TOTAL-SYSTEM INNOVATION MANAGEMENT

Concepts and Applications

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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
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.

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.
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.
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

INNOVATION PROCESS: An Interactive System with Common Key Elements

Ideation: Creative Idea Generation → Seek/Provide Initial Support → Expand Organizational & Innovation Development

Assess Impact from Innovation Adoption and Feedback on Adopter Needs

Formulate and Implement Business Strategies → Start Operations, Marketing & Sales
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

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.*
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.

INSIGHT ON STAKEHOLDER DECISIONS

- Perceived Expected Net Value (Benefit – Cost)
- Risk Tolerance
- Efficient Frontier
- Optimal Innovation

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.
VALUE AND RISK BALANCES FOR IDEA GENERATOR

- Entrepreneur
- Intrapreneur
- Nontrepreneur

- Perceived Expected Net Value
  - Low
  - Mid
  - High

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

Perceived Expected Net Value

Low
Mid
High

Basic Research, Military R&D
Leading Corporations
High-Tech Venture Capitalists
Advanced Economies

Applied Research
Large Corporations
Business/Equity Investors
Newly Industrialized Economies

Incremental Improvements
Small/Medium Businesses, OEMs
Fixed Income Investors
Developing Economies

VALUE AND RISK BALANCES FOR INNOVATION ADOPTER

Perceived Expected Net Value

Low
Mid
High

Early Adopter
Late Follower
Non-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
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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.

TRADITIONAL VIEW OF HUMAN NEEDS

Self-actualization
Esteem
Love/Belonging
Safety
Physiological

morality, creativity, spontaneity, problem solving, lack of prejudice, acceptance of facts
self-esteem, confidence, achievement, respect of others, respect by others
friendship, family, sexual intimacy
security of body, of employment, of resources, of morality, of the family, of health, of property
breathing, food, water, sex, sleep, homeostasis, excretion
THE BASIS FOR PRODUCTIVE IDEA GENERATION: AN ALTERNATIVE VIEW OF HUMAN NEEDS

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

**Stimulation**
- Creative work
- Intellectual pursuits
- Ego-satisfaction, power & Influence
- Addictions (alcohol, drugs, etc.)
- Recreations (games, arts, entertainment, sports, travel, etc.)
- Comfort, luxury
- Tasty foods
- Sex

**Emotional Security**
- Connections to nature/super-nature
- Relaxation, peace, tranquility, etc.
- Affinity & identification with groups (tribe, school, region, country, etc.)
- Love and acceptance (family, social, traditions, etc.)
- Control, stability and power
- Ego-satisfaction related (significance, self-esteem, fame, shame, etc.)
DETAILS OF THE SECURITY-GROWTH MODEL OF HUMAN NEEDS - Continued

Meaning
- Spiritual/religious/mystic beliefs
- Self-actualization
- Philosophical thinking
- Significance, contribution
- Creative work
- Existential

Emotional Security
Stimulations

Physical Security

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

Inspired by Arnold Mitchell’s, Psychographic Segmentation, SRI International 1968
PRODUCTIVE CREATIVITY
A System Model of Key Enablers of the Ideation Process

MOTIVATIONS (Seeds)
- Stimulate
- Generate

PERCEPTION AND THINKING PROCESSES (Tools)
- Reduce
- Induce
- Enhance

CREATIVE IDEAS

RESOURCES (Soil)

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

Inspired by Arnold Mitchell's Psychographic Segmentation, SRI International 1968
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

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

[Diagram showing the system model of perception and thinking process]

- Input Integration Through Induction
- Perception Mental Model & Thinking Process
- Modification Through Integration
- New Information
- Thinking & New Ideas Through Deduction
- Extension to Applications
- Incremental Changes
- Expansion to Other Fields
- Modification Through Experimentation
- Challenge to existing Models
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*

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

![Diagram of 4 connected straight lines through 9 dots inside a box, marked as incorrect.]

Revision: Lines can be outside the “box”

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

![Diagram of 3 connected straight lines through 9 dots, with lines extending 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

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

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

- Management Commitment
  - Stimulate Creative Thinking
    - Evaluate Ideas
      - Guide Implementation
        - Monitor Progress
          - Assess Impact
            - Provide Feedback

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.
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.


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

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.
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](mailto:oliveryu@starstrategygroup.com)

**THANK YOU!**