



# THE LIFE CYCLE OF INNOVATIONS

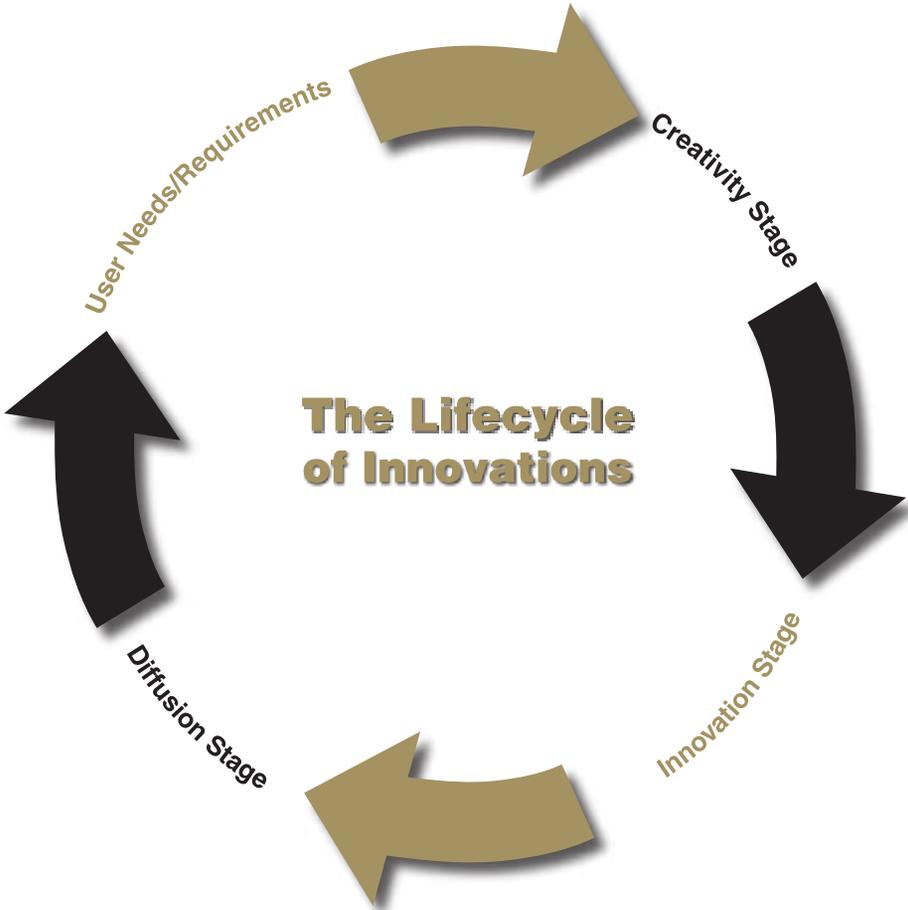
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Innovations have been shown to have a positive influence on the success of organizations. However, without individual and group creativity, innovations cannot occur. Likewise, the benefits of those innovations will never be fully realized in an organization unless each innovation is adopted and diffused throughout the organization. This article will lead to a better understanding of the relationship between creativity, innovation, and diffusion in the context of the *The Life Cycle of Innovations*. Much can be learned from the research that has been done on the subject of innovation. Throughout this article, the findings of that research will be presented and conclusions drawn for further consideration by senior leaders of the defense acquisition workforce.

**W**hat is an innovation and how does it happen? With so much of the warfighters' present and future requirements depending on the innovativeness of individuals and organizations within the Department of Defense Acquisition, Technology and Logistics (DoD AT&L) workforce, the question of how innovativeness occurs is a vitally important question to consider. Extensive research has been performed within the private sector, which can be used to answer the questions we have concerning innovation. For instance, we know that an organization's long-term success is linked to its ability to provide innovations that meet a user's demands (Chandrashekar, Mehta, Chandrashekar, & Grewal, 1999). Many research studies have identified innovation as having a positive effect on organizational performance (Damanpour & Evan, 1984; Damanpour, Szabat, & Evan, 1989; Khan & Manopichetwattana, 1989; Zahra, de Belardino, & Boxx, 1988; Han, Kim, & Srivastava, 1998). Therefore, an understanding of how innovations are created inside an organization and distributed to users, such as warfighters, is a starting point for understanding how to increase organizational performance. In this article, innovation will be explored in the framework of an innovation life cycle. The life cycle begins

with the creativity stage, then proceeds to the innovation stage, and lastly to the diffusion stage. This is shown in the flow chart, which depicts the life cycle of innovation in meeting the user's needs/requirements.

LIFE CYCLE OF INNOVATIONS IN MEETING THE USER'S NEEDS/REQUIREMENTS



As a beginning to the study of each of the three stages in *The Life Cycle of Innovations*, the stages should be defined.

THE FOUNDATION OF INNOVATION

The foundation of innovation is creativity (Scott & Bruce, 1994). Creativity is simply the production of novel, appropriate ideas in any realm of human activity, from science, to the arts, to education, to business, to everyday life (Amabile, 1997; Mumford & Gustafson, 1988). Innovation flows from the creativity of individuals and is defined as the successful implementation of the novel and appropriate ideas (Ama-

bile, 1997). In other words, innovation is the implementation of creativity. However, just because a creative idea is implemented, does not mean that it has been adopted by a user or users. This occurs when the diffusion of the innovation occurs. Diffusion is the process by which an innovation spreads among a group of individuals (Rogers, 1962). Now that we understand the definitions of creativity, innovation, and diffusion, let us examine each of these more thoroughly.

## CREATIVITY

Individuals have been shown to have two styles of creativity: adaptive and innovative (Kirton, 1976). In problem solving, individuals who are adaptors prefer to do things better within the generally accepted boundaries of theory or policy. On the other hand, innovators prefer to do things outside of the boundaries or *differently*. In fact, Kirton (1976) proposed that individuals can be viewed as being anywhere from those that are able to do things *better* to those that are able to do things *differently* for solutions they have to similar problems. Each of these styles of creativity is important in different respects to the process of innovation. For instance, if a completely new innovation is sought by an organization, then it would be better to assign an individual who is an innovative decision maker to the task. However, if an organization would like to adapt a current innovation to other uses, then an adaptive decision maker may be better suited. A recent example of this is the Joint Strike Fighter aircraft competition. Both Boeing and Lockheed Martin developed unique designs for the Short Take-off and Vertical Landing (STOVL) version of the aircraft (Pipinich, 2006). However, vertical lift in the Boeing design was provided by redirecting thrust from the engine. This technology was already being used in one of Boeing's other aircraft platforms, the AV-8B aircraft. This could be characterized as an adaptive approach to the design. In comparison, the Lockheed Martin design used a novel approach by having a lift fan driven off the engine to provide vertical lift. This approach could be characterized as an innovative style.

The management of an individual's attention is one of the most critical aspects of managing creativity (Van de Ven, 1986). An individual's attention is usually split between several different competing priorities. Therefore, in most organizations, individual creativity is squelched to the point where only crisis can stimulate action (Scott & Bruce, 1994). A climate for creativity, and subsequently innovation, must exist in organizations. Individuals should be given the time and resources to create innovative solutions to problems. For instance, the Naval Air Systems Command (NAVAIR) is implementing the principles of Lean and Six Sigma under a program titled *AIRSpeed*. This program is intended to improve the business and technical processes that NAVAIR uses to acquire and support weapon systems for the U.S. Navy. Individuals are assigned to the *AIRSpeed* Program on a full-time basis to work specific initiatives so they are not distracted by other priorities and can work at their most creative best.

But why are individuals creative? Creativity within individuals is comprised of three components (Amabile, 1997). These three components are the precursors to individual creativity: expertise, creative thinking, and task motivation. The foundation

for all creative work is expertise (Amabile, 1997). Individual expertise includes the factual knowledge, technical proficiency, and special talents in the work area. These are essential in an individual before creativity can take place. Next, creative thinking is the skill necessary to look at a problem in a different way, with a work style conducive to persistence and energy. Expertise and creative thinking are components of what an individual is capable of doing, but task motivation determines what an individual will actually do. Creativity cannot be forced on individuals. Individuals are motivated to be creative for two reasons: intrinsic motivation and extrinsic motivation (Amabile, 1997). Intrinsic motivation comes from individuals who work on something because they enjoy what they are doing. Extrinsic motivation comes from individuals who work or create because they are being evaluated on their work or from promises of a reward. Positive evidence shows that people are most creative when they are primarily, intrinsically motivated (Amabile, 1983; Amabile, 1996). This is to say that individuals will be their most creative when they enjoy what they are doing.

## INNOVATION

Creativity has been shown to be the development of ideas. Innovation takes those ideas and puts them into action. Innovations can be separated into three basic categories: (a) line-extensions, (b) me-too products/services, and (c) new-to-the-world products/services (Lukas & Ferrell, 2000).

**Line-extensions.** These products/services expand on an existing product/service that an organization produces. For instance, the EA-18G aircraft is a line extension of the existing F/A-18 E/F aircraft program.

**Me-too products/services.** These products/services are new to the organization, but are not new to the marketplace. The implementation of Enterprise Resource Planning (ERP) within certain Department of Defense organizations is an example of a me-too service. ERP migrated over from the commercial world into government agencies as an innovation that was new to the government, but not new to commercial industry.

**New-to-the-world products/services.** These products/services are new to both the firm and the marketplace. For instance, the M-16A1 assault rifle was a new-to-the-world item for both the manufacturer and the warfighter in the 1960s when it was introduced.

## CHARACTERISTICS OF ORGANIZATIONAL MOTIVATION

Just as with individual creativity, organizations have certain characteristics necessary for innovation to occur. The three characteristics include organizational motivation to innovate, resources, and management practices (Amabile, 1997). The support for innovation must come from the highest level within the organization. The degree to which individuals perceive the organizational climate supporting innovation is positively related to their innovative behavior (Scott & Bruce, 1994). Management within an organization can support innovation by placing a high value on innovation,

by encouraging risk taking, by having a sense of pride in the individuals doing the innovating, and by taking an offensive strategy to lead into the future (Amabile, 1997; Cummings, 1965).

An organization must offer its resources to foster great innovation (Amabile, 1997). These resource elements include sufficient time to be creative, an adequate number of creative people assigned to the task that have expertise, material resources, relevant information, and any training that might be necessary to aid in the innovative process.

Management practices for innovation include issues related to leaderships' interaction with the individuals and work teams within the organization that are performing the innovative tasks (Amabile, 1997). The quality of leader-member exchange between an individual and his or her supervisor is positively related to the individual's innovative behavior (Scott & Bruce, 1994). Furthermore, the degree to which a supervisor expects a subordinate to be innovative is positively related to the subordinate's innovative behavior.

## DIFFUSION

Diffusion can be viewed as a process that an organization goes through to adopt an innovation (Roger, 1962). Adoption of an innovation within an organization occurs along a time continuum with some individuals accepting the innovation very early after being introduced to it and others taking longer, with the great majority of individuals being in the middle of the time continuum. Furthermore, the process that each individual will go through to adopt an innovation is basically the same. The adoption process proceeds from awareness, to interest, then evaluation and trial, and finally adoption (Rogers, 1983).

The stages of innovation and the antecedents for each of these stages are summarized in Table 1.

**TABLE 1. THE ANTECEDENTS OF CREATIVITY, INNOVATION AND DIFFUSION**

Creativity	Innovation	Diffusion
Individual expertise	Line extension	Awareness
Individual creative thinking	Me-too-product/service	Interest
Individual motivation (intrinsic and extrinsic motivation)	New-to-the world product/service	Evaluation and trial
		Adoption

## LEADERSHIP IMPLICATIONS

Since innovation is so important to performance of our DoD AT&L organizations, several implications for the leadership of the AT&L workforce may be drawn

from the research on creativity, innovation, and diffusion. First, creativity within an organization must be promoted at the highest level and throughout the organization. The degree to which individuals perceive organizational climate as being supportive of innovation is positively related to their innovative behavior (Scott & Bruce, 1994). Also, the more a group's culture is characterized by innovativeness, the greater the number of innovative outcomes the group will produce (Hurley & Hult, 1998). As an example, Toyota Material Handling USA has an employee suggestion system with a goal of three suggestions per associate per month. This typically equates to 1,200-1,500 actual plant-wide suggestions per month (Gembutsu, 2007). This is just one opportunity the company uses for encouraging its employees to be innovative. However, organizational commitment to innovativeness in the long term may conflict

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with organizational performance in the short term. For instance, encouragement a leader gives to a team to take risk is positively related to innovativeness (Sethi, Smith, & Park, 2001). However, the reality is that if products/services fail the user, then the performance of the organization suffers. Therefore, organizations are less likely to take risk knowing that the performance of the organization may suffer. Second, leadership and the individuals that are innovating must communicate. The quality of leader-member exchange between an individual and his or her leader is positively related to the individual's innovative behavior (Scott & Bruce, 1994). Also, the degree to which a leader expects an individual to be innovative is positively related to the individual's innovative behavior (Scott & Bruce, 1994). For instance, it has been shown in the private sector that product innovativeness increases as the level of senior management monitoring increases (Sethi, Smith, & Park, 2001). All of these studies support the importance of leadership support for innovativeness. Third, leadership within an organization should take special care when selecting individuals who will be innovators for the organization. Since individual creativity comes from individuals with expertise, creative skills, and task motivation, then it is important for leadership to focus on finding individuals with these qualities or developing these qualities in individuals within the organization. For instance, if leadership determines that an individual has the intrinsic motivation and creative skills to innovate, but lacks the expertise, then training can be provided to that individual to develop the expertise. Furthermore, leadership should take special care in selecting individuals that are able to work together on innovations. It has been shown that certain aspects of group dynamics have an effect on innovativeness (Scott & Bruce, 1994; Hurley & Hult, 1998;

Sethi, Smith, & Park, 2001). For instance, the more a group's culture emphasizes participative and open decision making, the greater its cultural innovativeness (Hurley & Hult, 1998). Therefore, leadership in an organization should encourage these qualities in the teams that they organize to develop new innovations. Empowerment of these teams to implement innovations and creative solutions is also critical. This empowerment gets results faster and it can be a significant motivating factor for the team members (Gembutsu, 2007). Those closest to the problems and with the most expertise should be able to make decisions to implement innovative changes. Table 2 summarizes the leadership implications for innovation within an organization.

**TABLE 2.** LEADERSHIP IMPLICATIONS OF INNOVATION WITHIN AN ORGANIZATION

Motivation to Innovate	Resources to Innovate	Management Practices
Top management support	Time	Interaction between individuals and supervisor
Encouragement to risk take	Expertise	Interaction between team members
Corporate strategy to innovate	Training	Expectation of individuals to innovate
	Materials	
	Information	

## CONCLUSIONS

Through various research studies, innovations have proven to be essential to the long-term survival of any organization. In order for an organization to understand and implement *The Life Cycle of Innovations*, it must first understand important stages in the life cycle: creativity, innovation, and the diffusion of the innovation. Leadership in an organization has an important function to perform in each of these steps to insure the individual's needs, as well as the team's needs, are met, creating an atmosphere where innovation is encouraged and valued. Also, once the innovation has been developed, leadership must insure that the steps are taken to diffuse the innovation to the appropriate users. With this understanding of what innovation is and how it occurs within an organization, the DoD will have the basis for accelerating innovation and change to the warfighter into the future.



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