Strategy for Higher Education

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Coimbatore, India

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Dr. K. (Subbu) Subramanian
Instructor – Bio.

After his education from Osmania University, India, Dr. Subramanian studied in the Mech. Engg. Department at MIT between 1972 and '77and earned S.M, M.E and Sc.D degrees.

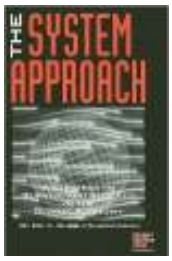
He has worked in the industry in the manufacturing sector for over 34 years, leading to basic research, new product development, new business development, new market development and establishment of technology centers across the globe (USA, Germany, Japan, China, India and Brazil). Development of grinding processes leading to Thin Film Magnetic Recording Heads and "machining to Grinding" are among the many notable accomplishments of his teams. He started his new company in June 2011. Details of his profile can be seen at his company website. www.STIMSInstitute.com . According to Dr. Subramanian,

"*The goal of our company is Knowledge Integration (i.e.) to develop people and industrial outcomes (products, business models, education, etc.) that exploit human skills as a parallel and in synergy with what computers can do (which is almost everything)* **!"**

He is an elected Fellow of ASME and SME and author of two books. He continues to be engaged with research, teaching and mentoring. Over the years, he has taught over 1000 engineers and managers in the industry from across the globe on System Thinking and Transformational Skills. He has mentored over 200 among them, who are now leaders in their own merit in industry and research.

References:

- **The system Approach**
  - *A strategy to survive and succeed in the Global Economy (2000)*



- **Thriving in the 21st century economy:** *Transformational skills for Technical Professionals (2013)*

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Session 1:

Binary Economy: 45 Min.

What is it?

How it is affecting all of us: Students, Teachers, Department, University, Industry and society at large?

Need for relentless stream of "New Solutions"?

Discussion 15 Min.

Break

Session2:

System Thinking: 45 Min.

What is a "Solution"?

Every Solution viewed as a "system"

Levels of System Thinking = Levels of Education? Awareness, Analysis, Synthesis

Task execution (doing what you are asked to do) Vs. System Thinking

Discussion: 30 Min.

Education and courses to promote "system thinking" and solution orientation.

Is there a need for modification of current courses and teaching methods?

Break / Lunch

Session 3:

Transformational Skills: 45 Min.

What are they?

Discover / Develop / Deploy "New Solutions"

Discussion: 45 Min.

Transformational Skills- student level? At faculty level? At Department level? At Institute level?

Session 4:

Transformation of an academic institution to a research institution? 30 Min.

Discussion: 45 Min.

Next Steps 30 Min.

Adjourn

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Session 1:

- **Binary Economy:**

- **What is it?**
- **How it is affecting all of us:**
  - **Students, Teachers, Department, University, Industry and society at large?**
- **Need for relentless stream of "New Solutions"?**

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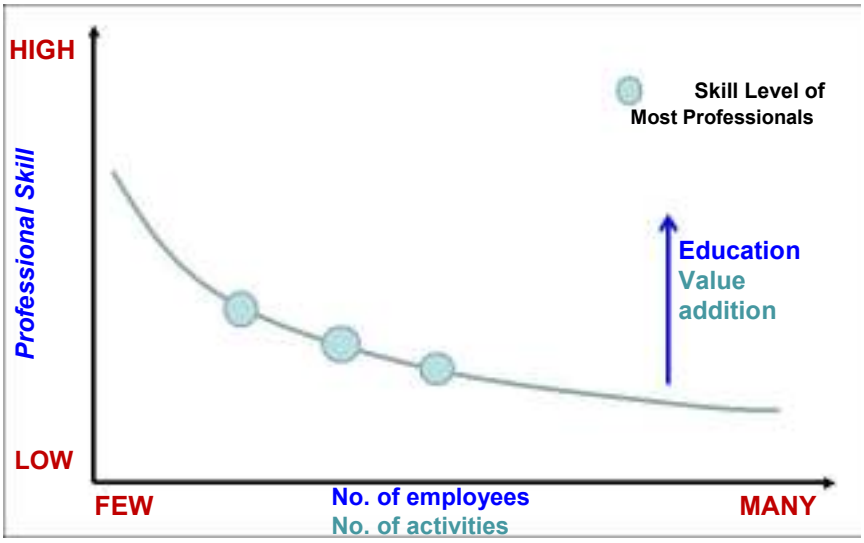
Worker Skill Vs. No. of employees (No. of activities)



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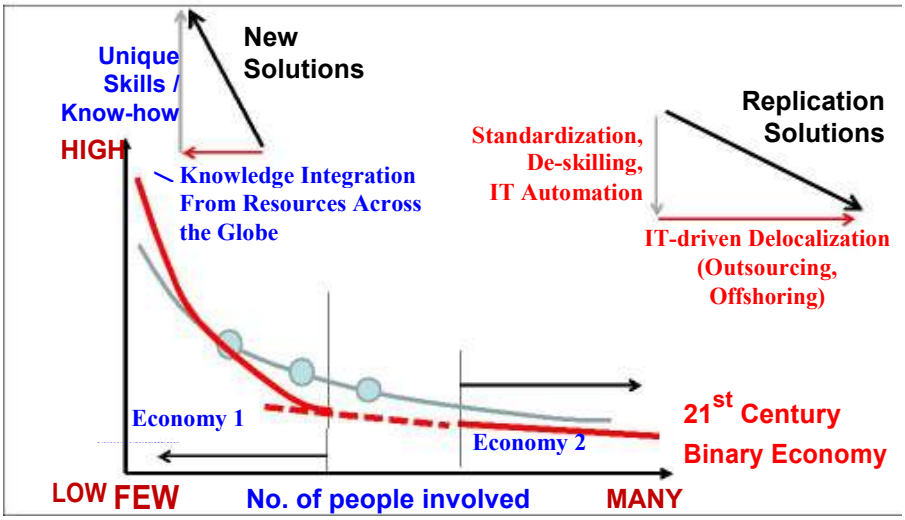
Binary Economy



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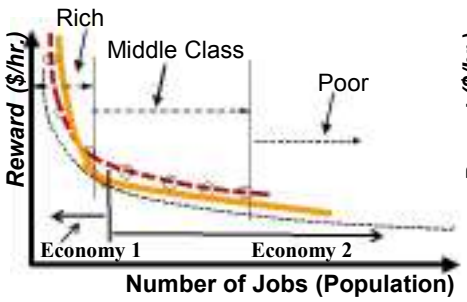
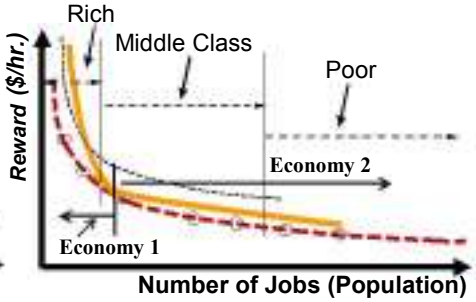
Global Economy:
Equal wage across the globe for equal (basic) skills?



Developed Economy

- Higher labor productivity and efficiency in Economy 2 leading to lower wages ($/hr.) and jobless recovery
- Middle class—most of the population in these economies are now in Economy 2
- Few investors and innovators, who participate in Economy 1 are rewarded very well.



Emerging Economy

- Much of the middle class and some poor in these economies benefit from Economy 2
- Many investors and innovators, who participate in Economy 1 have done extremely well.
- Extreme poor have not seen any benefits

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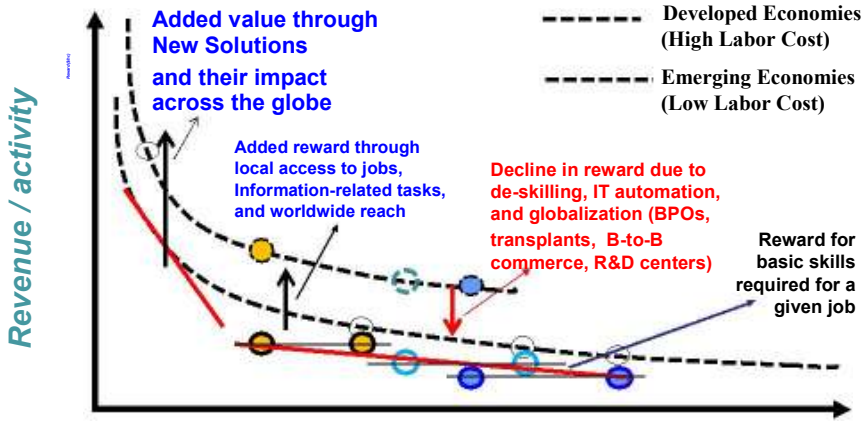
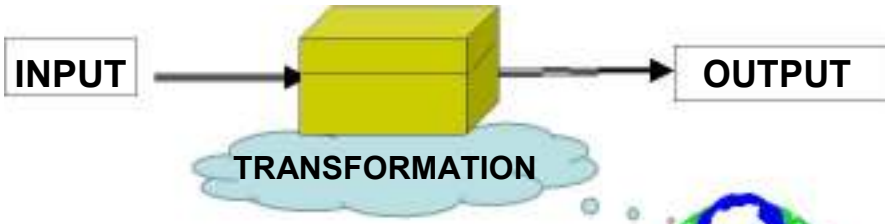
High wage jobs are selective and fewer than before?



Who is a Professional?

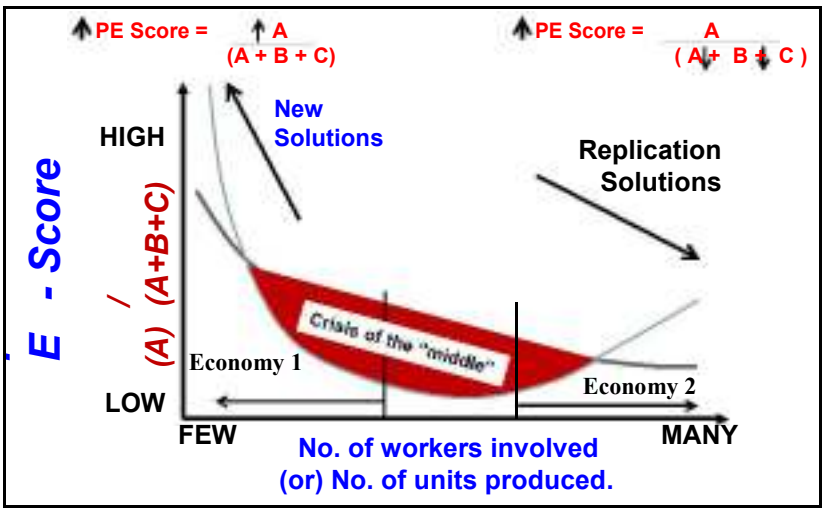


Profesional's Output:

KNOWLEDGE and its USE --- A
Information Work --- B
Physical Work --- C

Professional is a Knowledge Worker
Professional's Efficiency: PE Score = A / (A+B+C)

Today there are two alternatives for high PE - Score



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Work – What is it ?

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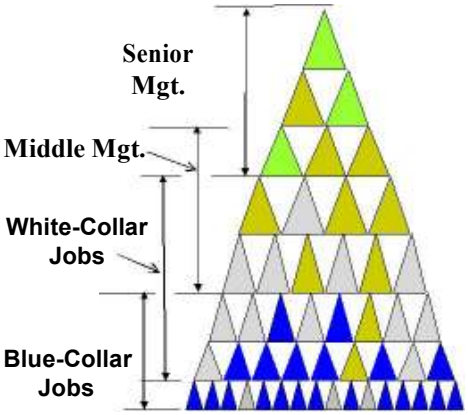
Work – What is it ?



Traditional Organization

Traditional:

- Mobility from one level to the next higher level:
  - Possible
  - Through on-the-job training
  - Continuing education
- The mobility across levels created:
  - Increase in income
  - Created the "middle class"
  - Career plans and opportunities for growth

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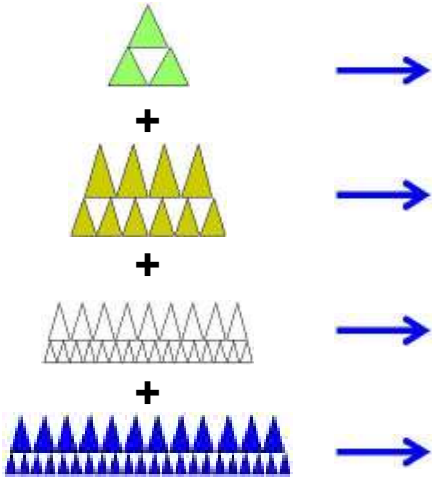
Work – How is it Changing?

Stratification into four impermeable layers.



Investment and Finance
"Global Capitalism"

Professional Work (A)
Innovation; Entrepreneurship; Work Smarter and Work Harder; Keep Jumping from Job to Job; Become Global; Higher Education; Interdisciplinary, …….

Information Work (B)
"IT" Applications
(Plug and Play Activities)

Physical Labor (C)
Routine Tasks
(Standardization, de-skilling)

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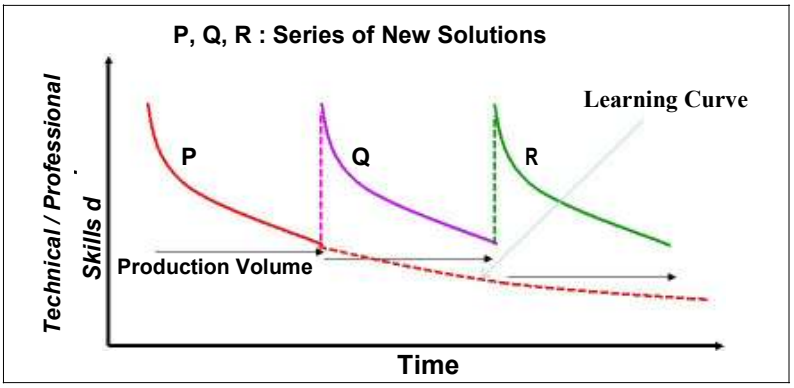
Traditional model for Innovation: Saw Tooth model - Series of sequential and time phased solutions.

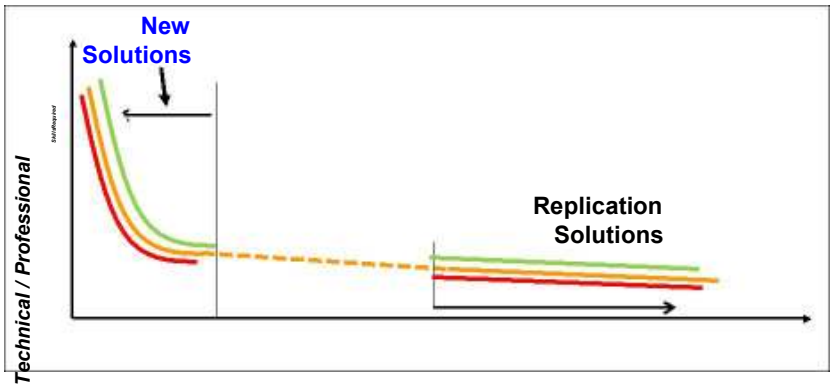


Binary Innovation:

Parallel streams of: New and Replication Solutions

New Solutions : New Product, Process, and/or Use driven by core capability from all sources of knowledge

Replication Solutions: Copy Exact, Toll manufacturing, Plug and Play, driven by IT applications.

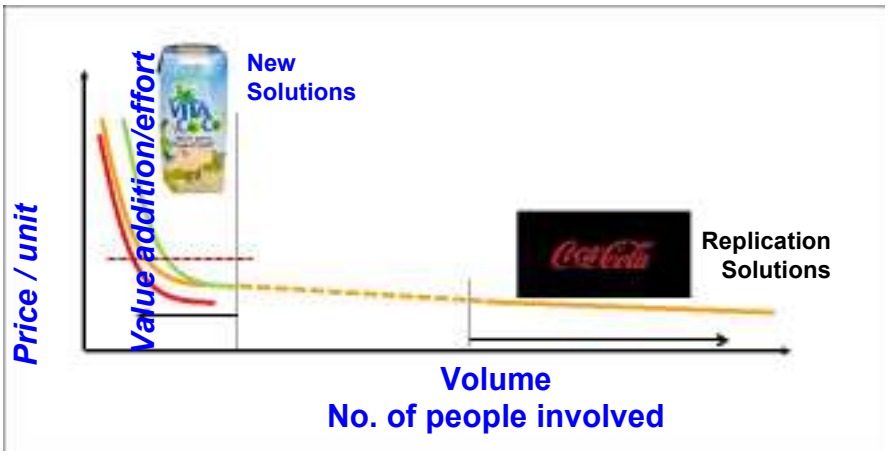


Volume

Predicament faced by every one

(Students, Teachers, Institution, Industry, Society):

Bet on New Solutions or safe bet in Replication Solutions?



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New Vs. Replication Solutions: Features

	New Solutions	Replication Solutions
Higher Education and Technical Knowledge	Intensive (critical)	Neutral and useful (not critical)
Skill required	System Thinking; Solution driven; Transformational	Task oriented; Narrow and Generic;
Risk and uncertainty	High, thanks to new ideas and their experimentation	Low, but can also be replaced easily and readily
Reward	Team reward, IPO, Co. growth, and stock options Global Intellect.	Individual reward based on task execution

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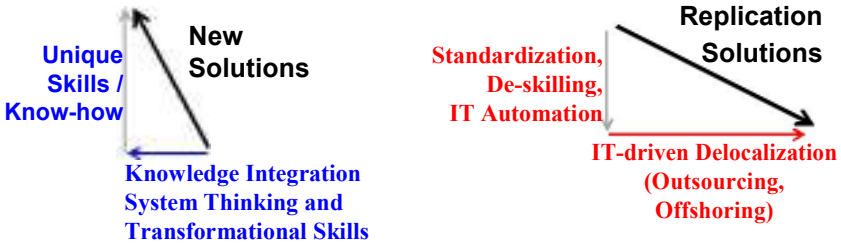
Higher Education in the Binary Economy



- **Need: A relentless stream of new solutions ?**
- **Education / Training: Means to the above end?**

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New Solutions Vs. Replication Solutions

Features	New Solutions	Replication Solutions
Domain specific knowledge	Intensive (critical)	Neutral and useful (not critical)
IT solutions	Custom and tailored	Standard (plug and play)
Organization/team	Small and specialized	Large and flat
Team skills	Cross functional	Narrow and common
Rules and standards	Create new rules as needed	SOP and follow the rules strictly
When you need to break the rules?	Be creative, wise, and considerate of others	Don't try: you will be shut out of the "system"
Authority	Belongs to those with specialized know-how	Belongs to those in charge of the operations mgt.
Risk and uncertainty	High, thanks to new ideas and their experimentation	Low, thanks to proven "plug and play" solutions
Reward	Team reward such as IPO, growth, and stock options	Individual reward based on task execution

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Discussion:

Binary Economy – Is this real for us? How?

- **High Volume Vs. Small Volume**
- **Standardized /routine Vs. Non-standard / unique**
- **"Middle" is no longer as valuable**

- **New Solution Vs. Replication Solutions already in place – Examples ?**

- **Do we need "New Solutions"? Why?**

  Examples from your work that validate the Binary Economy model and its impact?

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Session 2:

- **System Thinking:**
- **What is a "Solution"?**
- **Every Solution viewed as a "system"**
- **Levels of System Thinking = Levels of Education?**

  Awareness, Analysis, Synthesis

- **Task execution (doing what you are asked to do) Vs. System Thinking**

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"Professional"

Some one who provides a "solution" that meets the need and gets paid for that.

Carpenter: Makes furniture that some one wants to buy and USE (Furniture Provider)

Plumber: Identifies the leak in a pipe line and fixes it to the satisfaction of the home – owner (Plumbing Service Provider !)

Cardiac Surgeon: Fixes the broken heart and restores it to good health

Engineer: Develops and implements a series of "Solutions" of value to the user

Educator: ???

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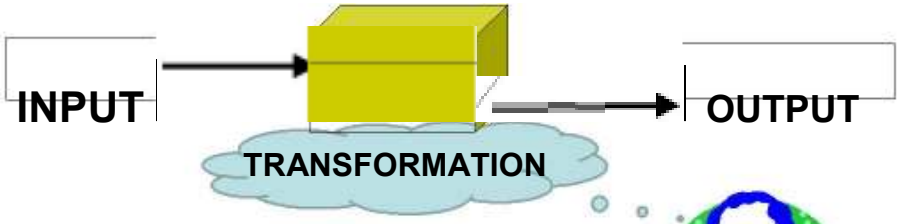
What is a Solution?

Every Solution is an:

"input/transformation/output" System,

leading to added value

to those who are willing to reward such value addition!



Solution is the KNOWLEDGE and its USE through SYSTEM THINKING.

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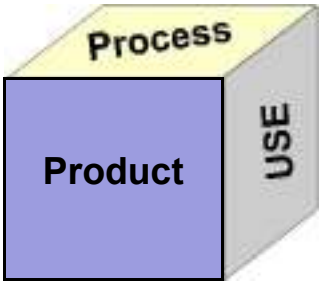
Output of any solution:

Product:

Something of value to the user for which the producer (of the product) receives something of value in return!
Processes enable the Products and their USE.



Process:

input/transformation/output system(s) that enable the Product and USE

Application / USE:

Customer's process where the product used; "performance" of the product as seen by the users.

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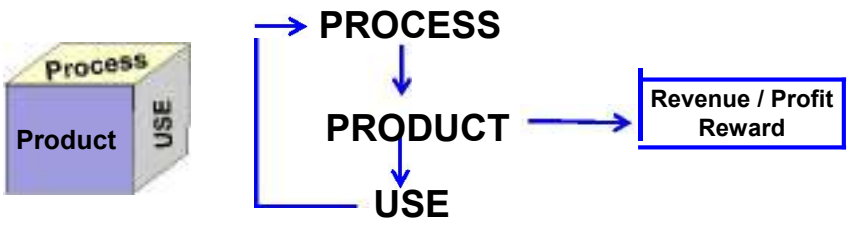
Outputs of every solution:

- **Every "Solution" is an:**

  "input/transformation/output" System

- **"Outputs" of every professional solution are:**
  - **PRODUCT**
  - **PROCESS**
  - **Application / USE**



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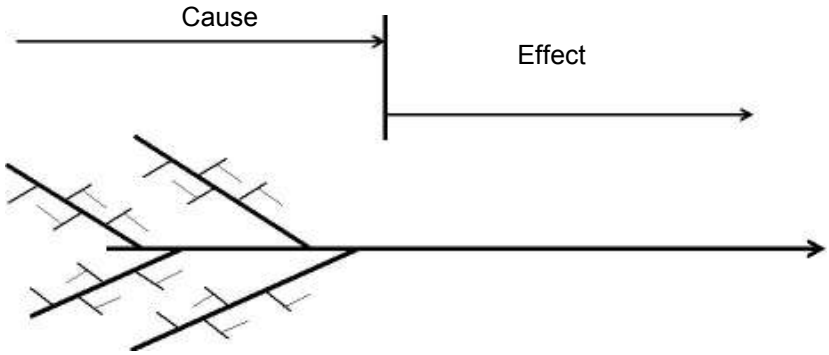
Solution: It is more than mere cause and effect.

Traditional - Fish Bone Diagram



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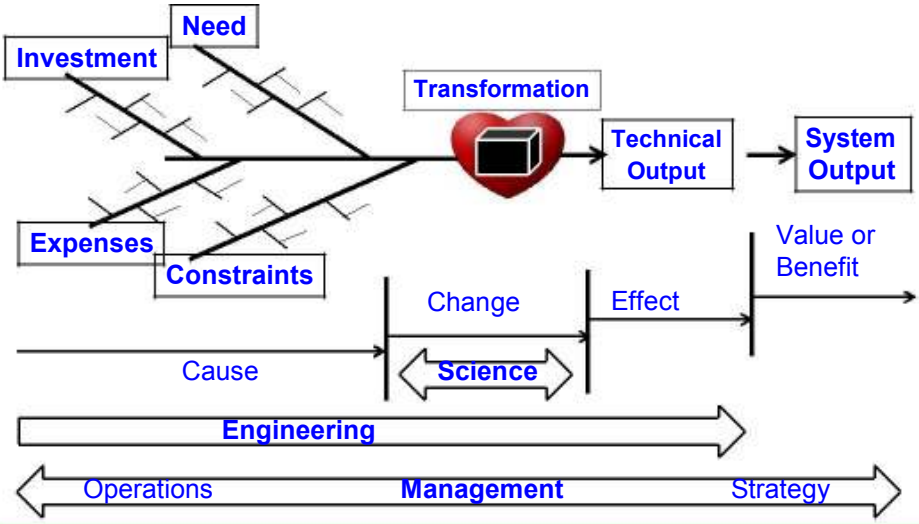
System Thinking

Solution:
Integrated deployment of core capabilities as a system



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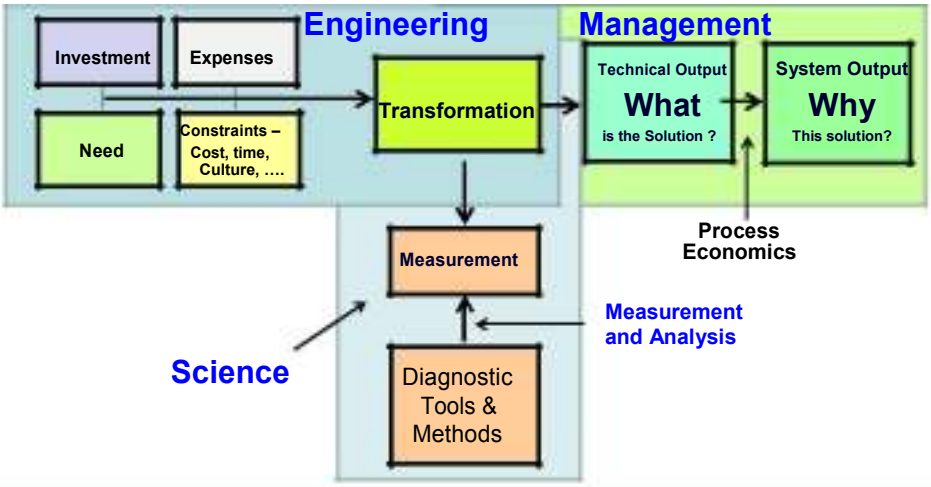
Technology = Knowledge and its Integration !

= "Science" + "Engineering" + "Management" (Operations + Strategy)



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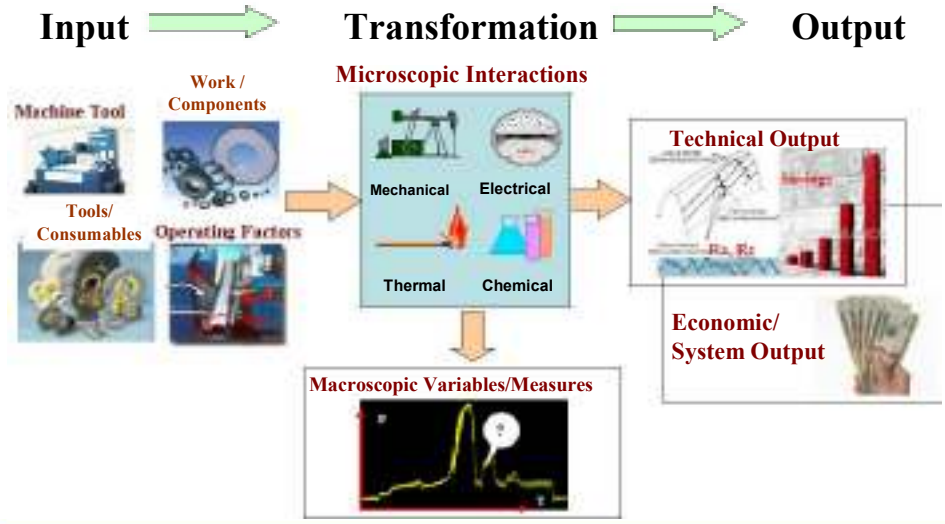
Every Industrial Process is a "System"



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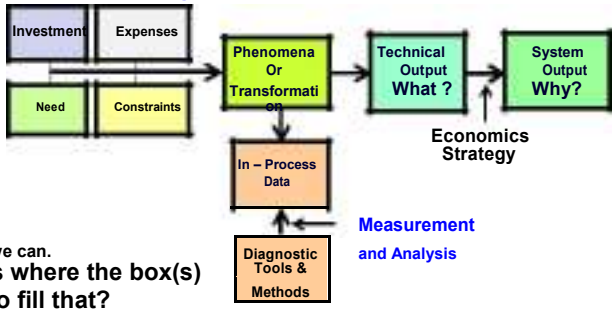
Three levels of system Skills



- **Awareness:**
  - Fill all the boxes as much as we can.
    Then ask questions where the box(s) is empty and how to fill that?
  - Which question to be asked and in what order?
- **Analysis:**
  - Apply the principles of Science, Engineering and Management in an interdisciplinary manner
  - Resolve process problems; Develop solutions and validate impact
- **Synthesis:**
  - Configure "New Solutions" based on knowledge gained through Awareness and Analysis; Develop them into "New Solutions"; Implement and validate and get rewarded

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System Thinkers

Ability to:

- **Establish the problem on hand as a "Input/Transformation/Output" scheme and its context.**
- **Identify the outputs as: Technical and System outputs**
- **Aggregate all the inputs comprehensively into: four input categories**
- **Identify or recognize the "Transformation" involved.**
- **Now start with relevant questions to ask with respect to the relevant *Science, Engineering and Management* aspects of the solution.**

The above are the minimum requirements (awareness) for "System Thinkers"

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Discussion:

- **Education and courses to promote "system thinking" and solution orientation.**
- **Is there a need for modification of current courses and teaching methods?**

Session 3:
Transformational Skills:

- **What are they?**
- **Discover / Develop / Deploy "New Solutions"**

Innovation and Knowledge

Jack Andraka Story

http://www.cbs.com/shows/60_minutes/video/RiQKqFPFfbNm2X9t2___Z_9_6zFT2AKno/boy-wonder-jack-andraka/

"With out an ability to put to your knowledge to use, you are no better than your smart phone!"

There are lots of smart people readily available across the globe. Over 80% of what you need to know is readily available through Google search!

What is needed are:

Transformational Skills

Integrate all available knowledge and resources to identify, develop and deploy a stream of new solutions.

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Source of Knowledge

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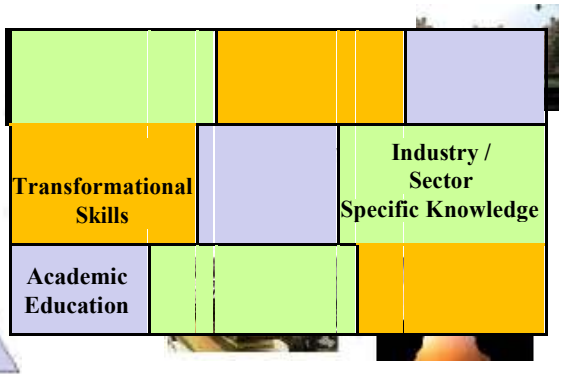
Sources of knowledge and their ordering

20st Century



21st Century: Knowledge Integration
(Orderly assemblage from the three sources)

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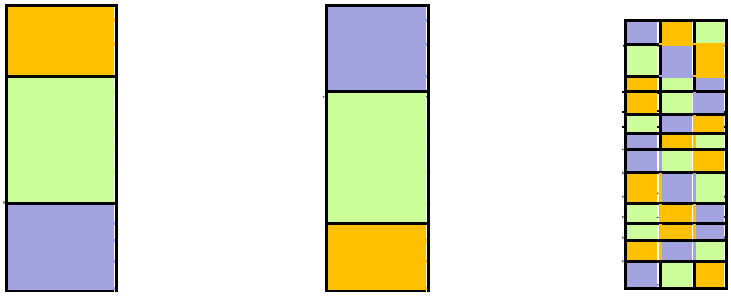
Sources of "Knowledge" – recap:



20th Century | End of 20th Century | 21st Century

Legend:
Academic Education: **Industry / Sector specific Skills:** **Transformational Skills:**

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Transformational Skills

- Emotional Intelligence for New Solutions
- End-to-End Innovation

Deploy

X

- Build Ecosystem for Core Technology Platforms
- Emphasis on Science and Mobile Diagnostics
- System Approach for Knowledge Integration

Develop

X

- 3-D View of Core Capabilities
- Develop a Common Language

Discover / Define

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Transformational Skills to Identify and Foster New Solutions (Discover, Define or Identify):

Ability to develop a common language: Understanding of the common terms used by professionals such as Product, Process, Use/Application, manufacturing, technology, supply chain, value chain, etc.

Use such understanding to promote dialogue across a larger pool of resources to identify and formalize the unmet needs or opportunities.

3-D view of the core capabilities: Core capabilities are the transformation engines for any solution. They come from the professional as an individual, through a collection of such core capabilities across many professionals who work in the team, and finally they are exploited as the core capabilities of the company, enterprise, or industry.

What are your core capabilities? What are those of the fellow professionals in your department? What are the core capabilities of your company or team? How do you integrate the 3-D core capabilities for all stakeholders inside the team? What is missing or lacking?

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Transformational Skills to Develop New Solutions By Integrating Knowledge From All Available Resources

The System Approach: The framework necessary to integrate the knowledge (science, engineering, and management skills) in a simultaneous and comprehensive manner; Exploit the skills from all available resources; Achieve the solution, of benefit to all stake holders.

Shift away from task execution to systems and solutions?
The whole is larger than the mere sum of its parts.

Emphasis on the science and use of mobile diagnostic tools and methods: Relentless focus on the "transformation" at the core of the solution and the scientific understanding of the same; emphasis on portable diagnostic tools and methods.

Use problem-solving skills using in-process data; logic and scientific reasoning; Diagnostic Tools; Manage the forces that tend to de-skill the work content.

Ability to build ecosystem based on identified Core Technology platforms: Physical processes and their integration leading to Core Technology platforms; constantly connect the dots in the domain specific space (through physical processes) and domain neutral space (through service processes) to see the big picture instead of the pixel.

Leverages resources and opportunities across the globe; Constantly focus on building the eco-system (as a whole).

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Transformational Skills to Exploit New Solutions and Achieve Maximum Impact Across Long Reaches (and thus attract Users from across the globe)

End-to-End Innovation:

= Idea X Use X Impact.

Focus constantly on expanding the role from discovery to development to launch, leading to maximum of identifiable impact.

Emotional Intelligence for New Solutions:

Build value from outside in; Co-create value with your users and suppliers. Learn and use the metrics that matters to the end user.

Foster solutions that benefit others, which in turn benefit you as well.

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1. Develop a common language:

- Product
- Process
- USE/Application
- Quality
- Manufacturing / Production
- Physical Processes
- Service Processes
- Supply Chain
- Value Chain
- Technology
- Physical Technology,
- Digital Technology
- ……..

- Knowledge
- Value
- Job
- Solution
- Task
- Technical Output
- System Output
- Science
- Engineering
- Management
- ……..

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2. Core Capabilities

- They represent the "Transformation" behind the solution.
- They are "subtle" and intangible
- BUT, they can be inferred through:
  - Changes in inputs and their effect
  - Changes in outputs
  - Measurements or data obtained in real time (when the transformation happens)
- Interpretation of the real time signals and inferences based on them

Worker	Project/ Solution	Enterprise
Knowledge	Science	Physical Technology
Experience	Engineering	Digital Technology
People Skills	Management — Strategy	Finance / Market Drivers
	--- Operations	

Transformational Skills:
Application of core capabilities to Discover, Develop and Deploy "New Solutions".

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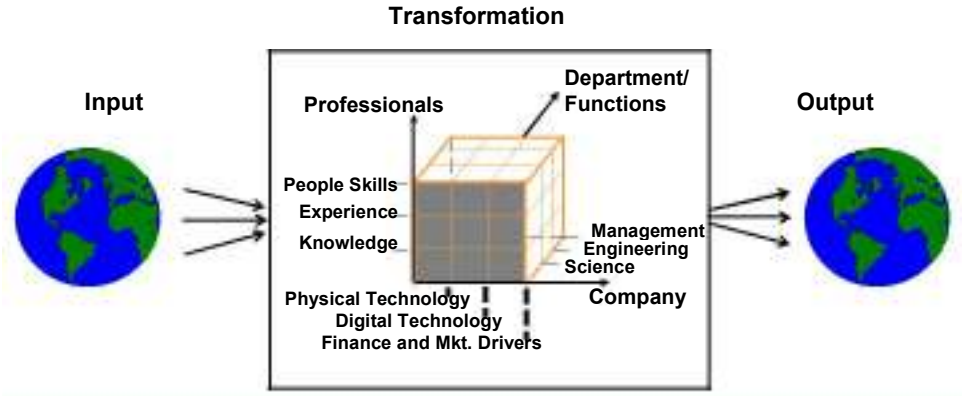
Globalization – the need:

- Create and Implement New Solutions by leveraging all Core Capabilities, using resources from all across the Globe
- Provide Value-Added Solutions for all Users across the Globe



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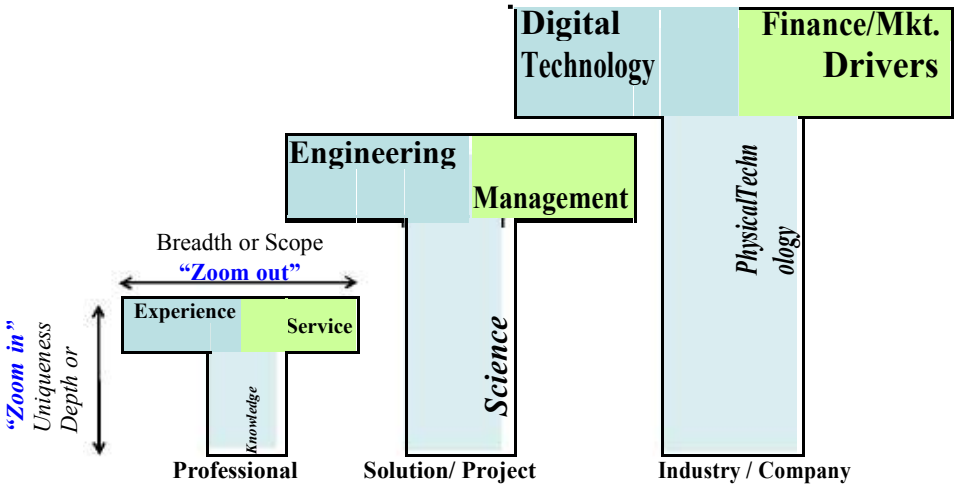
2. Alignment of core capabilities at each level.



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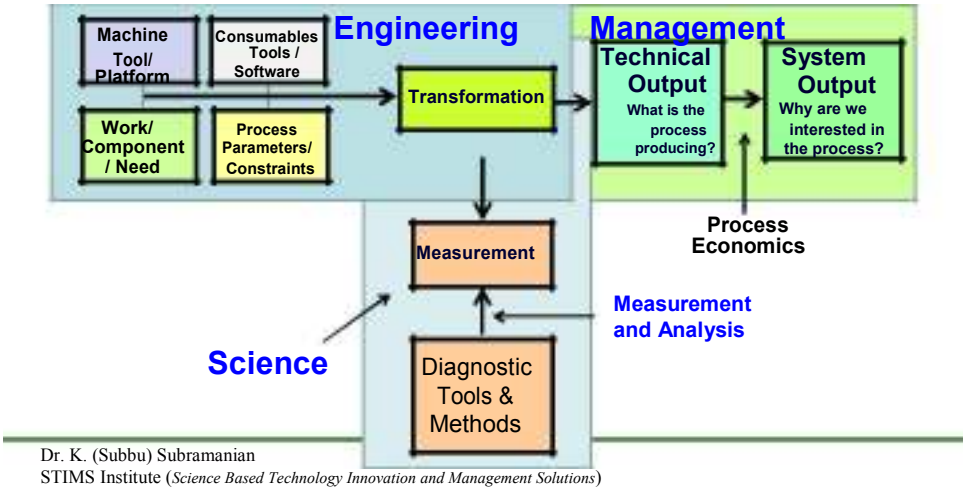
3. System Approach: Knowledge Integration

Technology = Knowledge and its Integration !

= "Science" + "Engineering" + "Management" (Operations + Strategy)



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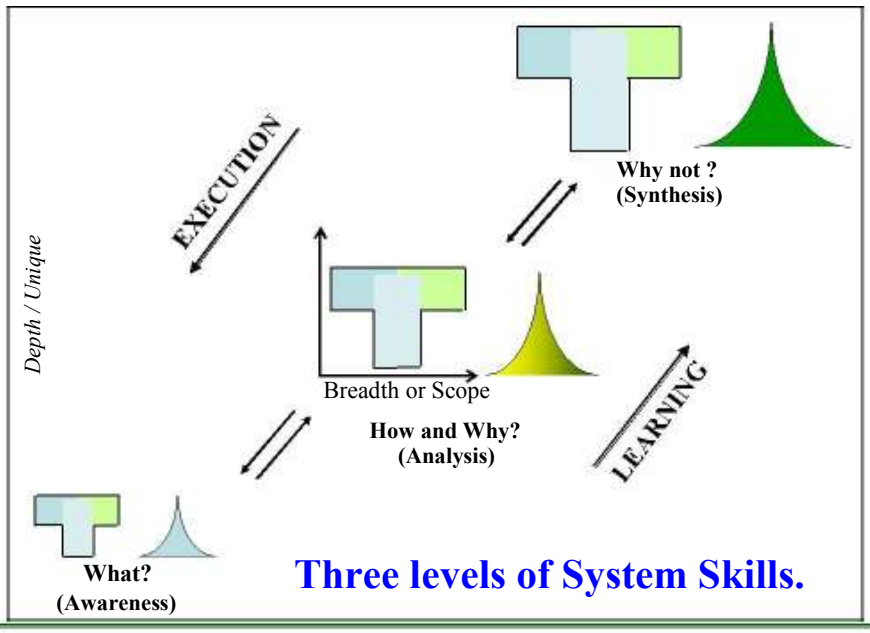

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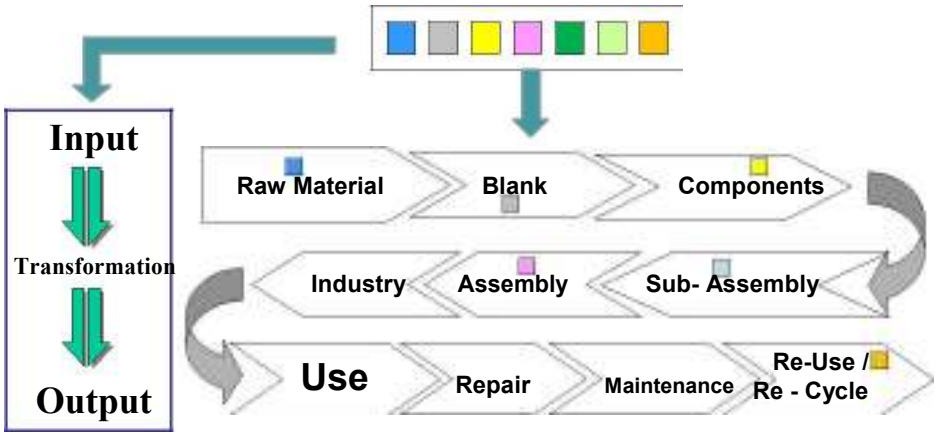
3. System Approach:

Every facet of Industrial Activity can benefit from "System Thinking"



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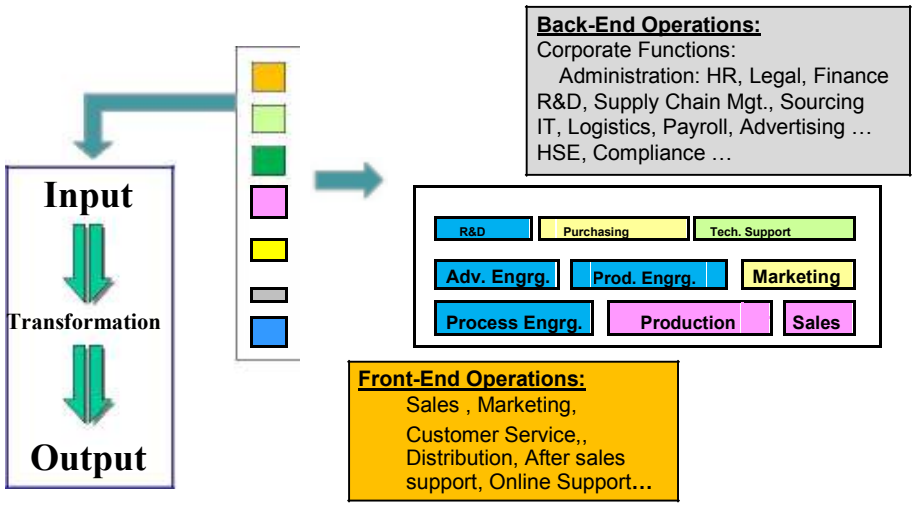
3. Every department or function Can be better managed through "System Thinking"



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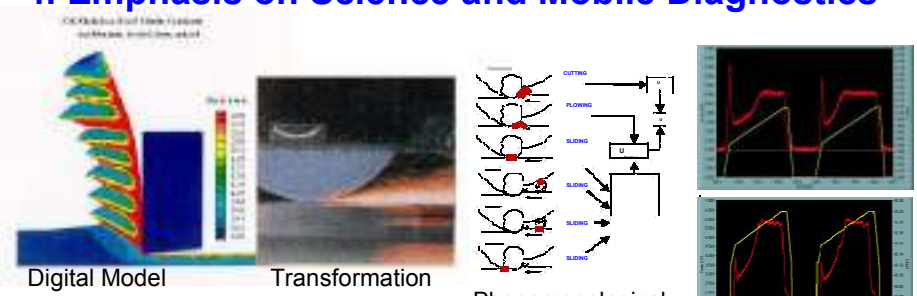
4. Emphasis on Science and Mobile Diagnostics



Digital Model | Transformation | Phenomenological Model | Data and Diagnostics

Science: Understanding the "Transformation"

- **What really happens during the "Process"?**
- **Transformation / Phenomena:**
  - **They represent the "Physical Science"**
  - **They can not be "seen"**
  - **They can be measured, analyzed and inferred**

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"Management" Science?

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Engineer:
What are the diagnostic tools in your job?
Profession / Department? Company / Industry ?

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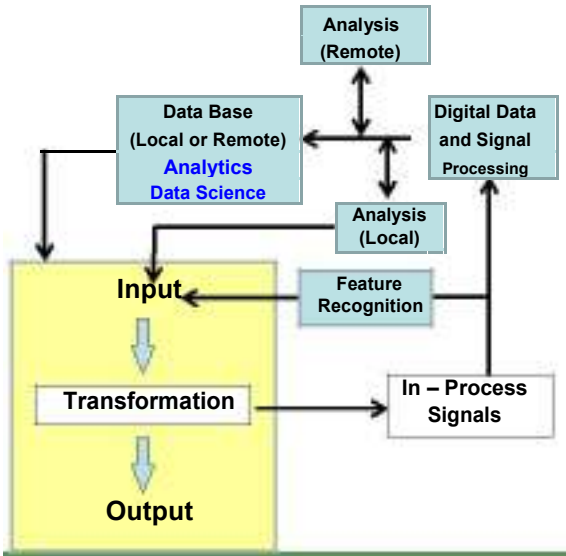
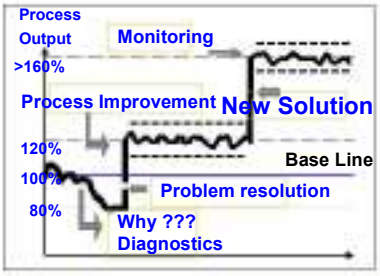
In-process Signals and their Analysis



Five Steps in the Scientific Approach using In-process Signals:

- ***Diagnostics***
- ***Problem Solving***
- ***Process Improvement -***
- ***Process Maintenance***
- ***Process Innovation (New Process)***



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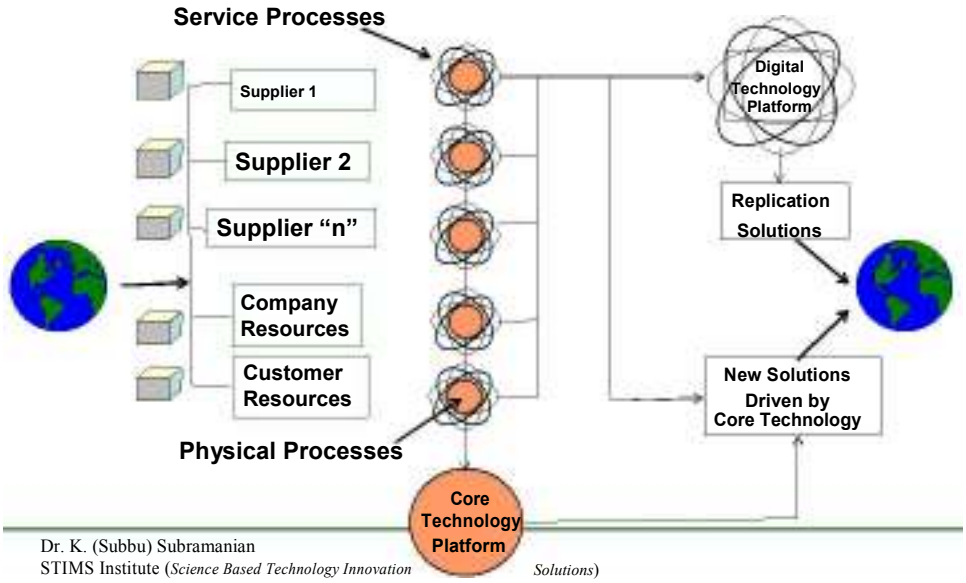
5. Eco- system Development: Knowledge Integration Across the Industry



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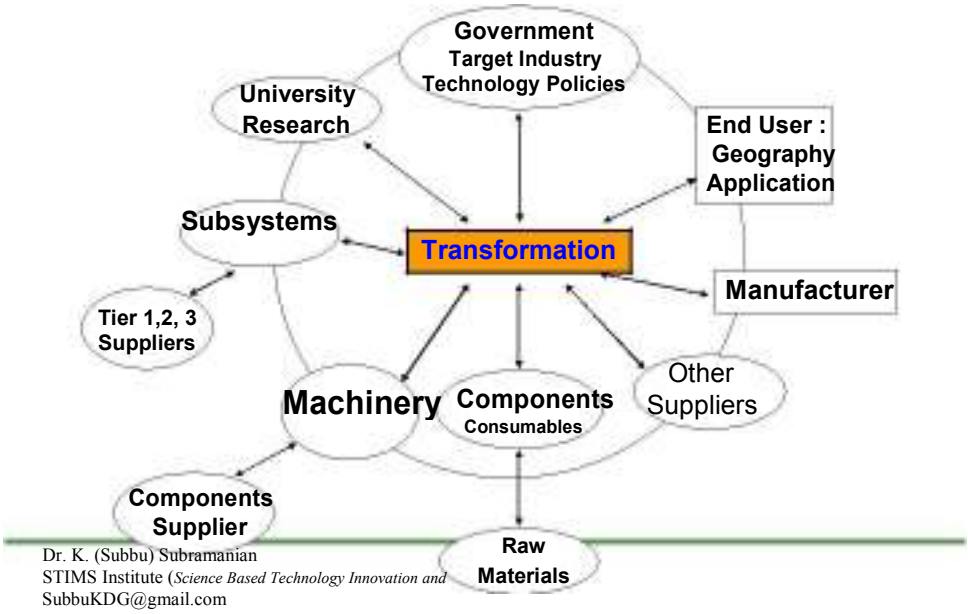
5. Core Technology Based Ecosystem Development



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6. End to End Innovation:

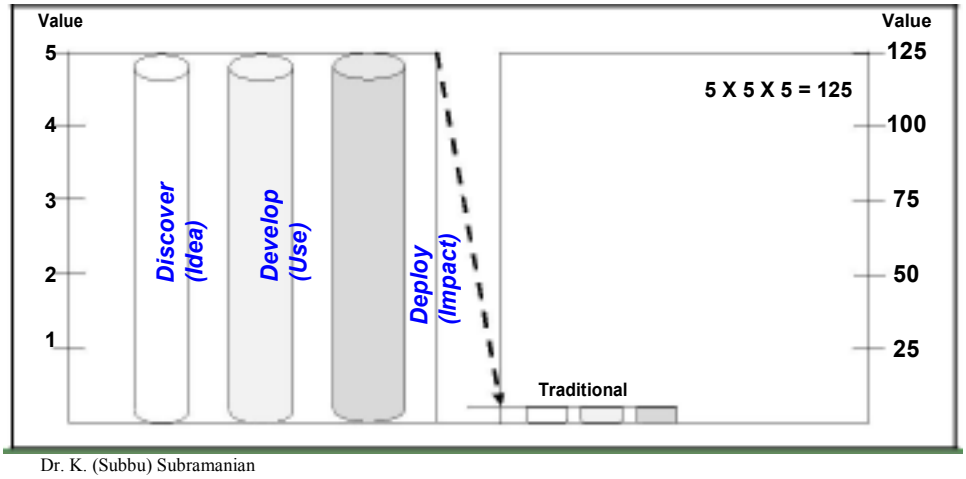
Creation and replication of New Solutions With Impact

= Idea X Use X Impact

5 5 5

25

125



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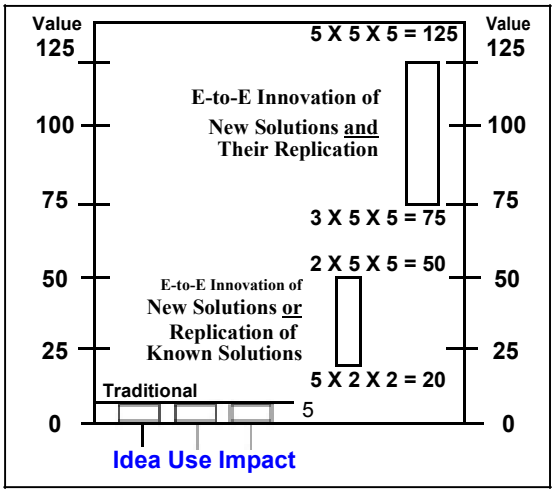
E 2 E Innovation in Binary Economy:



Outcomes Measured in a Scale of 1 to 125

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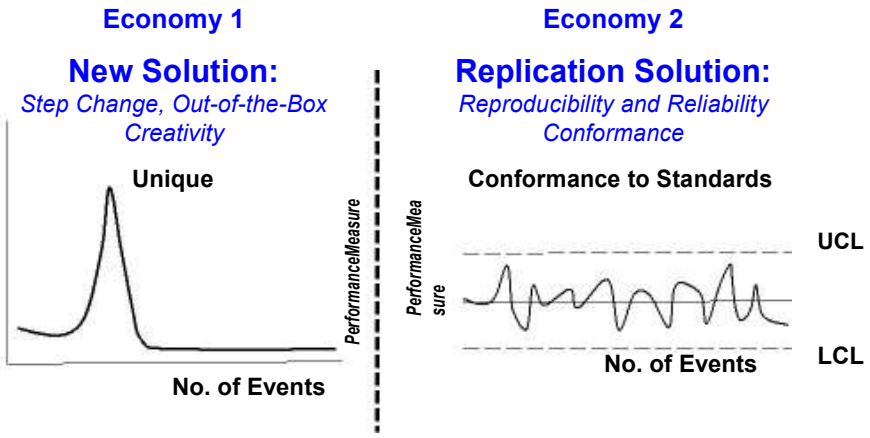
7. Emotional Intelligence for New Solutions in the Binary Economy



Creativity Versus Conformance

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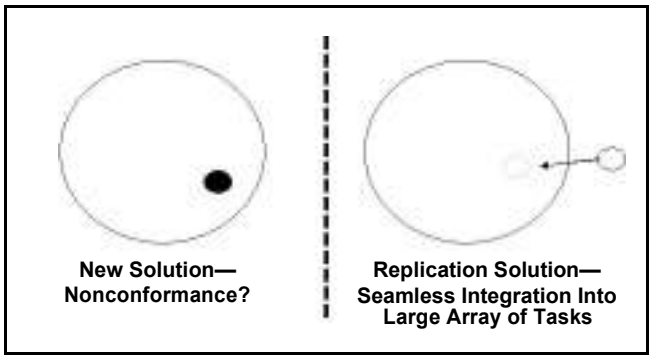
Need for "Co-existence" of New Solutions With Replication Solutions



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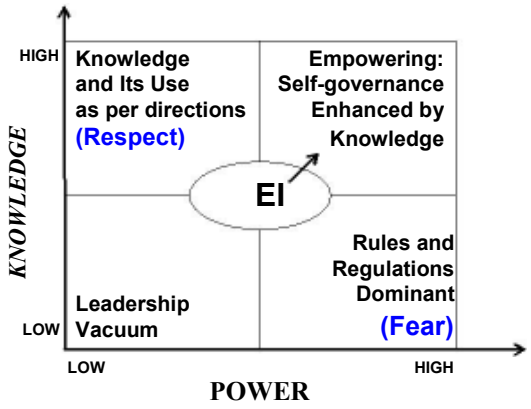

Styles of Leadership – Emotional Intelligence

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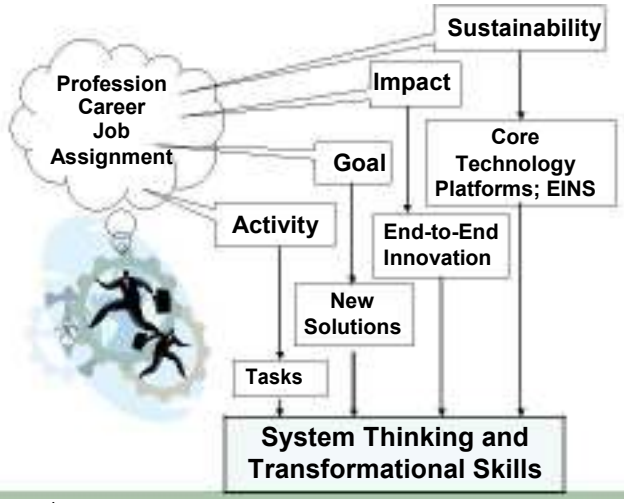
Progressive Evolution of a professional through Transformational Skills.



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Discussion:

Transformational Skills-
- **student level?**
- **faculty level?**
- **Department level?**
- **Institute level?**

Session 4:

Transformation of an academic institution to a research institution?

Discussion:

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Source of Knowledge

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Source of Knowledge

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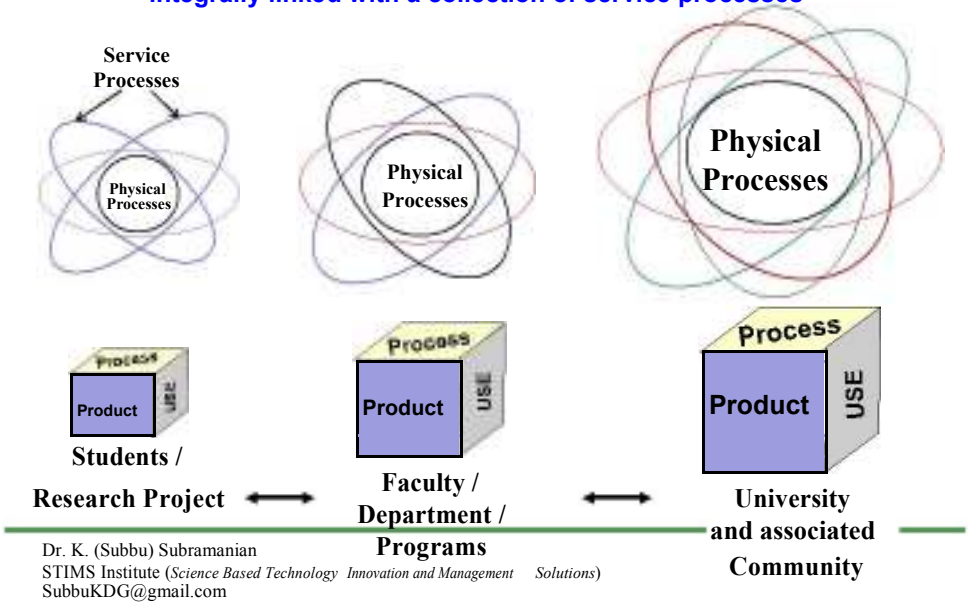
Education in a Research University:

Composed of Education in "Physical Processes" integrally linked with a collection of service processes



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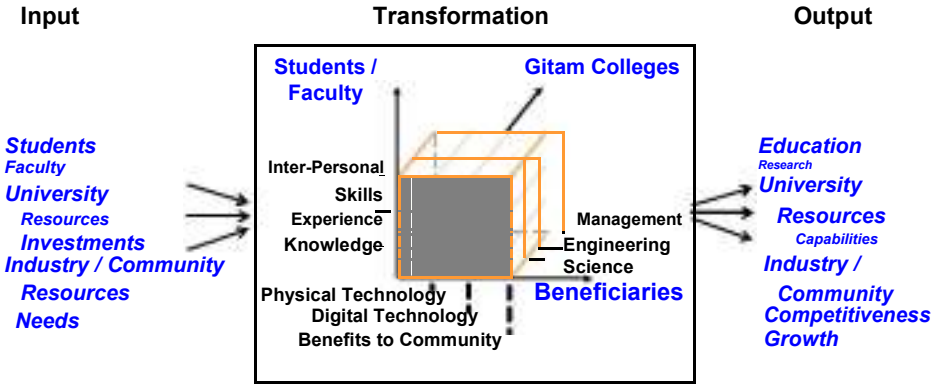
Research University : Vision:

Create and Implement projects and programs by leveraging all core capabilities; provide value added "New" solutions for all users of university resources / capabilities.



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Vision for transformation to a "Research" University

- **I**dentify --- "New" Solutions / Systems
- **C**reate --- By integrating the "Knowledge" and resources available from all sources
- **I**mplement -- Make it happen with impact for students, faculty, local area industry and community

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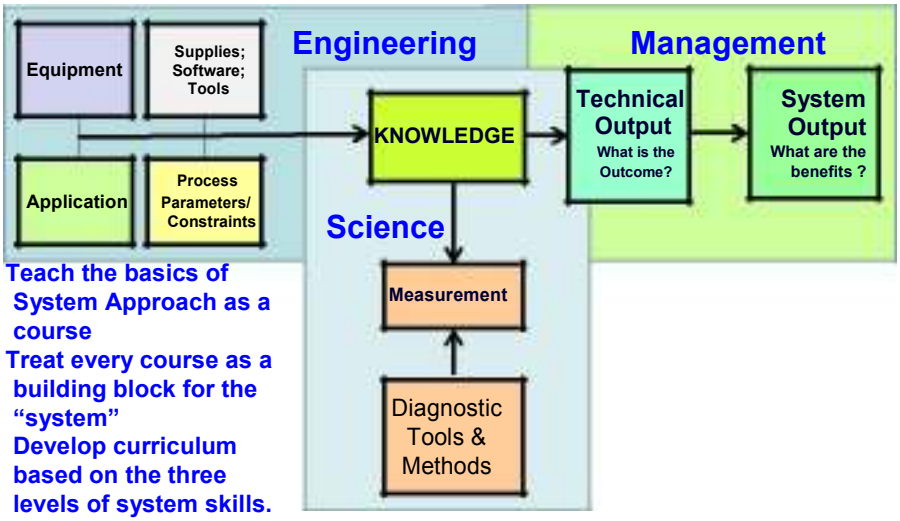
Every "New" Solution is a "System"



- Teach the basics of System Approach as a course
- Treat every course as a building block for the "system"
- Develop curriculum based on the three levels of system skills.

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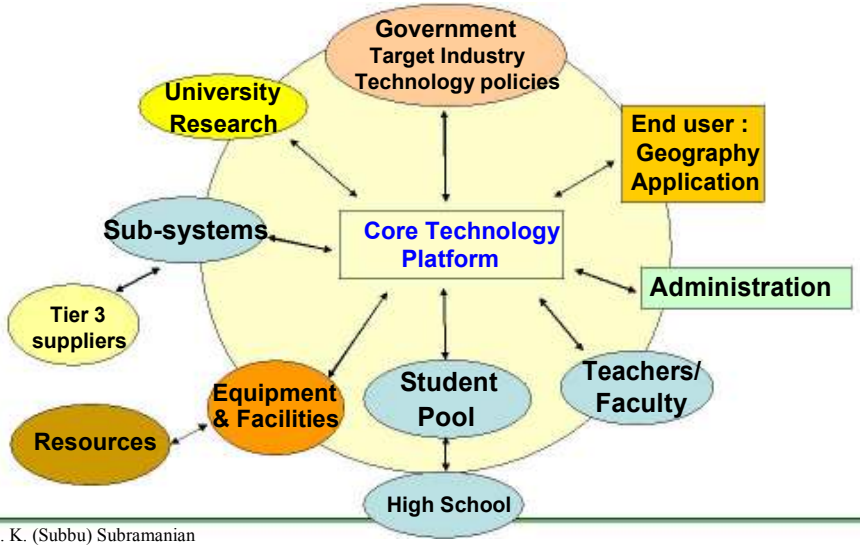
Knowledge Integration: Eco System Development



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The University has to define its Vision and Mission in terms of "System Outputs" – why? - in the following areas:

- What are the **academic goals** (in terms of projects, programs and thrust areas)? Why?

  This will determine the areas of academic training, education, courses and research projects for the students at the university.

- What are the **"commercial" goals** (in terms of products, applications, markets) ? Why?

  This will determine the areas of commercial investment in terms of equipment, facilities and capabilities.

  The above will in turn determine the resources and industrial connections that can also be used for the academic programs at the university.

- What are the **"Technological" goals** of the university (which in turn define the areas of Science and Engineering to focus on, while management education remains a constant)? Why?

  The above will determine the focus areas for scientific research, capability development (in terms of students, faculty, alliance with other resources (such as other universities, suppliers and users (like local area industries), etc.

Emerging models for eco-system development:

- **Internship and training with mentoring at established and progressive companies --- MGTL / STIMS model**

- **Seeding targeted courses and education at a University followed by recruitment and training and mentoring at an established company**

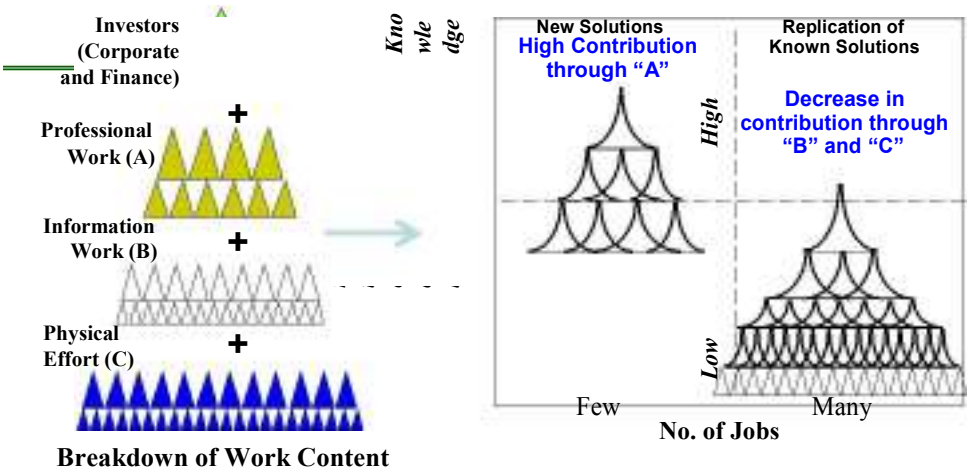
Course Title: System Approach for Engineers--- TVS / TCE/IIT – M/STIMS model

- **University / Industry collaborative research model**

NGPG Machine tool development --- IIT – M/MGTL/IMTMA/STIMS

- **University / Industry/ GoI collaboration for Center of Excellence in Machine Tool and Production Technology**

---- IIT – M/Several companies/IMTMA/STIMS



Task Oriented

Solution Oriented
(System Thinking; Transformational Skills)

Organizational structures in the 21st Century (to maximize PE – Score) and their requirements for Technical Know-how /Knowledge

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Three components of the work for any professional

Professional Work	Information Work	Physical Work
A	B	C
• Not easily replaced • Depends on worker's unique Knowledge and hands on experience • Clearly related to: ○ Product or Revenue source ○ Process leading to Product ○ Application or USE of the Product • Mostly work driven by ○ Science and Strategy ○ Developing common language – Why, What, When and how? • New Solutions leading to: ○ Diagnostics – using probes, sensors, analytical tools, data mining, etc. ○ Developing and implementing such diagnostic tools ○ Use of such tools to improve the process. • Step change solutions in terms of new outcomes of value to the company or department.	• Anyone can do it • Indeed there are many who do the same activity • Very much dependent on IT tools and their use • Information activity such as data entry, drafting, coding, spread sheet work, presentations, e-mails, filing, etc. • Mostly work related to operations and their details • Mostly plug and play type of activity Usually low wage work (when viewed across the globe) • Most supervision and administrative work including regular reports, routine reviews, updates, etc. fall in this category of work.	• Anyone can do it • Your presence is requited mostly to create the quorum • Physical activity such as travel, sit in the meetings, typing or entering data, preparing slides, etc.

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Grinding Process Solutions

- A Business Model Proposal

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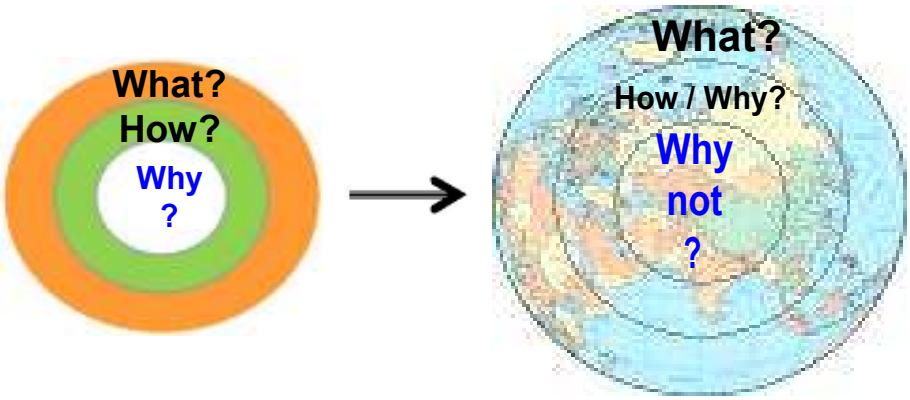
Research University: A Strategic Approach



From "Why?" to "Why not?"

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