Chapter One

# INTRODUCTION

A revolution in manufacturing has swept through the United States within the last 10 years, a revolution that has changed the way innovative firms develop and manufacture their products and deal with their customers and suppliers. The aggregate results have been notable, with a 40 percent improvement in manufacturing productivity in the United States between 1989 and 1998 (Weinstein, 1999, pp. B1, B3).

Sources of the improvements that have led to this revolution are many. New technologies are a traditional driver of higher productivity, as improvements in machines and other kinds of tools enable workers to become more efficient. New processes and ways of organizing work have also contributed to productivity improvements over the years, exemplified historically in the introduction of the assembly line and more recently by the explosive expansion in the use of computer technologies. The past decade has seen the introduction of dramatic improvements in technology and manufacturing processes. New computer technologies allow firms to regulate and improve everything from the initial design of their products to the ordering of material to incorporate into the product to the movement of the product through the factory floor. On the factory floor, the movement from batch production to cellular manufacturing has been linked with reduced labor hours, higher quality, lower inventories, lower floor space requirements, and other efficiency improvements. The "lean manufacturing" system offers one systematic strategy for improvement that incorporates many of these new best practices, including those new technologies and best practice techniques and tools.

The military aircraft sector in the United States has to some extent been historically shielded from the pressures that have driven other firms to seek cost reductions through the adoption of such production practices as lean manufacturing. National security considerations and a lengthy Cold War kept service requirements, personnel, and airplane manufacturers more focused on developing the new technology required to stay competitive in the arms race than on cost considerations of weapons systems. These firms also have not faced the same level of foreign competition as commercial industries, because the U.S. Department of Defense (DoD) is essentially required to purchase its weapons from domestic firms. A strong domestic defense industrial base is seen by most as a strategic requirement. Hence no Toyota or other foreign company can realistically expect to make inroads into the defense market, as they have in the U.S. automobile market.

More recently, with the end of the Cold War and increased pressure from Congress and DoD to emphasize affordability, even at the expense of cutting-edge capability, U.S. weapons manufacturers have begun adopting the principles and techniques of lean manufacturing. Several events in particular stand out as drivers of this focus on cost. One is congressional resistance to the high total program costs of the F-22. This has driven Lockheed Martin and Boeing to adopt new practices to control cost growth in an attempt to stay within the congressionally mandated budget limits. The second is the upcoming Joint Strike Fighter (JSF) aircraft production, a program of some 3,000 aircraft. DoD has indicated to the competitors that they need to demonstrate the cost savings from lean manufacturing by defining these practices now, rather than by making vague promises of cost savings at some future date. Furthermore, these two companies as well as others have the incentive to cut costs to get follow-on business on existing programs from both the U.S. government and foreign sales. Foreign governments in particular have a choice in their procurement and will only buy from U.S. arms manufacturers if their prices are competitive in the world market.

This report addresses three questions regarding the adoption of lean manufacturing in the U.S. defense aircraft sector:

- To what extent have U.S. aircraft manufacturers implemented lean production in their factories and what are the likely savings on military aircraft from this implementation?
- Is sufficient documented and quantified evidence available from industry to support the notion that these savings should be incorporated into cost estimating methodologies?
- If so, what techniques should be used to modify cost estimating methodologies so estimates of future aircraft costs reflect the latest industry initiatives? Can a taxonomy be established for assigning these savings somehow into the Contractor Cost Data Reporting (CCDR) categories?