
TOTAL-SYSTEM INNOVATION MANAGEMENT

Concepts and Applications

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Consulting Associate Professor, Stanford University
Executive in Residence, San Jose State University*

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OUTLINE

Topics

Introduction and Personal Background

Innovation, Innovation Management, and the Total-System Approach

Additional Applications of the Total-System Approach

- ❖ Productive Creativity for Idea Generation
 - ❖ Organizational Innovation Culture Development
-

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INTRODUCTION

It is generally recognized that innovations:

- ❖ from  to  to 
- ❖ from  to  to 
- ❖ from  to  to 
- ❖ from  to  to  etc.

have been the *driving forces of civilization*.

It is also widely believed that *effective management of innovation* could solve many social, economic, and environmental problems of the world.

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INTRODUCTION - concluded

However, *innovation is boundless and management is an art*.

Thus, this presentation will *not* be a definitive scientific treatise, but a *system-based conceptual framework* for:

- ❖ analyzing the *structure*
- ❖ generating insights on the *underlying principles*
- ❖ collecting *best practices*
- ❖ identifying *future areas of research*
- ❖ *provoking additional thinking*

about the *effective management of innovation*.

This system-based framework also betrays the *bias* of my perception and thinking process as reflected in my personal background.

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PERSONAL BACKGROUND

System Thinker and Innovation Manager

Education:

Ph.D., Operations Research, Stanford; MSEE, Georgia Tech; BSEE, Taiwan University

Experience:

2000-present : President, STARS Group; developer of *Technology Portfolio Planning* tools

1989-2000: Director, Energy and Technology Strategies, *SRI International*

1974-1989: Manager, Planning Analysis, *Electric Power Research Institute*

Some Others:

Vice Chair, IEEE Technology Management Council

Chair, Power & Energy, International Society of Service Innovation Professionals (ISSIP)

Board Member and Director of Smart Grid Task Force, US-China Green Energy Council

Managing Editor, IEEE *Advances in Technology and Innovation Management*

Organizer, IBM, SRI, SJSU joint Global Innovation Forum

Publications:

Over 80 technical papers, 6 books, including *Technology Portfolio Planning and Management*, Springer Publisher, 2006; and "Total-System Innovation Management" in *Quality Innovation*, Chen and Hakim (Eds.). IGI Publishing, 2014.

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INNOVATION

A Popular but Not Well-defined Concept

There is a lack of unified definition of Innovation:

- ❖ Webster Dictionary: *Innovation* -
 1. *The introduction of something new;*
 2. *A new idea, method, or device.*
- ❖ OECD (2005):

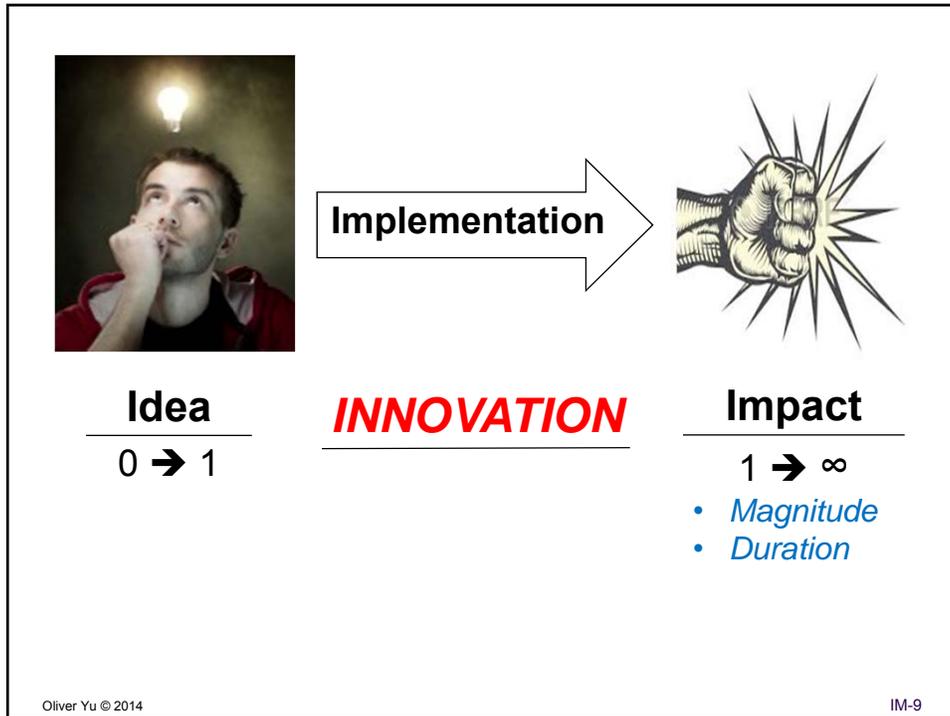
*An **innovation** is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organisation or external relations.*

But Innovation is *more than* introducing something new or developing an improved product for business.

INNOVATION

A Simple Definition

***Innovation:
Idea Implemented with Impact.***



INSIGHTS FROM THE SIMPLE DEFINITION

- ❖ Innovation is *not a* static *idea* but a *dynamic process* involving implementation to produce impact, and a systems approach can be applied for its analysis.
- ❖ We are *ALL Innovators* with differences in *Impact*.
- ❖ For an innovation to have significant impact, idea is important, but *implementation is critical* as well as *complex and difficult*, because it will require the collaboration and coordination of many participants over time, a fact generally *sensed*, but often not fully appreciated.

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THE SIMPLE DEFINITION APPLIES TO A WIDE RANGE OF INNOVATIONS

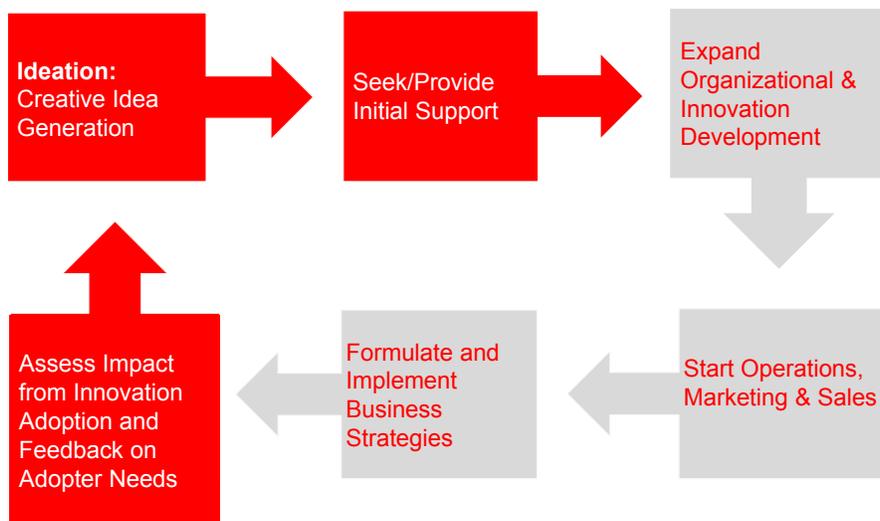
Examples:

- ❖ Technologies: nuclear fission, semiconductor
- ❖ Products: light bulb, iPhone
- ❖ Services: social network, iPhone apps
- ❖ Management practices: standardization, quality control
- ❖ Theoretical concepts: evolution, relativity
- ❖ Ideological principles: democracy, Marxism
- ❖ Philosophical tenets: Confucianism, Buddhism

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*INNOVATION PROCESS: An *Interactive System* with Common Key Elements*



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INNOVATION MANAGEMENT

- ❖ **Innovation Management.** *In addition to* traditional management functions, like organization, operations, marketing, strategy, etc., it emphasizes:
 - *Fostering productive creativity for idea generation*
 - *Matching common interests among key stakeholders*
 - *Developing innovative organizational culture*
- ❖ Statistics indicate that the commercialization rate of patented ideas in the U.S. has been less than 0.2%*; a major goal of Innovation Management should be to *increase this rate*.

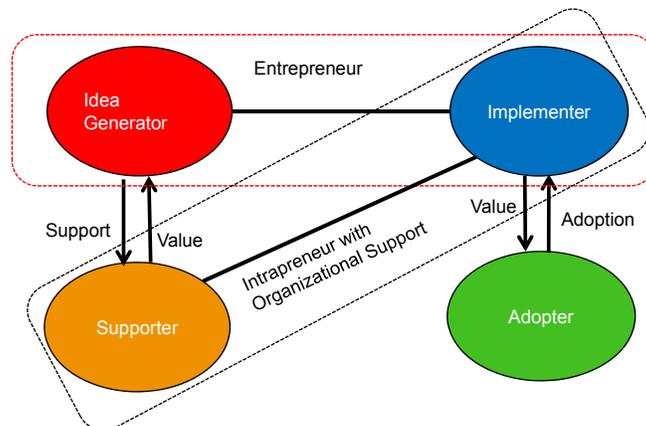
* *Business Week, November 20, 2005*

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INNOVATION MANAGEMENT AND KEY STAKEHOLDERS OF THE PROCESS

Innovation management also manages the relationships and interactions among key stakeholders of the innovation process: *Idea Generator, Supporter, Implementer, and Adopter.*

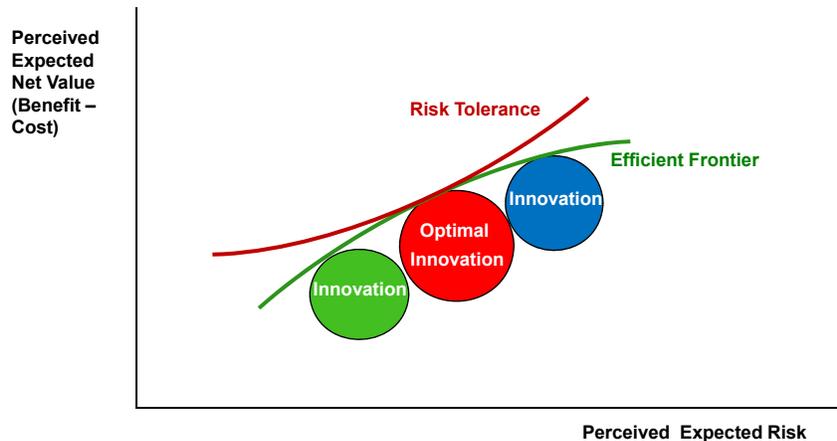


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INSIGHT ON STAKEHOLDER DECISIONS

For potential innovations, a stakeholder will make *investment decisions for its limited resources* (time, money, effort, etc.) to *balance Perceived Expected Net Values & Risks* and *Portfolio Analysis* can be used to identify *the optimal innovation*.



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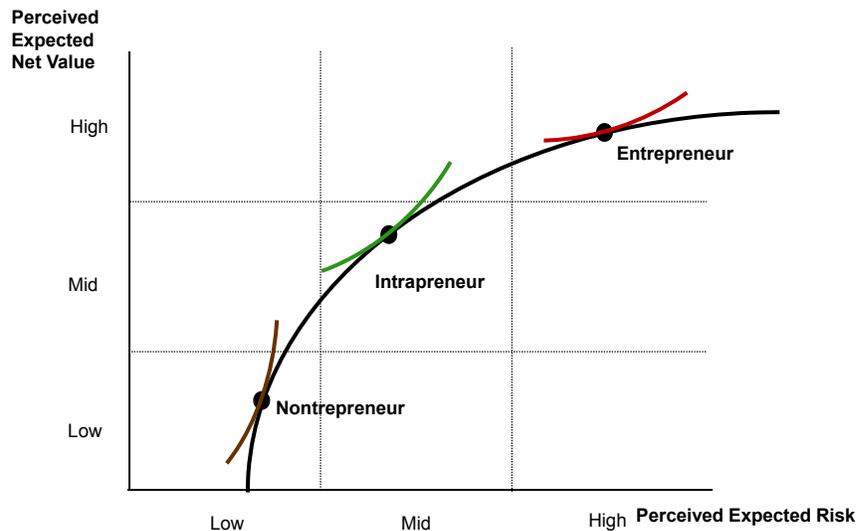
DIFFERENT VALUE-RISK BALANCES

- ❖ Dependent on *individual value and risk preferences*, these optimal innovations can be *different* not only among stakeholders, but also within a stakeholder class.
- ❖ For example, the optimal innovation for an *Idea Generator*, who is:
 - an *Entrepreneur*, generally has high value and high risk.
 - an *Intrapreneur*, tends to have medium risk and medium value.
 - a *Non-trepreneur*, largely will have low risk and low value.

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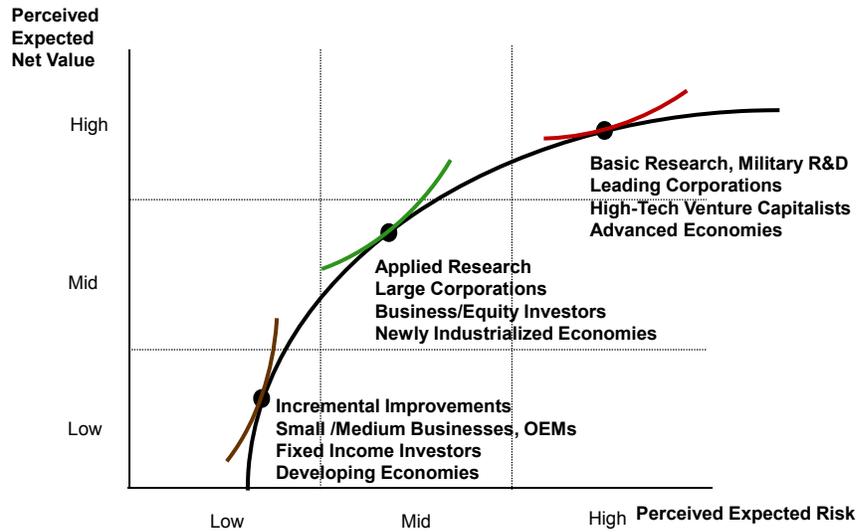
VALUE AND RISK BALANCES FOR IDEA GENERATOR



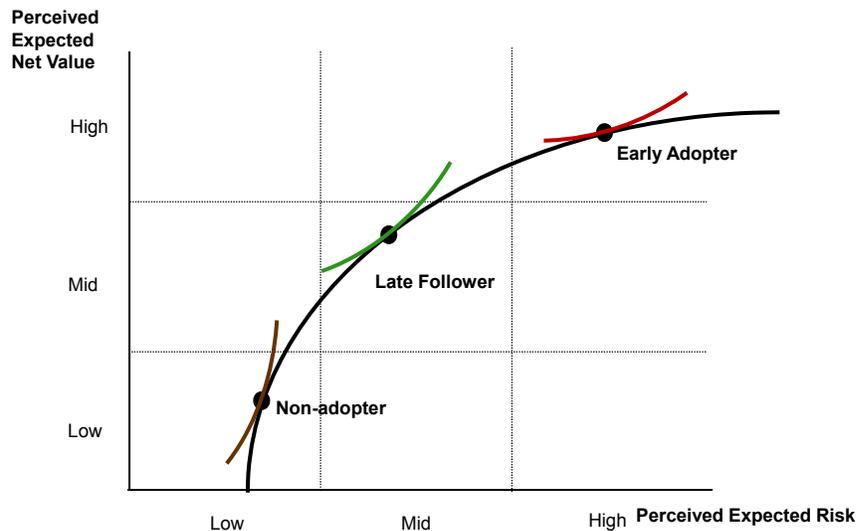
DIFFERENT VALUE-RISK BALANCES

- ❖ Similar differences exist for *Supporter* and *Adopter*.
- ❖ Innovation Management needs to *match* these optimal innovations among different stakeholders for them to *work together and make innovation happen*.

VALUE AND RISK BALANCES FOR INNOVATION SUPPORTER



VALUE AND RISK BALANCES FOR INNOVATION ADOPTER



TOTAL-SYSTEM INNOVATION MANAGEMENT

❖ **Total-System Approach:**

- View a process from an *overall system perspective*.
- *Systematically* examine and analyze the *interactive* key elements of the process to develop *insights and tools for improving its effectiveness*.

❖ **Key Emphases for Innovation Management:**

- A *system framework* for the innovation process
- *Systematic development of tools* to improve the effectiveness of both individual key elements and the innovation process as a whole.

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Additional Applications of the Total-System Approach

- ❖ **Productive Creativity for Idea Generation**
 - ❖ **Organizational Innovation Culture Development**
-

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PRODUCTIVE CREATIVITY FOR IDEA GENERATION

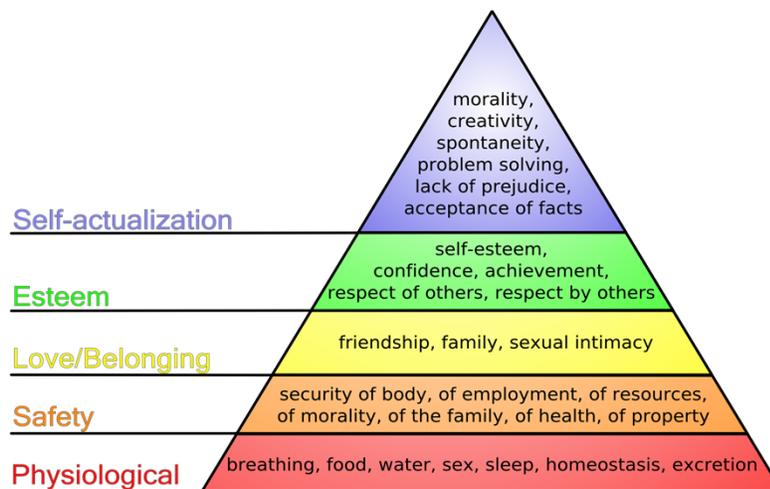
Productive Creativity is to use the total-system approach to enhance the *productivity* of Idea Generation:

- ❖ Improving the *efficacy of the ideas* by generating them *based on a systematic identification of the needs of the adopter*, so that an idea generated will
 - either *respond* to an existing need;
 - or *anticipate* a future need;
 - or *uncover* a hidden need
- ❖ Increasing the *efficiency of idea generation* by
 - a *system-based understanding* of the process;
 - a *systematic development* of creative thinking tools.
- ❖ *Understanding human needs* is at *the heart of Productive Creativity*, as identifying the appropriate human needs is the basis for motivating both *innovation adoption* and *creative thinking*.

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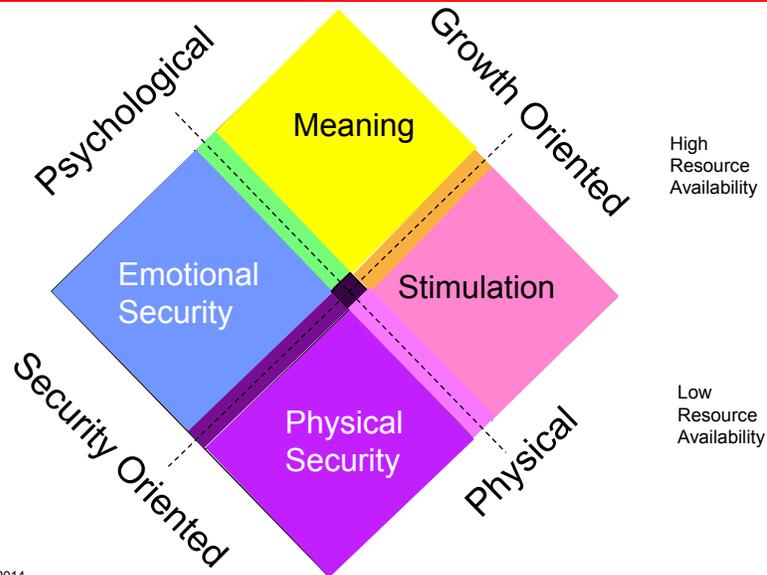
TRADITIONAL VIEW OF HUMAN NEEDS



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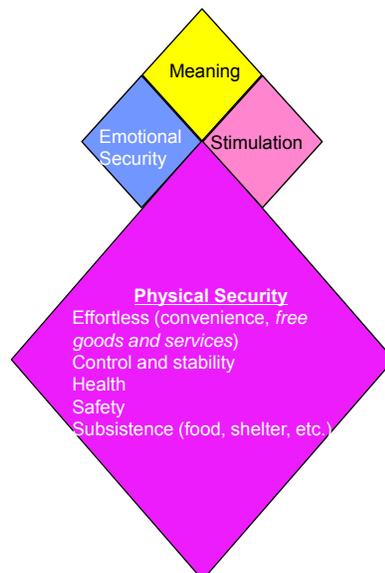
*THE BASIS FOR PRODUCTIVE IDEA GENERATION:
AN ALTERNATIVE VIEW OF HUMAN NEEDS*



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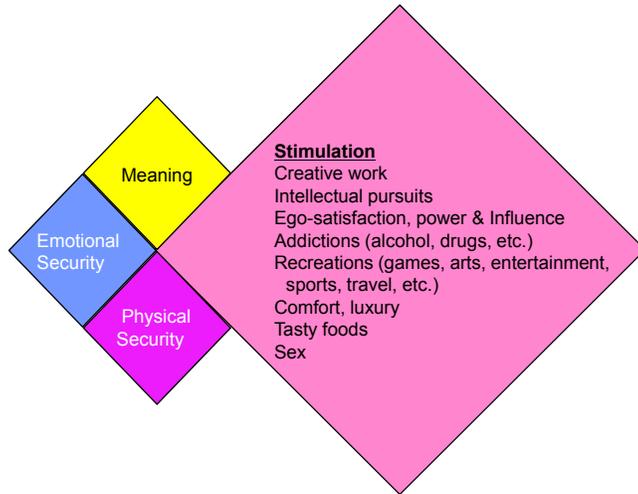
*DETAILS OF THE SECURITY-GROWTH
MODEL OF HUMAN NEEDS*



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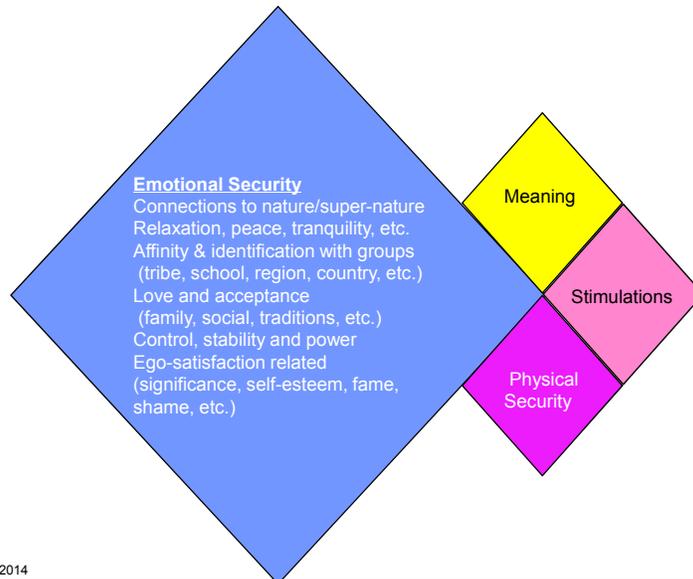
DETAILS OF THE SECURITY-GROWTH MODEL OF HUMAN NEEDS



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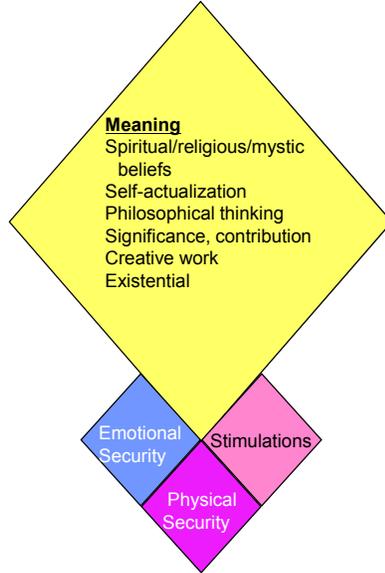
DETAILS OF THE SECURITY-GROWTH MODEL OF HUMAN NEEDS - Continued



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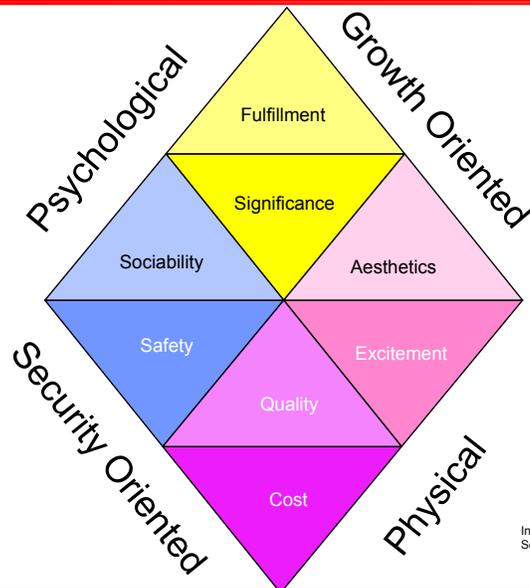
DETAILS OF THE SECURITY-GROWTH MODEL OF HUMAN NEEDS - Continued



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PRODUCTIVE CREATIVITY: Creative Idea Generation based on Need Segmentation to Motivate Innovation Adoption

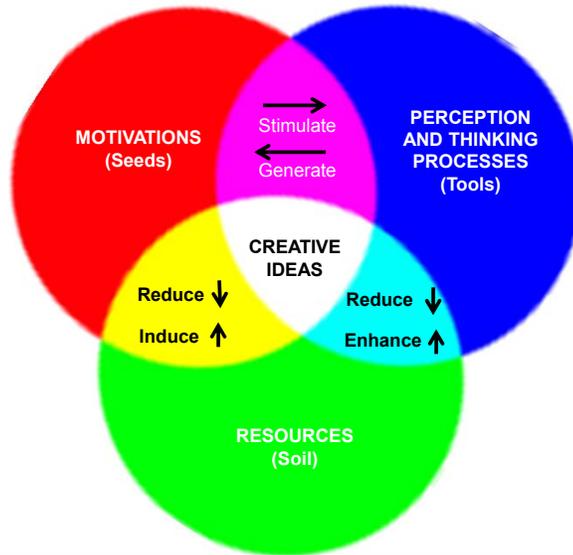


Inspired by Arnold Mitchells, Psychographic Segmentation, SRI International 1968

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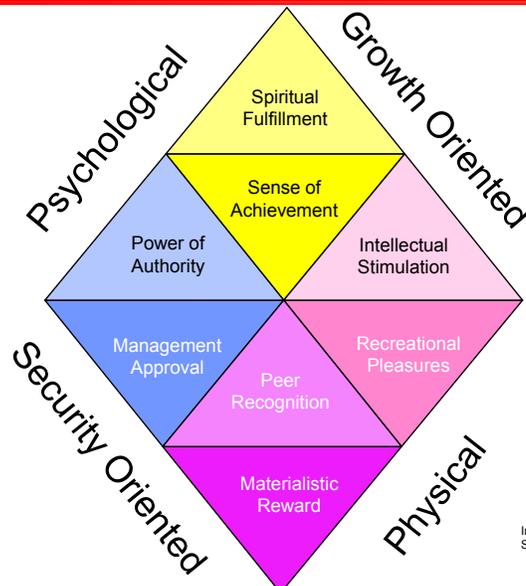
PRODUCTIVE CREATIVITY
A System Model of Key Enablers of the Ideation Process



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PRODUCTIVE CREATIVITY
*Key Enabler of Creative Idea Generation - Motivation:
 Incentive Development Based on Need Segmentation*



Inspired by Arnold Mitchells, Psychographic Segmentation, SRI International 1968

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*PRODUCTIVE CREATIVITY :
Key Enabler of Creative Idea Generation – Resources:
A Wide Range of Interactive Elements*

❖ *Tangible Resources:*

- *Financial*
- *Time*
- *Physical environment* (affecting behavior and thinking process)
- *Technology* (saving time, facilitating interactions, and improving thinking effectiveness, etc.)

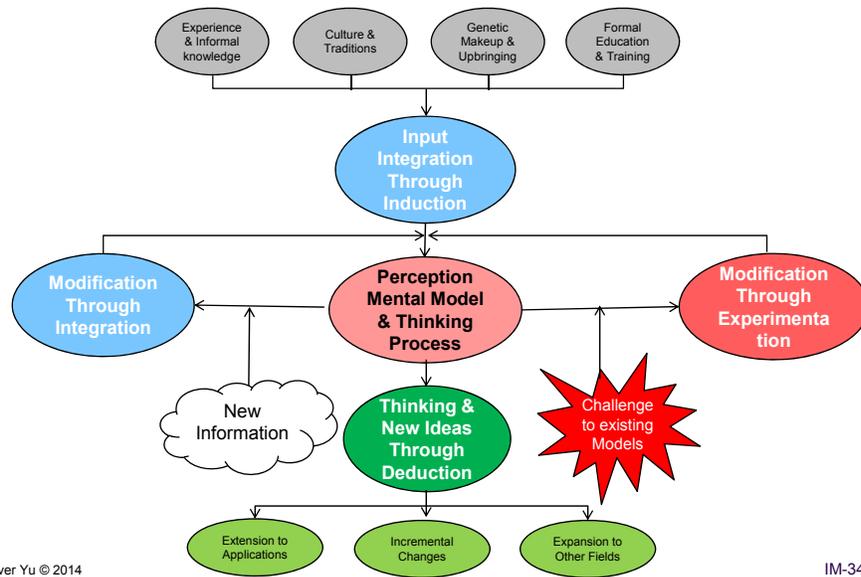
❖ *Intangible Resources:*

- *Knowledge from education and training* (providing the foundation for creative ideas)
- *Social environment* (stimulating creative interactions)
 - Culture
 - Leaders/Mentors
 - Peers

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*PRODUCTIVE CREATIVITY
Key Enabler - Perception and Thinking Process
A System Model*



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*CREATIVE IDEA GENERATION:
Systematic Development of Creative Thinking Tools*

- ❖ **Induction-based:** *Developing alternative mental models by integrating various inputs*
 - Examination of existing mental models under challenge: *Introspection to re-examine underlying assumptions*
 - Inputs from diverse domain experts: *Brainstorming, Crowd-sourcing*
 - Different perspective or focus of thinking process: *Reframing*
 - Forced thinking: *Forced reversal of an “inferior” idea*
 - Alternative mode of thinking style: *Role-playing and empathy*
 - Reverse direction of thinking process: *Design thinking*
 - Expanding scope of thinking process: *Total-system approach*
 - New synthesis of thinking process: *TRIZ, Lateral Thinking*

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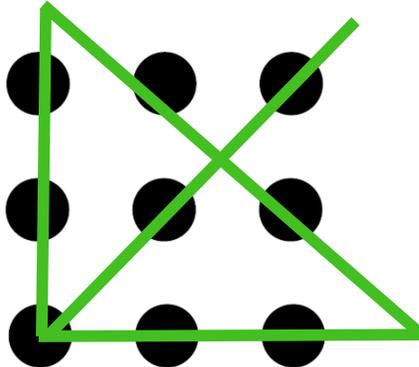
*CREATIVE IDEA GENERATION:
Systematic Development of Tools – concluded*

- ❖ **Deduction-based:** *Extending the implications of existing Mental Models*
 - Systematic thinking of new applications from mental model on future trends: *Transforming manufacturing into service through technology advances*
 - Analogy for different fields: *From Hedging concepts to Real Options applications*
 - Human behavior and need observation-based opportunities: *Eye focus, attention span*
- ❖ **Experimentation-based:** *Mindful Trials and Rapid Prototyping*
 - Systematic trial-and-error and rapid prototyping: *Incandescent light bulb filament experimentation*
 - Exhaustive trials: *100 ideas*
 - Serendipity with awareness: *Post-it, Playdoh*
 - Improvisation

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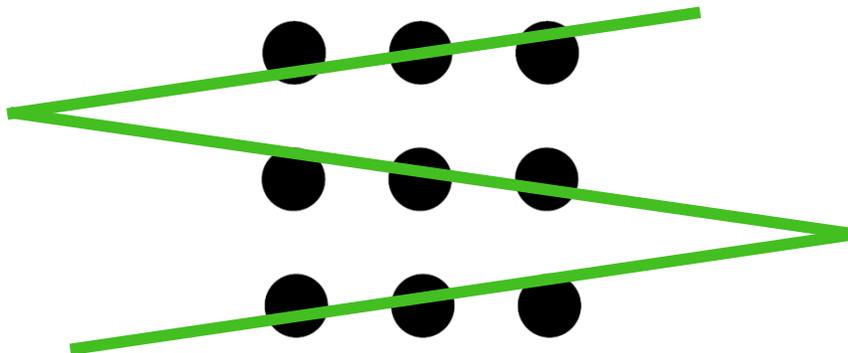
CREATIVE THINKING PROCESS: A SIMPLE EXAMPLE
Draw 4 connected straight line through 9 dots
Initial mental model - All lines should be inside the "box"



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CREATIVE THINKING PROCESS: A SIMPLE EXAMPLE
Draw 3 connected straight line through 9 dots
Revision: Lines can be outside the "box"



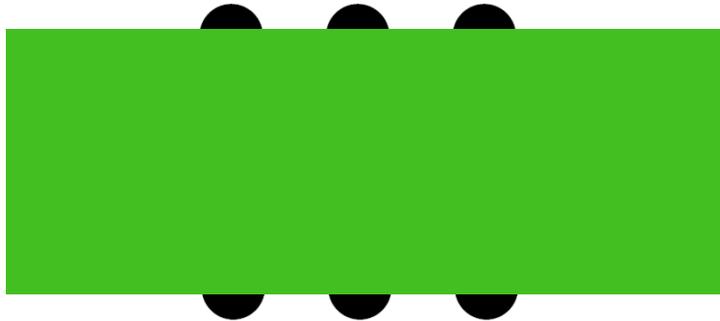
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CREATIVE THINKING PROCESS: A SIMPLE EXAMPLE

Draw 1 straight line through all 9 dots

Revision and deduction: Lines can be outside and size can vary



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REAL-WORLD APPLICATION OF CREATIVE THINKING

Transforming Manufacturing Into Service

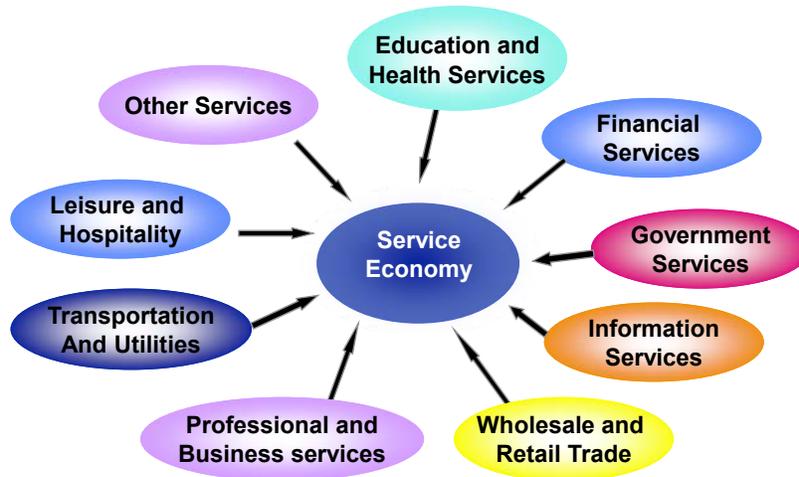
Common Mental Model about Service vs. Reality

- ❖ *Service is viewed as having little or mainly artificially created value. **The reality** is that service has historically been **undervalued** because the traditionally goods-oriented economic accounting system did not include the value of self-service.*
- ❖ *Service is viewed as mainly related to **low-level, low-tech, labor-intensive activities**, such as those provided by Leisure and Hospitality industry. **The reality** is that most services requires high-level, high-tech, and skilled labor forces.*

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*REAL-WORLD APPLICATION OF CREATIVE THINKING:
Transforming Manufacturing Into Service
New Perspective on Service*



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*REAL-WORLD APPLICATION OF CREATIVE THINKING
Transforming Manufacturing Into Service
A New Perspective and An Important Challenge*

New Induction-Based Mental Model on Service

- ❖ The ***ultimate objective*** of Manufacturing is to produce products for ***value-added Service***.
- ❖ ***Demand for Service will increase*** rapidly with economic development.

An Important Challenge

How to Transform Manufacturing Into Service?

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*REAL-WORLD APPLICATION OF CREATIVE THINKING:
Case Studies of Transforming Manufacturing Into Service*

- ❖ Rolls Royce's jet engine "Power by the Hour" program turns the product into a *performance information platform*.
- ❖ John Deere's "Intelligent Solutions and Equipment Financing" program turns the product into a *business intelligence and decision support center*.

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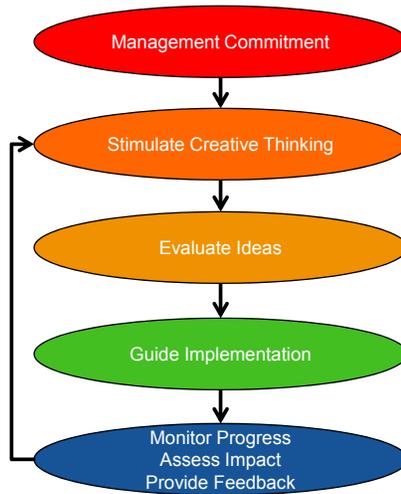
Additional Applications of the Total System Approach

- ❖ Productive Creativity for Idea Generation
 - ❖ *Organizational Innovation Culture Development*
-

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APPLICATION TO ORGANIZATIONAL CULTURE
*Developing Innovation Culture is a **Process that Not Only Stimulates Creativity But Also Controls Risk***



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APPLICATION TO ORGANIZATIONAL CULTURE
It Starts With Management Commitment

- ❖ Developing an organizational culture must start with **Management Commitment**. However, balancing **control (security) and stimulation (growth)** of employees has been a **classic challenge to management**, as too little stimulation will lead to stagnation and obsolescence, while insufficient control can lead to near-term inefficiency and even chaos.
- ❖ This is also the dilemma for an organization to balance between **maximizing short-term profitability** of existing innovation and **stimulating long-term growth** through new innovation as observed by Clayton Christensen.
- ❖ Management commitment to an innovative organizational culture can be achieved if **stimulation of creativity** can be combined with **rigorous control of implementation risks**.

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APPLICATION TO ORGANIZATIONAL CULTURE
Successful Case Study: The SRI Approach

Since year 2000, SRI International has had a near 20% average annual growth of its research revenues, from \$100 million to over \$600 million in 2013, by following a disciplined, systematic approach to develop an organizational culture for innovation that:*

- ❖ Uses the idea generation system to provide a powerful environment for *stimulating creative thinking*.
- ❖ Applies a rigorous system to *control implementation risks*.

* Carlson and Wilmott, Innovation: *The Five Disciplines for Creating What Customers Want*, Crown Business, 2006

APPLICATION TO ORGANIZATIONAL CULTURE
Case Study: The SRI Risk Control System

- ❖ *Evaluate idea* rigorously by requiring:
 - an idea be explicitly based on adopter needs with a *clear value proposition*
 - a *systematic assessment* of the technical, economic, market, socio-political, and implementation feasibility
 - a *business plan* including expected cost, benefit, market assessment, and competitive analysis
 - the idea be in *alignment with the organization*
- ❖ Identify *champion and core team (No Champion, No Project)*
- ❖ Assign *sponsors and mentors* to support and guide implementation
- ❖ Continuously *monitor* implementation progress*, *assess* impact, and *provide feedbacks*.

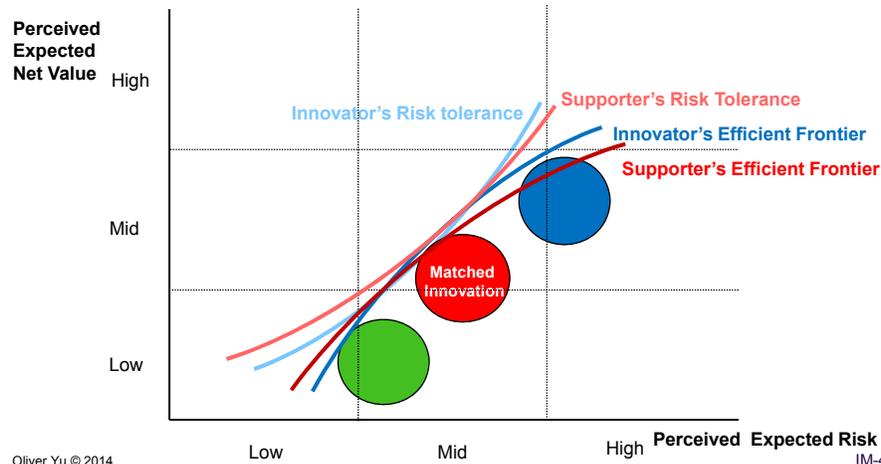
* *SRI Early Alert System (SEAS)* - a computer-aided expert system-based project monitoring system.

APPLICATION TO ORGANIZATIONAL CULTURE

Evaluating Idea for *Alignment with Organization*

To gain support, innovation must be aligned with organizational value and risk preferences, which is also the basis for organizational innovation portfolio planning*.

* Yu, *Technology Portfolio Planning and Management*, Springer, 2006



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SUMMARY OF KEY POINTS

- ❖ *Innovation*, as *idea implemented with impact*, is a *dynamic process*; a *total-system approach* with a *system framework* and *systematic tool development* can be used for effective *management* of the process to increase its *impact success rate*.
- ❖ Each of the key stakeholders of the process: *Idea Generator*, *Supporter*, *Implementer*, and *Adopter*, will make resource investment decisions to *balance Perceived Expected Net Value and Risk*, for which *Portfolio Analysis* can be used to identify the *optimal innovation*, and Innovation Management needs to *match the optimal innovations among stakeholders*.
- ❖ *The security-growth model of human needs* provides an analytical basis for *motivating* both innovation adoption and creative idea generation.
- ❖ A *systems approach* to analyze *the perception and thinking process* provides the basis for *systematic tool development* for *productive creativity*.
- ❖ A proven successful approach to develop *innovative organizational culture* and fostering *intrapreneurship* is to combine *vigorous stimulation of creative idea generation* with *rigorous control of implementation risks*.

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I earnestly invite you to *review, modify, and apply*
the **Total-System Approach** to Innovation Management
to *Productively Generate Ideas*
and *Successfully Implement them*
for *Significant Impact!*

Please send feedbacks to oliveryu@starstrategygroup.com

THANK YOU!