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# Management of Innovation in R&D

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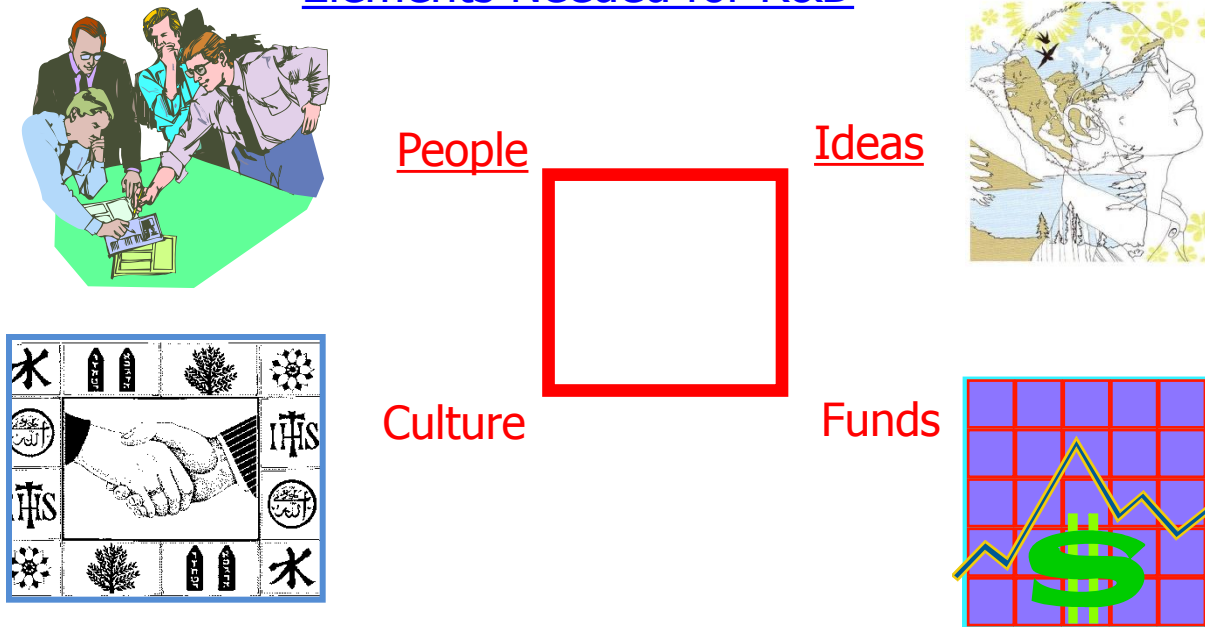
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# Table of Contents

- Components required for an R&D organization
- R&D Investment and innovation
- R&D return on investment
- Inventor, Innovator, and Entrepreneur (or Intrapreneur)
- Why understanding innovation is important?
- Creative thinking
- Creativity and innovation implementation
- Team innovation
- Team-level creative personality and team composition
- Climate for innovation and its four dimensions
- A framework for innovation in R&D
- Conclusions

# Components Required for R&D Organization

## Elements Needed for R&D

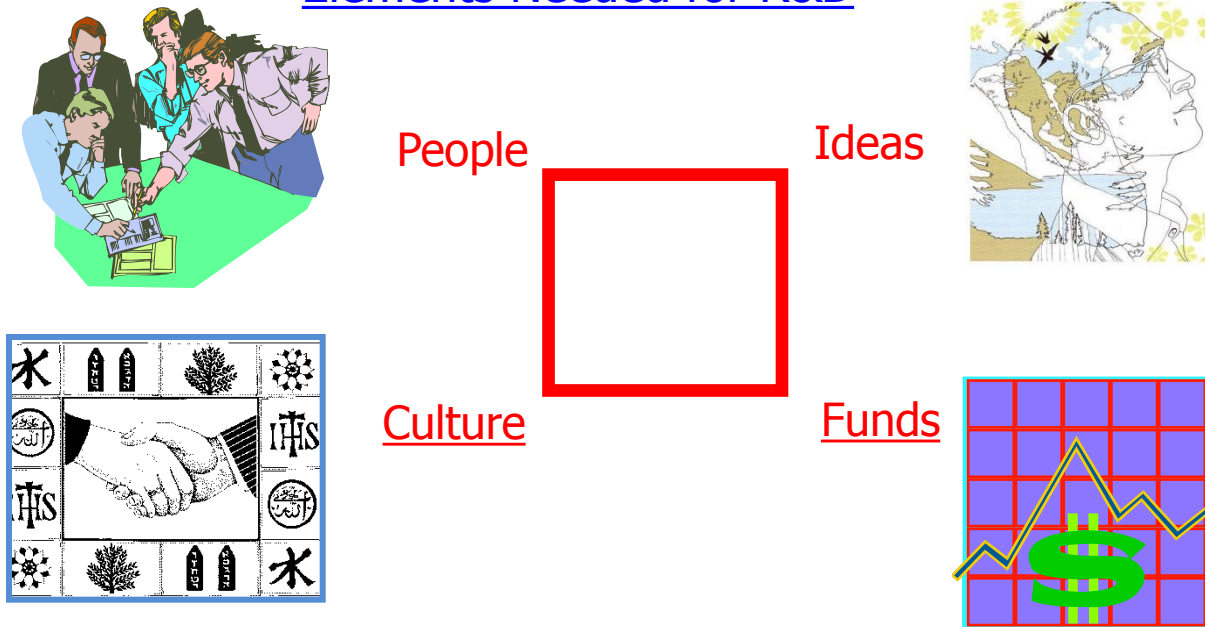


- Creative **people** have
  - bright **ideas**
  - and skills to do **research**

Ideas + Research = translate into useful products
- **People** must be organized into structures that allow effective cooperation
- Certain blend of **people** work better than the others

# Components Required for R&D Organization

## Elements Needed for R&D



- To ensure smooth operations, we need:
  - Beliefs, norms, and values, or, in other words, organizational culture that favors
    - Creativity
    - Innovation
- Lastly, not least, need **FUNDS**

# R&D Investment and Innovation

|    | Company              | R&D expenditures 2007 (\$ million) | CAGR 1997–2007 (in %) | Former rank R&D 1997 |     | Company                | R&D expenditures 2007 (\$ million) | CAGR 1997–2007 (in %) | Former rank R&D 1997 |
|----|----------------------|------------------------------------|-----------------------|----------------------|-----|------------------------|------------------------------------|-----------------------|----------------------|
| 1  | Microsoft            | 8 164                              | 14.0                  | 32                   | 51  | Denso                  | 2 505                              | 7.1                   | 59                   |
| 2  | General Motors       | 8 100                              | -0.1                  | 1                    | 52  | BT                     | 2 492                              | 16.1                  | 109                  |
| 3  | Pfizer               | 8 089                              | 13.9                  | 31                   | 53  | NTT                    | 2 435                              | -0.4                  | 19                   |
| 4  | Toyota Motor         | 7 974                              | 7.8                   | 6                    | 54  | Philips Electronics    | 2 345                              | 1.4                   | 28                   |
| 5  | Nokia Finland        | 7 721                              | 20.3                  | 68                   | 55  | Hyundai Motor          | 2 343                              | 24.7                  | 201                  |
| 6  | Johnson & Johnson    | 7 680                              | 12.3                  | 26                   | 56  | Fujitsu                | 2 274                              | -1.6                  | 13                   |
| 7  | Ford Motor           | 7 500                              | 1.5                   | 2                    | 57  | Texas Instruments      | 2 155                              | 3.1                   | 41                   |
| 8  | Roche                | 7 325                              | 12.5                  | 29                   | 58  | SAP                    | 2 132                              | 15.1                  | 112                  |
| 9  | Volkswagen           | 7 198                              | 10.3                  | 20                   | 59  | Google                 | 2 120                              |                       |                      |
| 10 | Daimler              | 7 147                              | 7.7                   | 8                    | 60  | Procter & Gamble       | 2 112                              | 4.6                   | 53                   |
| 11 | Sanofi-Aventis       | 6 671                              | 5.6                   |                      | 61  | BASF                   | 2 046                              | 3.4                   | 46                   |
| 12 | Samsung Electronics  | 6 489                              | 21.8                  |                      | 62  | Volvo                  | 2 029                              | 5.8                   | 61                   |
| 13 | GlaxoSmithKline      | 6 461                              | 11.8                  | 34                   | 63  | Sun Microsystems       | 2 023                              | 8.5                   | 78                   |
| 14 | Novartis             | 6 414                              | 8.8                   | 18                   | 64  | Delphi                 | 2 000                              |                       |                      |
| 15 | Intel                | 5 755                              | 8.5                   | 21                   | 65  | AMD                    | 1 847                              | 13.3                  | 110                  |
| 16 | IBM                  | 5 747                              | 2.6                   | 4                    | 66  | Qualcomm               | 1 829                              | 20.4                  | 178                  |
| 17 | Robert Bosch         | 5 205                              | 10.0                  | 36                   | 67  | LG Electronics         | 1 802                              |                       |                      |
| 18 | Matsushita Electric  | 5 175                              | 4.0                   | 7                    | 68  | EMC                    | 1 767                              | 20.8                  | 187                  |
| 19 | AstraZeneca          | 5 042                              | 7.9                   |                      | 69  | Takeda Pharmaceuticals | 1 730                              | 10.9                  | 98                   |
| 20 | Honda Motor          | 4 940                              | 8.9                   | 30                   | 70  | Nortel Networks        | 1 723                              | -2.0                  |                      |
| 21 | Alcatel-Lucent       | 4 924                              | 9.4                   |                      | 71  | Infineon Technologies  | 1 709                              |                       |                      |
| 22 | Siemens              | 4 921                              | 0.7                   | 3                    | 72  | STMicroelectronics     | 1 705                              | 10.8                  |                      |
| 23 | Merck                | 4 883                              | 10.1                  | 38                   | 73  | Sharp                  | 1 699                              | 5.3                   | 70                   |
| 24 | Sony                 | 4 869                              | 7.6                   | 24                   | 74  | United Technologies    | 1 678                              | 3.2                   | 58                   |
| 25 | BMW                  | 4 597                              |                       |                      | 75  | Nestle                 | 1 656                              | 10.8                  | 102                  |
| 26 | Cisco Systems        | 4 499                              | 12.7                  | 57                   | 76  | Merck                  | 1 642                              | 12.8                  | 117                  |
| 27 | Motorola             | 4 429                              | 4.4                   | 12                   | 77  | Fuji Film              | 1 584                              | 9.5                   | 94                   |
| 28 | Ericsson             | 4 256                              | 3.0                   | 10                   | 78  | NXP                    | 1 547                              |                       |                      |
| 29 | Nissan Motor         | 4 161                              |                       |                      | 79  | Daiichi Sankyo         | 1 527                              | 17.2                  | 167                  |
| 30 | EADS                 | 3 949                              |                       |                      | 80  | Astellas Pharma        | 1 503                              | 8.0                   |                      |
| 31 | Bayer                | 3 867                              | 5.2                   | 23                   | 81  | Honeywell              | 1 459                              | 11.3                  | 113                  |
| 32 | Boeing               | 3 850                              | 6.5                   | 33                   | 82  | Novo Nordisk           | 1 457                              | 12.4                  | 127                  |
| 33 | Hitachi              | 3 693                              | -0.5                  | 5                    | 83  | Caterpillar            | 1 404                              | 9.3                   | 104                  |
| 34 | Hewlett-Packard      | 3 611                              | 1.4                   | 9                    | 84  | Broadcom               | 1 349                              |                       |                      |
| 35 | Renault              | 3 600                              | 8.2                   | 42                   | 85  | DuPont                 | 1 338                              | -5.9                  | 16                   |
| 36 | Toshiba              | 3 527                              | 2.9                   | 17                   | 86  | France Telecom         | 1 307                              | 3.5                   | 73                   |
| 37 | Eli Lilly            | 3 487                              | 8.7                   | 49                   | 87  | Dow Chemical           | 1 305                              | 4.7                   | 81                   |
| 38 | Canon                | 3 296                              | 8.7                   | 50                   | 88  | Safran                 | 1 297                              |                       |                      |
| 39 | Bristol-Myers Squibb | 3 282                              | 8.1                   | 47                   | 89  | Medtronic              | 1 275                              | 14.7                  | 161                  |
| 40 | Amgen                | 3 266                              | 16.1                  | 89                   | 90  | Unilever               | 1 269                              | 3.2                   | 72                   |
| 41 | Wyeth                | 3 257                              | 7.6                   |                      | 91  | Continental            | 1 231                              |                       |                      |
| 42 | Peugeot (PSA)        | 3 032                              | 10.5                  | 66                   | 92  | Telstra                | 1 231                              | 36.2                  |                      |
| 43 | General Electric     | 3 009                              | 6.6                   | 43                   | 93  | Lockheed Martin        | 1 206                              | 3.9                   | 80                   |
| 44 | NEC                  | 2 995                              | 1.0                   | 14                   | 94  | Royal Dutch Shell      | 1 201                              | 5.5                   | 87                   |
| 45 | Schering-Plough      | 2 926                              | 11.9                  | 75                   | 95  | Yahoo!                 | 1 195                              | 59.6                  |                      |
| 46 | Finnmeccanica        | 2 858                              |                       |                      | 96  | Mitsubishi Electric    | 1 188                              | -1.9                  | 44                   |
| 47 | Oracle               | 2 741                              | 15.6                  | 97                   | 97  | Valco                  | 1 155                              | 11.7                  | 137                  |
| 48 | Fiat                 | 2 545                              | 6.8                   | 54                   | 98  | Electronic Arts        | 1 145                              | 25.5                  |                      |
| 49 | Boehringer Ingelheim | 2 529                              | 10.5                  | 76                   | 99  | Applied Materials      | 1 142                              | 5.6                   | 90                   |
| 50 | Abbott Laboratories  | 2 506                              | 6.1                   | 51                   | 100 | UCB                    | 1 142                              |                       |                      |

Ranking of the world's 100 largest R&D corporations

| Company |                     | Rank R&D expenditures 2007 | Primary reason for selection                                         |
|---------|---------------------|----------------------------|----------------------------------------------------------------------|
| 1       | Apple               | 124                        | Breakthrough products                                                |
| 2       | Google              | 54                         | Unique customer experiences                                          |
| 3       | Toyota Motor        | 4                          | Innovative processes                                                 |
| 4       | General Electric    | 43                         | Innovative processes                                                 |
| 5       | Microsoft           | 1                          | Breakthrough products                                                |
| 6       | Tata Group          | 295                        | Breakthrough products                                                |
| 7       | Nintendo            | 272                        | Breakthrough products                                                |
| 8       | Procter&Gamble      | 60                         | Innovative processes                                                 |
| 9       | Sony                | 24                         | Breakthrough products                                                |
| 10      | Nokia               | 5                          | Breakthrough products                                                |
| 11      | Amazon              | 114                        | Unique customer experiences                                          |
| 12      | IBM                 | 15                         | Innovative processes                                                 |
| 13      | Research in Motion  | 261                        | Breakthrough products                                                |
| 14      | BMW                 | 25                         | Unique customer experiences                                          |
| 15      | Hewlett-Packard     | 34                         | Innovative processes/new business models/Unique customer experiences |
| 16      | Honda Motor         | 20                         | Breakthrough products                                                |
| 17      | Disney              |                            | Unique customer experiences                                          |
| 18      | General Motors      | 2                          | Breakthrough products                                                |
| 20      | Boeing              | 32                         | Breakthrough products                                                |
| 22      | 3 M                 | 138                        | Breakthrough products                                                |
| 26      | Samsung Electronics | 12                         | Breakthrough products                                                |
| 27      | AT&T                | 107                        | Unique customer experiences                                          |
| 29      | Audi                |                            | Breakthrough products                                                |
| 31      | Daimler             | 10                         | Breakthrough products                                                |
| 35      | Cisco               | 26                         | Breakthrough products                                                |
| 38      | Siemens             | 22                         | Breakthrough products                                                |
| 42      | Exxon Mobil         | 135                        | Innovative processes                                                 |
| 44      | BP                  | 173                        | Innovative processes                                                 |
| 45      | Nike                |                            | Unique customer experiences                                          |
| 46      | Dell                | 166                        | New & differentiated business models                                 |
| 47      | Vodafone            | 205                        | New & differentiated business models                                 |
| 48      | Intel               | 15                         | Breakthrough products                                                |

Source: BCG Senior Executive Innovation Survey (2008, 21)

BCG Ranking of the Most Innovative Global Companies

- Large investment in R&D is a critical requirement for success, but it is not a sufficient condition



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# R&D Return on Investment

- Important positive effect on economic growth
- Nevertheless, R&D activity renders, on average, a 20 to 30 percent annual return on private (industrial) investments.

| Estimated annual rates of return to R&D expenditures |                             |
|------------------------------------------------------|-----------------------------|
| Author(s) and year of study                          | Rate of return <sup>a</sup> |
| <b>Firm-level studies</b>                            |                             |
| Link (1983)                                          | 3                           |
| Bernstein-Nadiri (1989b)                             | 7                           |
| Schankerman-Nadiri (1986)                            | 13                          |
| Lichtenberg-Siegel (1991)                            | 13                          |
| Bernstein-Nadiri (1989a)                             | 15                          |
| Clark-Griliches (1984)                               | 19                          |
| Griliches-Mairesse (1983)                            | 19                          |
| Jaffe (1986)                                         | 25                          |
| Griliches (1980)                                     | 27                          |
| Mansfield (1980)                                     | 28                          |
| Griliches-Mairesse (1984)                            | 30                          |
| Griliches-Mairesse (1986)                            | 33                          |
| Griliches (1986)                                     | 36                          |
| Schankerman (1981)                                   | 49                          |
| Minasian (1969)                                      | 54                          |
| <b>Industry-level studies</b>                        |                             |
| Terleckyj (1980)                                     | 0                           |
| <sup>b</sup> Griliches-Lichtenberg (1984a)           | 4                           |
| Patel-Soete (1988) <sup>c</sup>                      | 6                           |
| Mohnen-Nadiri-Prucha (1986)                          | 11                          |
| Terleckyj (1974)                                     | 15                          |
| Wolff-Nadiri (1987)                                  | 15                          |
| Sveikauskas (1981)                                   | 16                          |
| Bernstein-Nadiri (1988)                              | 19                          |
| Link (1978)                                          | 19                          |
| Griliches (1980)                                     | 21                          |
| Bernstein-Nadiri (1991)                              | 22                          |
| Scherer (1982, 1984)                                 | 36                          |



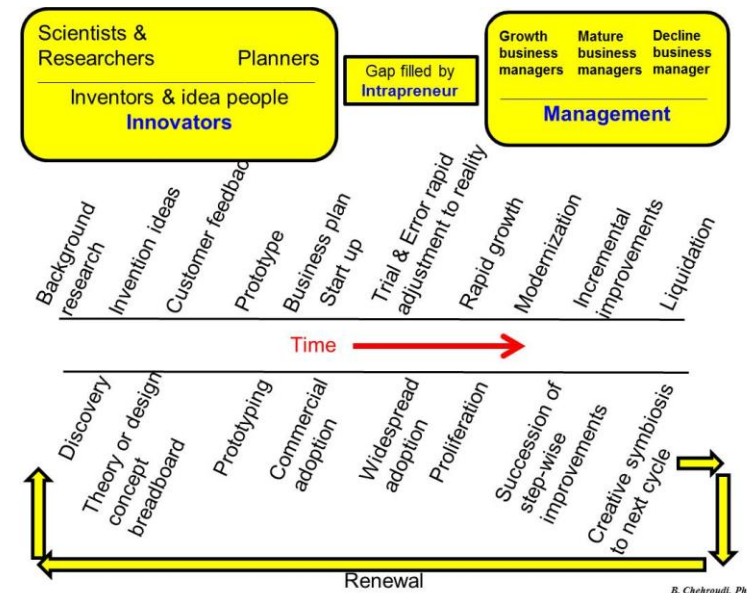
<sup>a</sup>For studies for which Nadiri (1993) reports a range of possible returns, the midpoint of that range is provided in this table.

<sup>b</sup>Not significantly different from zero in a statistical sense. This result, however, may be a reflection of limitations in the quantity of data used in the study.

<sup>c</sup>Economy-level study (all industries grouped together). SOURCE: M.J. Nadiri, "Innovations and Technological Spillovers," Working Paper No. 4423 (Cambridge, MA: National Bureau of Economic Research,

# Inventor, Innovator, and Entrepreneur (or Intrapreneur)

- **Inventor:** Creates new knowledge or new ideas.
- **Innovator:** One of the first to introduce into reality something better than before.
- **Intrapreneurs:** A person within a large corporation who takes direct responsibility for turning an idea into a profitable finished product through assertive risk-taking and innovation.
  - The intrapreneur may be the creator or inventor but *is always the visionary who pursues how to turn an idea into a profitable reality.*
- Entrepreneurship/Intrapreneurship and innovation are not confined to the initial stages of a new venture.



# Why is Understanding Innovation Important ?

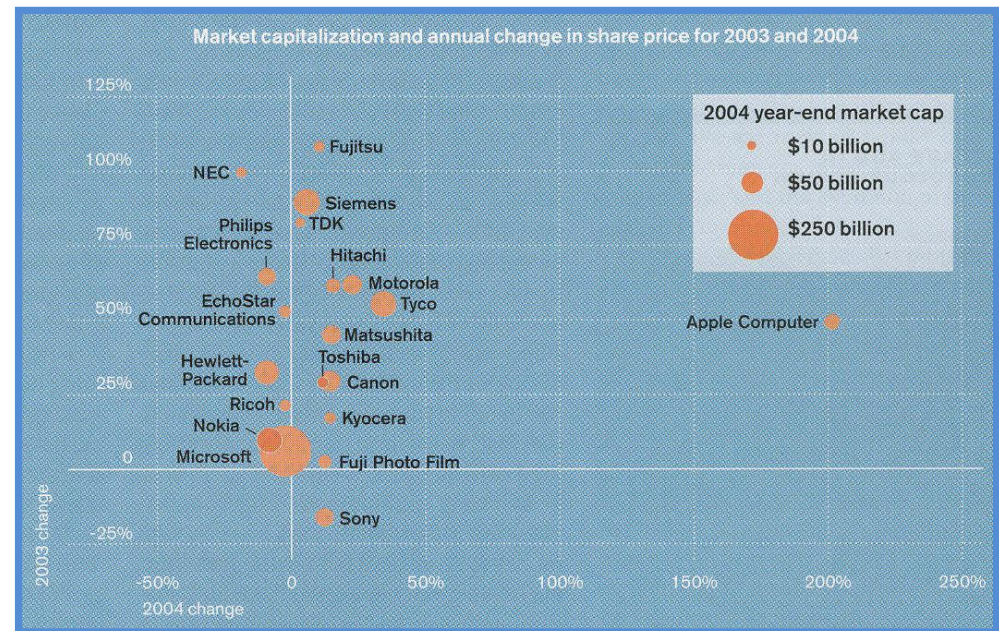
- Scientific breakthroughs and innovative thinking have given us so many useful products
- To maximize the corporation's success rate, efficiency, and speed on R&D and commercialization
- Affects bottom line
- Highly competitive global economy
- For the good of the human race

## iPod Impact

A look at the performance of the top 20 consumer electronics stocks shows just how far the iPod apparently pulled Apple Computer away from the pack.

Apple registered a 201% appreciation in share price in 2004, on top of a 49% appreciation in 2003. (Microsoft's stock was flat in both years.)

Sales of 4.6 million iPods during the last three months of 2004 helped drive Apple to \$3.5 billion in quarterly revenue – the highest ever recorded by the company

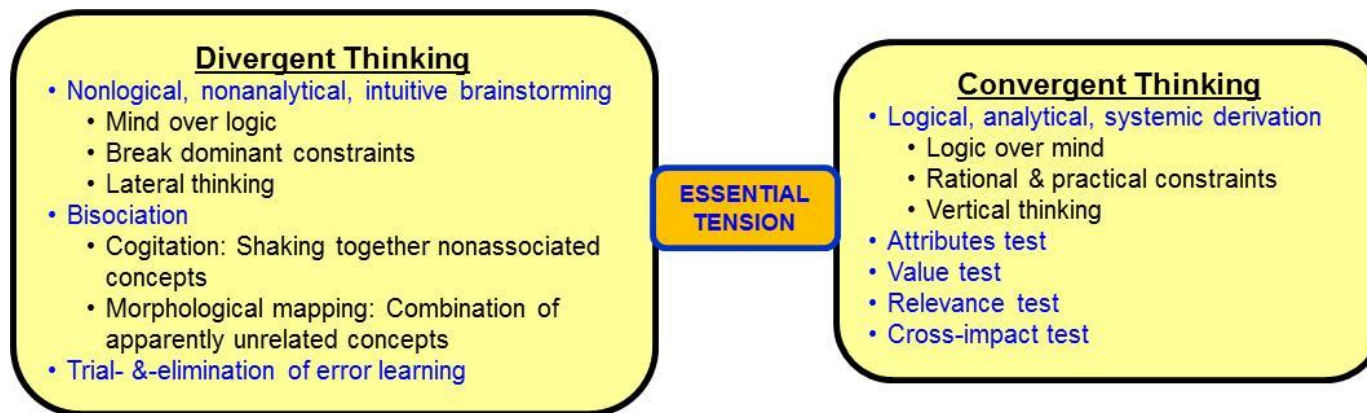
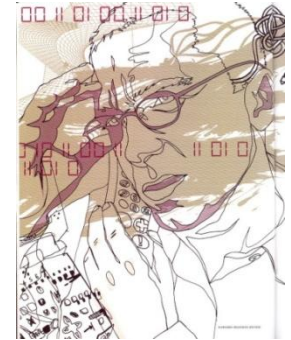


Top 20 consumer electronics stocks based on market capitalization as of Dec 31, 2004. Source: Revere Research

B. Chehroudi, PhD; Advanced Technology Consultants; Chehroudib@aol.com

# Creative Thinking

- Innovation is initiated and enacted through the **wisdom, insight, and efforts of a team of talented human beings.**
- **Relating the processes of innovation and creative thinking.**
- Hudson (1966) dissected creative thinking into **divergent** and **convergent** thinking.

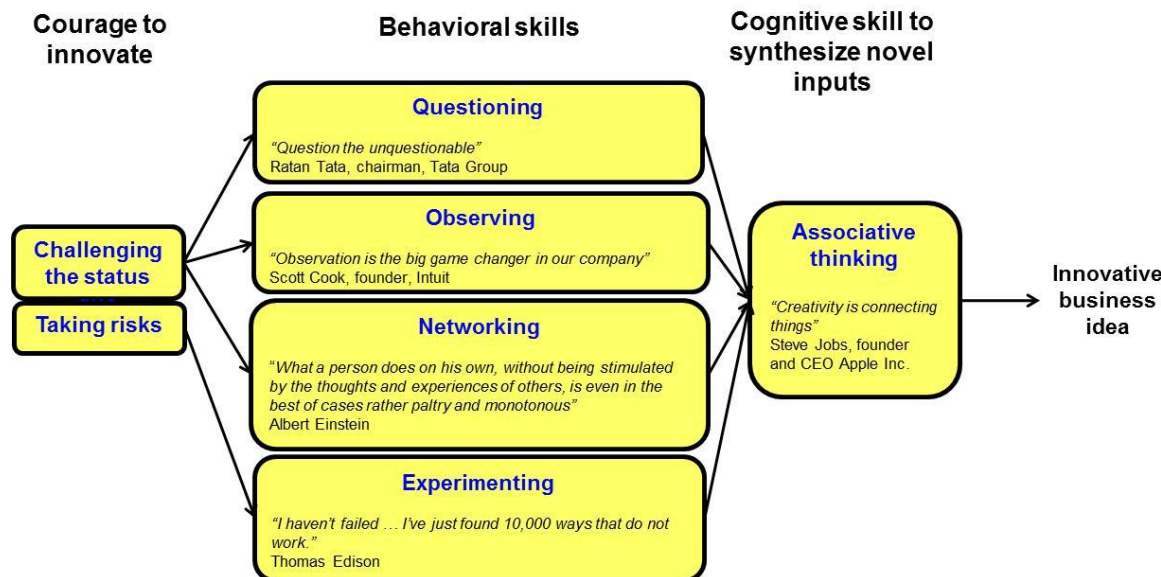
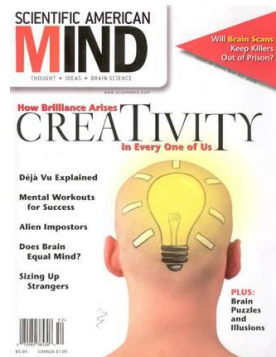


Basic Elements in **Creative Thinking Process** based on Kuhn (1963), Green (1964), Koestler (1969), and Martin (1984)

Bisociation: the simultaneous mental association of an idea or object with two fields ordinarily not regarded as related  
Cogitation: The process of cogitating; thought, deliberation or mediation; attentive consideration and mediation

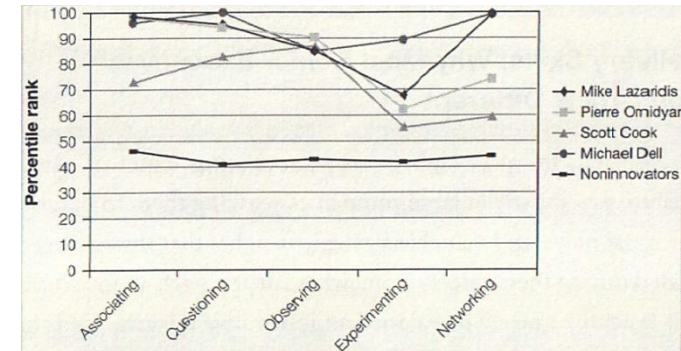
# Creative Thinking

- Although genetic factor is still there, it is not a dominant predictor.
- If innovators can be made and not just born, how then do they come up with great ideas? *Courage to Innovate and Discovery Skills.*
- Generally, it was observed that “associating” and “questioning” behaviors are very high in (disruptive) innovators.



**Discovery skills:** Associative thinking, Questioning, Observing, Networking, and Experimenting

*"The Innovator's DNA", Dyer et al.*



High-profile innovator's discovery skills profile

|            |                          |
|------------|--------------------------|
| Omidyas:   | Founder of eBay          |
| Dell:      | Founder of Dell Computer |
| Lazaridis: | Founder of BlackBerry    |
| Cook:      | Founder of Intuit        |

# Why Innovative Leaders Make a Difference

## Why Innovative Leaders Make a Difference

It is a known fact now as to how Steve Jobs got key ideas for the Macintosh computer (mouse and GUI interface) during his pivotal visit to Xerox PARC. He recalled being shown a rudimentary graphical user interface (GUI). It was incomplete, some of it wasn't even right, but *the germ of the idea was there*. Jobs assembled a team of brilliant engineers, gave them the needed resources, and infused the Macintosh team with a vision of what was possible. *That's what an innovative leader does*.

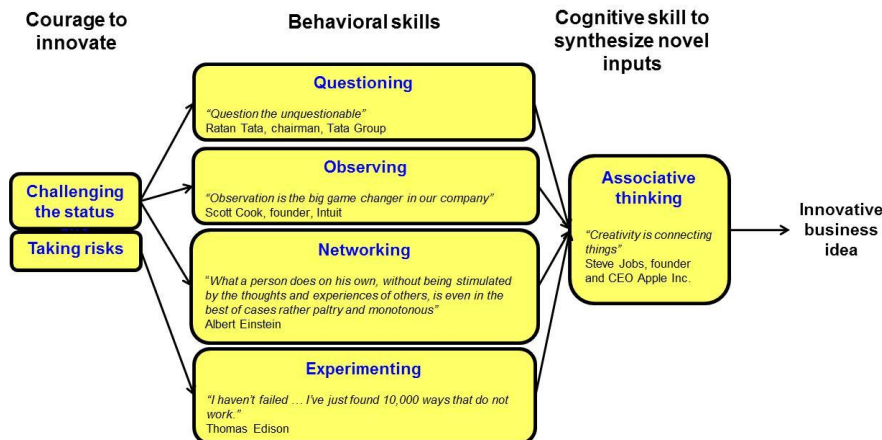
In stark contrast, *the executive team at Xerox lacked the discovery skills* necessary to exploit technologies developed in their own company. As PARC scientist Larry Tesler observed, after an hour looking at demos, they [Jobs and Apple programmers] understood our technology and what it meant, more than any Xerox executive understood after years of showing it to them.<sup>a</sup>

Jobs agreed with Tesler, saying, "Basically they were copier heads that just had no clue about a computer or what it could do." And so they just grabbed defeat from the greatest victory in the computer industry. *Xerox could have owned the entire computer industry today.*<sup>b</sup> No wonder Tesler left PARC and joined Apple. *Innovators want to work with and for other innovators*.

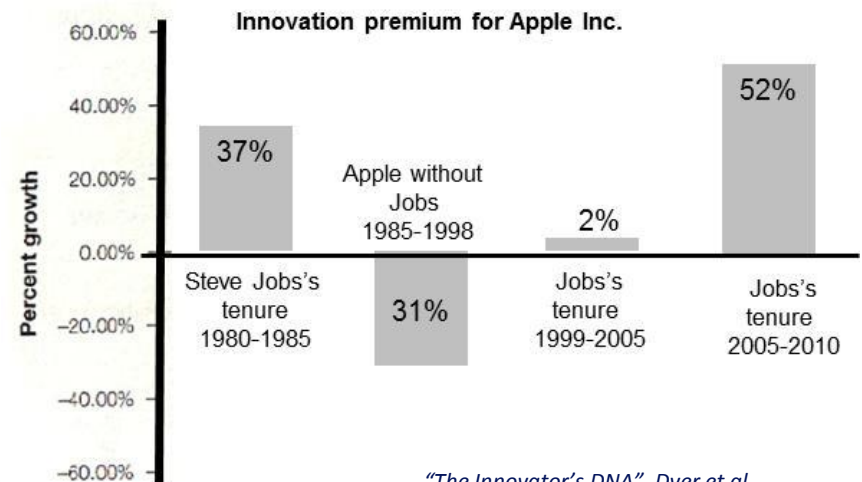
Moreover, *companies with innovative leaders* are much more likely to devote the resources required to pursue potentially revolutionary ideas.

a. Robert X. Cringely, *Triumph of the Nerds*, PBS documentary, New York 1996.

b. Ibid.

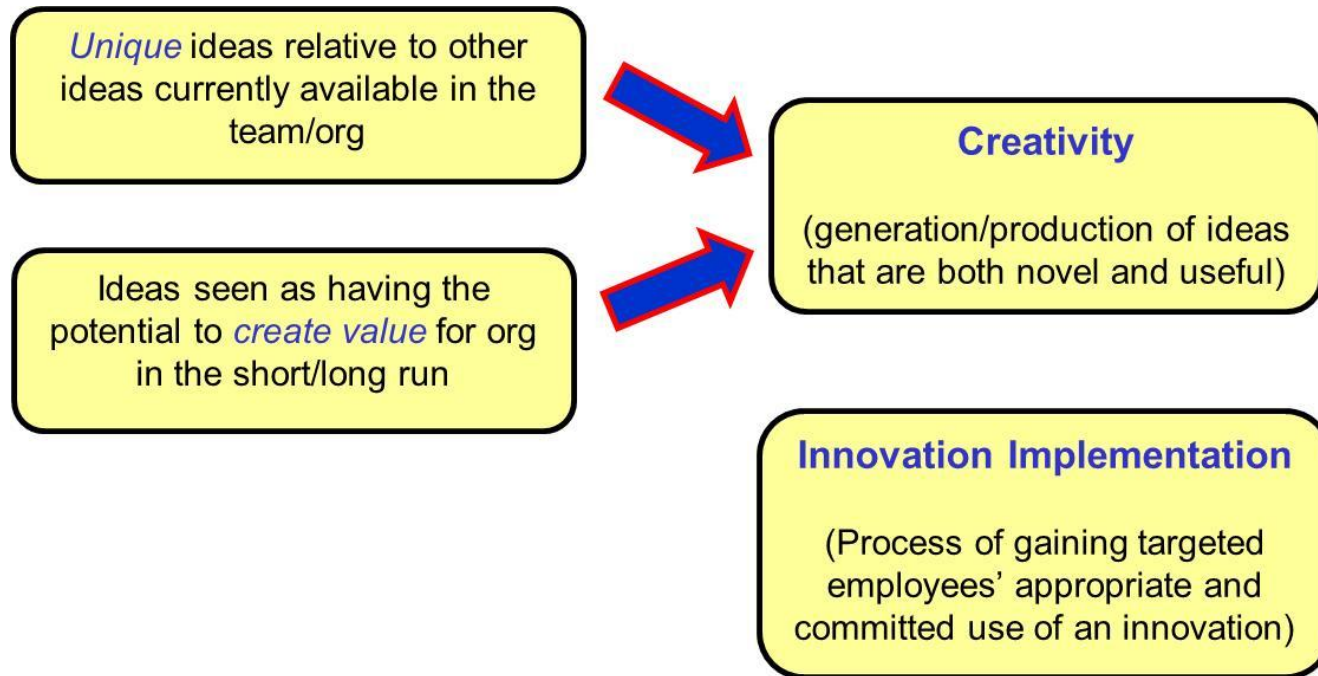


**Discovery skills:** Associative thinking, Questioning, Observing, Networking, and Experimenting



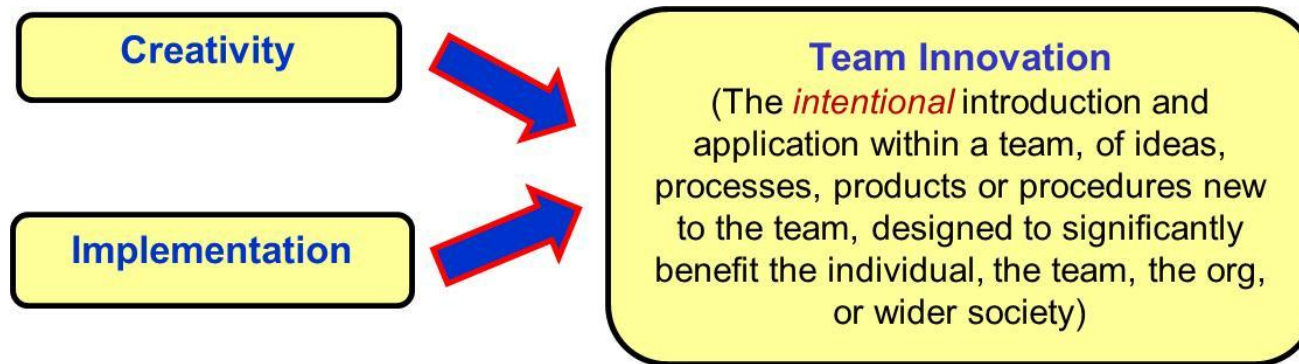
"The Innovator's DNA", Dyer et al.

# Creativity and Innovation Implementation



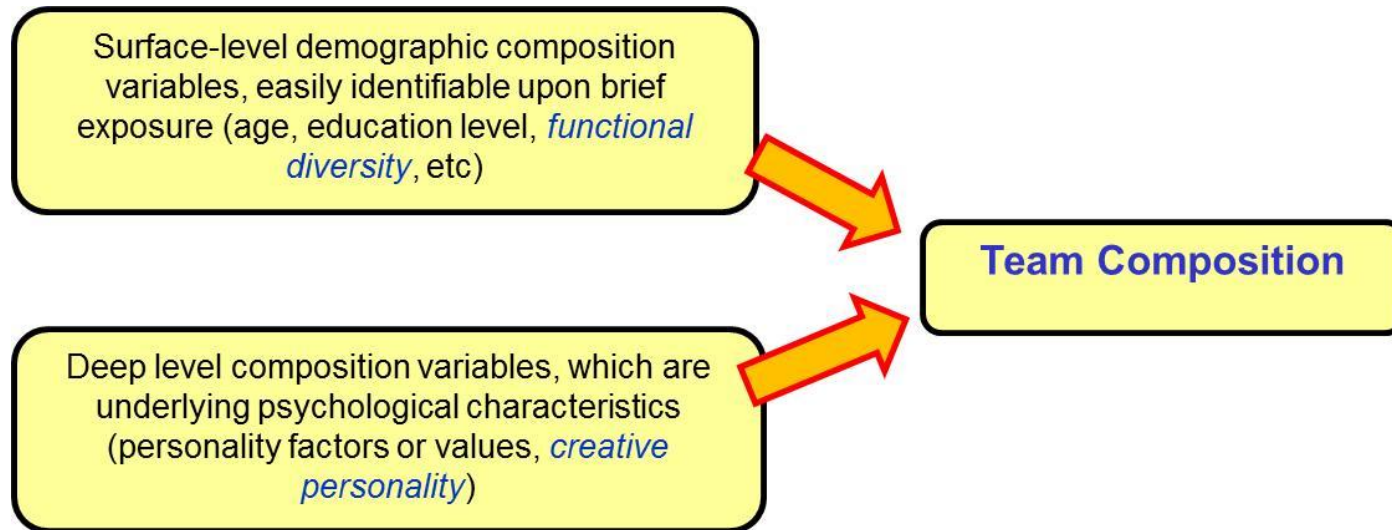
- **Innovation:** Not only having a good idea, but also developing that idea beyond its initial state
- **Innovation** is to be considered as a complex interaction of person (or team) and situation (or context)

# What is meant by Team Innovation Here?



- *Team innovation* is not the simple aggregate of all team members' creativity, although it is clearly a function of the creativity of individuals on the team.
- *Team innovation* is also influenced by
  - Team functional **composition**,
  - Team **processes**, and
  - **Context** (context may facilitate or inhibit innovative accomplishments)

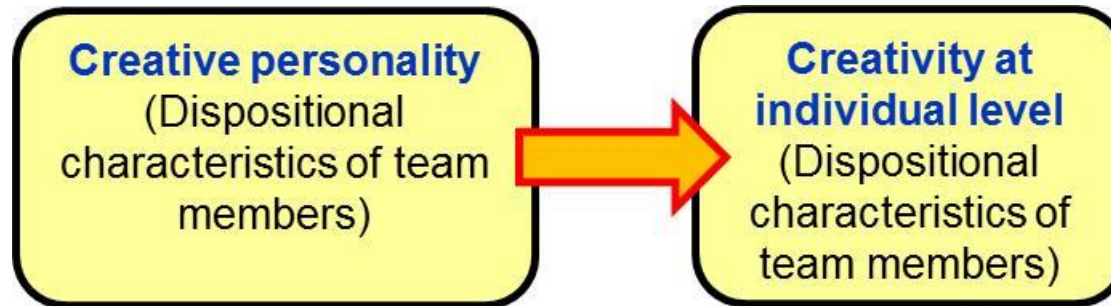
# What Constitutes a Team Composition?



- Focus here is on *Functional Diversity* and *Creative Personality*
- Recent team creativity research showed critical role of
  - Exposure to various perspectives, knowledge, and experiences, as well as to unusual ideas, in promoting team creativity.

*Drach-Zahavy & Somech, 2002; Taggar, 2002*

# Creative Personality



- **Creative personality:**
  - Generate **many alternative solutions** to an open-ended problem
  - Approach problems with **an open mind**, allowing the individual to recognize divergent information and opinions
  - **Self-confidence** and tolerance for ambiguity
  - **Patience** with competing views, and
  - **Persistence** in developing original ideas

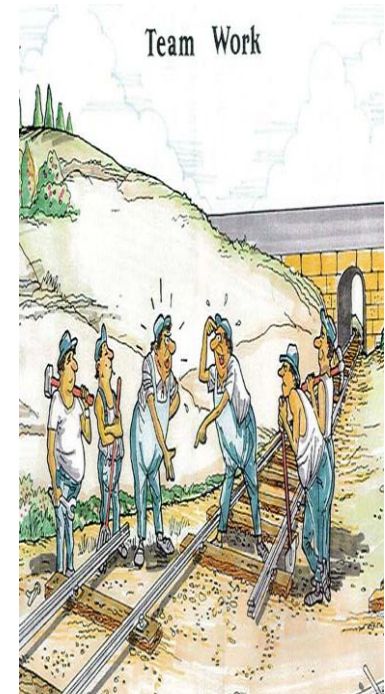
# Team-Level Creativity

- Teams that are able to **rely on each other's resources** perform at a higher level (shown in research studies).
- **Working with highly creative members** creates circumstances in which other team members become exposed to divergent information and opinions and to a variety of unusual ideas.
- Moreover, **observing creative models** allows individuals to acquire relevant strategies and approaches that enable them to exhibit higher creativity in the team context.
- In addition, **highly creative members can help the team develop attitudes and behaviors** such as persistence or tolerance of ambiguity in the work environment that are crucial to promoting team creativity



# Functional Heterogeneity

- Creativity can be fostered in the work group itself, through *diversity in team members' roles*
- Functionally heterogeneous teams collect people from *different disciplines/functions who have relevant expertise*
- This kind of diversity might contribute to team creativity in several different ways.
  - First, assembling people with different org roles, who have *a broad set of skills, knowledge, and expertise*, aids the team in solving the complex task of developing new products or procedures
  - Second, functionally heterogeneous teams *carry variety of vocabularies, cognitive patterns, and styles* which may operate on creativity by exposing individuals to a greater variety of unusual ideas;
  - Third, team diversity triggers *communication with members outside the team*, which in turn leads to the incorporation of diverse kinds of information, broadens team members' perspectives and facilitates the generation of new approaches and ideas



# Role of Climate for Innovation

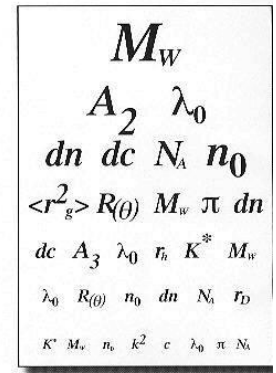
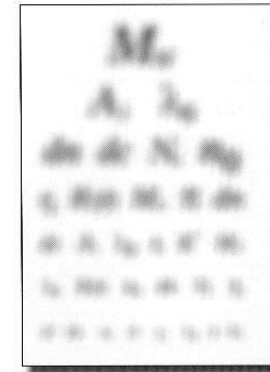
- Researchers showed that the **success/failure of a team strongly depends on the team's context** or environment
- Innovating teams are required **not only to develop/explore new ideas but also to align team members to the implementation of these creative ideas.**
- Maximizing the conditions fostering creativity is **unlikely** to turn directly into innovation implementation
- A **climate for innovation**, which is a team-level concept of **how far a team's values and norms emphasize innovation**, will function as a critical factor in enhancing the implementation stage of innovations.
- It is expected that team creativity and climate for innovation to coordinate together to positively affect innovation implementation.
  - It is suggested that the climate for innovation will **moderate the relationship** between **team creativity** and **team innovation implementation**.



# Four Dimensions of Climate for Innovation

## 1. Vision

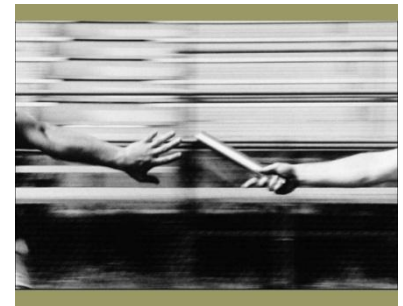
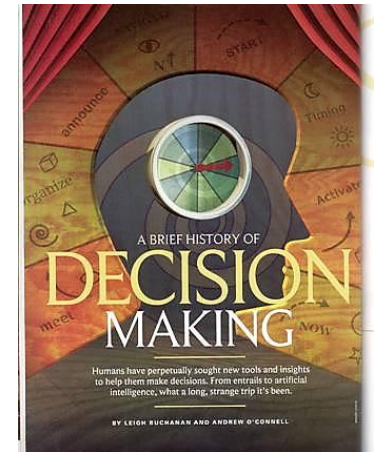
- “*is an idea of a valued outcome, which represents a higher order goal and motivating force at work*” (West, 1990: 310)
- Teams with “**clearly defined objectives**” are more likely to develop new goal-appropriate methods of working
- Hence, **teams with high vision (i.e., clear org goals, goals perceived attainable, and members feel committed to them)** will be more likely to implement their creative ideas than teams with vague/abstract vision



# Four Dimensions of Climate for Innovation

## 2. Safety in participation

- Participation in **decision making**
- Speaking up and **taking risk**
  - **Non-threatening psychological atmosphere**
  - Filled with **trust and mutual respect**
  - As problem develops during the implementation phase,
    - members need to collaborate more and must be able to venture to suggest new ways of working and to come up with alternative problem-solving approaches.
    - Hence, **a climate where it is safe to speak up and take risks** complements the implementation of team creativity



# Four Dimensions of Climate for Innovation

3. **Task orientation** (this do not specifically relates to innovation but reflects a more general concern with excellence)
- Means team members sharing concern for achieving a good standard of performance
  - **Excellence in task performance** is characterized by
    - Evaluation
    - Modification
    - Control systems
    - Critical appraisals
  - Teams are willing to **work harder** when there is high level of **task orientation** and more likely to overcome hurdles during the implementation phase



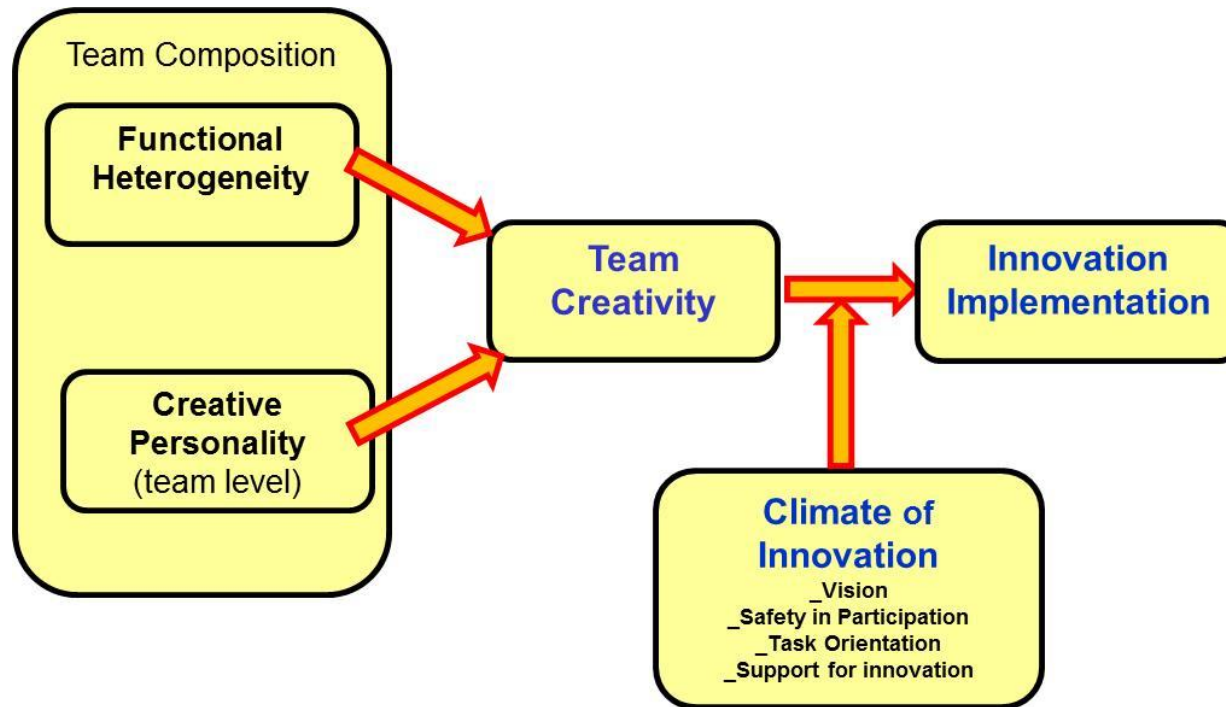
# Four Dimensions of Climate for Innovation

## 4. Support for innovation

- Means the **expectation, approval, and practical support for efforts to introduce new and improved ways of doing things** in the work environment
- Support for innovation can be
  - **Articulated** in personnel documents, policy statements, or words of mouth
  - **Enacted** by act or promotion of innovative behavior
  - Obviously, practical support is required to implement new products or methods
  - **Perception of the adequacy of resources** may affect team members psychologically by leading to beliefs about the intrinsic value of the projects they have undertaken



# Components of the Framework

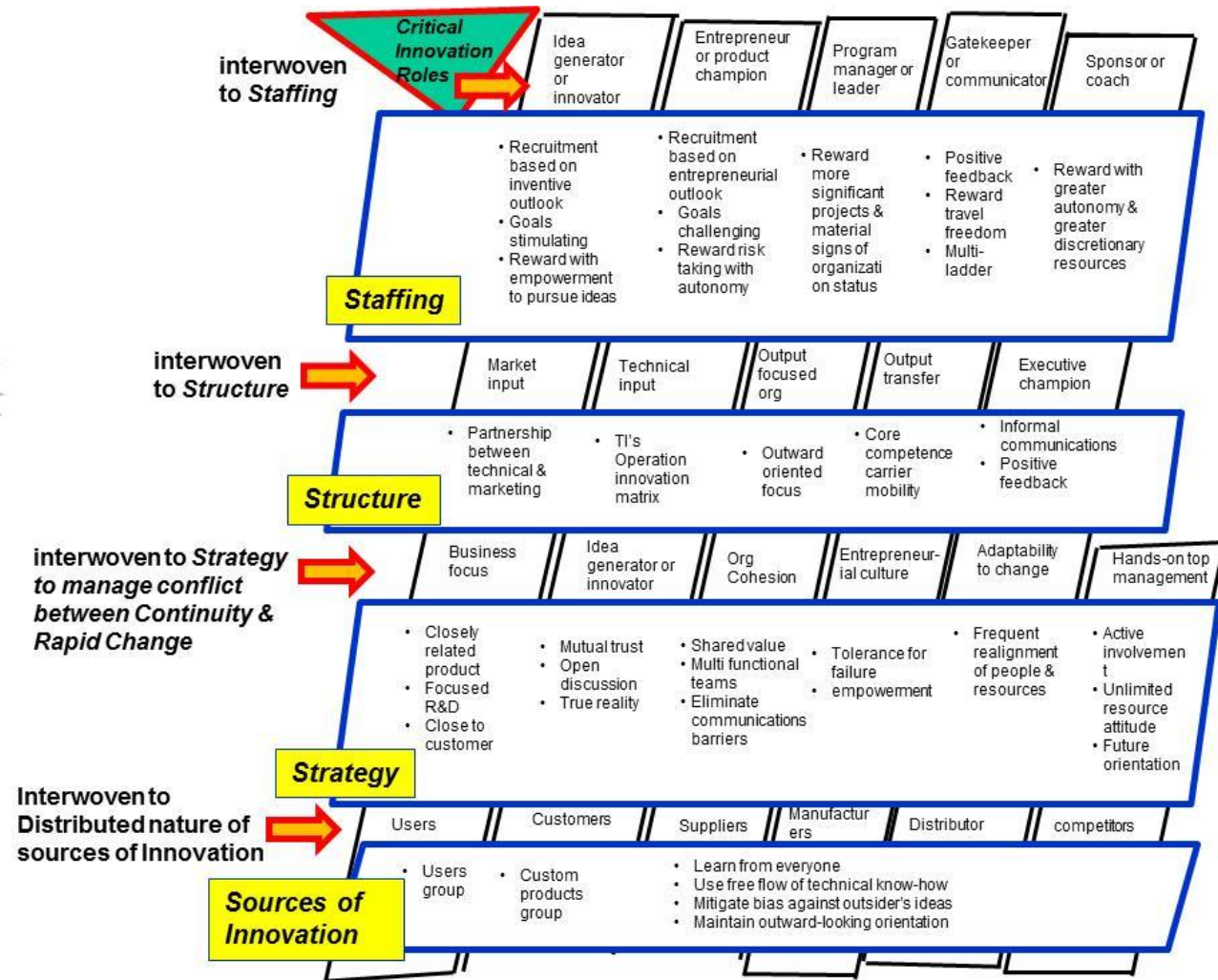


- Team composition has **indirect effect** on implementation (through intervening process variable of team creativity) and is **conditional** on the variable of climate for innovation
- Climate of innovation functions as a **critical contingency** in enhancing innovation implementation

# Attributes of Innovative Organizations



A technologically innovative organization's "fabric" (based on Roberts and Fusfeld (1981), Quinn (1979), Haggerty (1979), Maidique and Hayes (1984), and von Hippel (1988))



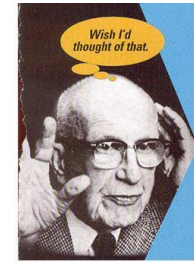
# Conclusions

- *Team composition* is an important tool for promoting team innovation.
- If team members are exposed to individuals with high creative abilities, as well as to diverse individuals, who pose different organizational roles, with new kinds of information, and diverse viewpoints, they will show a *stronger link to team creativity*.
- Managers should invest efforts in *designing team composition* and not only to rely on individual characteristics, such as *creative personality*, but also to integrate *functional diversity* into the conditions for selection of individuals for teams
- Teams seem able to generate a high number of creative ideas, but if they do not operate *in* the proper environment, which affords them
  - a *supportive and participative context* as well as
  - a *nonthreatening psychological atmosphere* with
  - *excellence of task performance*,team creativity will not be translated to innovation implementation.



"Advances in the various fields of human endeavor are due, to a large extent, to the cooperation of the best brains and best talents available everywhere",

-Thomas J. Watson Jr



The work of the individual still remains the spark that moves mankind ahead even more than teamwork",

-Igor Sikorsky

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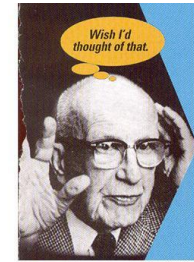
# Conclusions

- If managers can be trained/educated or assisted in designing and shaping *teams' work contexts*, one can expect more innovations among teams
  - *Climate for innovation* consists of *shared norms*.
  - *Norms* rapidly develop in the early stages of team development based on the reciprocal and mainly unconscious influence processes among team members. Once established, however, shared norms are relatively resistant to revision
- Consequently, orgs should try to *boost climate for innovation right from the start. This can be done* by anchoring such norms in their teams' *visions* and *missions* and by *promoting their importance in everyday business*



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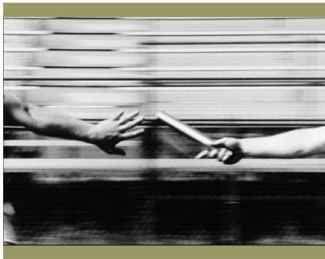


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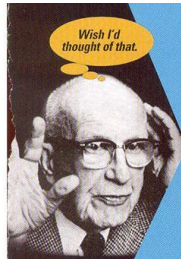
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# The End



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*"Let's make a dent in the universe.  
We'll make it so important that it will  
make a dent in the universe"*

- Steve Jobs (urging the original Macintosh development team to innovate)

**Dr. Chehroudi, Managing Director of the Advanced Technology Consultants**, has accumulated over twenty five years of technical and leadership experiences in different capacities and organizations. This includes such positions as a Principal Scientist and Group Leader appointment at the Air Force Research Laboratory (AFRL) ERCInc, a Chief Scientist at Raytheon STX, a Visiting Technologist at Ford's Advanced Manufacturing Technology Development (AMTD) center, a tenured Professor of Mechanical Engineering at Kettering University and University of Illinois, and served as a Senior Research Staff/Research Fellowship at Princeton University. Dr. Chehroudi directed numerous interdisciplinary projects in areas involving chemically reacting flows, combustion and emission of pollutants, sustainable and alternative energy sources, distributed ignition, material/fuel injection, advanced pollution reduction technologies, propulsion concepts, gas turbine and liquid rocket engines, combustion instability, laser optical diagnostics, spectroscopy, supercritical fluids and applications in environmental and propulsion systems, advanced composites, MEMS, nanotechnology, and micro fluidics. He has won many merit and leadership awards by such prestigious organizations as the Society of Automotive Engineers (Arch. T. Colwell Merit Award), (Forest R. McFarland Award for sustained leadership in professional and educational service), and (Outstanding Faculty Advisor), American Institute of Aeronautics and Astronautics (Best Publication Award of the Year), Air Force Research Laboratories (Outstanding Technical Publication Award), (STAR Team Award for demonstrating world-class combined scientific and leadership achievements), Institute of Liquid Atomization and Sprays Systems (Marshall Award for best publication with lasting contributions), and Liquid Propulsion Subcommittee of Joint Army-Navy-NASA-Air Force (JANNAF) (Best Liquid Propulsion Paper Award involving graduate students), and has been a consultant with many organizations such as, Ford, GM, Honda R&D, AFRL, Honeywell, NASA, AFOSR, VW, Bosch, Siemens, NGK, Cummins, and TRW. Through professional societies, Dr. Chehroudi delivers invited professional seminars on Management of R&D Teams and Organizations, Management of Innovation, and other technical areas. He has a PhD in Mechanical & Aerospace Engineering (Princeton University), Post-Doctoral Fellow (Princeton University), MS in Mechanical Engineering (Southern Methodist University, Summa Cum Laude), MS in Economics (Swiss Finance Institute, Magna Cum Laude), a member of American Institute of Aeronautics and Astronautics Propellant & Combustion Committee, and is an Associate Fellow of American Institute of Aeronautics and Astronautics. Dr. Chehroudi has delivered over 200 presentations in technical meetings and to nontechnical audiences, has more than 150 publications with extensive experience in both scientific and management areas and intensive trainings in finance and financial engineering.

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