Chapter 11
Creativity in R&D Organizations

Abstract Today R&D organizations deal with broad spectrum of contemporary challenges like market pressures, technical complexities, and limitations which demand a high degree of creativity and innovation in R&D organizations. This chapter explains the role of creativity in organizations and factors influencing the organizational creativity. Further, we have provided a brief account on creative process, creativity climate, and barriers of creativity, creativity training, tools, and techniques to measure creativity. The final section of this chapter emphasizes on core job dimensions and its characteristics in R&D to elicit, manage, and mapping creativity. Further, idea development and management emphasizes on continuous engagement of employees leading toward creative organization.

Learning Objectives: To provide overview on the role of creativity and innovation in organization, specifically R&D organization and the factors affecting organizational creativity; to describe creativity and the various aspects related to it, such as creativity process, creative climate in a scientific organization, barriers to creativity, training for creativity, and techniques of creativity; to explore a range of ways to build greater creativity in R&D.

Keywords The overview of creativity in R&D organization • The affecting factors in organizational creativity • Ideas and innovations in R&D organizations • Techniques of creativity • Core job dimensional characteristics in creativity • Redesign of job in R&D organizations • Supervising creativity in R&D • Idea management

11.1 Creativity in Organizations

Organizations today are knowledge based in nature and the role of creativity becomes important with increasing focus on technological innovation. The role of organizational culture becomes important in this context, as it influences the degree of creativity and innovation in the organization (Martins and Terblanche 2003). Creativity is not simply an inherent quality in a person, process, product, or place. It is an important aspect in today's organizational level. Organizational creativity gives importance to both social and group creative processes. It is a phenomenon that ensures that there is an environment for creative activity (Sundgren and Styhre 2007).
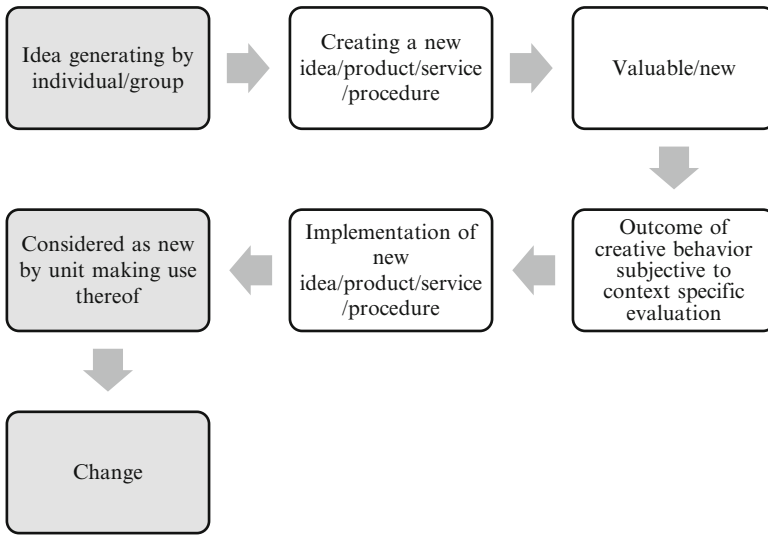
Fig. 11.1 Role of creativity and innovation in an organization (*Source*: Martins and Terblanche 2003)

Figure 11.1 shows the role of creativity and innovation in bringing about change in organizations.

Organizations have to focus on building "creative circles," through which people in the organization have a way to discuss new ideas and innovations in a conducive environment, thus fostering creativity. The Snowflake Model of Creativity states different psychological traits found in creative people that organizations should make a note of. They are as follows:

- Objectivity and the encouragement of criticism.
- Mental mobility.
- A high tolerance to complexity.
- Inner motivation—a zealous passion for work.
- The ability to excel in finding problems.
- "An enjoyment of risk taking." (Burke 1994).

There are various factors that affect organizational creativity. They are organizational climate, leadership style in the organization, resources and skills available, structure and systems, and organizational culture (Andriopoulos 2001).

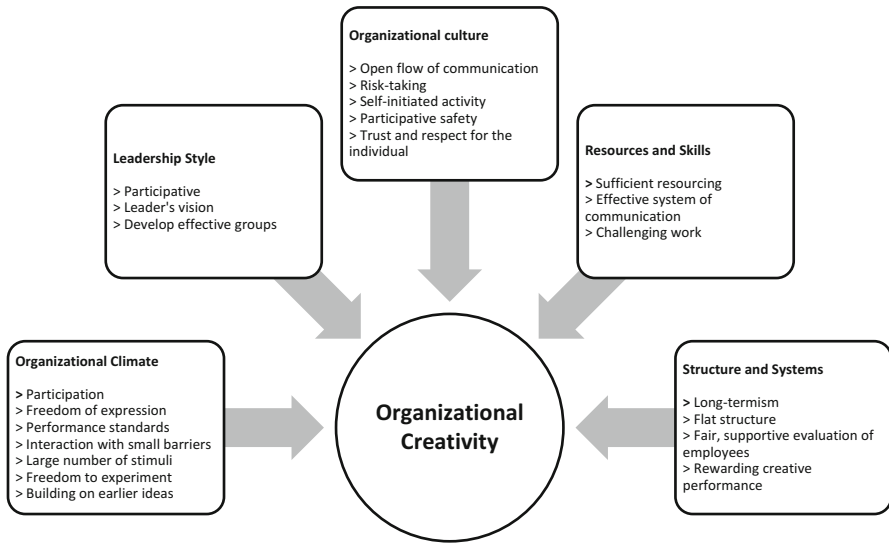Figure 11.2 illustrates these factors.

Fig. 11.2 Factors affecting organizational creativity (*Source*: Andriopoulos 2001)

11.2   Creativity in R&D Organizations

Creativity is essential to R&D work. Every individual has some amount of creativity in him. The more exposed he is to limitations in which a creative response is encouraged and fostered, the more creative he becomes. In other words, creativity can be a planned effort; that is, creating a situation where the need arises to nurture and develop creative technological innovation.

11.3   What Is Creativity?

Definitions and interpretations of "Creativity" are many. Karger and Murdick (1963) described creativity as an intuitive process, which reaches a solution to a problem without going through step-by-step reasoning. It employs the individual's knowledge, often subconsciously and may follow a period of unstructured thinking. Raudsepp (1963) felt the process "entails a selective structuring of vague ideas." Taylor (1964) distinguishes between creativity and productivity. He says that creativity is reflected in the originality and value of the product, and same productivity is required before the creative person is identified and recognized by society. He continues to say that it is true that there is a high correlation between productivity and creativity.

Allen et al. (1960) spoke of creativity not as a single ability but a cluster of abilities. They have isolated some factors of creative ability, such as sensitivity to

problem, ideational fluency, flexibility of set, ideational novelty, synthesizing ability, analyzing, reorganizing or redefining ability, span of ideational structure, and evaluation ability.

Some identifiable characteristics of creative individuals are as follows:

- People are creative to some degree. These creative potential surfaces only in stimulating environments.
- Creativity can be learned. Creative potential can be increased under favorable conditions, high motivation, appropriate training, and an encouraging environment.
- People can be creative in different ways. Creativity is not a single ability but a cluster of abilities. People vary in their creative abilities.
- Some kinds of creativity can be tested.
- Creative intelligence equates comparably with IQ intelligence. Although high intelligence may be necessary for high order of creative ability, it does not ensure it.
- There is little evidence to show the reduction of creativity potential with age. Creative skills are often reduced because they are not exercised.
- Low morale reduces creativity.
- Creativity is therapeutic.
- Only a small percentage of our creative potential is utilized.
- Creativity can be focused undisciplined freedom, which is not a necessary prerequisite to creative output. Industrialists can think of creativity in terms of focused objectives. The results of focused creativity are more satisfying and effective than random, undirected efforts.

Furthermore, creative R&D personnel tend to be independent intellectual non-conformists, valuing to set their own goals and to pursue them in their own way. Studies show that scientists are characterized by a very high level of intelligence, and that they are in the upper 2 % of the population when classified according to IQ; although a high IQ may be needed for high order of creative ability, it does not ensure it. Besides intellectual factors, emotional factors and culture and environment in which the person does creative work are influencing factors.

11.4 The Creative Process

The exercise of creativity can take place in any phase of the total creative process in each of these phases, and both ideation (idea generation) and evaluation (judgment as to the utility of the idea) must occur, if creativity is to be achieved. Some basic steps for the creativity process are listed as follows:

- *Preparation*: The preparation stage involves a great deal of hard work and high level of motivation. An individual's thoughts change rapidly and constantly receive new ideas.

- *Incubation*: A single idea or concept recurs spontaneously from time to time with some modification occurring, while the subjects are thinking of other matters.
- *Inspiration*: The point at which the idea or concept is distinctly formulated.
- *Validation*: The idea or concept is tested by research, experimentation, or other means.

11.5   The Creativity Climate in R&D

It is absolutely essential to set up a creative climate in an R&D setup. Karger and Murdick (1963) suggest ten steps to promote a creative climate in a scientific organization:

- Where possible, give engineers a choice of problems.
- Permit freedom for responsible engineers.
- Give time for far ideas to incubate.
- Minimize distractions and trivia.
- Be receptive to new ideas.
- Allow for personal differences.
- Provide proper tools to accomplish the job.
- Encourage personal intellectual growth.
- Establish a review and recognition system for technical achievement.
- Set the pace and establish a pattern for creativity in organization.

11.6   Barriers to Creativity

If there is a tendency in any organization for the formation of cliques, members tend to conform to group norms and mediocrity prevails. The creative individual must participate in the group but he must not be highly involved and become a communistic conformist. The timing of his innovation activity is important. He must not cause undue stir in the group.

Resistance to change is another barrier to creativity. Fear of change can be attributed to uncertainty and to the vested interest which might be disturbed.

The group approach and indiscriminate use of committees can hinder creativity of an individual, unless he can dominate the group with his creative ideas, but most likely he will be overwhelmed by force of members.

Other responsibility barriers to the creative process are ignorance, lack of ability, negative attitudes, indecision, overspecialization, entrance caution, and fear of ridicule.

11.7   Training for Creativity

Because of its increased popularity in recent years, many consultancy firms have begun to specialize in creativity training. Although there is a general consensus that certain aspects of creativity can be taught, there is less agreement on how it should be done. A few principles are offered here as follows:

- People who participate in creativity training gain self-confidence and judge themselves to be more creative.
- Teaching the theory of creative behavior, not just creative techniques for long-term effects.
- Showing participants examples of desirable outcomes improves the production of creative solution.
- People who work with those whom they like do better than people who work with whom they dislike.
- Warm up for practice exercises seem to enhance both quality and quantity of solutions.
- Extraneous activities, such as transcendental meditation do not seem to effect creative production.

11.8   Techniques of Creativity

A number of techniques have been developed to stimulate creative thinking. The most widely used techniques for generating creative ideas is brainstorming (Alex Osborn 1953). Here, a problem is presented clearly to the brainstorming panel, and each member is requested for an idea for several rounds. No one can criticize any-one's ideas. In this way various creative ideas are generated.

A technique that combines the convergent thinking principle of forming categories with the brainstorming principle of generating many alternative solutions is the technique of attribute analyses (Crawford 1954). In this method, given an object that one wishes to design, be it a tangible object or an activity, we identify first its major attributes. Next we take up each attribute and generate as many alternative ways of securing the attribute as we can. After generating these alternative designs, we need to evaluate them in terms of criteria such as cost, marketability, and so on. A usual technique for solving many complex technical problems is the technique of synectics, created by Gordon, Advertising executive and management consultant (Gordon 1961). These techniques are based on the principle that constructive psychological strain can lead to original solutions to problems. Basically, it consists of mechanisms that bend and stretch the mind in every direction through the style of poetry. It is a technique for churning the mind so that novel visions and insights rise to the surface.

Another technique that can be usefully combined with any of the other four techniques is the checklist of questions, also developed by Osborn (Osborn, Applied imagination (1953)).

11.9   Core Job Dimensions

Creativity training aims to help trainees develop motivation and abilities congenial to creativity. Thus, the question that arises is will internal motivation occur on the job? According to Oldham and Hackman (1981), there are three critical psychological states for internal motivation to occur. They are the following: (1) experiencing meaningfulness of the work, (2) experienced responsibility for the outcomes, and (3) knowledge of the actual results of work activities. Further they say, "What are needed are reasonably objective, measurable, changeable properties of the work itself that foster these psychological states and through these states enhance internal work motivation" (Oldham and Hackman 1981). Figure 11.3 shows the five core job characteristics interacting with the psychological states resulting in the creative outcome.

11.9.1   Five Core Job Characteristics with the Psychological States

Skill variety: Refers to the degree to which a job requires a variety of activities in carrying out the work, involving the use of different skills and talents of the person.
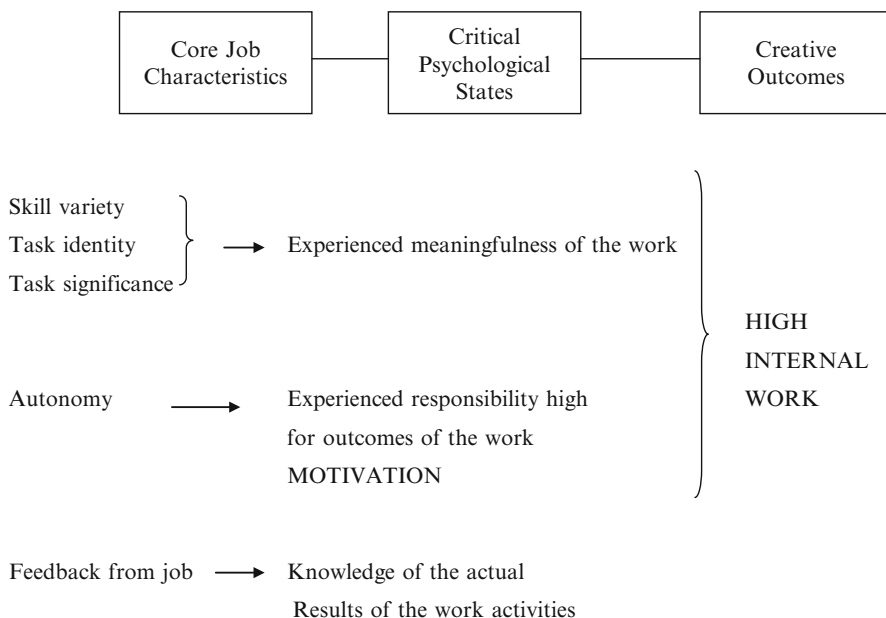

Fig. 11.3   Core job dimensions (*Source*: Oldham and Hackman 1981)

Task identity: The degree to which a job requires completion of a "whole" and identifiable piece of work, that is, doing a job from beginning to end with a visible outcome.

Task significance: The degree to which the job has a substantial impact on the lives of other people, whether those people are in the immediate organization or in the world at large.

Autonomy: The degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out.

Job feedback: The degree to which carrying out the work activities required by the job provides the individual with direct and clear information about the effectiveness of his or her performance.

11.10 Job Redesign in R&D

When redesigning certain jobs within a unit in the organization, one has to decide on whether work redesign is feasible for that unit. One has to know to distinguish between those aspects of the job that need improving and those that are fine as they are. It is also important to know how to identify how ready the people are who will be involved for the change. The diagnostic instrument Job Diagnostic Survey (JDS) can be ideally used to obtain answers to some of these questions. The major intended uses of the JDS are as follows: (1) to diagnose existing jobs prior to work redesign, as one input in planning whether how redesign should proceed; (2) to evaluate the effects of work redesign, for example, to determine how much jobs have changed, to assess the effects of the changes on employee motivation and satisfaction, and to test for any spin-off effects of the job changes on employee growth need or satisfaction with the work context. Alternative instruments for assessing characteristics of jobs have also been provided by Jenkins et al. (1975) and by Sims et al. (1976).

11.10.1 Four Steps Can Be Suggested for Using the JDS for Job Redesign

Step 1: Conducting the JDS, that is, administration of the JDS.

Step 2: Compare the survey data with the JDS normative data. Means and standard deviations are available for technicians and professionals. However, norms for the Indian group are not available.

Step 3: Feedback and discussions.

Step 4: Job redesign, training for creativity, evaluation, and improving creative climate.

The JDS can be effectively used to improve performance in the R&D department. Organizations also work to increase employee creativity. Unsworth (2001) considered the paradigms of the type of problem and driver for engagement and gives a typology for creativity. This also considers the perceived personal risk aspect (Dewett 2004a, b). Figure 11.4 below exhibits this typology.

While the role of the organizational culture is important to understand employee creativity, it is also essential to have a leader who promotes creativity in the organization (Escribá-Esteve and Montoro-Sánchez 2012). Thus, for an R&D organization, the process of creativity, the factors affecting creativity, and the role of creativity is paramount to understand how innovation takes place.

Open	**Expected Creativity**	**Proactive Creativity**
	Required Solutions to Discovered Problem	Volunteered Solution to Discovered Problem
	Example: Idea to improve process-nature of outcome not specified.	Example: Unprompted suggestion directly relating to one's own work.
Problem type	*Modest Perceived Personal Risk*	*High Perceived Risk*
	Low Perceived Personal Risk	*Modest Perceived Personal Risk*
Closed	**Responsive Creativity**	**Contributory Creativity**
	Required Solutions to Specified Problem.	Volunteered Solutions to Specified Problem
	Example: Idea to improve process-nature of outcome specified.	Example: Unprompted suggestion not directly relating to one's own work
	External **Driver for Engagement** **Internal**	

Fig. 11.4 Modified version of Unsworth's (2001) Topology of creativity (*Source*: Dewett 2004a, b)

11.11   Managing Creativity in R&D

Creativity is not a latent ability. It is a skill and built by learning and applying the right disciplines. The key to building greater creativity is to generate ideas, manage ideas, and give recognition to and appreciate idea. Linking the idea from hidden is essential. The more idea links you make, the more creative your team will become.

11.11.1   Generate New Ideas

Standard idea-generation techniques concentrate on combining or adapting existing ideas. This can certainly generate results. But here, the focus is on equipping the reader with tools that help him/her leap onto a totally different plane. These approaches push one's mind to forge new connections, think differently, and consider new perspectives. These techniques can be applied to spark creativity in group settings and brainstorming sessions as well. All these techniques are aimed to: (1) breaking thought patterns; (2) connect the unconnected; (3) shift perspectives; and (4) employ enablers.

11.11.2   Brainstorming

This is one of the best known and most used in the business world group-based creativity process for problem solving. It is a technique for generating a large number of ideas from a group of people in a short time. It can be used for generating a large number of ideas or solutions for well-defined strategic or operational problems, such as for engineering design processes. It also forms a basic framework or constitutes the initial phase for the implementation of many other groups based on creative techniques.

11.11.3   Storyboarding

It is a creativity technique for strategic and scenario planning based on brainstorming and is used mainly by groups. It requires a leader, a secretary, and takes place in a group of 8–12 people. The leader arranges the ideas generated by brainstorming in a logical order on a white board creating a story. This technique allows identifying the interconnections of ideas and how all the pieces fit together. It can be used to identify issues, problems, solve a complex problem, and determine ways to implement solutions.

11.11.4   Checklists

This creative technique is used mainly for product improvement or modification. It involves applying a series of words, verbs, adjectives, or phrases contained in checklists or tables to an existing product or service or its attributes. Osborn's checklist is the best known and includes the verbs: put to other uses, adapt, modify, magnify, minify, substitute, rearrange, reverse, and combine. Each verb also contains an expanded definition in the form of questions.

11.11.5   Mapping Process

The use of maps is particularly useful in strategic management thinking in organizations, helping to organize discontinuities, contradictions or differences, and bring pattern, order, and sense to a confusing situation, acting as a spatial representation of a perspective. There are many forms of mapping, including computer-based tools to support mapping.

11.11.6   Morphological Analysis

This method is another product improvement technique, permitting the in-depth analysis of products or processes. It involves applying a set of words to a product or process. Normally, one set of words is verbs and the other set is attributes of the product.

11.12   Idea Management

Idea management provides an organized method for collecting and moving ideas from conception to selection. It is a structured process for the following:

- Developing a targeted idea search strategy
- Soliciting ideas that address the defined problem
- Developing a methodology for capturing ideas
- Establishing idea evaluation criteria
- Evaluating and scoring/ranking ideas
- Determining which ideas have the greatest potential to add value to the organization
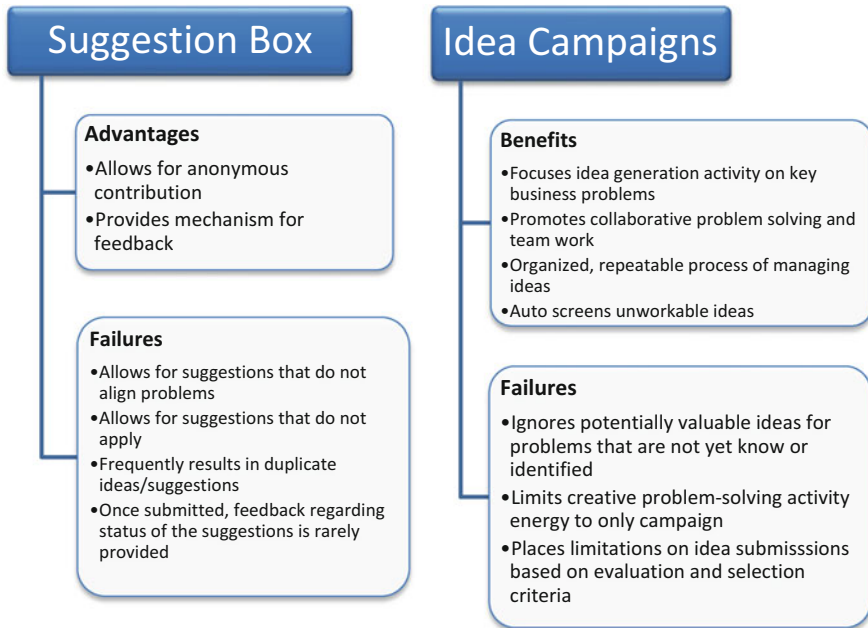- Taking action on the most promising ideas

Suggestion Box

Advantages
- Allows for anonymous contribution
- Provides mechanism for feedback

Failures
- Allows for suggestions that do not align problems
- Allows for suggestions that do not apply
- Frequently results in duplicate ideas/suggestions
- Once submitted, feedback regarding status of the suggestions is rarely provided

Idea Campaigns

Benefits
- Focuses idea generation activity on key business problems
- Promotes collaborative problem solving and team work
- Organized, repeatable process of managing ideas
- Auto screens unworkable ideas

Failures
- Ignores potentially valuable ideas for problems that are not yet know or identified
- Limits creative problem-solving activity energy to only campaign
- Places limitations on idea submisssions based on evaluation and selection criteria

Fig. 11.5 Advantages and limitations of two main models for idea management

There are two main models for idea management: the first one is (a) open suggestion scheme and (b) targeted idea campaign. Many organizations today blend both types for effective idea management. Figure 11.5 summarizes the advantages and limitation of these two models.

Suggestion box is traditionally a physical box with a slot in the top to submit ideas, comments, and concerns anonymously. From 1994 onwards, physical suggestion boxes began to be replaced by email or other electronic submission methods. NCR was the first major organization (1892) to use the suggestion box as a source of employee ideas for new product development.

The idea campaigns are events focused on generating ideas and solution relating to a specific business problem or need. It begins with the identification of the "problem to be solved." The idea campaign is communicated, marketed, and promoted to increase participation of development teams and later these ideas are captured, assessed, scored, and selected.

Many organizations and even idea management vendors envision a software tool that allows anyone in the organization to submit ideas into a central repository. Ideas in the repository are reviewed by an innovation team who decide which to forward for further development and which to reject. Most suggestion schemes fail after 12–18 months, for the following reasons:

- Suggestion overflow
- Duplicate idea submission
- Many irrelevant ideas
- Opacity

Fig. 11.6 The process of idea management

Idea management is a structured process for capturing ideas from across the workforce and evaluating those ideas to determine which have the greatest potential. For effective idea management, a good organizational climate, climate of experimentation, and continuous loop of feedback-based learning is essential. Figure 11.6 shows the process of idea management.

11.12.1   Recognition and Appreciation

Once you have generated and identified the potential of each of your ideas, the next challenge is to set up your ideas toward recognition, appreciation, and collaborative idea development. The main means of motivating employee's idea management include promotion and rewards.

11.12.2   Promotion of the Idea

Promotion at minimum should include e-mail notification to all participants of an idea campaign. The e-mail should provide the following:

- Information about the ideas campaign, especially the challenge.
- Explain why the challenge is a business issue and the importance of the selected ideas.
- List rewards associated with the campaign.

In addition to e-mail promotions, posters (elevators are a great place to put promotional posters), T-shirts, and announcements in divisional meetings are all good ways of promoting idea campaigns.

11.12.3   Rewards

Rewards are a key motivational tool. They need not be big. Indeed, big rewards are often less effective than small rewards. There are several reward types:

- Recognition.
- Small gifts for every idea.
- Slightly larger rewards for the most creative ideas (this motivates people to stretch their thinking and be more creative).

- Whatever rewards choice you make, be sure your colleagues know about it.
- Rewards are one of the biggest motivators for participating in an ideas campaign.

11.12.4   Collaborative Idea Development

Once the innovation challenge has been formulated and the ideas campaign launched, it is time to generate ideas. Participants submit ideas and collaborate on each other's ideas in an open, transparent environment.

During the collaborative idea development phase, feedback should be positive and participants should be encouraged to push their ideas further. Criticism must be prohibited. Such a positive environment is essential for the incubation of creative ideas—and it is creative ideas that turn into your most significant innovations. Negative feedback is discouraging not only to the recipient of the feedback, but also to other participants. And as soon as people fear their ideas will be criticized, they quickly stop being creative.

Questions

1. Briefly discuss with a flow diagram how creativity has contributed in bringing change in an organization.
2. Define idea management and explain the two main models for idea management.
3. Define Job Diagnostic Survey. When and why is there a requirement of this instrument?

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