# ORGANIZATIONAL STRUCTURE AS AN ENGINE FOR INNOVATION: DISCOVERING STEALTH AT LOCKHEED MARTIN'S SKUNK WORKS

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*During the Vietnam War, the U.S. lost intolerable numbers of aircraft to the pervasive threat of radar detection and antiaircraft missilery. Striving to regain air supremacy, the Pentagon held a secret competition to build an aircraft that could trump the Soviet's embattlements. At the time, the aerospace defense industry included five major players: McDonnell Douglas, Rockwell, Hughes Aircraft Company, Northrop, and Lockheed. Each firm boasted an impressive track record of military innovation, but only Lockheed had a Skunk Works, an autonomous rapid-prototyping shop staffed with a cross-functional team of the most talented individuals from across the organization. Although insulated from the affairs of the parent corporation, the Skunk Works faced challenges regarding cost, quality, security, and mandatory compliance with government requirements. In the end, Lockheed Martin's Skunk Works won the Pentagon contract with its revolutionary subsonic night fighter, the F-117A Nighthawk. What key elements of the skunk works organization structure made Lockheed Martin successful when all others had failed? What is it about Lockheed's winning skunk works formula that provides the right mix of managerial support and autonomy to create a nurturing entrepreneurial environment?*

## INTRODUCTION

Developing an organizational structure suitable for innovation can be a challenge, especially given the capricious nature of the most prolific industries in today's economy. History has shown that skunk works, a small loosely structured group of individuals with a common goal, can become a powerfully creative force. Using this configuration Apple Inc., reimagined personal computers, Sony Ericson made pioneering strides in mobile broadband access, and Pfizer, Abbott, and

GlaxoSmithKline revitalized entrepreneurial behavior in pharmaceutical research. The notion of organizing for innovation, however, predates these contemporary examples. The common origin for the modern template of organizational creativity can be traced to one of the most significant military conflicts of the 20th century: the Vietnam War.

The year was 1975, and the Indo-Chines peninsula had been embroiled with conflict for nearly twenty years. The U.S. was losing intolerable numbers of aircraft to the pervasive threat of radar detection and antiaircraft missilery. In fact, over 5,000 U.S. and Southern Vietnamese aircraft had be destroyed, while North Vietnam loses number approximately 150. The Pentagon needed planes that could not be easily detected. In a move that bordered on desperation, the Pentagon invited a select group of aeronautics firms to participate in secret competition to build an aircraft that could outdo enemy embattlements. At the time, the aerospace defense industry included five major players: McDonnell Douglas, Rockwell, Hughes Aircraft Company, Northrop, and Lockheed. Each firm boasted an impressive track record of military innovation, but only Lockheed had a skunk works, an autonomous rapid-prototyping shop insulated from the affairs of the parent corporation (Rich & Janos, 1994). Ultimately, Lockheed's efforts not only gave birth to the revolutionary stealthy F-117A Nighthawk, but also demonstrated the utility of the skunk works organizational structure as an engine for innovation. What key elements of the skunk works organization structure made Lockheed Martin successful when all others had failed? What was it about Lockheed's winning skunk works formula that provided the right mix of managerial support and autonomy to create a nurturing entrepreneurial environment? How do large creative companies today still use skunk works in the never-ending race for wildly successful products?

## THE DEVELOPMENT OF STEALTH TECHNOLOGY

The Pentagon's contract selection criteria were twofold: (a) produce an aircraft with a low radar signature, and (b) do so under top-secret development standards. McDonnell Douglas was the largest company involved in the competition. It had impressive manufacturing facilities that turned out hundreds of F-15s each year. Rockwell's clout was tied to its B-1 bomber design, the long-awaited replacement for the aging B-52 (Rich & Janos, 1994). The Hughes Aircraft Company was well familiar with missile systems. It had developed the successful AIM-4 Falcon air-to-air guided missile. Northrop Aircraft designed the first U.S. military aircraft intended for night missions, the P-61 Black Widow (Parker, 2013). Most of McDonnell Douglas' and Northrop's programs were large, which enabled these companies to effectively utilize a matrix structure with each department being responsible for meeting cost and time constraints (Winner, 1976). In contrast to this approach, the other competitors emphasized pure task specialization. As such,

a classic functional configuration was the organizational structure of choice for Hughes (Baskin & Sullivan, 1985) and Rockwell (Hedujnd & Hart, 1970). The winning design, however, came from Lockheed's rapid-prototyping shop: the Skunk Works.

## ORGANIZATIONAL DESIGN

A skunk works was a quasi-independent group of people within an organization. The most talented individuals within the organization were borrowed from various departments forming a cross-functional, entrepreneurial environment. Both geographically and hierarchically isolated from the rest of the organization, a skunk works was more willing to experiment and to accept failure. Therefore, it was indispensable for promoting innovation and creativity, especially in large companies. Furthermore, within skunk works it was possible for an organization to quickly kill those ventures once they proved inefficient or unprofitable. The skunk works usually had full control over its resources, budget, and procedures so that it could pursue innovative ideas from concept to realization. Every shop worker was responsible for quality control, having full authority to send back a part that didn't meet standards. This allowed skunk works to minimize rework and scrap waste. Skunk works also typically received strong support from top management in the form of autonomy and funding. Short chains of command and freedom from organizational culture and bureaucracy allowed for efficient time utilization and rapid prototyping. The skunk works team managed its own progress, promoting a sense of ownership, empowerment, and when necessary, a sense of urgency. As a catalyst for morale and productivity, the application of skunk works for project management was widely revered (Bommer, DeLaPorte, & Higgins, 2002; Deutschman, 2005; Greenstein, 2016).

Lockheed Martin's Skunk Works was founded during World War II to be an innovative and intentionally insulated subunit of Lockheed. Security was paramount at Lockheed's Skunk Works as it specialized in highly-classified military R&D contracts. If the enemy, "didn't know these aircraft existed until we introduced them in action, they would be that much farther behind" (Rich & Janos, 1994, pp. 8-9). Lockheed's Skunk Works was located in a remote corner of its Burbank, California complex. Tucked behind a smelly plastics factory, the engineers likened the prototype shop to the dilapidated factory featured in Al Capp's "Lil Abner" cartoon (Rich & Janos, 1994). According to the strip, the fumes emanating from the factory smelled like a mixture of worn shoes and dead skunks.

Behind this secret subunit was Lockheed's chief engineer, Clarence "Kelly" Johnson (Janos & Rich, 1994). Kelly, who joined Lockheed in 1933, was regarded as the leading aerodynamicist of his time. He had built a reputation as the creator of the fastest and highest-flying military airplanes in history Most "Skunk Workers"

were handpicked by Kelly for their expertise and tenacity (Rich & Janos, 1994).

After a long, 42-year career, Kelly was succeeded by Ben R. Rich, who led the Skunk works from 1975 to 2011 (Janos & Rich, 1994). Rich's first big challenge at the helm of Skunk Works was responding to the Pentagon's call for a stealth plane. For this project, Rich faced the difficult challenge of satisfying the Pentagon's need for secrecy while still upholding the requirements of government regulatory agencies. The larger problem, however, was that up to this point, the idea of radar stealth was consigned almost entirely to the realm of speculation (McCarthy & DeBerry, 2002).

**STEALTH TECHNOLOGY**

The breakthrough in stealth technology came from Denys Overholsers, a Skunk Works mathematician and radar specialist. Overholsers' approach to stealth was built on a set of formulas published nine years earlier by a Soviet physicist named Pyotr Ufimtsev. At the time, the Soviet Union dismissed Ufimtsev's work as having no significant military or economic value (Colaresi, 2014). Ufimtsev's model made it possible to calculate an object's total radar cross section based on the individual radar signatures of its component parts. Overholsers' idea was to break down an airplane into thousands of flat triangular shapes, the geometric shape with the smallest radar signature. This process later became known as "faceting" (Rich & Janos, 1994, p. 21). Each triangle was further finished with a special radar-absorbing ferrite top coat. In order to remain invisible, however, the airplanes' surface had to remain absolutely smooth. In one test flight, "The heads of three screws ... extended above the surface by less than an eighth of an inch. On radar, they appeared to be as big as a barn door!" (Rich & Janos, 1994, p. 69). When finished, the plane flew with a radar cross-section 1,000 times less visible than any aircraft previously produced. Lockheed's Skunk Works had achieved the fundamental breakthrough the Pentagon was looking for. The aircraft was christened the F-117A Nighthawk, and the first production variant was delivered to the Air Force in 1982. Given Lockheed's low bid for the stealth project, the first five airplanes were unprofitable. Simply put, "The fewer the new airplanes produced, the more expensive the unit cost" (Rich & Janos, 1994, p. 322). Subsequent orders, however, were profitable.

Previously, it was believed that large armadas were needed to overwhelm the enemy and get a few aircraft through to do damage. Until 1988, the stealthy F-117A was kept shrouded in complete secrecy (Cunningham, 1991). After stealth technology was revealed, however, a small numbers of aircraft could once again be used to conduct surgical strikes. Combat proof from Operations Desert Storm further attested to the pivotal contribution that stealth made to modern warfare. In its first major outing, just ten F-117A fighters eliminated Iraq from the Gulf War in

about 20 minutes, without losing a single plane. This was a great success for the USAF and for the Skunk Work.

## CONCLUSION

Even with five major aeronautics firms pursuing stealth technology, only Lockheed Martin's Skunk Works proved to be the ideal organizational structure for developing stealth technology. In many ways, the application of the skunk works organizational structure that gave birth to the F-117A was just as revolutionary as the aircraft itself. Today the skunk work configuration extends beyond its origins at Lockheed, serving as a catalyst for corporate innovation in many industries. In addition to the personal computing, smartphone, and pharmaceuticals, skunk works has been driven creativity in information technology (e.g, IBM, Xerox; Greenstein, 2016), Internet applications (e.g, Apple, Google, Facebook; Ibrahim, 2016), and chemical manufacturing (e.g, 3M, Monsanto; Gummesson, 2014). Captivated by the story of stealth, corporate executives at these organizations and others knew that a well-crafted organizational structure was invaluable for fostering innovation.

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