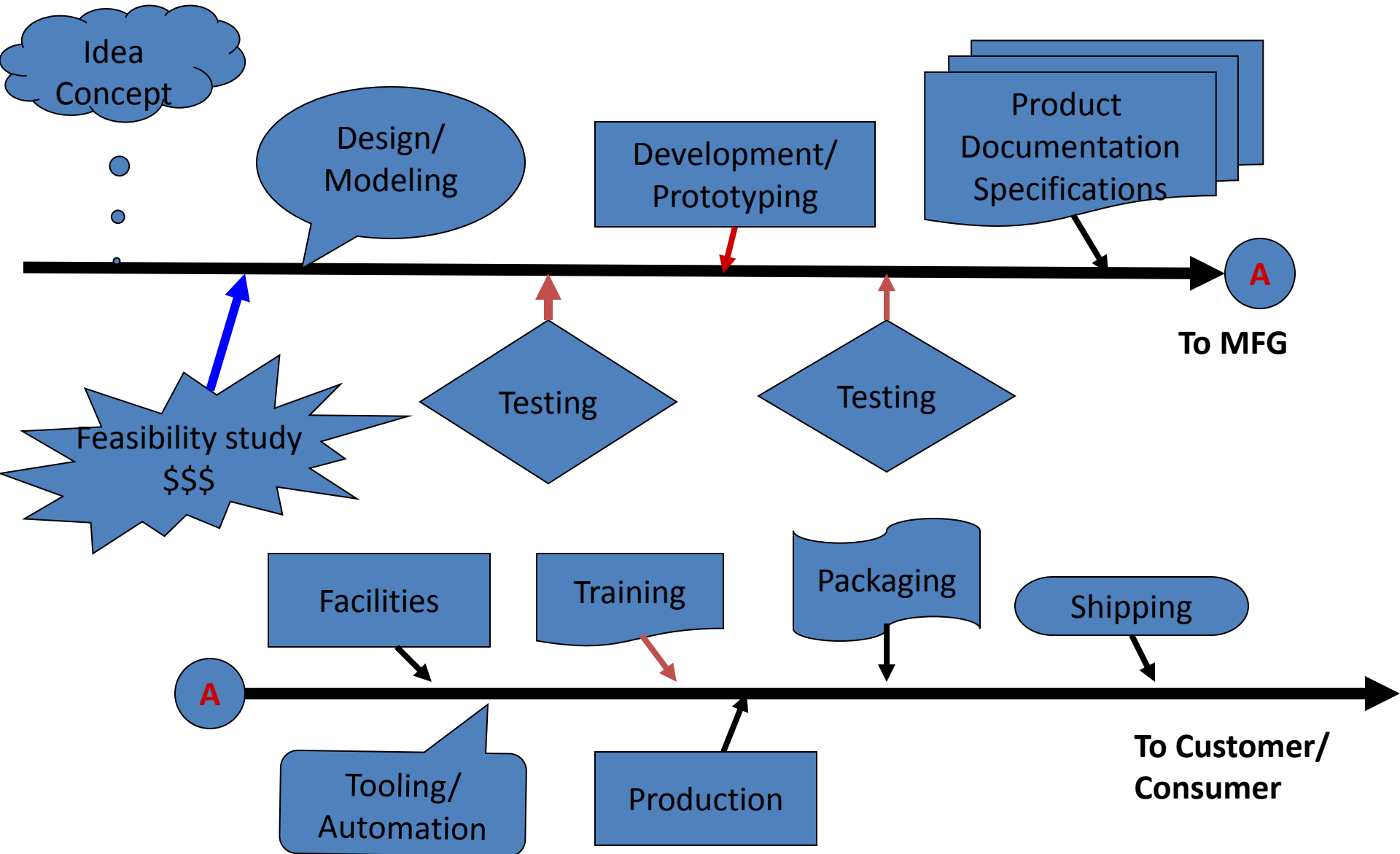


From Student to Professional

Step 2



General Product Cycle



Engineering Functional Jobs-A

Title	Function	Skills/Knowledge
<i>Research E.</i>	<ul style="list-style-type: none"> -Solves new problems. -Obtains new data. -Devises new methods of calculation -Gains new knowledge 	<i>Perceptiveness (intelligence)</i> <i>Patience</i> <i>Self-Confidence</i>
<i>Analytical E.</i>	<i>Models physical problems using math to predict performance.</i> <i>Performs failure analysis</i>	<i>- Math, physics, engineering science, applications software</i>
<i>Development E.</i>	<ul style="list-style-type: none"> -Develops products, processes, or systems -Uses well-known principles and employs existing processes or machines to perform a new function -Concerned only with a prototype or model 	<i>Ingenuity</i> <i>Creativity</i> <i>Judicious Judgment</i>

Engineering Functional Jobs-B

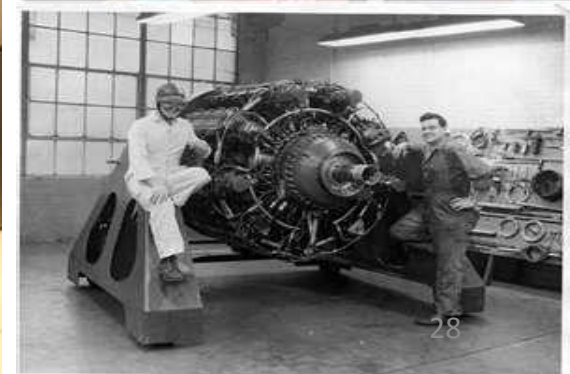
Title	Function	Skills/Knowledge
<i>Design E.</i>	<p><i>-Converts concepts and information into detailed plans and specs from which the finished product can be Manufactured.</i></p> <p><i>-Restricted by the state of the art</i></p>	<ol style="list-style-type: none"> <i>1. Creativity</i> <i>2. Innovation</i> <i>3. Fundamental knowledge of many disciplines</i> <i>4. Understanding of economics and people</i>
<i>Production E.</i>	<p><i>-- Devises a schedule to efficiently coordinate materials and personnel</i></p> <p><i>-- Orders raw materials at the optimum times</i></p> <p><i>-- Sets up the assembly line</i></p> <p><i>-- Handles and ships the finished product</i></p>	<p><i>-Knowledge of design, economics, and psychology.</i></p> <p><i>-Ability to visualize the overall operation of a project</i></p> <p><i>-Knowledge of each step of the production effort</i></p>

Engineering Functional Jobs-C

Title	Function	Skills/Knowledge
<i>Test E.</i>	<ul style="list-style-type: none"> <i>-Develops and conducts tests to verify that a new product meets design specs.</i> <i>-Products are tested for structural integrity, performance, and reliability .</i> <i>-Testing is performed under all expected environmental conditions.</i> 	<ul style="list-style-type: none"> <i>-Knowledge of statistics, product and process specifications.</i> <i>-Measurement techniques.</i> <i>-Fundamental engineering aspects of the design</i>
<i>Operations or Plant E.</i>	<ul style="list-style-type: none"> <i>-Selects sites for facilities-</i> <i>-Specifies the layout for all facets of the operation</i> <i>-Selects the fixed equipment for climate control, lighting, and communication</i> <i>-Responsible for maintenance and modifications</i> 	<i>Industrial engineering, economics and law</i>

Q1: What is the functional job description (name) of the engineer who “Converts concepts and information into detailed plans and specifications from which the finished product can be manufactured”?

- A. Test engineer***
- B. Experimental engineer***
- C. Development engineer***
- D. Design engineer***
- E. Production engineer***



Career Paths for Engineers

There are at least seven career options for graduating engineering students:

1. Corporate ladder
2. Independent entrepreneur (contractor)
3. Military or government
4. Engineering and social service aboard
5. Professor/engineer
6. Graduate work outside engineering
7. A mix of first six options



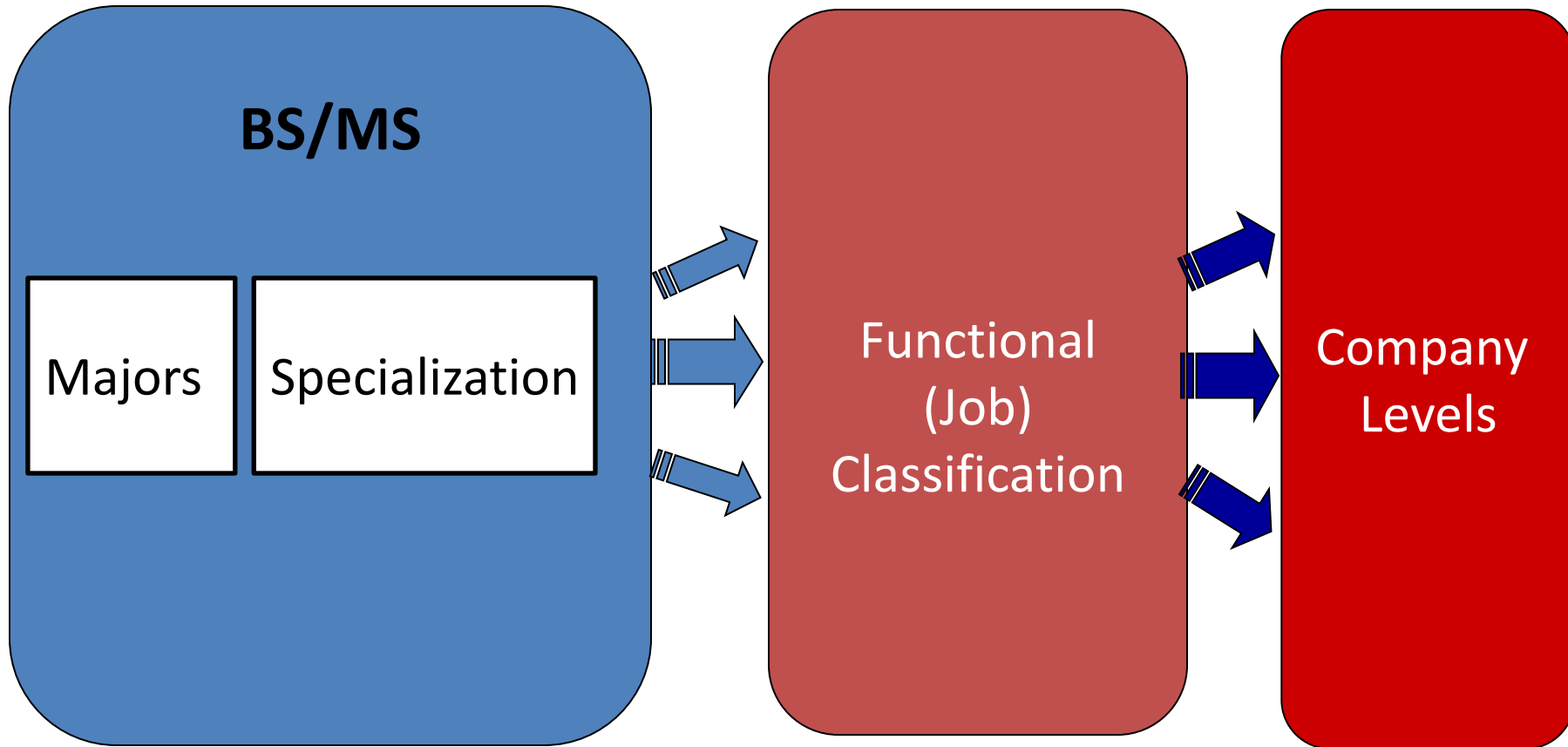
Corporate Ladder



Entrepreneur

From Student to Professional Engineer

Step 3



Company Levels (Publicly owned)

Management

Corporate Management

COB
Chair of the Board of Directors

CEO=Chief Executive
Officer

CFO = Financial Officer
COO= Operating Officer
CTO= Technology Officer

V.P. of Marketing
V.P. of Engineering
V.P. of MFG
V.P. of

Director of
Director of

Plant Mgt.
Functional Mgt.*
Project Mgt.
Line Mgt.
.....

Engineering

Fellow*
Senior E.
Project E.
 or Lead E.
Advisory*
Staff*
Sr. Associate E.*
Engineer
 or "Entry Level"

* Large Co.



Board of Management

There are three sets of skills required by companies from a professional engineer

Group A: Good Understanding of:

- 1. Engineering science fundamentals:**
 - a. Physical and life science.*
 - b. Information technology.*
 - c. Math (including statistics)*
- 2. The design and manufacturing process**
(understanding engineering).
- 3. Good communication skills:**
 - a. Written*
 - b. Verbal*
 - c. Graphic*
 - d. Listening*

Group B: Basic understanding of:

- 1. The context in which engineering is practiced, including:**
 - Economics/business practice*
 - History*
 - The environment*
 - Customer and social needs*
- 2. A multidisciplinary systems perspective.**
- 3. The importance of teamwork.**
- 4. Ethical standard .**

Group C

- 1. Curiosity and a LifeLong desire to Learn. (LLL)**
- 2. Ability to think critically and creatively as well as independently and cooperatively.**
- 3. Flexibility – the ability and the self – confidence to adopt.**

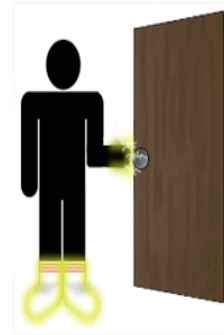
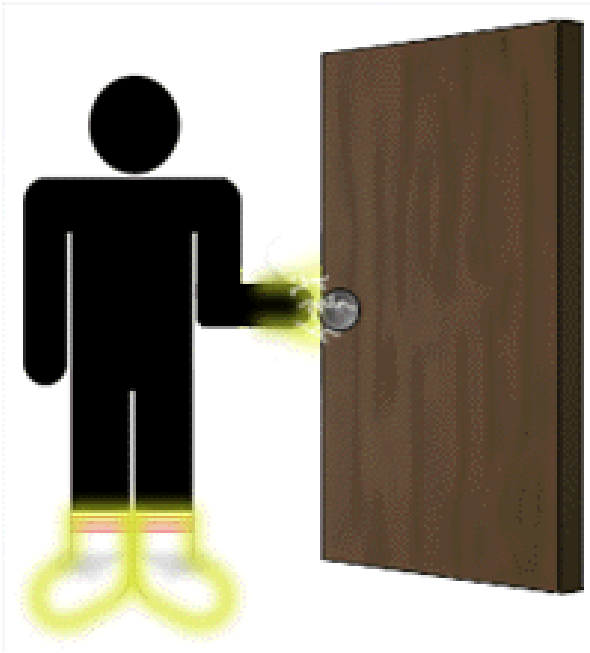
Bachelors of Science in Engineering:

The Key to “Maaaaany” Doors

What employers are looking in new graduates ?

Fast learners

Team players



Other Directions

1. **Advanced Degrees-Academic Institutions**
(Teaching, researching, publishing, community involvement)
2. **Engineering Management** (MSE/MBA)
3. **Law** (Patent law, Corporate Law)
4. **Medicine** (bioengineering, prosthetics (artificial body parts),)
5. **Government, Defense**
6. **Engineering Consultant**
7. **Your Own Business**
8. **2020 ???**

Becoming a Professional Engineer

- Understand that Engineering is a Profession.
- Become familiar with Code of Ethics of your Discipline.
- Join Student Engineering Societies.
- Join other Professional Organizations.
- Always think of how you would like to be treated under similar circumstances.

*****There's more to being an engineer than technical competence.*****