



**“What we have learned:
Managing Invention and
Innovation”**

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Agenda

- Invention and Innovation
- Staffing Considerations
- Organization Structure
- Strategy
- Conclusion

Is this an invention or innovation?



Bottle Opener Remote



Sauce Dispensing Chopsticks



Self-Locking Bendy Bike



Pizza Scissors

Invention and innovation

Invention	Innovation
<p>Marked by discovery or a state of new existence, usually at the lab or bench</p>	<p>Marked by first use, in manufacturing or in a market.</p> <p>Innovation is composed of two parts :</p> <ul style="list-style-type: none">(1) The generation of an idea or invention and(2) the conversion of that invention into a business or other useful application <p>Innovation = Invention(1) + Exploitation(2)</p>

Invention and Innovation

How to manage technological innovation?

- Organization and direction of human and capital resources toward effectively
 - (1) Creating new knowledge;
 - (2) Generating technical ideas aimed at new and enhanced products, manufacturing processes and services;
 - (3) Developing those ideas into working prototypes; and
 - (4) Transferring them into manufacturing, distribution and use.

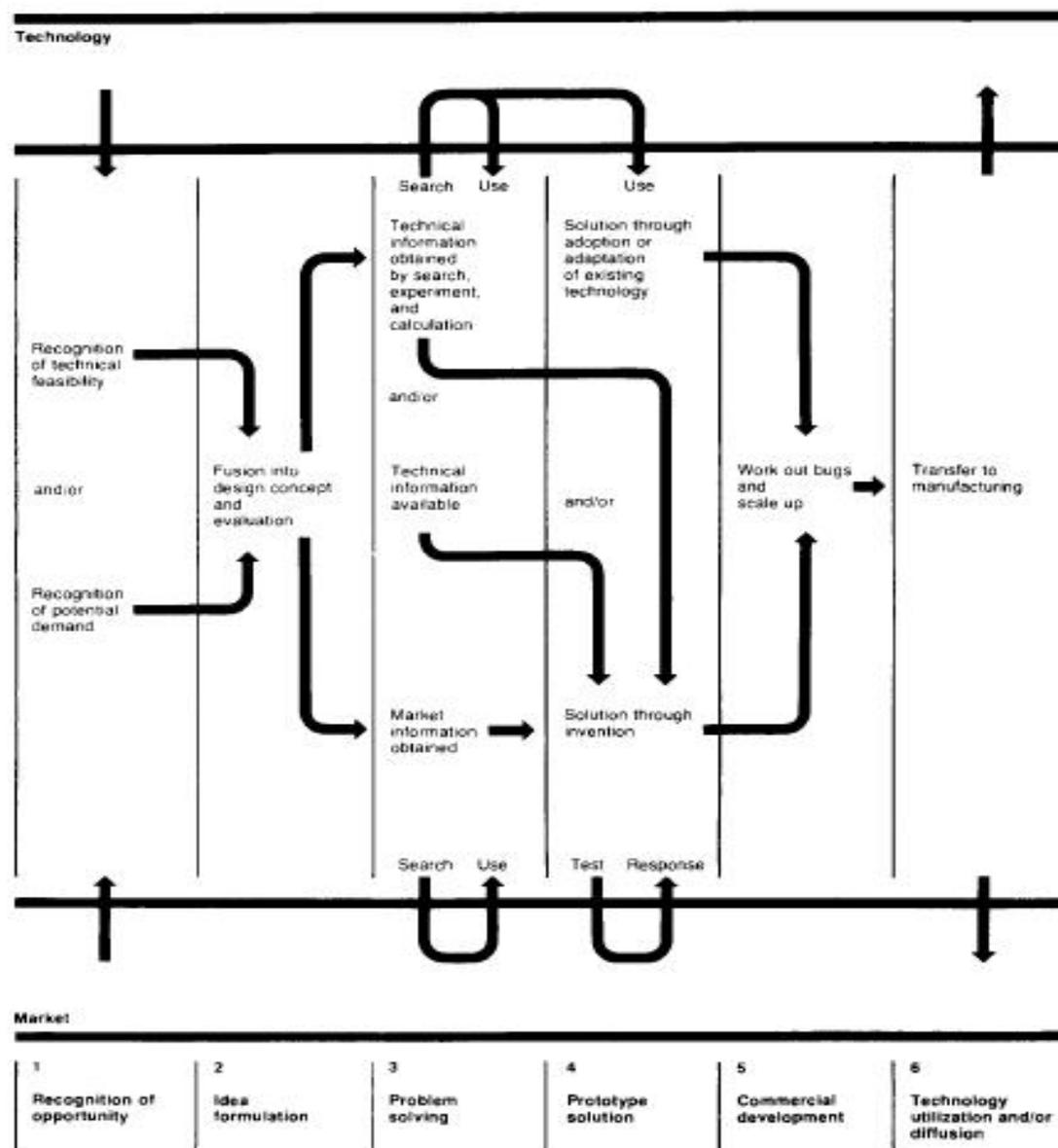


Figure 1.—The process of technological innovation can take as long as 20–30 years, according to some studies, but for most industrial product innovations the duration from initial idea to market is more likely to be three to eight years. (Reprinted with permission from E. B. Roberts and A. L. Frohman, "Strategies for Improving Research Utilization," *Technology Review*, vol. 80, no. 5, March/April 1978.)

Invention and Innovation

Two key generalization of technological innovation:

(1) Technological innovation is a multi-stage process, with significant variations in the primary task as well as in the managerial issues and effective management practice occurring among these stages.

Invention and Innovation

<p>Example: Stage 1 – Recognition of opportunity</p>	<p>Example: Stage 5: Commercial development</p>
<p>Primary task: Coming up with one or more technical and/or market goals that stimulate initiating a research, development and/or engineering project</p>	<p>Primary task: In depth specification and manufacturing engineering of ideas which have been already reduced to an acceptable working prototype</p>
<p>Managerial issues: How do more and better targets get generated? Which people, which structures, which strategies can be employed toward more effective idea generation for these objectives.</p> <p>Good managerial practice – Loose control</p>	<p>Managerial issues: How to coordinate a number of engineers of different disciplinary backgrounds toward achieving, within previously estimated development budget and schedule, a predefined technical output ready for manufacture in large volume, reliably, and at competitive production cost?</p>
<p>Effective management practices: Ready access to small amounts of R&D financing, free of heavy and discouraging evaluative procedures</p>	<p>Effective management practices: Tight control, elimination of duplication, strong financial criteria for resource accompanied by formal evaluation,</p>

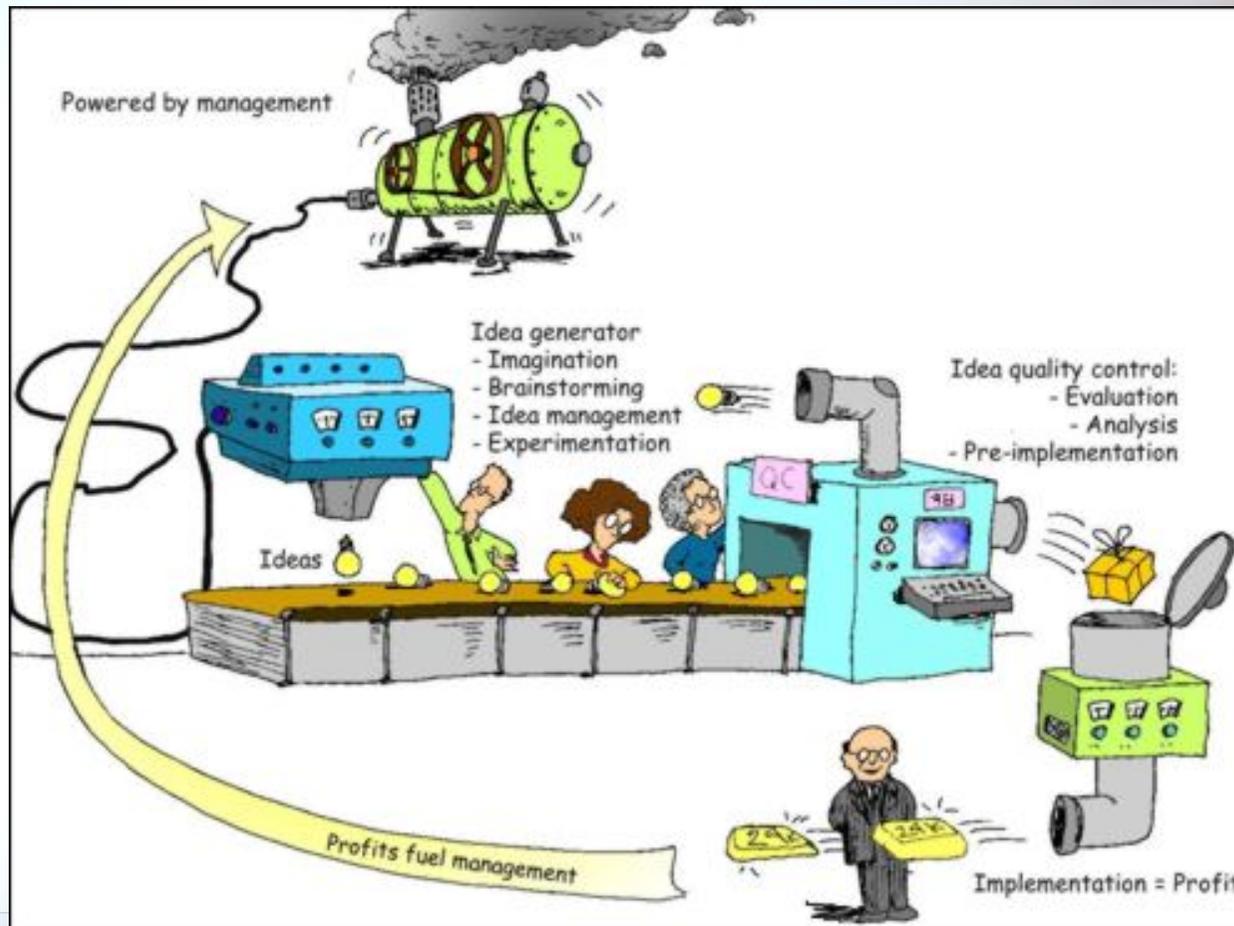
Invention and Innovation

(2) Innovation occurs through technical efforts carried out primarily within an internal organizational context, but involving heavy interaction with the external technological as well as market environment

- External sources of technology as critical supplements to internal R&D efforts
- Awareness of customer needs and competitors activity

Staffing Considerations

- What kind of people need to be involved for effective technical development?
- What managerial actions can be taken to maximize their overall productivity?



Staffing Considerations

- Roberts and Fusfeld identified a number of “Critical behavioral roles”

5 key roles:

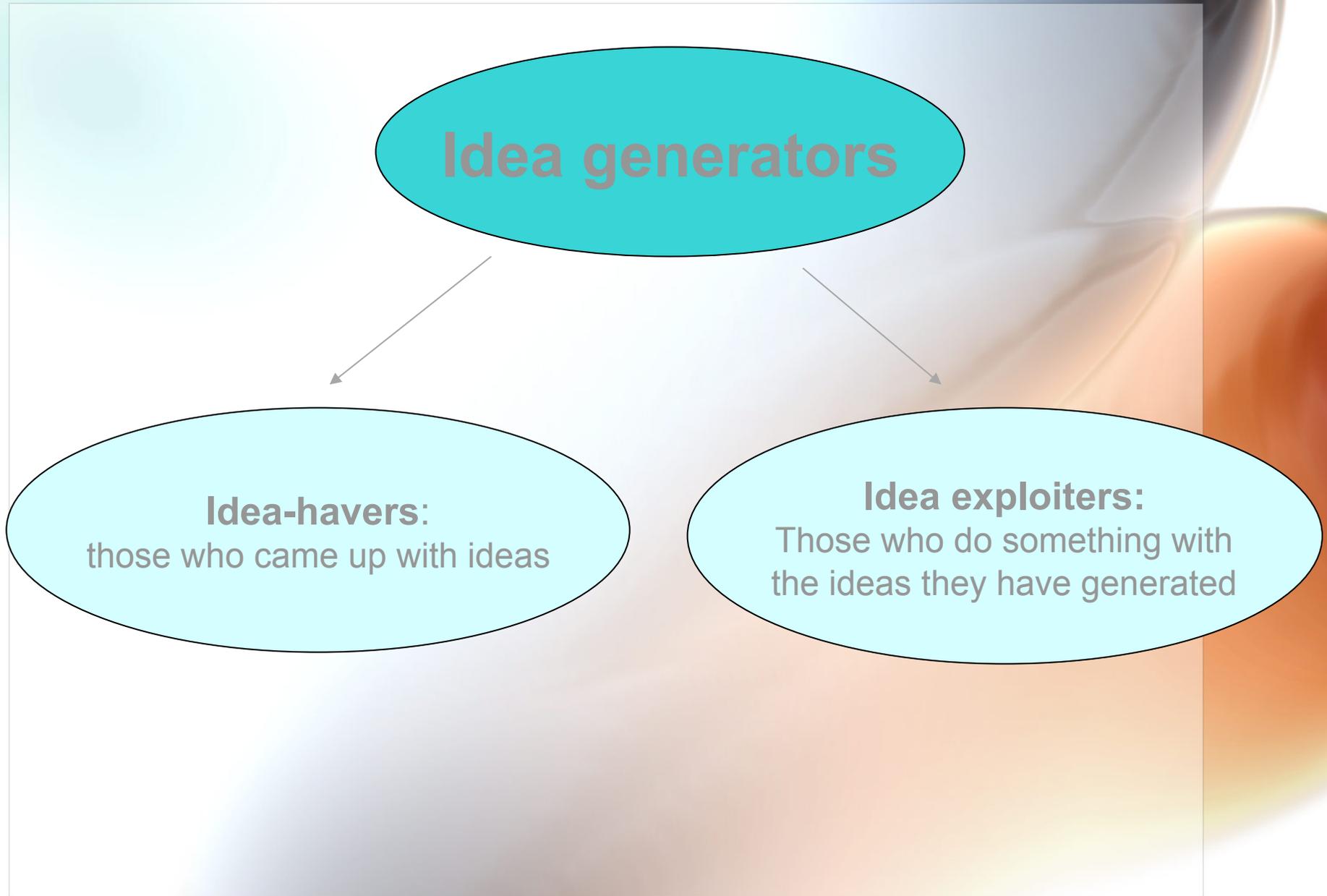
1. Idea generators
2. Entrepreneur/product champion
3. Program manager/leader
4. Gatekeepers
5. Sponsor/coach

Staffing Considerations

Idea generator

- Contributors of new insights that both initiate projects and contribute to problem solutions throughout technical projects
- They may be scientist or engineers, sales or marketing persons, or even managers
- Individual differences – distinctive characteristics of effective idea generators
- Managerial influences – for e.g. from the internal organizational climate or environment and especially supervisory practices

Staffing Considerations



Staffing Considerations

Entrepreneur/Product champion

- Advocate and push for change and innovation; they take ideas, whether their own or others and attempt to get them supported and adopted.
- Product champion to be a necessary condition for project success

Staffing Considerations

Program manager/leader/ “ business innovator”

Supply the support functions of :

- Planning
- Scheduling
- Monitoring and control
- Technical work supervision
- Business and financial coordination relating to the R&D projects

Staffing Considerations

Gatekeepers/Special communicators

- Bring information messages from sources outside of a project group into that group
- “Human bridges” – May bridge one technical group to another within the same company or may link university research activities to a corporate advanced technology center

Staffing Considerations

- Effective “bridgers” are rare but easily identified

Attributes:

- Interpersonally able (e.g. Good listeners)
- Have depth in at least one discipline
- Have a wide range of interest
- Problem solving oriented

Staffing Considerations

Sponsor/coach

- Provide encouragement, psychic support, facilitation to the more junior people involved in the task implementation
- Often including important help in “bootlegging” the resources needed by those trying to move technological advances forward in an organization
- Bootlegging is defined as research in which motivated individuals secretly organise the innovation process.
- Permitted bootlegging is research time where technical staff are allowed to spend a certain amount of their time working on ‘pet-projects’ in the hope that some day there is some return for the company.
- Famous examples of companies that follow such an initiative are 3M and Hewlett-Packard. They allow 10 to 15 percent of the working time for own product related interests.

Staffing Considerations

- The higher up in an organization a sponsor was located = the higher the probability of success of internal efforts to generate new product lines
- Needed for idea generators, project managers, and especially for entrepreneurs

Organization Structure

- Design of organization structures that will enhance technological innovation requires focusing on both the organization's inputs and its outputs
- Appropriate technical and market information inputs is required and their outputs need to be integrated toward mission objectives and transferred downstream toward their ultimate users

Market Inputs

- Research has demonstrated that 60-80% of successful technical innovations seem to have been initiated by activities responsive to “market pull”
- Recent IRI study of basic research in industry showed that “most innovations come about as a result of the recognition of a market need or opportunity. While the push of new technology is also important, it plays a distinctly secondary role.

Market Inputs

- Market gatekeepers frequently aid the technical organization to better understand its customers' requirements, priorities or preferences
- Company's own manufacturing activity can be a special prospective customer for innovations too
- If R&D's "market-orientated" ties to its own manufacturing group can be improved, the potential for significantly impacting company's performance is high

Market Inputs

- Strong & positive relations between R&D and marketing organization significantly improve the track record on new product introductions
- Market research helps to define consumer preferences but these methods have been less helpful for developing industrial goods
- Problem is to distinguish a customer demand that is truly in the vanguard of future broader market needs from the “cry for help”

Technical Inputs

- Technology push is a critical source of many significant product and process successes
- It is argued that if market pull is the key, market research should be more effective than it has proven to be!
- If technical advancement is the goal, a functional or discipline-based or specialist-orientated organization should be formed
- However, even a strong functional team needs to draw upon the pre-existing technical knowledge that is in the outside world for technical effectiveness

Technical Inputs

- An innovating organization might adopt or adapt technological solutions that already exist elsewhere for a new purpose
- One unique source of potential adoptions is the user where they create & implement innovations for their own use
- Technical organizations need to be designed to facilitate accessing these several different sources of technical information inputs

Output-focused organization

- The project, program, mission or product organization is intended to integrate all inputs toward well-defined outputs. By placing them in the same group, they would work towards achieving output goals
- To prevent the technical skills of the project members from eroding over time due to the fact that the technology base is always changing, there has been a creation of an organization that is intended as a “compromise”

Output-focused organization

- “Compromise” – technical performers are supposed to maintain active membership in 2 organizations, whereby both bosses will extract his appropriate “due”
- The influences that push a technologist’s time and attention toward competing sets of objectives would have to roughly balanced between those objectives
- For technical effectiveness, even a strong functional team needs to draw upon the pre-existing technical knowledge that is in the outside world

Output transfers

- Technical organization needs to be designed to enhance output transfer downstream toward eventual customers and users
- Downstream is where innovation takes place and where benefits are realized!
- 3 different clusters of bridging approaches were found helpful in increasing transfers

Output transfers

- **Procedural:** for e.g., joint planning of RD&E programs by the performing group and the organization that is expected to be the receiver, and joint project appraisal after project completion
- **Human bridges:** most effective. Can be upstream or downstream. For e.g., rotation programs, market gatekeepers etc
- **Organizational:** more complicated to design and implement. “integrators” are frequently appointed to tie together the sending and receiving organizations

Strategy planning

- focuses upon the formulation of an organization's goals and objectives, and upon developing the policies needed to achieve those objectives
- Primarily no overlapping set of strategic issues and priorities among 3 modes (small product, multi-product firm, multi-organization)

Strategy planning

- What are the underpinnings of technological change should an overall technology strategy should be based on?
 1. Characteristic patterns over the life cycle of a technology in how frequent product versus process innovations occur
 2. Stage of a technology
 - Fluid: freq product innovations
 - Transition: significant innovation and emergence of a dominant product design
 - Specific: lower rate of and more minor product and process innovations
 3. organization's efforts to generate technological innovation

Strategy planning

- Each stage of a technology is associated with different strategic implications.
 1. Earliest: feature freq major product innovations.
 2. Intermediate: major process innovation, with continuing but lessened product variation occurring, with increasing numbers of competitors.
 3. Late: less freq minor product and process innovations, mainly by large corporations, motivated mostly by cost reduction and quality improvement operational objectives.

Strategy planning

- A company's detailing of its product innovation charter or its application of project selection principles or techniques as part of technology planning, should reflect at least general consideration of the current stages of its principal technologies
- Technological forecasting and project selection techniques principally enhance tactical and operational aspects of technology planning and management.
- An e.g. can be competitive product profiling

Strategy Implementation

- Tactics and operations are the means of implementation of strategy
- Venture approaches have been a unique means for implementing overall strategies seeking accelerated technology-based new business development for growth and/or diversification
- It is become increasingly attempted by companies and even countries as part of their strategies for intensifying their technological industrial base

Strategy Implementation

- The further the new area is from the firm's base "familiar" business, the less resource-intensive the venture approach to be taken
- The more successful small high-technology companies tend to pursue product development strategies that are focused upon moderate degrees of technological and market change
- Government regulatory activities in regard especially to health and safety have had significant positive and negative influences on technological innovation
- The variety of alternatives facing governments for influencing technological change are equivalent to the corporate venture alternatives mentioned earlier

Conclusion

- **Managing at the creativity phase is not enough, nor is managing manufactured quality sufficient, nor is managing that is focused primarily upon any other single aspect of innovation**
- **Market technology linkages, effective program management, government intervention and appropriate goal-setting, planning and risk-taking for firms are important**
- **Technological innovation's purposeful management is complex, involving the effective integration of people, organizational processes and plans**
- **Both academics and technology managers need to join in this continuing search for clearer managerial insights about technological invention and innovation and more effective organizational performance**