U.S. Acquisition Cost Reduction & Avoidance Due to Foreign Military Sales

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Abstract

Foreign Military Sales (FMS) is a Department of Defense (DOD) process through which defense goods and services produced by U.S. manufacturers are sold to foreign purchasers. It is the primary mechanism administered by Defense Security Cooperation Agency (DSCA), an organization under DOD and integrated with several key DOD agencies, to build defense capacities of allies and partners of the U.S. to enhance global security and peace. Sales through the FMS program create an opportunity for cost reduction and avoidance for U.S. defense acquisition programs through several familiar pathways such as *economies of scale* and *scope*, *learning/experience curve* advantages, R&D recoupments and Production Line Gap measures. In addition, a non-traditional approach was considered in the study to associate the concept of *brand equity* to the FMS *distribution channel,* resulting in brand dividends that are used to lower U.S. acquisition costs. A notional scenario analysis was conducted in the study to determine cost savings based on FMS growth of 2%, 10% and 25%. Two variations of the notional scenarios, one using *90% experience curve* and the other using *70% experience curve*, were considered for the cost savings due to FMS. With *90% experience curve*, R&D recoupments and *brand equity* considerations, for sales through the FMS process, total cost reductions of $781.6 M, $886.3 M and $1075.3 M were realized from revenues of $11.8 B, $12.8 B and $14.6 B respectively; and with *70% experience curve*, R&D recoupments and *brand equity* considerations, for sales through the FMS process, cost savings of $1252.1 M, $1433.6 M and $1768.7 M were generated for $11.8 B, $12.8 B and $14.6 B of revenues respectively.

Chapter 1 - Introduction

U.S. Original Equipment Manufacturers (OEMs) develop and manufacture defense goods and make them available for purchase to foreign buyers that are allies of the U.S. to enhance security and stability in the world. Foreign Military Sales (FMS), a process in Department of Defense (DOD), is a channel through which the sale transactions occur. It has been noted in previous studies that FMS can reduce U.S. acquisition costs through economic mechanisms such as *economies of scale* and *scope*, *learning/experience curve* advantages, R&D recoupments, and others. However, a detailed understanding of the cost reduction approaches and the aggregate process has not been clearly elucidated.

To generate or increase sales through the FMS program, an assessment of the global defense market to include customers, competitors, and demand for products and services is required. After understanding the market situation, a competitive market positioning strategy could be developed. The sales through the FMS program could lower costs of manufactured defense goods based on widely used economic principles. In addition, a novel concept introduced in the study is that of *brand equity* associated with the FMS *distribution channel*. A *brand equity* premium, when substantiated, could translate to economic rents from OEMs who leverage the FMS process. The collected rents would be utilized to offset U.S. acquisition costs.

Background

The FMS program offers a potential opportunity for cost reduction or avoidance for U.S defense acquisition programs. Past studies recognized the merits that an increase in foreign sales leads to cost reduction and/or avoidance benefits through *scale* and *scope economies*, *learning/experience curve* advantages, and 'non-recurring cost' recoupments (Congressional Budget Office, 1976). Pindyck and Rubinfeld (2001) describe *economies of scale* as "output can

be doubled for less than a doubling of cost" and "increasing returns to scale occurs when output more than doubles when inputs are doubled proportionately" (Pindyck & Rubinfeld, 2001, p. 227) and further, "a firm's average cost of production can decline over time because of growth of sales when increasing returns are present" (Pindyck & Rubinfeld, 2001, p. 235); *economies of scope* is explained as "a firm is likely to enjoy production or cost advantages when it produces two or more products. These advantages could result from the joint use of inputs or production facilities, joint marketing programs, or possibly the cost savings of a common administration." (Pindyck & Rubinfeld, 2001, p. 229); and *learning curve* advantages are explained as "a firm "learns" over time as cumulative output increases" (Pindyck & Rubinfeld, 2001, p. 233) and as a consequence is able to lower its average costs over the long-run. Non-recurring cost recoupments are simply research and development costs, amortized over number of units produced, that are included in the total price of the defense equipment units purchased by a foreign purchaser.

Foreign Military Sales (FMS), according to Defense Security Cooperation Agency (DSCA) of DOD, "is a form of security assistance authorized by the Arms Export Control Act (AECA) and is a fundamental tool of the U.S foreign policy" (Defense Security Cooperation Agency, 2015, p. 1). Additionally, "Under Section 3, of the AECA, the U.S. may sell defense articles and services to foreign countries and international organizations when the President formally finds that to do so will strengthen the security of the U.S. and promote world peace" (Defense Security Cooperation Agency, 2015, p. 1). Importantly, "The FMS program is the primary means by which the U.S government sells defense articles, services, and training to partners. It allows partner nations to purchase defense articles and services, as well as design and construction services, from the U.S. government (Defense Security Cooperation Agency,

2015, p. 1).” The options that the U.S. government has to conduct the transactions for defense articles is to leverage Department of Defense (DOD) inventory or establish a contract to purchase the articles on behalf of foreign customers from the U.S. defense industry. Such a contract to enable the transaction is governed by Federal Acquisition Regulation (FAR).

The FMS program has no-cost to U.S. taxpayers because all administrative costs are borne by foreign purchasers. DSCA website notes “The Defense Security Cooperation Agency (DSCA) administers the FMS program for the Department of Defense” (Defense Security Cooperation Agency, 2015, p. 1). The revenues generated by FMS transactions originate as stated in the DSCA online information - “Eligible countries may purchase defense articles and services with their own funds or with funds provided through either U.S. government-sponsored assistance programs” (Defense Security Cooperation Agency, 2015, p. 1). See Figure 1 for revenues from U.S. FMS agreements (Financial Policy and Analysis, Business Operations, DCSA, 2013). As shown in Figure 1, the defense goods/services to the ‘Near East and South Asia’ region was higher compared to the other regions, and between 2011 and 2013, Saudi Arabia’s purchases increased sharply, most likely due to security concerns in the Middle East region.

As described in the DSCA website “The President designates countries and international organizations eligible to participate in FMS. The Department of State approves individual programs on a case-by-case basis. Currently, some 223 countries and international organizations participate in FMS” (Defense Security Cooperation Agency, 2015, p. 1). In addition to obtaining defense articles from the FMS process, another channel for such transactions is to directly work with a U.S. defense contractor through direct commercial sales (DCS) - “Under DCS rules, U.S. companies obtain commercial export licenses from the Department of State, allowing them to

negotiate with, and sell directly to, our partners" (Defense Security Cooperation Agency, 2015, p. 1). Further, U.S. laws apply to both channels as mentioned - "as with FMS, DCS are subject to applicable U.S. export laws and regulations and the approval of the Department of State" (Defense Security Cooperation Agency, 2015, p. 1).

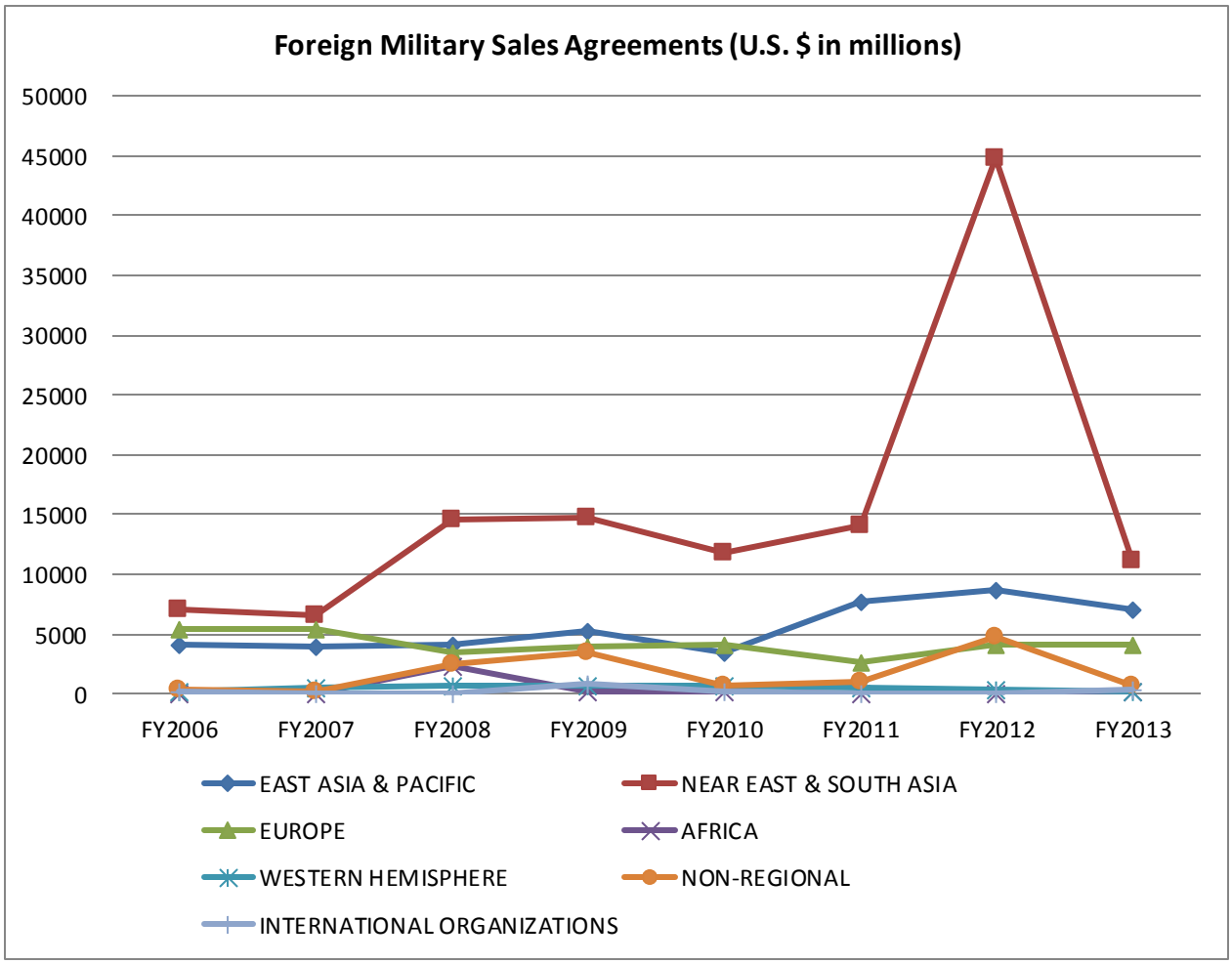


Figure 1 U.S. Foreign Military Sales Agreements (Financial Policy and Analysis, Business Operations, DCSA, 2013)

The FMS program has multiple implications for the U.S, not the least of which are the health of the industrial base, economy, employment, foreign policy and trade, and international

peace and security. Of particular interest for this research study is the global defense market outlook and the cost savings impact for U.S. defense acquisition due to increased sales. The relevance of the study is timely given the current austere U.S. budgetary environment, and the roll-out of the major DOD initiative known as Better Buying Power (BBP 3.0) to acquire affordable, value-added military capability (Under Secretary of Defense Acquisition Technology, and Logistics, 2015).

Prior research on the FMS topic appears limited in the details of the derived cost benefits, although the interest in understanding the approaches is high in the DOD community. According to a Congressional Budget Office report from 1976 (Congressional Budget Office, 1976), five major categories of information were analyzed: R&D recoupments, *learning/experience* curve effects and *economies of scale*, overhead costs, and Production Line Gap which injects funds to allow OEMs to continue production without idling capital equipment and labor. The analysis of the published DOD data showed that an $8.0 billion sales program will, on an average, generate $560 million in cost savings annually (Congressional Budget Office, 1976). The report, however, was published four decades ago.

In this study, potential opportunities to expand FMS through competitive market strategies were explored based on the current global situation, market characteristics and dynamics, customers, and competitors. Further, a potentially viable concept was advanced to quantify the value of the FMS *distribution channel*. The approach was studied because it appears to be a preferable method to conduct business for many foreign customers. Additional reduction in U.S. acquisition costs may be possible if OEMs, who utilize the FMS *distribution channel*, could be influenced through purchasing negotiations to offer price reductions for U.S. defense procurements. To that end, a case could be made that using the FMS channel as an

expert intermediary, similar to a real estate broker, OEMs would benefit from lower costs, and increased sales and profits, and some of these benefits could be passed on to DOD in terms of lower acquisition costs.

Specifically, OEMs need to recognize the intrinsic value that the FMS channel offers: knowledge of foreign purchasers and their requirements, a thorough understanding of the purchasing process, established relationships with U.S. government agencies and organizations to navigate through the purchasing process, credibility of the U.S. government institutions and governance and strong partnerships based on long-term security relations.

Statement of Purpose

The purpose of the research is to identify cost reduction opportunities for U.S defense acquisition due to FMS. To that end, the global market outlook for defense goods and services needs to be assessed; market analyses needs to be performed to comprehend customers and their needs; and competitors and their approach to business strategy needs to be weighed. According to published literature, one of the common means for cost reduction/avoidance is to increase product unit sales to take advantage of *scale economies*. R&D recoupment is another mechanism to lower the cost burdens. Also, *learning/experience curve* advantages typically observed in a manufacturing setting offer cost mitigation possibilities. This study proposes competitive strategies to increase FMS sales to enable cost reduction in U.S. procurements. Additionally, the value the FMS *distribution channel* delivers to OEMs is quantified. To that end, a rationalization is presented to influence U.S. OEMs to offer cost savings to U.S. acquisition programs.

Research Questions

The research questions examined were:

1. What is the current global defense market outlook?
2. What are the key market characteristics – customers, competitors, and products?
3. What competitive strategies can FMS employ to grow sales?
4. What innovative strategies can FMS employ to reduce/avoid costs, and what are the impediments to new strategies for cost savings/avoidance from FMS?
5. What are potential FMS sales and potential cost savings to DOD from the increased FMS sales?

Conceptual model

As shown in Figure 2, a conceptual model was developed to conduct the study. Central to the model is the FMS process responsible for overseeing the complex transaction of selling defense goods/services to foreign purchasers. Foreign customers begin the engagement with the U.S. government by expressing interest to acquire defense goods/services to build their defense capacities. In the early phase, technical exchanges occur to develop and define requirements. As the FMS process progresses leading to the development of a contractual agreement eventually, numerous government agencies and relevant OEMs become involved. The complex web of interactions are coordinated and managed by the FMS process.

The model also illustrates the major activities that the FMS process would employ for improved organizational effectiveness. Strategic marketing involves understanding several aspects such as: global defense market, customers and their needs, competitors and their advantages and the global geo-political situation. Based on the knowledge, a competitive positioning strategy is formulated to increase sales. A key concept that was studied is that of *brand equity*. Does the FMS *distribution channel* create *brand equity*? And if so, how can its value be assessed? And how can FMS capture the value it creates?

The model postulates that FMS would generate significant value for OEMs through reduced cost structure and increased sales of defense goods/services. And concomitantly, the U.S acquisition costs would also be lowered as a consequence.

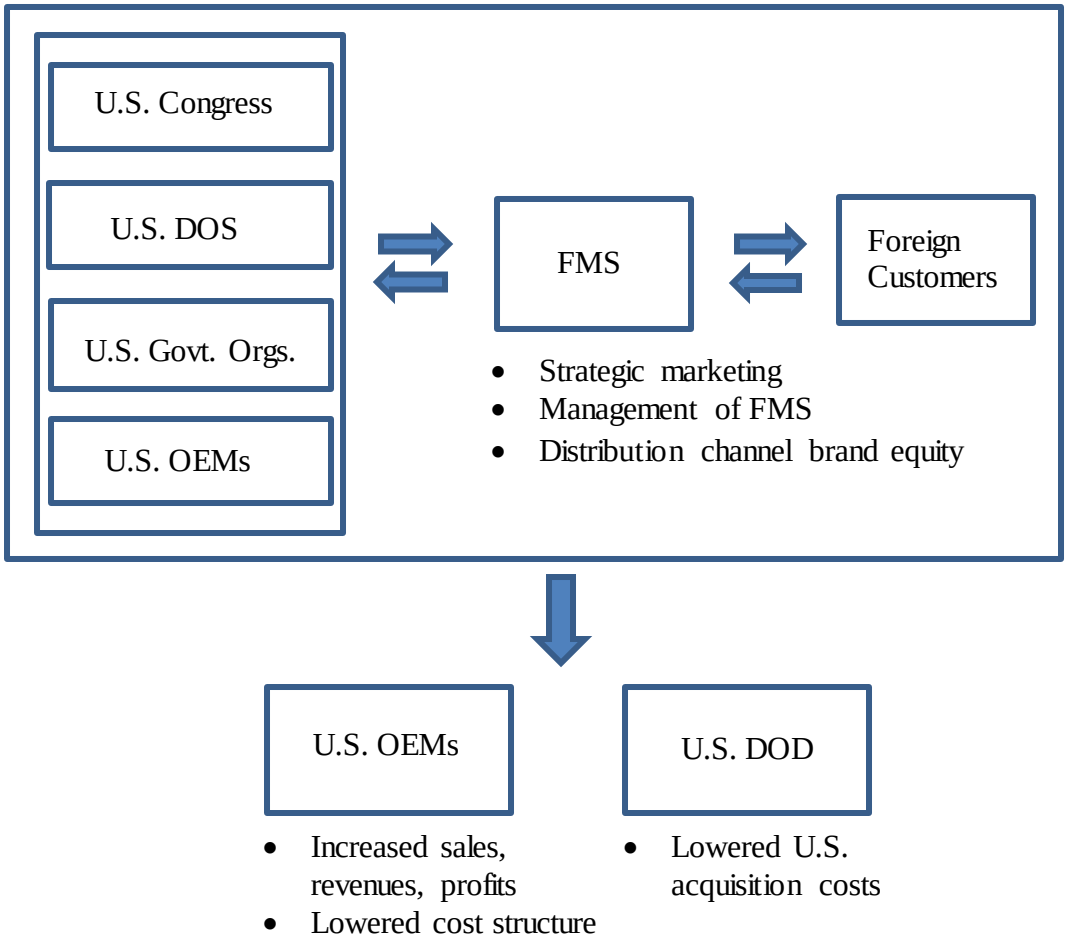


Figure 2 Conceptual Model for Cost Reduction/Avoidance through FMS

Research Methods

The research methods relied extensively on gathering, analyzing and synthesizing data from various sources ranging from previous publications, periodicals, books, public domain databases such as Central Intelligence Agency's (CIA) The World Factbook, databases related to

defense expenditures and world conflicts, company financial databases such as EDGARonline databases, Security Exchange Commission (SEC) reports and financial disclosures. The diversity of the sources of information enabled a holistic understanding of the global environment in terms of market size and growth rates, customer needs and spending trends, key success factors to win customer business, and the current situation of the FMS program relative to the market situation. With the current global business and security environment as a reference point, a competitive positioning strategy to increase market share was put forward. Analysis was performed to characterize competitors' positioning strategies, to understand their value vectors and their views of the defense industry relative to the United States government (USG) and U.S. OEMs. The study utilized established economic theories and empirical data obtained from publicly available reports and/or current Army programs in the manufacturing sector to quantify the cost benefits due to *economies of scale* and *learning curve* advantages. Furthermore, the FMS process was studied to identify factors that validate the *brand equity* of the FMS *distribution channel*.

Significance of research

Previous efforts have focused on *economies of scale*, *learning/experience curve* advantages, reduction of overhead costs and recoupment of R&D costs to mitigate U.S. acquisition costs from sales through the FMS program. This study broadened the scope and developed strategies for FMS effectiveness based on strategic marketing principles. In addition to the well-established approaches for cost reductions such as *economies of scale* and *learning curve* advantages, the *brand equity* factor for the FMS *distribution channel* was also examined as an avenue for cost mitigation.

Limitations of the research:

The research focused on current global trends in the defense industry and market analysis to include customers, competitors and the market for defense goods and services. Furthermore, cost savings from increased unit sales through the FMS channel were identified. However, considering the uncertainty and volatility in the world today, the global defense market outlook could potentially be affected and may deviate from what the study forecasts. Notwithstanding the inherent ambiguity in the global environment, the study puts forth a framework to address the demand for defense goods and services and a strategy to grow the FMS program. In turn, the uptick in market share is expected to lead to higher revenues and profitability for OEMs and that is projected to lower U.S. acquisition costs.

Organization of the paper:

The paper is organized into six chapters. Chapter 1 introduces the study topic and provides a background; establishes a statement of purpose; identifies research questions and postulates a conceptual model; describes the research methods, and closes the chapter with sections on the significance and limitations of the research study. In Chapter 2, a literature review is conducted to understand the global defense market characteristics, motivation for defense spending and key success factors for market entry. Chapter 3 describes the FMS and DCS processes and their discerning key features. Chapter 4 discusses the potential global market for FMS, using the principles of marketing strategy comprising competitive advantage, segmentation, selection and positioning. Chapter 5 provides a detailed discussion and analysis of cost reduction strategies and explores the concept of *brand equity* of the FMS *distribution channel*. And finally in Chapter 6, the research report concludes with a discussion of results, recommendations, challenges and future research.

Chapter 2 – Global Defense Market Outlook

Statement of Purpose

The purpose of the research is to identify cost reduction opportunities for U.S defense acquisition due to FMS. To that end, the global market outlook for defense goods and services needs to be assessed; market analyses needs to be performed to comprehend customers and their needs; and competitors and their approach to business strategy needs to be weighed. According to published literature, one of the common means for cost reduction/avoidance is to increase product unit sales to take advantage of *scale economies*. R&D recoupment is another mechanism to lower the cost burdens. Also, *learning/experience curve* advantages typically observed in a manufacturing setting offer cost mitigation possibilities. This study proposes competitive strategies to increase FMS sales to enable cost reduction in U.S. procurements. Additionally, the value the FMS *distribution channel* delivers to OEMs is quantified. To that end, a rationalization is presented to influence U.S. OEMs to offer cost savings to U.S. acquisition programs.

Global Defense Market Characteristics

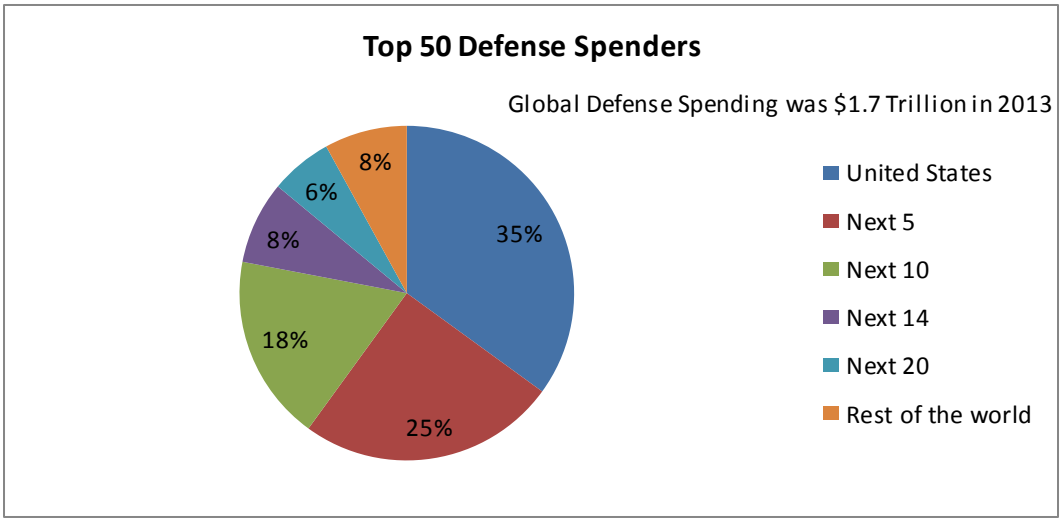
The global defense market is dependent on several factors such as geo-political, economic, policy and other unique security situations that motivate governments to invest in defense goods and services. According to the Deloitte report, "Instability in Ukraine, Japan's efforts to revitalize its defense, continued military build-ups in China, U.S. debates over post-war defense spending and force posture – these events highlight the fundamental shifts in global defense policy underway in 2014" (Deloitte, 2014, p. 4). The report adds, "Defense ministries in high-income nations adapt to new economic imperatives by restructuring, downsizing, and reexamining procurement budgets. Lower-income nations adapt to rapid economic growth and

low debt by increasing defense spending to bolster security, while increasing well-being." (Deloitte, 2014, p. 4). These dynamic circumstances influence global military spending.

Share of Global Defense Spending

The Deloitte report highlights that, "Fifty nations account for 92 percent ($1636 billion) of the world's total spending on national defense. The defense policies and programs of these Top 50 nations explain most of the world's defense activity and shape the global security environment in the broadest and most enduring ways. The Top 50 nations produce more than 90 percent of global economic output and include populations of more than five billion people across six continents" (Deloitte, 2014, p. 5). Figure 3 shows the top 50 countries with significant defense spending. Additionally, the report notes, "The U.S. share of global defense continues to decline from 40 percent in 2012 to 35 percent in 2013, as China, Russia, and other nations increase their defense budgets" (Deloitte, 2014, p. 5).

According to Stockholm International Peace Research Institute (SIPRI) press release, "World military spending totaled $1.8 trillion in 2014, a fall of 0.4 percent in real terms since 2013", and adds, "while falling for the third year in a row, has leveled off as reductions in the United States and Western Europe were largely matched by increases in Asia and Oceania, the Middle East, Eastern Europe and Africa. Spending in Latin America was virtually level." (Stockholm International Peace Research Institute, 2015, p. 1). The press release further expands, "US military spending fell by 6.5 percent, as part of ongoing budget reduction measures; spending has now fallen by 20 percent since the peak in 2010" (Stockholm International Peace Research Institute, 2015, p. 1).



[Next 5: China, Russia, Saudi Arabia, France, Japan; **Next 10:** UK, Germany, India, Brazil, Italy, South Korea, Australia, United Arab Emirates, Canada, Turkey; **Next 14:** Israel, Spain, Columbia, Taiwan, Netherlands, Algeria, Iran, Poland, Singapore, Oman, Indonesia, Pakistan, Mexico, Norway; **Next 20:** Iraq, Sweden, Greece, Kuwait, Thailand, Ukraine, Switzerland, Chile, Belgium, Angola, Argentina, South Africa, Portugal, Malaysia, Denmark, Venezuela, Egypt, Morocco, Azerbaijan, Finland]

Figure 3 Top 50 Global Defense Spenders, (Deloitte, 2014)

In discussing other countries that invest in defense, the press release notes, "the next three highest spenders – China, Russia and Saudi Arabia – have all substantially increased their military expenditures, with Saudi Arabia's increase of 17 percent making it the largest increase of any of the top 15 spenders worldwide" (Stockholm International Peace Research Institute, 2015, p. 1).

Further shedding light on recent events in Europe, the press release states, "the conflict in Ukraine is prompting many European countries near Russia, in Central Europe, the Baltics and the Nordic countries, to increase military spending", and the consequence is highlighted as "Ukraine increased spending by over 20 percent in 2014 and plans to more than double spending on armed forces in 2015" (Stockholm International Peace Research Institute, 2015, p. 1).

The SIPRI press release refers to "military expenditures in Asia and Oceania rose by 5 percent in 2014, reaching $439 billion. The increase is mostly accounted for by 9.7 percent increase by China, which spent an estimated $216 billion. Among the other major spenders, Australia increased its spending by 6.7 percent, with smaller increases by South Korea and India, by 2.3 and 1.8 percent, respectively, while Japan's spending remained steady." And, reiterating that increased defense expenditures occur due to security concerns, "Vietnam, which has had tensions with China over territorial disputes in the South China Sea, increased its spending by 9.6 percent", but also provides an opposing perspective, "conversely, Indonesia, a fellow South China Sea-littoral state, broke its trend of several years of increases with a 10 percent cut in 2014" (Stockholm International Peace Research Institute, 2015, p. 1).

Further, the SIPRI press release cites cases where economic hardship plays a role, "in Latin America, Brazil's spending fell slightly due to economic difficulties, while crisis-hit Venezuela had the largest fall in the region of 34 percent", and also points out the increasing economic burdens, "the economic burden of military spending has increased in some regions, with the number of countries spending more than 4 percent of their GDP on the military increasing from 15 to 20 in 2014". The press release also mentions, "Meanwhile in Mexico increased its spending by 11 percent due to the ongoing war with drug cartels" (Stockholm International Peace Research Institute, 2015, p. 1).

The SIPRI press release also highlights defense spending for oil producing countries, "military spending in Africa increased by 5.9 percent, with the top two spenders Algeria and Angola, both major oil producers, increasing their spending by 12 and 6.7 percent, respectively." Surmising that there may be other factors at play, the report notes, "It is unclear what impact the sharp fall in the price of oil in late 2014 may have on the large rises in military spending that

have taken place in many oil producing countries in the Middle East, parts of Africa and Asia, and Russia among others. While some producers, such as Saudi Arabia, have built up large financial reserves that will enable them to withstand lower prices for some time, others may be more affected, and indeed Russia has already cuts its military spending plans for 2015 as a result" (Stockholm International Peace Research Institute, 2015, p. 1).

Motivation

A 2014 report by McKinsey & Company, a consulting firm, focused its market analysis on Southeast Asia indicating, "The ongoing dynamic growth of economies in Southeast Asia presents defense companies with significant opportunities", and further clarifies, "following a sustained period of positive growth, many Southeast Asian countries are building up military capabilities, with an eye toward better protection of their assets, especially shipping lanes, ports and maritime boundaries that are critical to exports and supply chains. They also seek to defend their territorial integrity in the context of a fast changing security landscape" (McKinsey Innovation Campus Aerospace and Defense Practice, 2014, p. 6). However, as noted previously not all countries are on the same footing when it comes to defense expenditures, and the report corroborates, "While defense spending for the region is growing, the scale and pace varies significantly from country to country. Indonesia, for instance, had more than doubled its spending in the past 5 years, whereas Cambodia and Laos are expanding their budgets more slowly" (McKinsey Innovation Campus Aerospace and Defense Practice, 2014, p. 6).

Important drivers for defense spending growth are, "modernization and replacement of aging fleets", "many countries are today focusing on strengthening their local industries", to "enable local manufacturing and research and development" (McKinsey Innovation Campus Aerospace and Defense Practice, 2014, p. 6). The report reiterates observations noted

previously, "Across the Western world, defense budgets have undergone substantial and far-reaching cuts as a response to, among many factors, reduced war spending in the United States and allies", and identifies the period as, "Between 2009 and 2012, the majority of NATO member states slashed their defense spending, several by more than 10 percent" (McKinsey Innovation Campus Aerospace and Defense Practice, 2014, p. 6).

Distinctly, the McKinsey report draws attention to the growth prospects, "For the first time in more than two centuries – since the start of the Industrial Revolution – the majority of the world's economic growth took place in the developing world, driven in large part by China, India and other emerging economies" (McKinsey Innovation Campus Aerospace and Defense Practice, 2014, p. 6). The report specifically lists countries that have an uptick in defense spending, "Emerging markets are now spending more on defense than ever before. Countries such as China, Brazil and India have doubled or even tripled their defense spending during the past two decades. Southeast Asia-Brunei, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand and Vietnam - is now among the top defense spenders globally" (McKinsey Innovation Campus Aerospace and Defense Practice, 2014, p. 7). In terms of budgets, the report indicates that "these countries have collectively doubled their military spend between 1992 and 2012." (McKinsey Innovation Campus Aerospace and Defense Practice, 2014, p. 7).

Of the various sources of information gathered for the study with regard to the defense spending by countries, the SIPRI dataset, with the most comprehensive data, was used to plot the global expenditure trends by regions. As shown in the Figure 4, Asia & Oceania and Middle East regions expenditures indicate a positive trend; the trend for Africa also shows growth but at a much slower pace; the trend for Europe is flat; and, the trend for the Americas (Central America & Caribbean, North America and South America) depicts retrenchment. To

disaggregate trends at a more granular level for analysis, a set of charts were generated for a select set of countries identified as potential opportunities from the readings referenced earlier in the paper: Latin America (Brazil, Columbia, Mexico), Asia and Oceania (Japan, Australia, South Korea, India, Pakistan, Taiwan, Brunei, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand and Vietnam), Middle East (Saudi Arabia, UAE, Turkey, Israel, Oman), Eastern Europe (France, Ukraine, Baltics, Nordic) and Africa (Algeria and Angola). They are described further in Chapter 4.

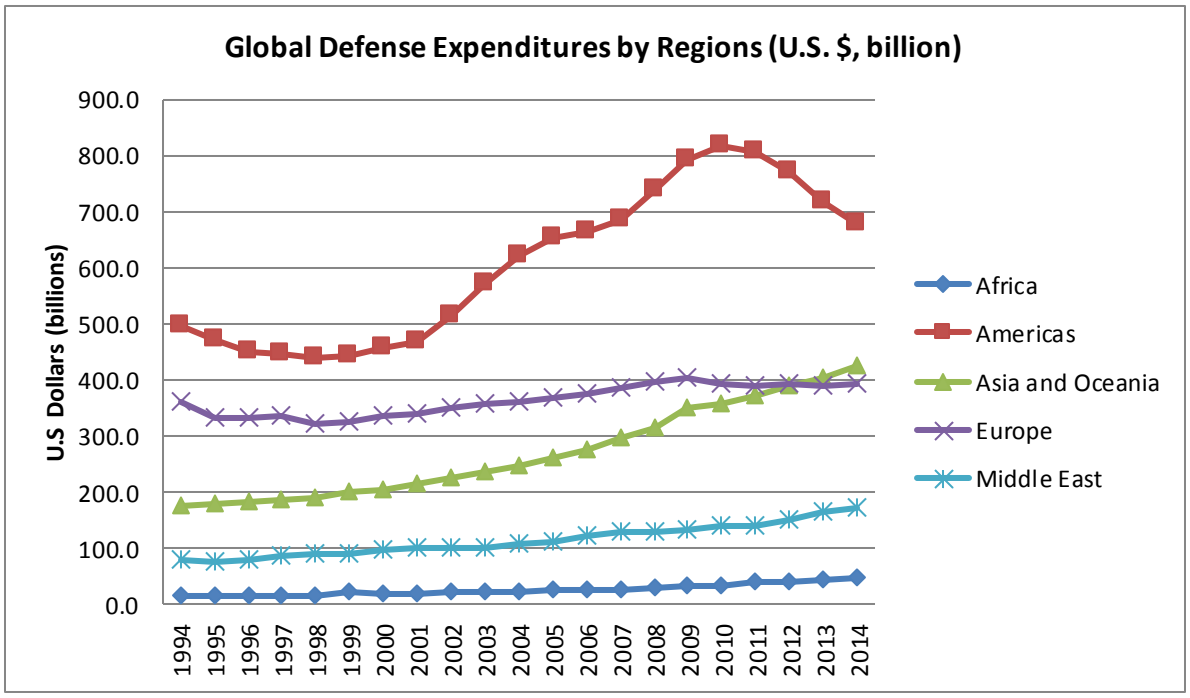


Figure 4 Global Defense Spending by Regions in U.S dollars (billions), (www.sipri.org, 2015)

Key Factors for Market Entry

The 2014 McKinsey report highlights some key factors to consider for market entry for the defense sector: 1) Market size and growth opportunities, 2) Customer needs such as security

concerns, modernization and replacement of aging fleets, 3) Offsets requirements for local manufacturing and R&D capabilities, 4) Market segmentation, 5) Competitor analysis, and 6) Competitive product positioning strategy (McKinsey Innovation Campus Aerospace and Defense Practice, 2014, p. 15). Some of these factors and others will be explored further in Chapter 4 to advance a marketing strategy for the FMS organization.

Chapter 3 – Benefits of FMS to U.S. Original Equipment Manufacturers

Statement of Purpose

The purpose of the research is to identify cost reduction opportunities for U.S defense acquisition due to FMS. To that end, the global market outlook for defense goods and services needs to be assessed; market analyses needs to be performed to comprehend customers and their needs; and competitors and their approach to business strategy needs to be weighed. According to published literature, one of the common means for cost reduction/avoidance is to increase product unit sales to take advantage of *scale economies*. R&D recoupment is another mechanism to lower the cost burdens. Also, *learning/experience curve* advantages typically observed in a manufacturing setting offer cost mitigation possibilities. This study proposes competitive strategies to increase FMS sales to enable cost reduction in U.S. procurements. Additionally, the value the FMS *distribution channel* delivers to OEMs is quantified. To that end, a rationalization is presented to influence U.S. OEMs to offer cost savings to U.S. acquisition programs.

Foreign Military Sales (FMS) and Direct Commercial Sales (DCS) Processes

As stated in Chapter 1, the FMS program is part of security assistance authorized by Arms Export Control Act (AECA). It is a complex process and for major weapon system the sale may last for more than seven years. Binding contractual agreements between USG and an authorized foreign purchaser are established to conduct FMS business transactions. These government-to-government contracts to transfer defense articles and services are known as Letters of Offer and Acceptance (LOAs) and sometimes they are also referred to as a FMS case. The USG infrastructure to handle the FMS transaction comprises military departments (MILDEPs) and DOD agencies and collectively they are termed as implementing agencies (IA)

(Defense Institute of Security Assistance Management, 2015). Foreign purchaser or customer triggers the FMS process with requirements definition as the preliminary activity and the process ends with the FMS program/case closure effort. The FMS process is illustrated in Table 1.

The direct commercial sales (DCS) process allows foreign purchasers to directly engage with U.S. manufacturers to purchase defense articles and/or services. USG generally is neutral regarding which route, FMS or DCS, is preferred by a customer. A foreign purchaser directly negotiates with U.S. OEM for defense articles and as such the transactions and any risks associated with them, such as non-payment or lack of performance, do not involve USG (Defense Institute of Security Assistance Management, 2015). Figure 5 shows the revenues generated through the FMS and DCS channels. Sharp increases in sales through DCS during 2003-2005 time frame may be attributed to the security concerns in the Middle East region due to Operation Iraq Freedom (OIF) when U.S. led coalition forces invaded Iraq.

When is FMS Appropriate?

Various other considerations would determine which method is more suitable to a particular customer or a situation. As stated in the report (Defense Institute of Security Assistance Management, 2015), four general criteria are used to govern whether a sale needs to go through the FMS process only: 1) U.S. legislative or Presidential restrictions, 2) DOD/MILDEP policy, directive or regulatory requirement, e.g., National Disclosure Policy; 3) government-to-government agreement requirements, and 4) interoperability and safety requirements for the U.S. forces. The report decomposes the criteria into sub-components and provides more understanding, specifically related to DOD/MILDEP policy: 1) U.S. political/military relationship with end-user and inherent strengths of the licensing methods of

FMS or DCS that best suits the interests of both parties in the context of global security conditions, 2) Complex system or service where FMS may be recommended to

Table 1 Foreign Military Sales Process (Defense Institute of Security Assistance Management, 2015)

Foreign Militar Sales Process		
Pre-Case Development	**Preliminary and definition** *Indefinite period*	Customer identifies defense capabilities Customer research options/sources Customer refines requirements Customer and US exchange technical information
	Request *Indefinite period*	Customer prepares Letter of Request (LOR) Price or Availability (P&A) or LOA Country Team Assessment (CTA) LOR Channels of submission Security assistance survey teams
Case Development	**Offer** 45 - 150 days Anticipated Offer Date depends on type and complexity of case Formal Congressional review is 15 - 30 days	IA and DSCA receive and evaluate LOR IA develops LOA data (LOAD) DSCA Case Writing Division finalizes LOA Congressional notification, if required, is concurrent with LOA development DSCA-CWD countersigns LOA IA issues LOA to customer
	Acceptance OED is generally 85 days from IA approval in DSAMS (includes 60 days for country review)	Customer signs LOA by Offer Expiration Date Customer sends signed LOA to the IA Customer sends signed LOA and Initial Deposit to Defense Finance and Accounting Service (DFAS-SCA) Indianapolis
Implementation, Execution, and Closure	**Implementation** 10 - 15 days average	DFAS issues Obligational Authority (OA) IA issues Implementation Directive IA activates FMS computer systems
	Execution Longest phase, depends on delivery schedule	Articles/Services/Training are ordered/contracted Articles shipped and services performed Training conducted IA reports performance to customer /DFAS-SCA
	Closure 2 years from supply/service complete (Accelerated Case Closure Procedures	IA/DFAS/Customer reconcile records IA sends closure certificate to DFAS-SCA DFAS-SCA issues final bill to customer

maximize the purchaser's ability to assimilate the technologies and manage its acquisition/logistics; enhance interoperability; requiring complex integration; requiring sensitive USG databases, libraries and software source code; requiring end user monitoring (EUM) or on-site accountability, 3) Avoid proliferation of sensitive U.S. technologies to rogue states and requiring higher scrutiny and monitoring, 4) Feasibility to separate weapon system into FMS and

DCS components. Key point to note per the report is that AECA "gives the President discretion to designate which military end items must be sold exclusively through FMS channels" (Defense Institute of Security Assistance Management, 2015, p. 2). The report goes on further to explain that the "authority is delegated to the Secretary of State and executed by DOD through the DSCA in close coordination with the Defense Technology Security Administration (DTSA) and the MILDEP responsible for the end item" (Defense Institute of Security Assistance Management, 2015, p. 2). Important to spotlight is the role of DTSA to monitor the process by working closely with Department of State (DOS) to review commercial export license requests and if DOS determines that the sale falls in the category of FMS only, then it will not issue a commercial license. In such situations, the only option is to use the FMS process.

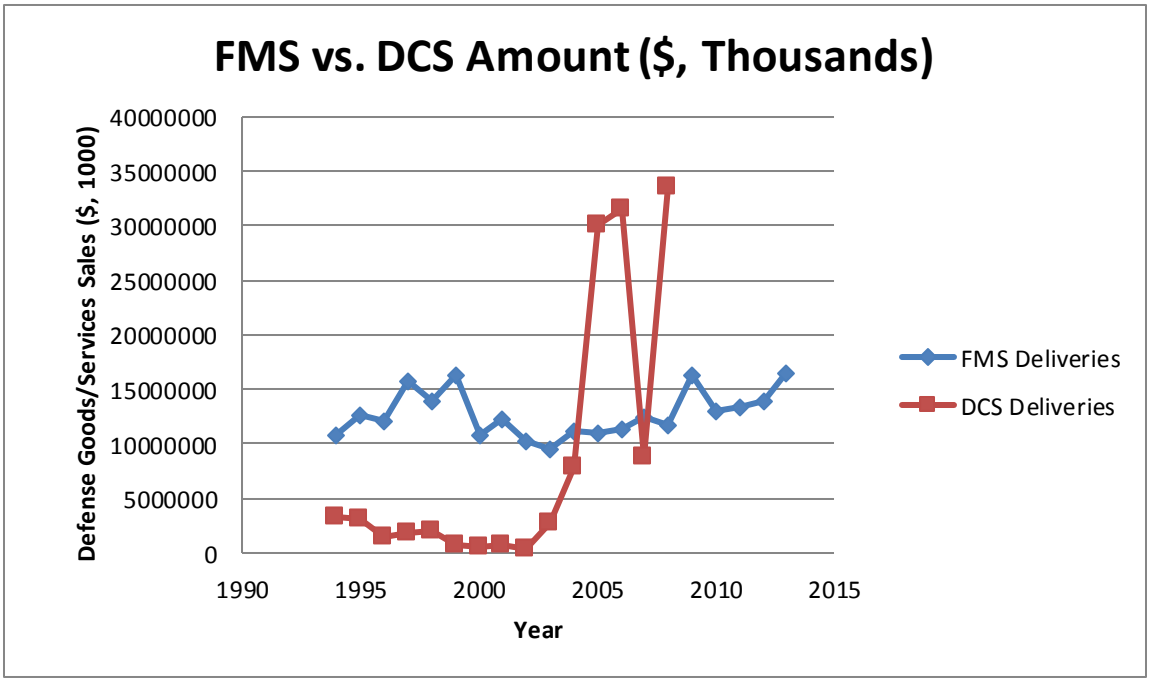


Figure 5 FMS and DCS Sales Comparison (Defense Security Cooperation Agency, 2014)

Factors to Consider for Purchase of U.S. Goods/Services

Several factors are typically considered when foreign purchasers contemplate purchasing goods and/or services from the U.S. either through the FMS or DCS processes and they are: system cost, performance, delivery schedule, life cycle logistics support, interoperability, industrial utilization and political relationship (Defense Institute of Security Assistance Management, 2015).

Whether a foreign customer uses the FMS or DCS process to purchase defense articles or services is dependent on the relationship and the political climate between the foreign government and USG. In both cases however, USG is involved in the approval of the sale. For FMS, DSCA coordinates with DOS for approval to develop a new FMS case; for DCS, the contractor must apply to DOS to obtain an export license to proceed with the sale. DOD is involved in the authorization process for both FMS and DCS.

As illustrated in Table 1, the longest phase of the purchase process is the 'Execution' phase of the FMS case, where defense articles or services are ordered and/or contracted, shipped and installed, and customer training is provided. If the articles are in DOD inventory or stock, then the procurement and delivery could be expedited, but in case these items need to be manufactured or assembled in an OEM production line that is actively supporting U.S. acquisition programs, then the process could be prolonged.

Potential Advantages of FMS (Gilman, Nichols, Totman, & Minarich, 2014, pp. 37-38)

The advantages have been categorized as soft and hard benefits as described below. For a more extensive list, see Appendix A.

Intangible (soft) benefits

The intangible benefits that the FMS process offer are:

- Established relationships with foreign purchasers through U.S. government agencies and embassies
- Credibility of U.S. government institutions and governance
- Motivation to engage in business based on long-term regional security and peace
- Partner nations to purchase defense articles and services, as well as design and construction services, from the U.S. government
- Knowledge of foreign purchasers and their requirements
- Transparency provided by U.S. acquisition system (Implementing Agencies)

Tangible (hard) benefits

- Sound understanding of the purchasing process, to navigate through the purchasing process
- Ability to leverage DOD inventory for rapid delivery
- Establish a contract that is governed by Federal Acquisition Regulation (FAR), to purchase the articles on behalf of foreign customers from the U.S. defense industry
- Use existing DOD contracts to get lower prices due to economies of scale (longer production runs)
- DOD to conduct contract negotiations on behalf of foreign purchasers
- DOD provides "Total Package Approach" in FMS that includes for example, "weapons platform such as fighter aircraft, but also with weapons, sustainment, and training needed for operational use of that weapon platform" (Gilman, Nichols, Totman, & Minarich, 2014, p. 39)

Potential Advantages of DCS (Gilman, Nichols, Totman, & Minarich, 2014, p. 39)**.** See Appendix B.

- Potential for fixed delivery or fixed price, with penalty if OEM fails
- Direct foreign purchaser negotiation with U.S. OEM allows for some flexibility for contract terms for price and faster delivery schedule
- Tailor products/services for unique country needs such as non-standard items not offered through FMS
- Offsets negotiations and implementations are handled through DCS, not FMS
- Lower prices possible in certain conditions and may include installment payments to reduce cost burdens
- FMS administrative surcharge and DOD management costs can be avoided
- Continuity of personal contact with OEM technical staff

Importance of a Customer-Orientation Process

In considering both the FMS and DCS methods of sale to foreign purchasers, the compelling advantages of the FMS process are the government-to-government binding contract obligations and the involvement of DOD personnel in the business engagement. To that end, U.S. military operational knowledge and experience is leveraged and employed during the early requirements development process involving DOD and foreign purchaser. Also, DOD policies and regulations with respect to defense articles and contract terms are consistent with the U.S. acquisition process and thus, risk of non-compliance, misunderstanding or misrepresentation of contract terms and issues with defense goods/services and their delivery are avoided. However, in certain situations, the FMS process is the only justified path due to nature of the engagement such as: developing government-to-government relationships, product/service complexity, DOS

regulatory requirements and compliance, critical technologies, proliferation risks, training and interoperability with U.S. military.

Ease of ordering, customer service responsiveness and rapid delivery of defense goods/services and in some circumstances, flexibility to adapt to bespoke foreign orders become high priorities in foreign transactions. Understandably, expeditious delivery of goods/services is vital due to the gravity of security concerns for some foreign buyers. As such, the FMS organization needs to satisfy these urgent requests from current DOD inventory if approved by the U.S. authorities. From an efficiency standpoint, the delivery schedule should be given the utmost attention for these types of customers during the 'Pre-Case Development' phase when requirements are identified and generated. To that end, IA need to coordinate across the government agencies to develop an effective strategy to address a customer's request for rapid delivery.

Analogous to a real estate broker in the housing industry who successfully executes a sale by coordinating with buyers, sellers and other parties and by bringing invaluable knowledge to bear in the transaction, the FMS organization plays a pivotal intermediary role in the sale of defense goods/services. For instance, not only is a real estate broker equipped with knowledge of local real estate market such as housing prices and availability, but also has information about local community with respect to neighborhood crime and quality of schools; is aware of regulatory compliance with local, state and federal government laws and coordinates with legal entities to document and legitimize a sale; and has access to network of banks for financing options and home inspectors and repair service providers; and importantly, has the experience, interpersonal and negotiation skills to converge to a sale by meeting expectations as best as possible of all involved parties.

To support foreign customers, the FMS organization fields a team of experts who perform complex tasks requiring deep knowledge and possess coordination and negotiation abilities to interact with diverse agencies and organizations of the U.S. to successfully execute a foreign business engagement. Unlike the FMS process, the DCS process requires U.S. OEMs and foreign purchasers to have the above stated skills and knowledge and be willing to accept responsibilities and risks (Gilman, Nichols, Totman, & Minarich, 2014, p. 39) of potential contract delinquencies resulting in forfeiture, regulatory non-compliance, and possible misunderstandings, misrepresentations that might cause a business deal to fail. Moreover, from a monetary standpoint, it would be formidable for OEMs to develop relationships and conduct marketing campaigns around the world, an opportunity cost that could be wisely applied to their core competencies. Instead, by leveraging the expertise and relationships of DOD with other government agencies to spearhead the customer acquisition efforts, OEMs would benefit by avoiding or mitigating international business development costs.

Chapter 4 – Potential Global Market for FMS

Statement of Purpose

The purpose of the research is to identify cost reduction opportunities for U.S defense acquisition due to FMS. To that end, the global market outlook for defense goods and services needs to be assessed; market analyses needs to be performed to comprehend customers and their needs; and competitors and their approach to business strategy needs to be weighed. According to published literature, one of the common means for cost reduction/avoidance is to increase product unit sales to take advantage of *scale economies*. R&D recoupment is another mechanism to lower the cost burdens. Also, *learning/experience curve* advantages typically observed in a manufacturing setting offer cost mitigation possibilities. This study proposes competitive strategies to increase FMS sales to enable cost reduction in U.S. procurements. Additionally, the value the FMS *distribution channel* delivers to OEMs is quantified. To that end, a rationalization is presented to influence U.S. OEMs to offer cost savings to U.S. acquisition programs.

Industry Analysis and Competition

In the report on defense outlook for 2017, McKinsey & Company, a consulting company, surveyed thirty-seven defense industry leaders in October 2014 and the feedback indicated that the global defense spending will stabilize or even return to modest levels of growth (Dowdy & Oakes, 2015). According to Dowdy & Oakes (2015), the spending will come from new market segments rather than traditional home markets: survey results in 2014 indicate that spending will decline in Europe and North America by 1% to 5%; the defense spending in Africa and South America will remain the same; whereas, the defense spending in Asia-Pacific and Middle East will increase by 6% to 10% in the next three years. The survey responses from the executives

identified affordability of the defense goods/services as the most important factor that customers are seeking now. Growth is projected in the international markets and some of the challenges that the respondents anticipate are: political risks such as export-control regulations and offset (local manufacturing and cooperation program) requirements, technology-transfer requirements, and intellectual property issues (Dowdy & Oakes, 2015). Further, the survey respondents indicated that outsourcing, affordability, performance-based logistics, risk-sharing and strategic partnering as the biggest opportunities.

In another McKinsey report regarding international defense sales opportunities, Chin, Dehoff and Sonnino (2015) suggest that defense companies can be successful if they have the marketing capabilities and a global business mindset (Chinn, Dehoff, & Sonnino, 2015). In addition, the report highlights that most defense customers now demand the highest quality and technology at the lowest price. However, they also note that not all companies can overcome the challenges in the global market place (Chinn, Dehoff, & Sonnino, 2015). Here, the FMS enterprise would be able to add significant value in terms of strategic marketing, management and coordination expertise to provide the competitive edge to U.S. OEMs.

Posture for International Sales

The McKinsey report puts forth five challenges for defense companies to address in the global defense market (Chinn, Dehoff, & Sonnino, 2015): what is the value in the opportunity? Do the existing products/services meet international customers' requirements? Could the firms deliver to international customers? Do the companies have the staff to conduct business in the international environments? How should offsets and other regulatory requirements be addressed?

To address the first challenge, the McKinsey report recommends that "Companies need to understand the international opportunity accessible to them based on their specific capabilities

at a detailed level, assess the opportunities alongside those in their core Western markets, and allocate efforts accordingly. However, focusing on international markets might not be the answer for everyone" (Chinn, Dehoff, & Sonnino, 2015, pp. 7-8).

For the second challenge, Chin et al (2015), propose "Current products and service offerings, developed for traditional defense customers, do not always meet international customers' needs. Defense companies must understand these customers' specific cost and performance requirements; often this will reveal the need to develop more affordable products. Relying on Western-funded product development might not be enough to win international business" (Chinn, Dehoff, & Sonnino, 2015, p. 8).

When it comes to the third challenge, Chinn et al (2015) stated "A performing business in Europe or North America needs to evolve to deliver internationally. Companies must set a clear international aspiration: Is it multinational? Is it global? They should then manage strategies, organization structures, and risks accordingly, adapting their operating model and supply chain to win in new markets and leverage the international footprint" (Chinn, Dehoff, & Sonnino, 2015, p. 9).

Discussing the fourth challenge, Chinn et al (2015) remark "Developed-market defense organizations have plenty of successful managers who have built the business over time. This doesn't mean that they will be successful in establishing a business on the other side of the world. The company's vast pool of skills, knowledge, and experience is an asset, but making the most of it is difficult. Attracting, developing, and deploying talent in new markets at the required pace is a challenge; nevertheless, defense companies must do it compete" (Chinn, Dehoff, & Sonnino, 2015, p. 10).

And finally, to address the fifth challenge, Chinn et al (2015) explain "Companies typically look at offsets as a burden and a source of risk along with the extra regulatory challenges attached to entering new markets. Being successful in international markets requires turning offsets and regulations into a source of competitive advantage, while also complying with relevant laws, such as Foreign Corrupt Practices Act. Offsets can be an important enabler for success in international markets. Companies need to develop sound offset strategies and adapt quickly to shifts in market-access regulation (Chinn, Dehoff, & Sonnino, 2015, p. 11).

Table C1 in Appendix C lists the top 25 global defense companies (of the original 100 companies) and the annual reports of a sample of four companies were studied to gain an understanding of the competition and risks associated with the international markets.

Lockheed Martin tops the list and its 2014 Annual Report states that the company is facing increasing competition in both information technology and cyber security areas. Due to budget constraints all across the globe, defense customers are demanding lower prices for high value goods and services. Lockheed Martin's management strategy in the competitive environment is to maintain strong customer relationships and to thoroughly understand customers' requirements and priorities. Lockheed Martin is also facing tough competition in global markets from international defense companies "whose governments sometimes provide research and development assistance, marketing subsidies and other assistance for their products" (Lockheed Martin, 2015 , p. 13). As stated in the report, the company's "principal factors of competition include value of our products and services to our customer; technical and management capability; the ability to develop and implement complex, integrated system architectures; total cost of ownership; demonstrated ability to execute and perform against contract requirements; and our ability to provide timely solutions" (Lockheed Martin, 2015 , p.

6). In the international markets, the U.S and other government laws and regulations influence sale of defense goods and services. Also, a purchasing government's relationship with the U.S. government and its industrial cooperation programs, termed offsets, play an important role in determining the competition.

Number 20 in the list, shown in Table C1 in Appendix C, is Safran, a French defense company, and states in its 2014 Annual Report that "Safran builds front-line positions on the Aerospace, Defense and Security markets. In all its business areas, it enjoys wide recognition for technological excellence serving customers' critical applications" (Safran , 2014, p. 14). The Safran report also mentions that the company differentiates itself from the competition through technological expertise and that its "complementary businesses give it genuine advantage, driving growth and enabling the Group to withstand economic cycles" (Safran , 2014, p. 14). According to the report, "Safran faces competition from both global rivals and niche players in some markets", and the company pursues partnerships to pool resources and innovative ideas to bid for large-scale and high cost projects (Safran , 2014, p. 32).

Cobham plc, listed at 47 (DefenseNews, 2016), is a United Kingdom based firm that "is a provider of specialist technologies and know-how for components and subsystems, in its four sectors: Communications and Connectivity, Mission Systems, Advanced Electronic Solutions and Aviation Services" and caters to three broad markets of commercial, US defense/security and non-US defense/security (Cobham, 2014, p. 2). The company's competitive edge is derived from its high value and leading edge technology, close customer relationships to understand their needs and develop products accordingly, and with a focus on sub-systems and components as opposed to major systems (Cobham, 2014).

The company Aerojet Rocketdyne listed at number 50 in the list (DefenseNews, 2016) is owned by parent company GenCorp and based out of Sacramento, California. They are in the business of developing tactical missile motors and warheads for the U.S. military and its allies. According to the report, their competitive strengths are: leadership in propulsion technologies, multi-year contracts, strong customer relationships and significant barriers to entry due to highly specialized technology (Aerojet Rocketdyne, 2014, pp. 10-11).

FMS Growth Opportunities

From Figure 4 in Chapter 2, defense spending indicates that Asia and Oceania (Japan, Australia, South Korea, India, Pakistan, Taiwan, Brunei, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand and Vietnam), Middle East (Saudi Arabia, UAE, Turkey, Israel, and Oman) and Africa (Algeria and Angola) are the regions of growth. In contrast, the trend for Europe is flat and the trend for the Americas (Central America & Caribbean, North America and South America) shows a drawdown. A country-by-country defense spending trends are shown in Figures 6, 7, 8, 9, 10. For comparison purposes, the percentage increase of defense spending for countries from 1995 to 2015 is roughly categorized into: 'A (100% and greater)', 'B (50% to 100%)', 'C (Less than 50%)' and D (flat, no increase).

In the Latin American market, as shown in Figure 6, of the three countries illustrated, Columbia and Mexico have almost doubled their defense spending and fall in the 'A' category, whereas Brazil which does not exceed 100% would fall in the 'B' category.

In Figure 7, which shows Asia and Oceania region comprising several countries. India falls in the 'A' category, whereas South Korea, Australia fall in the 'B' category. Indonesia, Pakistan, Thailand, Malaysia and Philippines belong to the 'C' category. Spending for Japan, Taiwan, Singapore, Brunei, Cambodia and Laos has remained flat, and belong to 'D'.

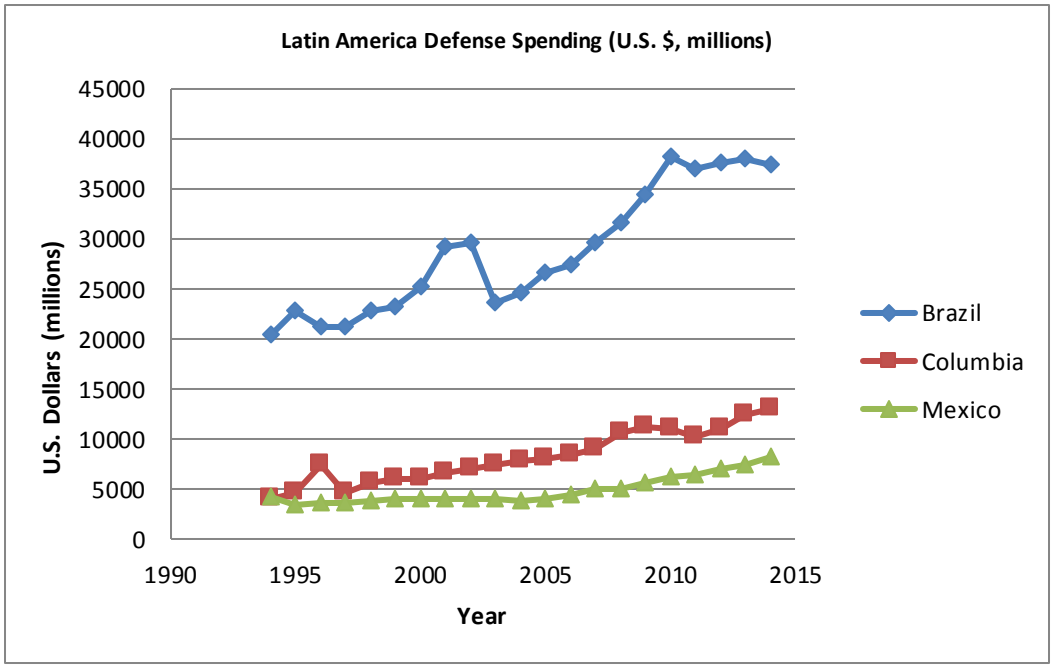


Figure 6 Latin America Defense Spending in U.S dollars (millions), (www.sipri.org, 2015)

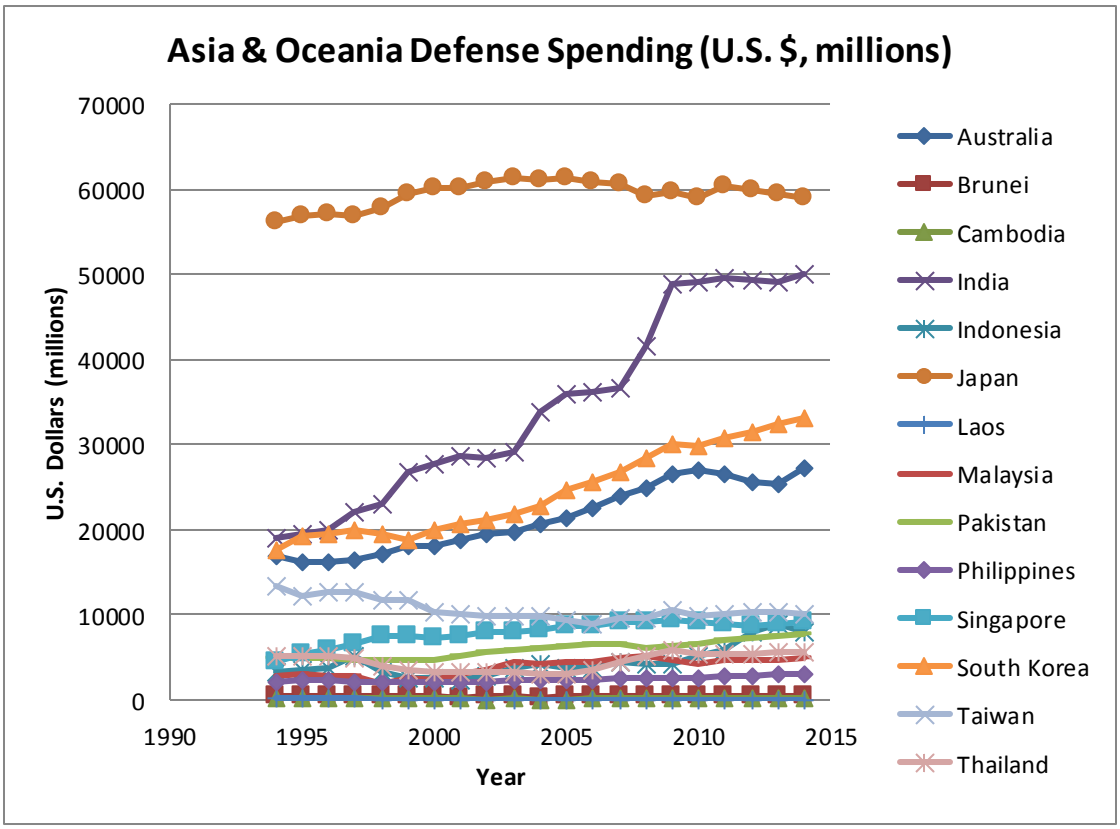


Figure 7 Asia & Oceania Defense Spending in U.S dollars (millions), (www.sipri.org, 2015)

The Middle East defense spending is shown in Figure 8, Saudi Arabia's defense investments have accelerated rapidly over the last two decades compared to its neighboring countries and falls in 'A'; and at a relatively slower pace of spending are United Arab Emirates and Oman and they also belong to 'A'. Turkey and Israel defense spending is constant, in 'D' category.

Figure 9 illustrates defense spending in the Eastern European countries that include Ukraine and the countries in the vicinity. Among these countries, Ukraine, Azerbaijan, Estonia, Latvia, Lithuania, Belarus and Georgia fall in 'A'. Finland falls in 'B'.

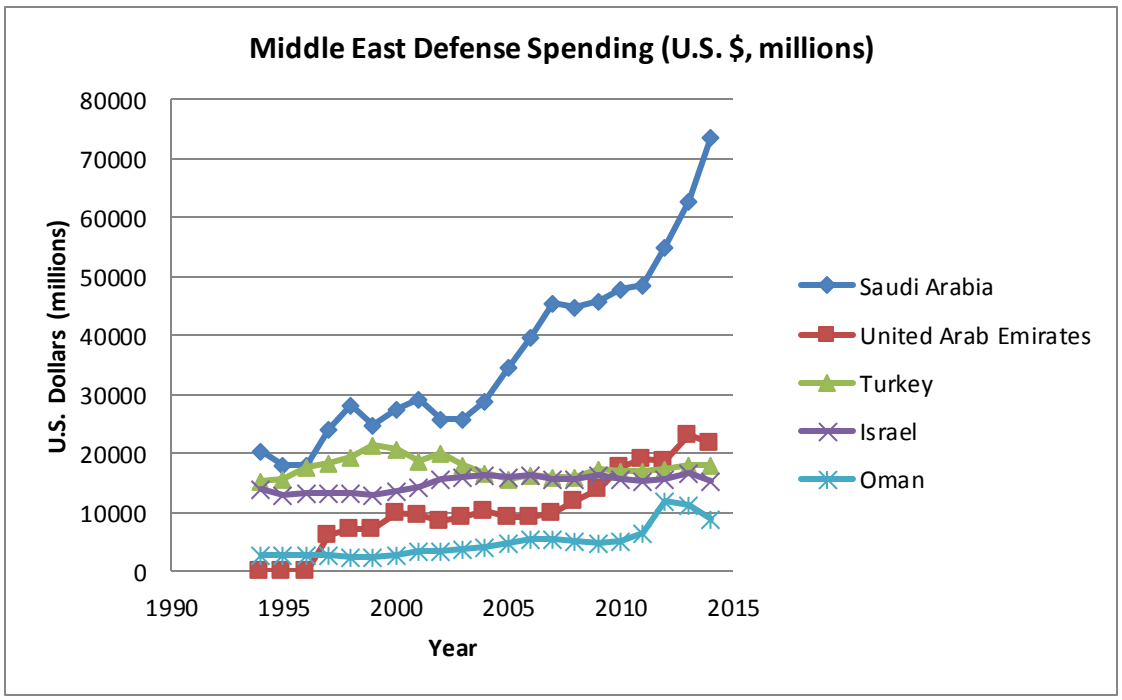


Figure 8 Middle East Defense Spending in U.S dollars (millions), (www.sipri.org, 2015)

As shown in Figure 10, in the African sub-continent, Algeria and Angola have been expanding their defenses capabilities significantly since 1995 and fall in 'A'.

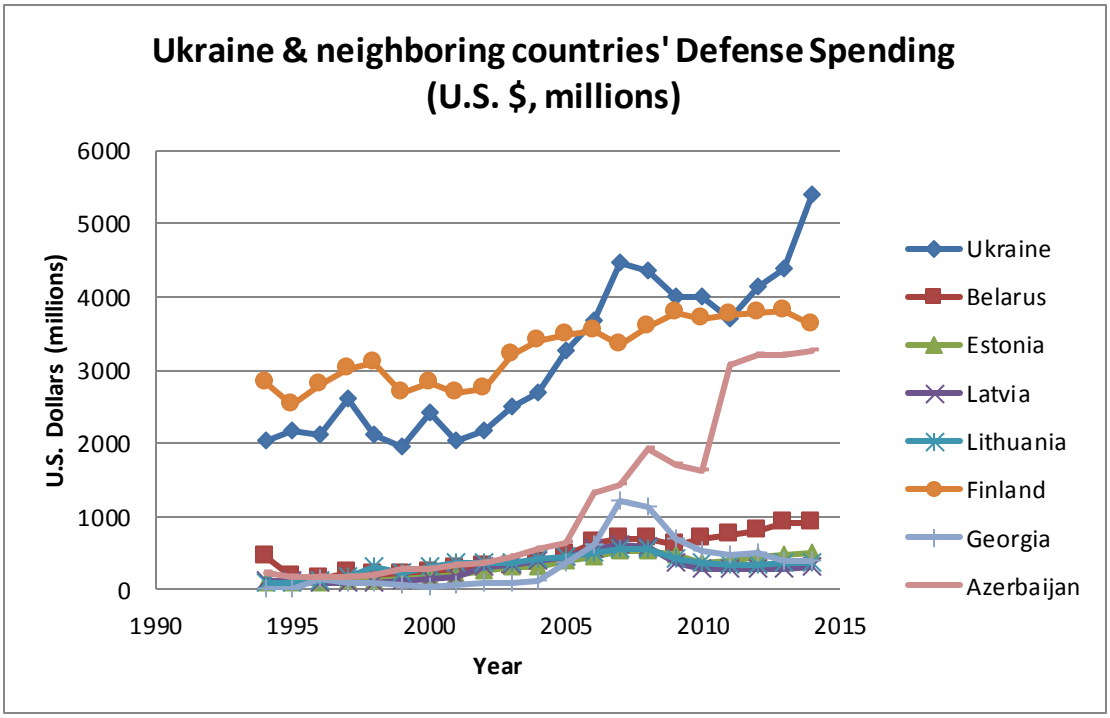


Figure 9 Ukraine & neighbors' Defense Spending in U.S dollars (millions), (www.sipri.org, 2015)

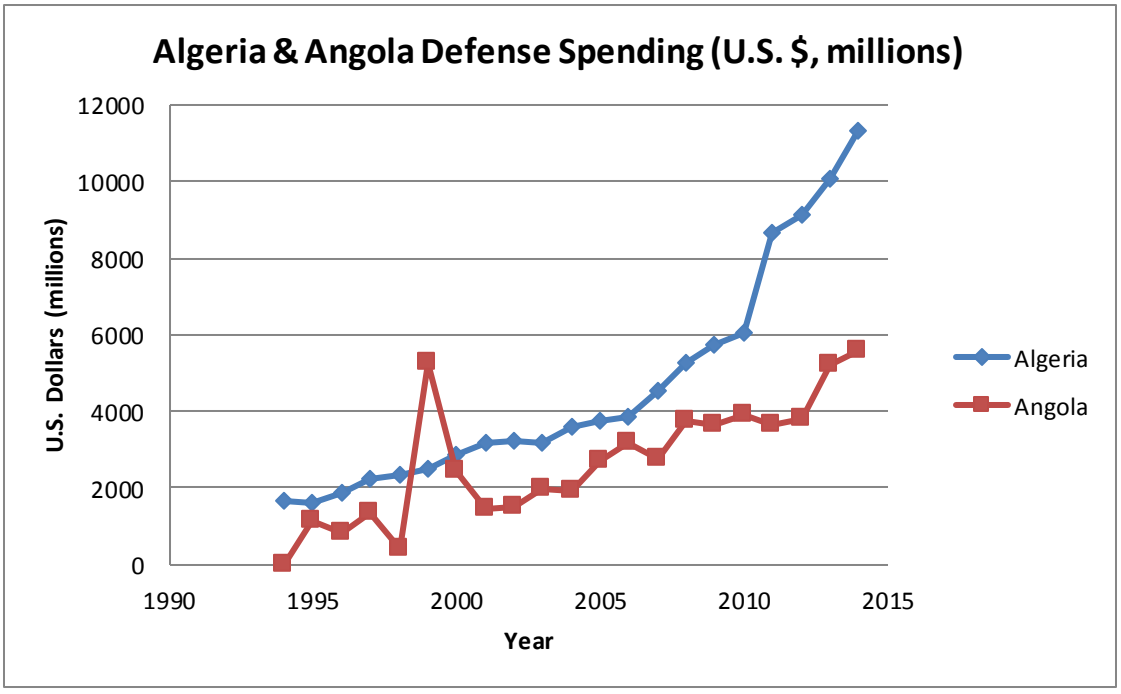


Figure 10 Algeria & Angola Defense Spending in U.S dollars (millions), (www.sipri.org, 2015)

Market Segmentation

Having collected and analyzed the defense spending pattern of the countries, an approach to identify a target market is to conduct *market segmentation*. For instance, 'customer spending' could be characterized as a market segment variable – those countries that have historically invested heavily on defense goods and services would be a potential market for the future. Kotler (2000) explains *market segmentation* as "market segmentation is an effort to increase a company's precision marketing" (Kotler, 2000, p. 256). He further elaborates on the segment marketing approach stating "a market segment consists of large identifiable group within a market with similar wants, purchasing power, geographical location, buying attitudes, or buying habits" (Kotler, 2000, p. 256). According to Kotler (2000), the three major steps for target marketing are (Kotler, 2000, p. 256):

1. Identify and profile distinct groups of buyers who might require separate products or marketing mixes (market segmentation)
2. Select one or more market segments to enter (market targeting)
3. Establish and communicate the products' key distinctive benefits in the market (market positioning)

In Figure C1 in Appendix C, the FMS data obtained from the DSCA organization's database was compared with the overall defense spending of the countries. The average values are shown for the data from 2006 to 2013. As evident from the data, the FMS amounts are in general a small portion of the overall defense spending of the individual countries, except for Cambodia and to some extent Saudi Arabia. Overall, for most countries shown in the chart, the average FMS amount per year is less than $3 billion. From the information generated, it can be inferred that either the countries are purchasing their defense goods directly from the U.S. OEMs

through the DCS process, or more likely, from other foreign defense manufacturers. Based on the data, it appears that FMS growth potential exists, not at the expense of DCS, but through increased sales to foreign customers – both current and new.

As suggested by Kotler (2000), by applying strategic marketing that includes market segmentation, selection and positioning, an organization could increase market share and returns. Proceeding with the market segmentation strategy (Kotler, 2000, p. 274), the countries that are grouped or segmented should have the following criteria:

- *Measurable:* The size, purchasing power, and characteristics of the segments can be measured.
- *Substantial:* The segments are large and profitable enough to serve. A segment should be the largest possible homogenous group worth going after with a tailored marketing program.
- *Accessible:* The segments can be effectively reached and served.
- *Differentiable:* The segments are conceptually distinguishable and respond differently to different marketing-mix elements and programs.
- *Actionable:* Effective programs can be formulated for attracting and serving the segments.

Given the criteria above, an initial screening of the market segment categories are listed below for effective marketing. Some of the segmentation variables proposed by Kotler (Kotler, 2000, p. 272) were adapted for this study:

1. *Country Income:* Gross Domestic Product (GDP), a monetary measure of the value of all final goods and services produced in a period of time (quarterly or yearly), and the GDP

Growth Rate in conjunction are good indicators of a country's affordability index. See Table C2 and Table C3 in Appendix C.

2. *Defense Expenditures Rate*: The percentage increase of defense spending for countries from 1995 to 2015 is roughly categorized into: 'A (100% and greater)', 'B (50% to 100%)', 'C (Less than 50%)' and D (flat, no increase). See the section on 'FMS Growth Opportunities' above for an explanation.
3. *Conflict Likelihood:* Countries who are susceptible to engaging in conflicts either with internal or external adversaries. Whether these conflicts impact the interests of the U.S. is also weighed into the analysis. See Table C4 and Table C5 in Appendix C.
4. *Technology:* What type of technologies are the countries interested? Whether a country is interested in high-technology or low-technology depends on the country's capabilities and needs.
5. *Nature of existing relationships:* Should one pursue customers with existing relationship or pursue the most desirable companies?
6. *General Purchase Policies:* Are the customers new to the purchasing process for U.S. defense equipment? Do they need financing?
7. *Purchasing criteria:* What purchasing criteria do the customers seek – price, quality, total system package including service and training or just hardware.
8. *Loyalty:* Should one pursue customers that show high loyalty to their suppliers?
9. *Ease of doing business:* How easy or difficult is it to do business with certain countries?
10. *Corruption:* Should one avoid countries with high corruption?

In Tables C2 and C3 in Appendix C, countries have been categorized based on 'GDP Per Capita' and 'GDP Growth Rate' respectively. For instance, as shown in Table C2 in Appendix

C, United Arab Emirates has 'High ($60K-$90K)' in the 'GDP Per Capita' measure and 'Moderate (4%-8%)' in the 'Military Spending as a % of GDP' factor.

As reported in Table C4 in Appendix C, 'conflict situation and status' was categorized as 'Worsening' or 'Unchanged' and the countries were marked as such if they were directly or indirectly involved or if they were affected by the neighboring conflict zones. Similarly in Table C5 in Appendix C, the 'impact on U.S. interests' were categorized as 'Critical', 'Significant' and 'Insignificant' based on the U.S. foreign policy, whether the engagement involves allies or partners, or whether a conflict affects U.S. security interests near-term or long-term (Council on Foreign Relations, 2016).

As shown in Table 2, the information discussed above and data from Appendix C, is consolidated with five key customer segmentation variables to develop the marketing strategy:

1. *Conflicts and current situation:* In today's global environment, unless there is a security concern regarding a country's direct or indirect engagement in a conflict or exposure to regional conflicts that may spill over, the need to expand defense goods/services capabilities is generally not necessary. In some situations, a country may be upgrading to newer technologies even though a conflict is not imminent (McKinsey Innovation Campus Aerospace and Defense Practice, 2014). In broad terms, the preponderance of security concerns and the need to protect national sovereignty as such, is of paramount importance to countries (Deloitte, 2014).
2. *Conflict's impact on U.S. interests:* If the U.S. interests are not impacted by certain conflicts around the globe, then the U.S. does not get involved or assist by selling U.S. defense goods/services. As stated in DSCA '2014 Strategic Plan –

Vision 2020', "U.S. national security and foreign policy interests can be achieved only by working closely with and building the capacities and capabilities of our partners", the U.S. builds strategic relationships with allies and partners to enhance security to deter adversaries in the complex and challenging global environment (Defense Security Cooperation Agency, 2014, p. 6).

3. *Country's GDP Per Capita:* It is a measure to assess whether a country can afford to purchase U.S. defense articles or not. The higher the value, the richer is the country to allocate resources to increase its defense capabilities.
4. *Country's GDP Growth Rate*: On the contrary, a country may have a lower 'GDP Per Capita', but due to rapidly expanding economy – increasing oil revenues for instance - the 'GDP Growth Rate' index exhibits an upward trend. In such a situation, a relatively poor country without adequate defense infrastructure, now decides to achieve parity with neighboring countries or attain global standards.
5. *Country's military spending rate:* The allocation of national budget to defense spending as a percentage of GDP is an indicator of a country's defense capabilities. Also, given recent trends as discussed earlier in the report, categories A (100% and greater), B (50% to 100%), C (less than 50%) and D (flat, no increase) were established.

Table 2 Summary of the Proposed Five Key Segmentation Variables

COUNTRY SEGMENTATION VARIABLES					
Countries	**Conflict Situation**	**Conflict's Impact on U.S. Interests**	**GDP per Capita**	**GDP Growth Rate**	**Military Spending Rate**
Angola	WORSENING	LIMITED	LOW	MODERATE	A
Pakistan	WORSENING	CRITICAL	LOW	HIGH	C
Cambodia	INSIGNIFICANT	INSIGNIFICANT	LOW	HIGH	D
Laos	INSIGNIFICANT	INSIGNIFICANT	LOW	HIGH	D
Algeria	WORSENING	SIGNIFICANT	LOW	MODERATE	A
Ukraine	UNCHANGING	SIGNIFICANT	LOW	LOW	A
India	WORSENING	SIGNIFICANT	LOW	HIGH	A
Georgia	UNCHANGING	SIGNIFICANT	LOW	HIGH	A
Colombia	INSIGNIFICANT	INSIGNIFICANT	LOW	HIGH	A
Mexico	UNCHANGING	SIGNIFICANT	LOW	MODERATE	A
Brazil	INSIGNIFICANT	INSIGNIFICANT	LOW	MODERATE	B
Philippines	WORSENING	CRITICAL	LOW	HIGH	C
Oman	WORSENING	SIGNIFICANT	MODERATE	HIGH	A
Turkey	WORSENING	CRITICAL	LOW	MODERATE	D
Latvia	UNCHANGING	SIGNIFICANT	LOW	MODERATE	A
Lithuania	UNCHANGING	SIGNIFICANT	LOW	MODERATE	A
Azerbaijan	UNCHANGING	SIGNIFICANT	LOW	MODERATE	A
Indonesia	INSIGNIFICANT	INSIGNIFICANT	LOW	HIGH	C
Thailand	INSIGNIFICANT	INSIGNIFICANT	LOW	MODERATE	C
Estonia	UNCHANGING	SIGNIFICANT	LOW	MODERATE	A
Israel	WORSENING	CRITICAL	MODERATE	MODERATE	D
South Korea	UNCHANGING	CRITICAL	MODERATE	MODERATE	B
Brunei	WORSENING	CRITICAL	MODERATE	LOW	D
Saudi Arabia	WORSENING	SIGNIFICANT	MODERATE	HIGH	A
Australia	INSIGNIFICANT	INSIGNIFICANT	MODERATE	MODERATE	B
Malaysia	WORSENING	CRITICAL	LOW	HIGH	C
Taiwan	UNCHANGING	CRITICAL	MODERATE	HIGH	D
United Arab Emirates	WORSENING	SIGNIFICANT	HIGH	MODERATE	A
Japan	UNCHANGING	CRITICAL	MODERATE	LOW	D
Finland	UNCHANGING	SIGNIFICANT	MODERATE	LOW	B
Singapore	INSIGNIFICANT	INSIGNIFICANT	HIGH	MODERATE	D

Market Target Selection

Given the current global perspective, a scoring scheme was developed as shown in Table 3, and utilized to generate a feasible market footprint for the FMS program. The market segmentation would enable an effective and targeted marketing campaign for the FMS program office. Using the scoring criteria, Table 4 was generated that shows the list of countries with associated overall scores shown in the last column – the higher the score, the more the likelihood

that a well formulated marketing strategy would be effective to penetrate that particular market. In this study, the highest weighting factors of 0.30 and 0.25 were assigned to 'Conflict's Impact on U.S. Interests' and 'Conflict Situation' segmentation variables respectively, followed by 'GDP Growth Rate', 'Military Spending Rate', and 'GDP Per Capita' of 0.20, 0.15 and 0.10 respectively.

Table 3 Scoring Criteria with Weighted Segment Variables

SCORING CRITERIA									
Conflict Situation (W=0.25)		**Conflict's Impact on U.S Interests (W=0.30)**		**GDP Per Capita (W=0.10)**		**GDP Growth Rate (W=0.20)**		**Military Spending Rate (W=0.15)**	
Worsening	2	Critical	3	High	3	High	3	A	3
Unchanging	1	Significant	2	Moderate	2	Moderate	2	B	2
Insignificant	0	Limited	1	Low	1	Low	1	C	1
		Insignificant	0					D	0

The FMS program provides security assistance to countries to enhance U.S. security and world peace, and to exercise U.S. foreign policy (Defense Security Cooperation Agency, 2015). As per the DOD guidance of the statute, the weighting factors associated with the first two market segment variables are considered appropriate and meaningful. The other three segment variables basically provide an indication regarding a country's ability to afford defense goods and services.

The list of countries with the associated overall scores were then separated into three market segments with the associated range of scores: (1) Market Segment 1 (weighted score range from 2.00 to 2.75), (2) Market Segment 2 (weighted score range from 1.25 to 1.99) and, (3) Market Segment 3 (weighted score range from 0.50 to 1.24). Of the three market segments only Market Segment 1 was considered for market entry in the study and is shown in Table 5.

Table 4 Overall Weighted Country Scores for Market Segmentation

COUNTRY SEGMENTATION VARIABLES						
Countries	Conflict Situation	Conflict's Impact on U.S. Interests	GDP per Capita	GDP Growth Rate	Military Spending Rate	Overall Score (Weighted)
Angola	2	1	1	2	3	1.75
Pakistan	2	3	1	3	1	2.25
Cambodia	0	0	1	3	0	0.7
Laos	0	0	1	3	0	0.7
Algeria	2	2	1	2	3	2.05
Ukraine	1	2	1	1	3	1.6
India	2	2	1	3	3	2.25
Georgia	1	2	1	3	3	2
Colombia	0	0	1	3	3	1.15
Mexico	1	2	1	2	3	1.8
Brazil	0	0	1	2	2	0.8
Philippines	2	3	1	3	1	2.25
Oman	2	2	2	3	3	2.35
Turkey	2	3	1	2	0	1.9
Latvia	1	2	1	2	3	1.8
Lithuania	1	2	1	2	3	1.8
Azerbaijan	1	2	1	2	3	1.8
Indonesia	0	0	1	3	1	0.85
Thailand	0	0	1	2	1	0.65
Estonia	1	2	1	2	3	1.8
Israel	2	3	2	2	0	2
South Korea	1	3	2	2	2	2.05
Brunei	2	3	2	1	0	1.8
Saudi Arabia	2	2	2	3	3	2.35
Australia	0	0	2	2	2	0.9
Malaysia	2	3	1	3	1	2.25
Taiwan	1	3	2	3	0	1.95
United Arab Emirates	2	2	3	2	3	2.25
Japan	1	3	2	1	0	1.55
Finland	1	2	2	1	2	1.55
Singapore	0	0	3	2	0	0.7

Essentially, the countries that comprise Market Segment 1 have higher values of the overall weighted scores. The high scores signify that these countries are engaged in a harmful and/or escalating conflict situation. Additionally, the countries are postured fiscally to modernize or enhance their defense capabilities due to the security concerns. Furthermore, strengthening their defense capabilities are in alignment to the U.S. foreign policy and security interests. As such, the countries in Market Segment 1 have the most promising market potential for defense goods/services. To that end, a market positioning strategy for Market Segment 1 is developed. The basis for the strategy is that the countries in Market Segment 1 are in a state of

conflict or are located in a region prone to conflicts or have serious security concerns. And these countries have the incentive to purchase the necessary defense articles or services rapidly.

Market Positioning

As observed in Table 5, the recent procurements of defense equipment and capabilities include aircraft, air defense systems, artillery, ammunition, amphibious vehicles, armored vehicles, missiles, ships, submarines and logistic support and maintenance. These defense products represent superior and complex technologies that only a handful of highly industrialized countries can design, develop and manufacture. Also, in Table 5, the competition that OEMs and USG face is listed. Some of these countries also offer advanced technologies and that would necessitate foreign customers to conduct due diligence prior to selecting suppliers. A foreign customer engagement in such complex defense products involves more than just a simple and straightforward transaction. The elaborate process entails requirements definition, ordering/contracting, delivery, installation, customer training to use the equipment, logistic support, maintenance and repair.

The U.S. is the world's largest economy, with an unparalleled military power and a global leadership stance in building country coalitions to diffuse conflicts, to promote peace and to deter and defeat adversaries who disregard international norms and laws. To that end, foreign purchasers seek advanced defense capabilities from the U.S. and trust that the products are of high quality and reliability with superior performance characteristics compared to products from other countries.

U.S. institutions such as DOS and United States Agency for International Development (USAID) have a strong reputation for integrity and leadership values that promote "collective security, shared prosperity, and human dignity through diplomacy and development around the

world" (United States Department of State, 2015). In view of the bedrock principles of the U.S. foreign policy and the reputable governance, the FMS program office needs to articulate a clear and compelling positioning strategy to purchasers of U.S. defense goods and services. Using the market segmentation and the selection of Market Segment 1 as the target marketing opportunity for the FMS program, the following are proposed as the key differentiation variables for a positioning strategy (Kotler, 2000):

1. *U.S. defense products:* Features, Performance, Durability, Reliability
2. *U.S. defense services:* Ordering ease, Delivery, Installation, Customer training, Customer consulting, Maintenance and repair
3. *U.S. defense personnel/staff:* Competence, Credibility, Reliability, Responsiveness, Communication
4. *Channel:* Foreign Military Sales (FMS) (and/or Direct Commercial Sales (DCS) if preferred by foreign purchasers), Expertise, Performance

The FMS program office needs to highlight the above four major differentiation variables and their sub-components to foreign purchasers of Market Segment 1 during the early information exchange engagements leading up to a potential sale. Specifically, for Market Segment 1 that is characterized by, (a) established relationship with the U.S. and their need for technologically advanced defense goods and/or services, (b) financial ability to purchase high-end products/services, and (c) procurement urgency due to security concerns. The FMS program office's market positioning statement should be compelling and impactful. To facilitate the communication with potential customers, the key points of the positioning strategy for Market Segment 1 are summarized in Table 6.

Table 5: Market Segment 1 - Most Promising Segment to Implement Marketing Strategy (see Appendix D for reference)

Countries	Defense Goods or Services Needs (recent, 2014 to now)	Competing Countries (in the period 2014 to now)
Pakistan	**Recent/Current U.S. Transactions:** AH-1Z VIPER Attack helicopters, AGM-114R Hellfire Missiles, MRAP ground vehicles [1], International military education & training (IMET) [3]	Brazil, China, France, Italy, Jordon, Russia, Serbia, Sweden, Turkey, Ukraine (see Appendix E)
Algeria	**Recent/Current U.S. Transactions:** helicopters, unmanned drones, self-propelled artillery, amphibious vehicle, armored vehicles, submarines [4]	China, Denmark, Finland, France, Germany, Italy, Netherlands, Poland, Russia, South Africa, Sweden, UAE, UK (see Appendix E)
India	**Recent/Current U.S. Transactions:** C-130 equipment, parts & logistics (24Apr2015), UGM-84L Harpoon missiles (01Jul2014) [5]	Brazil, Canada, Germany, France, Israel, Italy, Kyrgyzstan, Netherlands, Poland, Russia, South Korea, Spain, Sweden, Switzerland, Ukraine, UK (see Appendix E)

Table 5: Market Segment 1 - Most Promising Segment to Implement Marketing Strategy (see Appendix D for references) (contd.)

Countries	Existing or New Relationship (U.S. Dept. of State)	Financing	Offset Requirements
Pakistan	Existing relationship for security and stability in South Asia, counter-terrorism and defense & enhance professionalism of military [1]	1) China loan [2] 2) $265M (U.S. FMF-FY2015) [3]	No known offset requirements
Algeria	Existing relationship for law enforcement and counterterrorism; security and stability of region [3] Mostly DCS purchases of HMMWVs (AM General); TPS-70 radar (Northrop Grumman); C-130 (Lockheed Martin) [4]	1) FMF not used in the past [4] 2) Recent use of IMET funding ($550K-FY2003) [4]	No significant indigenous defense industry; low likelihood for offsets because of lack of resources and capabilities
India	Existing relationship to contribute to foreign policy and national security of the U.S. by helping strengthen the U.S.-India strategic relationship to improve security of an important partner [5]	No indication of FMF use	Potential offset requirement/agreement and international cooperation for defense equipment design/development [6, 7, 8, 9]

Table 5: Market Segment 1 - Most Promising Segment to Implement Marketing Strategy (see Appendix D for references) (contd.)

Countries	Defense Goods or Services Needs (recent, 2014 to now)	Competing Countries (in the period 2014 to now)
Phillipines	**Recent/Current U.S. Transactions:** Attack helicopters, naval helicopters, light aircraft, frigate [10]; C-130 cargo planes [11]	Canada, France, Indonesia, Israel, Italy, Russia, South Korea, Spain, UK (see Appendix E)
Oman	**Recent/Current U.S. Transactions:** F-16 aircraft, Javelin anti-tank system, Avenger, Stinger, AMRAAM, AIM "Sidewinder" Air-to-Air missile, TOW 2B missiles (ground-based air defense system), Logistics training and support for C-130J [14, 15]	Australia, Canada, Denmark, France, Germany, Italy, Netherlands, Norway, Singapore, Spain, Turkey, UK (see Appendix E)
South Korea	**Recent/Current U.S. Transactions:** Apache (AH-64E) helicopter, UGM-84L Harpoon Block II missiles, CH-47D helicopters [16, 17]	France, Germany, Israel, Italy, Sweden, UK (see Appendix E)

Table 5: Market Segment 1 - Most Promising Segment to Implement Marketing Strategy (see Appendix D for references) (contd.)

Countries	Existing or New Relationship (U.S. Dept. of State)	Financing	Offset Requirements
Phillipines	Existing relationship to contribute to the U.S. security and foreign policy goals by building Philippines' maritime domain security capacity and deepening strategic partnership [11]	U.S. provides security assistance and FMF ($20M) used for the C-130 purchase [12, 13]	Modest domestic arms industry; low likelihood for offsets because of inadequate of resources and capabilities
Oman	Existing relationship to contribute to foreign policy and national security of the U.S. by helping to improve the security of a friendly country, an important force for political stability and economic progress in the Middle East [14]	No indication of FMF use	Typically requests offsets [14]
South Korea	Existing relationship to "contribute to the foreign policy and national security objectives of the United States by meeting the legitimate security and defense needs of an ally and partner nation. The ROK is one of the major political and economic powers in East Asia and the Western Pacific and a key partner of the United States in ensuring peace and stability in that region. It is vital to the U.S. interest to assist our South Korean ally in developing and maintaining a strong and ready self-defense" [16]	No indication of FMF use	No known offset requirements

Table 5: Market Segment 1 - Most Promising Segment to Implement Marketing Strategy (see Appendix D for references) (contd.)

Countries	Defense Goods or Services Needs (recent, 2014 to now)	Competing Countries (in the period 2014 to now)
Saudi Arabia	**Recent/Current U.S. Transactions:** New/Upgrade to F-15 aircraft, ammunition, missiles, logistic support, Apache and Black Hawk helicopters [16, 17] M1A2 ABRAMS tank, M2A2 Bradley, F-15E Strike Eagle aircraft, Patroit surface-to-air missile [18]	Canada, China, France, Germany, Netherlands, South Africa, Spain, Sweden, Switzerland, Turkey, UK (see Appendix E)
Malaysia	**Recent/Current U.S. Transactions:** AIM-120C7 AMRAAM missiles and other [20, 21]	Brunei, Canada, France, Italy, Netherlands, South Africa, South Korea, Spain, Sweden, Switzerland, Turkey (see Appendix E)
United Arab Emirates	**Recent/Current U.S. Transactions:** Precision guided munitions (JDAM) [22] Patriot SAM/ABM system (see Appendix)	Canada, Denmark, Finland, France, Germany, Italy, Netherlands, Singapore, South Africa, Sweden, Turkey (see Appendix E)

Table 5: Market Segment 1 - Most Promising Segment to Implement Marketing Strategy (see Appendix D for references) (contd.)

Countries	Existing or New Relationship (U.S. Dept. of State)	Financing	Offset Requirements
Saudi Arabia	Existing relationship "contributes to the foreign policy and national security of the U.S. by increasing the security of an important partner that continues to be a significant force for political stability and economic progress in the Middle East. Sustaining Saudi military capabilities deters hostile actors, increases U.S.-Saudi military interoperability, and has a positive impact on the stability of the global economy. This acquisition also directly conveys U.S. commitment to the RSAF's current and future ability to sustain combat operations" [19]	FMF not used [18]	Offset requirements
Malaysia	Existing relationship for "foreign policy, political stability and improve security of key partner in SE Asia for political stability and economic progress" [20]	No indication of FMF use	Offset Requirements
United Arab Emirates	Existing relationship for "foreign policy and national security of the U.S. and to assist in Operation Inherent Resolve against ISIS/ISIL. Also to help key partner for political stability and economic progress in the Middle East" [22]	No indication of FMF use	No known offset requirements

Table 6 FMS Market Positioning for Market Segment 1

FMS market positioning strategy for Market Segment 1				
Organization/Company	**Target Customer**	**Benefits**	**Price**	**Value Proposition**
FMS Program Office	*Market Segment 1:* Pakistan Algeria India Philippines Oman South Korea Saudi Arabia Malaysia United Arab Emirates	1) Strong reputation of **integrity and trust** of the U.S. government institions to **enable ease of doing business and transparency** of business transactions 2) Technologically superior products, exceptional quality, reliability and performance 3) System-level package to include training, support and maintenance	**Value-driven**	**Exceptional quality, reliability and technologically superior** products/services offered through FMS Program Office staffed by **experts to efficiently and expeditiously** manage the **end-to-end** procurement process

Chapter 5 – U.S. Procurement Cost Reduction due to FMS

Statement of Purpose

The purpose of the research is to identify cost reduction opportunities for U.S defense acquisition due to FMS. To that end, the global market outlook for defense goods and services needs to be assessed; market analyses needs to be performed to comprehend customers and their needs; and competitors and their approach to business strategy needs to be weighed. According to published literature, one of the common means for cost reduction/avoidance is to increase product unit sales to take advantage of *scale economies*. R&D recoupment is another mechanism to lower the cost burdens. Also, *learning/experience curve* advantages typically observed in a manufacturing setting offer cost mitigation possibilities. This study proposes competitive strategies to increase FMS sales to enable cost reduction in U.S. procurements. Additionally, the value the FMS *distribution channel* delivers to OEMs is quantified. To that end, a rationalization is presented to influence U.S. OEMs to offer cost savings to U.S. acquisition programs.

Cost Reduction and Avoidance Due to FMS

In general, when OEMs in the U.S. sell defense goods to foreign purchasers through the FMS program, there are cost savings or cost avoidance aspects that are realized by the USG which in turn reduce the U.S. DOD budgetary pressures. If sales through the FMS program are marginal then most of the costs of sustaining the U.S. defense industrial base, whether they are capital expenditures, Research & Development (R&D) investments or production costs, would have to be borne by the U.S. Congressional Budget Office (CBO). To that end, when sales through the FMS program are healthy, the U.S. CBO cost obligations are lessened.

The 1976 CBO report analyzed FMS financial information related to 35 major weapons systems and stated that the estimated U.S. budgetary cost savings due to FMS were based on several categories: R&D recoupments, *learning curve* advantage effects and *economies of scale*, overhead, Production Line Gap, and other, from 1972 to 1981. The estimated savings from the past sales, 1972-1976, and the projected savings from the future sales, 1977-1981, as a result of FMS, were obtained from the DOD information repository for the study. As stated in the report, "An $8 billion sales program will, on the average, generate $560 million in cost savings annually. This estimate assumes the current mix of sales of weapons, services and construction." (Congressional Budget Office, 1976, p. IX). Although the report mentions the cost savings in the various categories based on the information provided by DOD, the underpinnings of the cost benefits were not elaborated, particularly in the areas of *scale economies* and *learning curve* advantages.

R&D Recoupment

R&D recoupments are typically a surcharge added to the purchase price of defense goods that a foreign customer buys. The amount is calculated by spreading the R&D costs over the number of units of a defense system produced and then applying this to foreign sales in proportion to the number of units in the procurement.

A report dated 05 May, 1976, from CBO, states "study finds that some individual cases do produce substantial savings against a given weapon's total program costs. These costs are, however, exceptional. Large savings do not seem to be generally characteristic of FMS." (Congressional Budget Office, 1976, p. VII). Further, the findings in the report quantify the cost savings and the product category that ranks high is noted as, "for a few, selected weapons systems, the savings from foreign sales are substantial, ranging up to 15 percent of a weapon's

procurement costs in a given fiscal year and 8 percent of its total research and development (R&D) costs. R&D cost recoveries appear to be the single largest source of FMS savings," and "these savings are primarily from sales of recently developed "high-technology" systems-particularly new fighter aircraft and missiles. Savings are, then, directly tied to the transfer, at cost, of recent and sophisticated U.S. weapons technology." (Congressional Budget Office, 1976, p. VII). To further expand, another report cites, "if weapon system is not newly developed then R&D recoupments are on a percentage basis of the total purchase price of the equipment. Normally this is four percent but can be less with the approval of DSAA" (Parker & Hawxhurst, 1977).

A DOS and DOD report in 1989 illustrates the importance of foreign military sales to U.S economy, "The cash sale of 315 M1A2 tanks to Saudi Arabia would have important economic benefits for the American economy," and indicates, "would generate over $940 million in direct income and almost the same amount of indirect income, for a total increase of national income of more than $1.8 billion." (Department of State and Department of Defense, 1989, p. 2). Saudi Arabia paid R&D recoupments of $75 million.

The topic of recovering non-recurring costs in FMS is mentioned in another report stating, "Certain nonrecurring costs of research, development, and production must be recovered on FMS sales unless they are waived" (Gilman, Nichols, Totman, & Minarich, 2014, p. 9). To explain the waiver process, the report notes, "the sale would significantly advance U.S. Government interests in standardization with NATO, Japanese, Australian, South Korean, Israeli, or New Zealand forces. Additionally charges may be waived if the Director, DCSA determines that imposition of the charges likely would result in loss of the sale" (Gilman, Nichols, Totman, & Minarich, 2014, p. 9). Furthermore, the report clarifies, "It should be noted

that in certain cases a foreign country may have incurred nonrecurring costs in the development of a defense article, or of a specific version of a defense article. In such cases, if the costs qualify as recoverable nonrecurring costs and the foreign country's nonrecurring cost investment exceeds $50 million, then the United States will collect the nonrecurring cost recoupment for the foreign country. Such recoupment cannot be waived" (Gilman, Nichols, Totman, & Minarich, 2014, p. 10).

Economies of Scale Cost Savings

The economic principle, *economies of scale*, is explained as the increased returns to scale when output more than doubles when input is doubled or in other words, when input factors such as labor or capital are doubled to increase plant production capacity, the output, namely, goods/services, is more than doubled. See Appendix G for an explanation on *economies of scale*.

Regarding the ABRAMS M1A2 tank sale to Saudi Arabia, the report referenced earlier states that "The Army would see savings in its own tank procurement program of more than $150 million over a five-year period." (Department of State and Department of Defense, 1989), which is judged to fall in the category of *economies of scale*.

Parker & Hawxhurst (1977) in a report, state, "Another possible cost savings resulting from FMS is in the area of reduced unit production costs. These can amount to fifteen percent of annual procurement costs. The lowered per unit production cost results from increased volume which FMS orders add to U.S. procurement. Under certain circumstances, increased volume can mean lower unit costs. These savings can be a result of economies of scale of increased production experience." (Parker & Hawxhurst, 1977, p. 50).

Parker & Hawxhurst (1977) assert that "The relationship between FMS and increased DOD weapon costs will therefore depend less on how many total sales dollars are earned than

upon how many sales of newly developed, high-technology systems are permitted." (Parker & Hawxhurst, 1977, p. 50). The incentive to offer newly developed, high-technology items through FMS is cited in another report, "key reason to offer our new-production equipment for Foreign Military Sales is for economies-of-scale contracting, or spreading the cost over bigger production runs." Further the report adds referring to the Advanced Medium Range Air to Air Missile (AMRAAM) pricing aspect, "Without the FMS quantities in FY-95 contracting actions, the United States would have recognized approximately a fifty-five percent per missile price increase based on reduced quantity buy for the United States." (Beard, 1995, p. 23). Another example of a significant cost reduction of 55 percent due to *economies of scale* and commonalities between the three variants was evident in the F-35 Lightning II fighter aircraft production (Lockheed Martin Corporation, 2016).

From a private industry perspective, Dyer et al (2016) highlight the mobile phone industry where the *economies of scale* curve for a wireless carrier is developed and quantified as "costs per subscriber drop by roughly 18 percent with each doubling of the number of subscribers" (Dyer, Godfrey, Jensen, & Bryce, 2016, p. 72). The authors add that "for AT&T, Verizon, and Sprint, the fixed costs per subscriber drop by 10 to 25 percent with every doubling of the number of subscribers" (Dyer, Godfrey, Jensen, & Bryce, 2016, p. 72).

According to Parker & Hawxhurst (1977), however, the cost savings wither away after reaching a limiting threshold of sales volume and learning experience and references a U.S. Marine Corps Headquarters letter stating, "The U.S. Marine Corps, for example, estimates that it has not realized any substantial savings because of sales to foreign governments." (Parker & Hawxhurst, 1977, p. 50).

Production Line Gap Cost Avoidance

Production Line Gap component is another cost benefit from FMS that the CBO report cited earlier highlighted. If production facilities in the U.S. remained open due to foreign orders, it would avoid the significant expenses of closing and re-starting plant operations (Congressional Budget Office, 1976).

With reference to the M1A2 ABRAMS tank sale to Saudi Arabia, $62 million was paid for the use of the U.S. government-owned plants and equipment used to produce the tanks (Department of State and Department of Defense, 1989).

As a downside of FMS, Parker & Hawxhurst (1977) report that "production costs do not always represent clear savings. There may be additional costs associated with the foreign order that would offset unit cost savings" (Parker & Hawxhurst, 1977, p. 51). Such costs are as a result of production readjustments as noted in the report, "other offsetting costs that may decrease unit cost reductions from foreign orders. One of these is production readjustments caused by the foreign order" (Parker & Hawxhurst, 1977, p. 51).

Another report from 1999, highlights, "The F-15 Eagle and the M1 Abrams tank are systems which the United States military no longer procures. Foreign military sales account for 100% of new procurement of these weapons systems" (Akins, 1999, p. 101). The report further states, "FMS will enable vital defense lines of production, such as M1 Abrams and F-15 Eagle, to remain open", and points out, "Also, when FMS purchases are procured alongside U.S. defense purchases of the same weapons system, the U.S. military benefits from a reduction in price per unit resulting from volume purchases." (Akins, 1999, p. 103).

Diversification and Economies of Scope

The term *diversification* refers to a business approach when a company produces different types of goods or services or when its customer base is diverse. In the same token, *economies of scope* is realized when a company produces different products using its core resources and capabilities; for instance, an automotive company could produce cars and agricultural equipment such as tractors.

According to the 2012 U.S. Government Accounting Office (GAO) report to Congressional Committees, that assessed the health of U.S. industrial base, highlights the fluctuating demand patterns in defense industry by noting that during wartime needs from 2007 to 2011, seven manufacturers supplied DOD with over 158,000 Tactical Wheeled Vehicles (TWVs), but dwindled to pre-war levels of 8000 over the next several years (United States Government Accoutability Office, 2012). In reference to FMS, the report says "U.S. manufacturers sold relatively few TWVs for use by foreign governments in fiscal years 2007 to 2011, when compared to 158,000 vehicles sold to DOD over that same period" (United States Government Accoutability Office, 2012, p. 15).

The importance of FMS when domestic demand declines is articulated in the report, "while sales of TWVs to foreign governments have not equaled those sold to DOD, such sales are becoming increasingly important source of revenue", and importantly points out that, "Nearly all TWVs sold to foreign governments were sold through the FMS program rather than through DCS." and the reasons are noted as "Approximately 95 percent of TWVs purchased through the FMS program from fiscal year 2007 through 2011 were paid for using U.S. government funding through different security and military assistance programs." (United States Government Accoutability Office, 2012, pp. 15-16).

Turning attention to *economies of scope* in production facilities in the defense industry, specifically with respect to tactical wheeled vehicles, manufacturers are versatile and are now somewhat less dependent on the DOD business. For instance, in the earlier referenced 2012 GAO report, "there is a wide range in the degree to which the manufacturers were reliant on DOD in a given year" and further notes that, "one manufacturer reported that for 2007 its revenues from sales to DOD accounted for 4 percent of its total revenue while another manufacturer reported such revenue was as high as 88 percent" (United States Government Accoutability Office, 2012, p. 14). See Table 7 developed from the GAO report. The report discusses the diversification strategy that firms pursue to offset the uncertainty of DOD purchases.

Table 7 Ranges of TWV Manufacturer Reported Reliance on DOD Sales, (United States Government Accoutability Office, 2012)

	Percent of revenue from DoD Sales	
Year	**Low**	**High**
2007	4%	88%
2009	26%	72%
2011	14%	73%

Some of the segments that the manufacturers target are noted in the report, "Aside from producing TWVs, manufacturers produced or assembled commercial vehicles, such as wreckers, fire trucks, school buses, and handicap-accessible taxis, as well as vehicle components, such as engines, transmissions, and suspensions." (United States Government Accoutability Office, 2012, p. 15). The diversification strategy is possible because the vendor's existing resources and

capabilities such as R&D, design and development, production, sales and distribution, components of the value-chain are leveraged for other similar commercial products.

Given that the U.S. government has been shouldering the costs in this case, the U.S. industrial base has reaped the benefits in the short run. However, the serendipity is difficult to sustain for the long-term. Now, the manufacturers need to pursue growth opportunities in the global markets with innovative applications and technological advancements. Furthermore, they should steer toward a position of competitive advantage and differentiate themselves by producing advanced technology products to have an edge in a crowded market place.

Learning/Experience Curve Cost Savings

The economic concept of *learning curve* advantage produces cost savings in the long-run for a production facility due to "learning" that occurs over long periods of time leading to increased productivity. Firms that perform complex design, engineering and technology activities and labor-intensive manufacturing operations typically benefit from the *learning curve* advantage cost savings.

Dyer et al (2016) report that in during World War II researchers noticed labor hours per unit decrease with an increase in cumulative output and calculated that "cost to build each aircraft fell by roughly 20 percent each time the cumulative volume of production doubled" (Dyer, Godfrey, Jensen, & Bryce, 2016, p. 74). Also, industry data suggests that a *learning curve* advantage could range from 5% to 25% (Strategos, 2016).

Discussing further, Dyer et al (2016), refer to the generalized concept of *learning curve* that not only includes direct labor hours but all costs incurred to produce a product or service. The relationship between cumulative volume produced and unit cost is termed as *experience*

curve and was originally developed by Boston Consulting Group in 1968. The *experience curve* includes economies of scale effects as well (Dyer, Godfrey, Jensen, & Bryce, 2016).

Regarding *learning curve* advantages or more appropriately *experience curve* advantages realized in a complex manufacturing process, a report on F-35 Lighting II described as a 5th Generation fighter aircraft, combining advanced stealth fighter with speed and agility, states that "Lockheed Martin is taking steps to improve its manufacturing processes for F-35 Lighting II. The company contends that more efficient manufacturing methods will help drive down the flyaway cost of the fifth-generation fighter by $10 million by 2019" (Carey, 2015, p. 1). Improved manufacturing and process methods are implemented based on continuous improvement initiatives to gain efficiencies. In the report, Carey (2015) elaborates on the cost dividends due to *learning curve* advantages, "At the time of the LRIP 8 contract award, Lockheed Martin said the average unit price of airframes for the three F-35 variants was 3.6 percent lower than the LRIP 7 price. The price of an F-35A with its engine was $108 million, which was $4 million lower than Lot 7 prices, according to the Pentagon's F-35 Joint Program Office (JPO)" (Carey, 2015, p. 1).

To understand how to quantify *learning curve* cost savings, an example using the F-35 data is illustrated. In Table 8, the number of cumulative production units (x-values) in each of the Low Rate Initial Production (LRIP) phases and the average unit cost (y-values) data for the F-35 aircraft are shown. Also, shown are the logarithmic (base 10) calculations of both the x and y values. The theory behind *learning curve* advantages and the *unit formulation* method to characterize the curve and to quantify *learning slope coefficient* are discussed in Appendix H. Given that the methodology described in Appendix H is based on the general multiplicative or power law formulation, $f(x) = ax^{-k}$, it can also be applied to *experience curve* calculations

because the curve profiles are similar. To that end, *learning (or experience) curve slope* can be obtained from *unit formulation* that states that as the quantity of production units doubles, the unit cost decreases by a constant percentage and represented by:

Y = AX^b, where,

Y = the cost (or average cost) at unit X;

A = the first unit cost;

X = unit number (cumulative volume);

b = slope coefficient = Log (*learning/experience curve slope*)/Log (2);

Learning/Experience curve slope **=** 2^b

To clarify further, Figure 11 graphically represents the data in Table 8, by plotting 'Units (cumulative)' on the x-axis and 'Unit Cost ($, million)' on the y-axis. And, Figure 12 represents the curves with the logarithm (base 10) calculations of the x and y values; and also the regression best fit line and the corresponding slope coefficient, b = -0.2427 are plotted. The value of *learning (or experience) curve slope* is calculated as $2^{-0.2427}$ which equates to 0.845. According to the *unit formulation* theory, the value 0.845 means that when F-35 production units are doubled, it results in (1 – 0.845) = 0.155 or 15.5% unit cost reduction. This value is within the range of the Dyer et al (2016) reference of 20% cost reduction observed in aircraft manufacturing during World War II. And the authors also state that "literally hundreds of studies have shown that production costs usually decline by 10 to 30 percent with each doubling of cumulative output" (Dyer, Godfrey, Jensen, & Bryce, 2016, p. 75). Also, Dyer et al (2016) add that manufacturing firms tend to have steeper experience curves than service firms.

Table 8 F-35 Aircraft Average Unit Cost (U.S. $, million) Due to *experience curve*

Sources: 1) (United States Government Accountability Office, 2013), 2) (Lockheed Martin Corporation, 2016)

	LRIP 1	LRIP 2	LRIP 3	LRIP 4	LRIP 5	LRIP 6	LRIP 7	LRIP 8
Units	2	12	17	32	32	36	35	43
Units (cum)	2	14	31	63	95	131	166	195
Unit Cost ($, million)	281	223	217	168	119	116	101	99
Units (cum) (LOG, base10)	0.30103	1.146128	1.491362	1.799341	1.977724	2.117271	2.220108	2.290035
Unit Cost (LOG, base10)	2.448397	2.34759	2.336695	2.224217	2.074766	2.064042	2.005426	1.996391

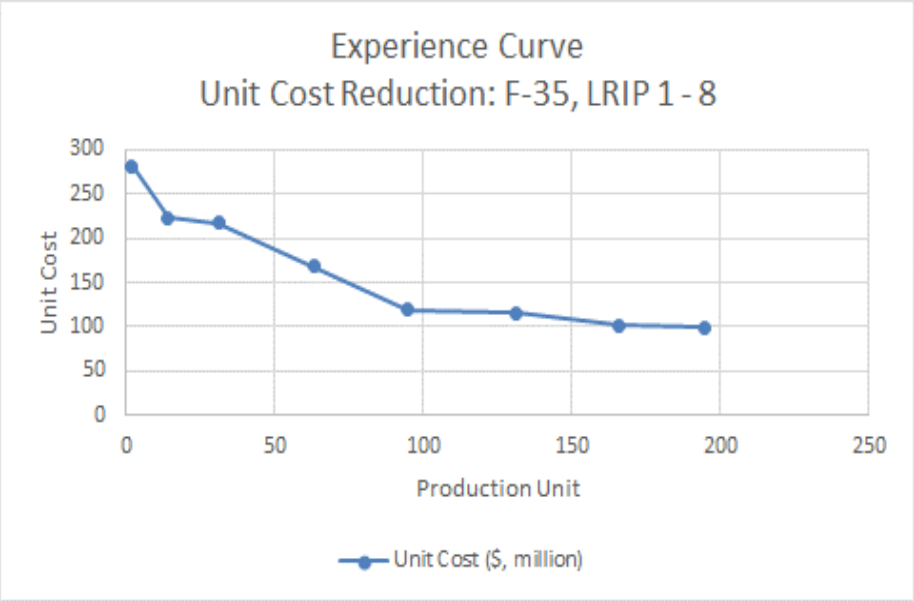


Figure 11 F-35 *experience curve* Showing Unit Cost Reductions from LRIP 1 to LRIP 8

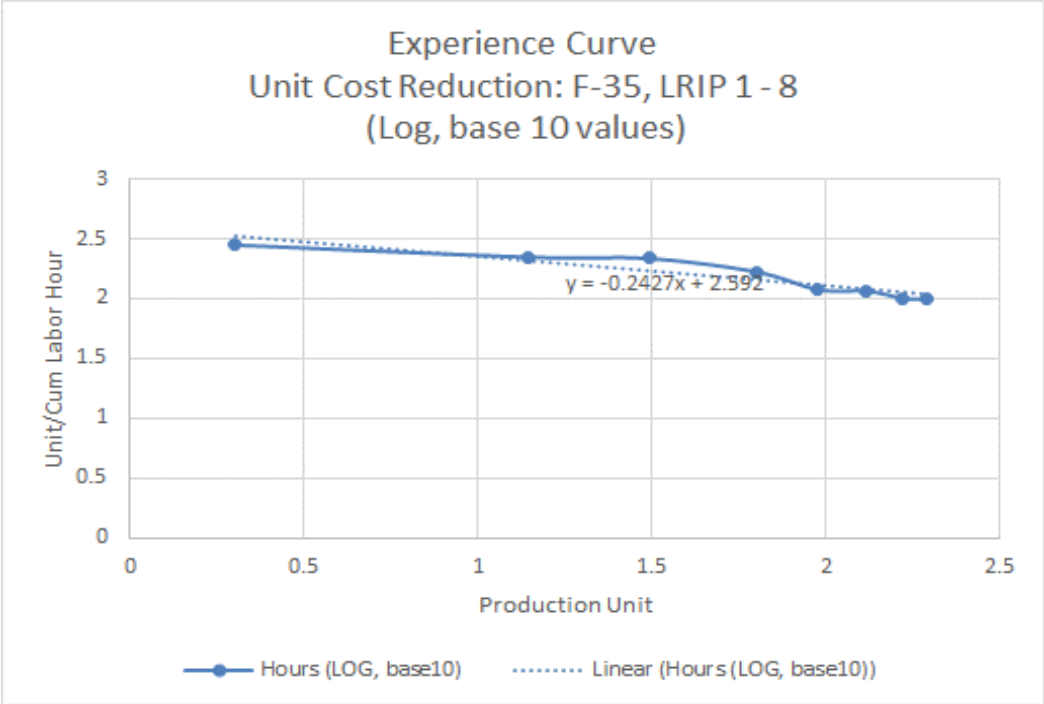


Figure 12 F-35 *experience curve* Using LOG (base 10) Calculations, Showing b = -0.2427

In summary, cost savings due to FMS are largely associated with high-technology weapons systems and can be categorized into R&D recoupments, which sometimes could be waived for foreign purchasers to strengthen relationships with allies for mission interoperability and if the additional cost hinders the sale itself; *economies of scale* and *learning curve* (and as noted above, the two together are bundled into *experience curve*) and certain special case production readjustment cost recoveries known as Production Line Gap, which are characteristic of defense goods that the U.S. no longer typically procures, but help to sustain the industrial base; and, *economies of scope* are primarily adopted as diversification strategy to avoid capacity under-utilization. These major factors of cost savings/avoidance and percent ranges are summarized graphically in Figure 13. In the categories for *economies of scale*, *learning curve* and *experience curve*, typical private industry values were also obtained through literature

review, but for the categories of R&D recoupments and Production Line Gap, which are more specific to the defense industry, the relevant information was elusive.

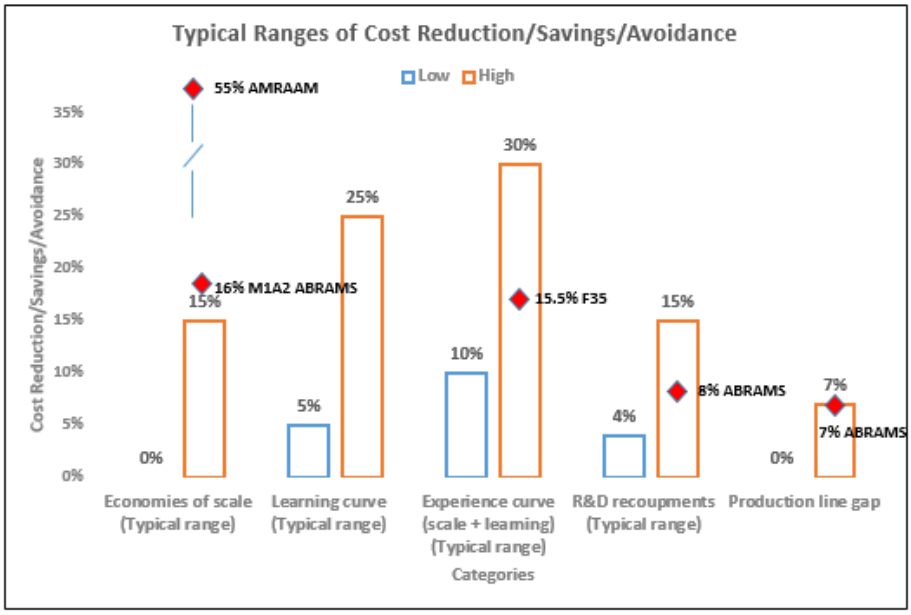


Figure 13 Major Cost Reductions Factors and Percent Ranges

Besides considering the cost saving categories noted above, the other novel and promising approach is to associate *brand equity* to the FMS *distribution channel*, to enable cost reductions directly from OEMs for U.S. acquisition programs.

Brand Equity of FMS Distribution Channel

In marketing terminology, *brand* is "a name, term, sign, symbol, or design, or a combination of them, intended to identify the goods or services of one seller or group of sellers and to differentiate them from those of competitors" (Kotler, 2000, p. 404). Further, Kotler (2000) explains that a *brand* is primarily the trust that buyers place on a seller to deliver a specific set of features, benefits, and services consistently as assured. Furthermore, a *brand* can signify and convey a company's or a product's attributes, benefits, values, culture, personality

and user (Kotler, 2000). And *brand equity* is described as "the degree of brand-name recognition, perceived brand quality, strong mental and emotional associations, and other assets such as patents, trademarks, and channel relationships" (Kotler, 2000, p. 405). In the private industry, some companies pursue growth by acquiring brand-name firms at a premium price. For instance, "Nestlé paid $4.5 billion to buy Rowntree, five times its book value", which clearly indicates "brand equity relates to the price premium the brand commands times the extra volume it moves over an average brand" (Kotler, 2000, p. 405)

In Chapter 4 the FMS and DCS processes were discussed in detail highlighting the benefits of FMS to foreign purchasers and U.S. OEMs alike. Specifically, as noted earlier, the FMS organization fields a team of experts who can perform complex tasks requiring comprehensive knowledge, coordination and negotiation abilities to interact with diverse U.S. agencies and organizations to successfully execute a foreign business engagement. Based on the rationale postulated, it is evident that FMS adds significant value to a foreign purchaser as well as U.S. OEMs. However, the question is how a monetary value can be associated to the FMS *distribution channel* so that when the U.S. buys defense goods/services for its own use, it could apply the FMS *distribution channel's* economic rents to lower its own defense acquisition costs. In other words, the U.S. government would be able to offset some of its own military procurement costs by leveraging the *brand* value of the FMS channel. And, this premium value is distinct from the administrative surcharge that DSCA charges foreign customers for the costs of providing the FMS services. The administrative surcharge of 3.5% is applied to an FMS transaction (Defense Security Cooperation Agency, 2016). In the study, the premium value associated with *brand equity* needs to be determined in a meaningful way.

One approach would be to survey the U.S. industry in diverse business sectors such as housing, banking, retail and others, where brokers, agents or intermediary entities bring a wealth of knowledge and expertise to help assemble and execute a business deal. Using the analogy and the fee structure as guidance, a monetary estimate of *brand equity* for the FMS *distribution channel*, empirical in nature, could be obtained. As stated in a report regarding real estate brokers and commissions by Shy (2009), sellers of private homes are motivated to hire real estate brokers to manage the sale of their homes (Shy, 2009). There are many value-added services that a real estate broker provides as previously stated in Chapter 4, and another key intangible measure is confidence – buying or selling a house is an expensive transaction where both buyers and sellers experience ambiguity and stress. Thus, by using the services of a real estate broker they gain confidence in the process as pointed out by Shy (2009), both the parties are comforted when real estate agents "hold their hands" during the process (Shy, 2009). Generally in the U.S. housing market, a sellers agrees to a binding contract with a real estate agent to help sell his/her house for a commission of 6% of the sale price of the house. In most cases, a real estate agent needs to split the commission with a buyer's agent which amounts to 3%. But in some cases, the seller's agent, acting on behalf of seller to sell the home, is also a buyer's agent helping acquire a house for a buyer. Such a unique situation allows the agent to retain the entire 6% commission.

To illustrate another example, in the food industry sector, Beaman & Johnson (2006) describe the food system comprising many steps in the process for distributing products to retail consumer, such as harvesting, processing, retailing and consuming. The process is known in numerous ways – marketing channel, distribution channel/chain, or supply chain or just plainly, middlemen (Beaman & Johnson, 2006). The authors highlight various types of distribution channel entities which perform specific functions: food distributors, food brokers, food

wholesale distributors, foodservice distributors and brokers and self-distributing retailers (Beaman & Johnson, 2006). From among these categories, food brokers appear to be most relevant to our discussion of the sort of activities the FMS organization conducts. Food brokers "act as food manufacturers' representatives and facilitate sales between manufacturers and retailers. They do not take ownership or physical possession of products". On average, food brokers charge a commission between 3% and 5% (Beaman & Johnson, 2006). An article discussing the benefits of manufacturer's representatives, who perform similar sales functions as noted above, garner commissions from a low of 5% to as high as 25% (Klonsky, 2010). These commission figures and others from the U.S. retail industry (Lisse & Media, 2016) are shown in Table 9.

Table 9 References of General Sales Commission Rates in the U.S Industry

No.	Industry	Agent	Services	General commission rates	Who pays the commission?
1	U.S. housing	Real estate broker	Real estate (seller's) agent coordinates with various parties involved in the home selling process to result in a successful sale of the house.	3%-6%	Seller
2	U.S. retail (food)	Food broker	Brokers have skills to facilitate sale between manufacturers and retailers	3%-5%	Manufacturer
3	U.S. retail (beauty, handbag)	Sales staff	Sales people behind beauty and handbag counters	3%-5%	Retail outlet
4	U.S. retail (shoes, appliances, electronics)	Sales staff	Sales people for shoes, appliances and electronics	8%-10%	Retail outlet
5	Manufacturer's Reps	Reps	Reps sell products or services to customers and are needed when new products need to be constantly explained	5%-25%	Manufacturer

A *brand equity* premium of 3.0% (the lower value in Table 9) applied to yearly sales through the FMS program is proposed for implementation. And in concert with the DOD budget cycle, every five years, based on the market and economic conditions, the prior value (3% in this case) is either increased or decreased corresponding to the percent change in the U.S. GDP. This fee imposition reflects the value-added and expert knowledge-based services that the FMS organization provides, as an intermediary, to both the parties, namely, OEMs and foreign purchasers. The 3.0% *brand equity* premium amount would be deducted from the foreign sale revenues and applied to DOD programs as a means to assuage current and/or future U.S. acquisition costs.

The *brand equity* of the FMS *distribution channel* plays a significant role to build the defense capacities of U.S. allies as a form of security assistance and to serve the best interests of U.S. foreign policy and national security. To that end, using a comparative assessment of other industry sectors, the fee structure of 3.0% is applied to sales through the FMS program, offers an economic underpinning to the FMS *distribution channel's brand equity*.

Notional Analysis of Cost Savings or Avoidance

In Chapters 2 and 4, the defense industry trends, its market characteristics and key success factors were studied; competition that exists in the defense industry and their viewpoints were examined; and, defense goods/services growth trends and FMS growth opportunities were explored. Furthermore, a marketing strategy was developed using: the situational analysis comprising economic factors such as GDP Per Capita, GDP Growth Rate and military spending; security concerns regarding global conflicts and their impacts on the U.S. foreign policies and interests; and the relationships with allies of the U.S. By applying the strategic marketing concepts, Market Segment 1 was targeted for market entry and it consisted of several countries

that have a compelling case to enhance their defense capabilities. In the final step, a market positioning for Market Segment 1 was formulated. Next, based on the comprehensive market strategy, a scenario analysis was conducted to quantify the cost advantages of FMS growth.

A notional 2%, 10% and 25% FMS yearly growth was applied to all the countries in Market Segment 1 and considered for the scenario analysis as shown in Table 10. The total FMS sales incorporating an increase of 2%, 10% and 25%, relative to the average sales of $14.1 B, from 2006 to 2013, was determined and illustrated in Table 10; the total sales values were approximately $11.9 B, $12.8 B and $14.6 B for the 2%, 10% and 25% sales growth scenarios respectively.

Table 10 FMS Sales Growth Scenario of 2%, 10% and 25%

FMS Growth Scenario Analysis				
Market Segment 1 Countries	**AVERAGE FMS (2006-2013) (U.S. $, millions)**	**2% (Low-level) increase in FMS (U.S. $, millions)**	**10% (Mid-level) increase in FMS (U.S. $, millions)**	**25% (High-level) increase in FMS (U.S. $, millions)**
Pakistan	565.339	576.646	621.873	706.674
Algeria	0.226	0.231	0.249	0.283
India	746.614	761.546	821.275	933.268
Philippines	46.345	47.272	50.979	57.931
Oman	304.963	311.062	335.459	381.204
South Korea	886.590	904.322	975.249	1108.237
Saudi Arabia	6799.115	6935.097	7479.027	8498.894
Malaysia	64.652	65.945	71.117	80.814
United Arab Emirates	2281.008	2326.628	2509.109	2851.260
Total FMS	**11694.852**	**11928.749**	**12864.337**	**14618.564**
	Sales increase	**233.897**	**1169.485**	**2923.713**

A select few major defense goods that are technologically advanced with potentially high demand from the foreign purchasers in Market Segment 1were identified. Additionally, information (See Appendix F) was gathered regarding these defense products with respect to

current unit price and total units produced to date, to use in calculations for cost reductions. Appendix H describes the calculations using the *unit formulation* method to determine cost reductions due to *experience curve*. Tables 11 and 12 incorporated the information from Table 10, and spreadsheet calculations were performed to produce the cost reductions.

To simplify the scenario analysis, the number of units offered for sale was kept the same for every defense article in the list, to achieve the total FMS revenues. For instance, in Table 11, for the FMS growth of 2%, 47 units of F-35, Apache, Blackhawk, and so on, were used to calculate the total FMS sales amounting to $11.8 B, a value close to the notional target sales value of $11.9 B in Table 10. Similarly, for the 10% and 25% notional FMS yearly growth figures, the quantities were determined to be 51 and 58 respectively.

Using the *experience curve* formulation (see Appendix H) the cost reductions due to the combined effects of *economies of scale* and *learning curve*, were generated in Table 11 and 12. The method, *unit formulation*, that characterizes *experience curve*, was used in the calculations to estimate the cost reductions in each of the defense products corresponding to the FMS sales growth projections of 2%, 10% and 25%. Two sets of cost reduction estimates were developed: Table 11 represents a 90% *experience curve*, which means that unit cost of a product reduces 10% when production units are doubled; and, Table 12 represents a 70% *experience curve* (typically the *learning curve* is steeper for newer and more technologically complex products, thus producing more cost reductions), which suggests that unit cost of a product reduces by 30% when production units are doubled.

As displayed in Table 11, the results from the *90% experience curve* scenario analysis indicated that costs are reduced by $54.5 M for the FMS sales of $14.6 B, a 25% growth; however, for sales growth of 2% and 10%, costs increase. And, as shown in Table 12, similar

scenario analysis using the 70% *experience curve* produced cost reductions of $424.9 M for FMS sales of $11.8 B; $536.0 M for $12.8 B; and, $747.9 M for $14.6 B. The percentage cost reductions for both the *experience curve* scenarios were also calculated and shown in Tables 11 and 12.

To explain the calculations and results further, for instance, using 90% *experience curve*, the sale of 58 F-35 fighter aircrafts, at a total sale amount of $5.8 B with a unit price of $101 M, would produce $39.158 M in cost reductions, in the case where a 25% FMS growth is forecasted, as shown in Table 11. In column 1 of Table11, a sampling of advanced defense products (e.g. F-35) that are in high demand were selected for sale to Market Segment 1; in column 2, the unit price (e.g. $101 M for F-35) of each defense item is listed; and the target market sales (growth of 25%) of $5.858 B for F-35 was arrived at by multiplying 58 with $101 M; similarly, the calculations for 2% and 10% growth using 47 and 51 units respectively are shown in columns 3 and 4; column 6 provides the quantities of defense items produced as of 2016 (e.g. 166 for F-35); columns 7 and 8 represents *experience curve slope coefficient*, b, and first unit, A, cost, as described in Appendix H and earlier in Chapter 5; column 11 calculates the cost (e.g. $5.818 B for F-35) for the 25% sales growth using the equation 2 in Appendix H; using the same calculations, cost values for 2% and 10% are obtained in columns 9 and 10 respectively; finally in column 15, the cost reduction (e.g. $39.158 M for F-35) due to *experience curve* is determined, at a 25% FMS growth, by subtracting column 11 from column 5. These calculations are repeated for each defense product in the list in column 1. And, the calculations are repeated in Table 12 for 70% *experience curve*. For instance, the same F-35 sale produces $356.344 M in cost reductions with *70% experience curve*, as opposed to $39.158 M using *90% experience curve* for the 25% sales growth projection.

Table 13 summarizes the cost reductions based on the notional scenario analysis to include cost reduction due to *experience curve*, R&D recoupment of 4% (assuming the lower end of the spectrum with an awareness that the surcharge could go as high as 15% as noted earlier) and the FMS *distribution channel brand equity* fee structure; Production Line Gap cost reductions were not included because they vary with product type and OEM production line operational status. The *experience curve* driven cost reduction benefits are directly realized by OEMs due to the increased production output and indirectly, the U.S. procurement costs would also be lowered in the long-run due to unit cost reductions. R&D recoupment from foreign purchasers benefit OEMs and the U.S. by alleviating budgetary pressures. FMS *brand equity* premium that embodies *brand equity* considerations of the FMS *distribution channel* would lessen the strain on the U.S. DOD budgets.

With *90% experience curve*, R&D recoupments and *brand equity* considerations, for sales through the FMS process, total cost reductions of $781.6 M, $886.3 M and $1075.3 M were realized from revenues of $11.8 B, $12.8 B and $14.6 B respectively; and with *70% experience curve*, R&D recoupments and *brand equity* considerations, for sales through the FMS process, cost savings of $1252.1 M, $1433.6 M and $1768.7 M were generated for $11.8 B, $12.8 B and $14.6 B of revenues respectively.

Table 11 FMS Growth and Cost Reduction Scenario Analysis Using 90% *experience curve*

		Costs without *experience curve* effects			
Defense Products	**Unit Price (U.S. $, million)**	**2% FMS Growth (47 units of each product) (U.S. $, million)**	**10% FMS Growth (51 units of each product) (U.S. $, million)**	**25% FMS Growth (58 units of each product) (U.S. $, million)**	**Total Delivered Production Units (as of 2016)**
		47	**51**	**58**	
F-35 Lightning II (JSF)	101	4747.000	5151.000	5858.000	166
Apache (AH-64E) REMANF helicopter	35	1645.000	1785.000	2030.000	188
Blackhawk (UH-60M) helicopter	17	799.000	867.000	986.000	829
CH-47F helicopter	29	1363.000	1479.000	1682.000	521
C130J cargo plane	68	3196.000	3468.000	3944.000	150
AIM AMRAAM missile	1	47.000	51.000	58.000	17500
AIM Sidewinder missile	0.42	19.740	21.420	24.360	5000
		11816.740	**12822.420**	**14582.360**	

Table 11 FMS Growth and Cost Reduction Scenario Analysis Using 90% *experience curve* (contd.)

		Costs with *experience curve* effects			Cost Reductions/Avoidance		
90% *Experience Curve* Equation Y = A(X)^b		**(Min. value of 10% cost reduction with doubling of units) (U.S. $, million)**			**(with *experience curve* effects) (10% with doubling of units) (U.S. $, million)**		
b (slope coeff.)	**A (1st unit price) (U.S. $, million)**	**2% FMS Growth (U.S. $, million)**	**10% FMS Growth (U.S. $, million)**	**25% FMS Growth (U.S. $, million)**	**2% FMS Growth (U.S. $, million)**	**10% FMS Growth (U.S. $, million)**	**25% FMS Growth (U.S. $, million)**
-0.1520	219.677	4753.644	5141.932	5818.842	-6.644	9.068	39.158
-0.1520	77.580	1650.813	1785.927	2021.555	-5.813	-0.927	8.445
-0.1520	47.215	812.559	879.962	997.806	-13.559	-12.962	-11.806
-0.1520	75.053	1382.775	1497.186	1697.113	-19.775	-18.186	-15.113
-0.1520	145.640	3194.378	3454.840	3908.771	1.622	13.160	35.229
-0.1520	4.415	47.990	51.988	58.985	-0.990	-0.988	-0.985
-0.1520	1.533	20.146	21.823	24.758	-0.406	-0.403	-0.398
		11862.305	**12833.659**	**14527.831**	**-45.565**	**-11.239**	**54.529**
Percent cost reductions					**-0.39%**	**-0.09%**	**0.37%**

Table 12 FMS Growth and Cost Reduction Scenario Analysis Using 70% *experience curve*

		Costs without *experience curve* effects			
Defense Products	**Unit Price (U.S. $, million)**	**2% FMS Growth (47 units of each product) (U.S. $, million)**	**10% FMS Growth (51 units of each product) (U.S. $, million)**	**25% FMS Growth (58 units of each product) (U.S. $, million)**	**Total Production Units (as of 2016)**
		47	**51**	**58**	
F-35 Lightning II (JSF)	101	4747.000	5151.000	5858.000	166
Apache (AH-64E) REMANF helicopter	35	1645.000	1785.000	2030.000	188
Blackhawk (UH-60M) helicopter	17	799.000	867.000	986.000	829
CH-47F helicopter	29	1363.000	1479.000	1682.000	521
C130J cargo plane	68	3196.000	3468.000	3944.000	150
AIM AMRAAM missile	1	47.000	51.000	58.000	17500
AIM Sidewinder missile	0.42	19.740	21.420	24.360	5000
		11816.740	**12822.420**	**14582.360**	

Table 12 FMS Growth and Cost Reduction Scenario Analysis Using 70% *experience curve* (contd.)

		Costs with *experience curve* effects			Cost Reductions/Avoidance		
70% *Experience Curve* Equation Y = A(X)^b		**(Max. value of 30% cost reduction with doubling of units) (U.S. $, million)**			**(with *experience curve* effects) (30% with doubling of units) (U.S. $, million)**		
b (slope coeff.)	**A (1st unit price) (U.S. $, million)**	**2% FMS Growth (U.S. $, million)**	**10% FMS Growth (U.S. $, million)**	**25% FMS Growth (U.S. $, million)**	**2% FMS Growth (U.S. $, million)**	**10% FMS Growth (U.S. $, million)**	**25% FMS Growth (U.S. $, million)**
-0.5146	1401.940	4538.208	4891.444	5501.656	208.792	259.556	356.344
-0.5146	517.951	1583.863	1707.999	1922.698	61.137	77.001	107.302
-0.5146	539.832	804.430	870.430	985.561	-5.430	-3.430	0.439
-0.5146	725.120	1361.099	1471.806	1664.590	1.901	7.194	17.410
-0.5146	895.916	3036.073	3270.952	3676.288	159.927	197.048	267.712
-0.5146	152.529	47.967	51.961	58.950	-0.967	-0.961	-0.950
-0.5146	33.623	20.111	21.783	24.706	-0.371	-0.363	-0.346
		11391.751	**12286.375**	**13834.448**	**424.989**	**536.045**	**747.912**
Percent cost reductions					**3.60%**	**4.18%**	**5.13%**

Table 13 Summary of Cost Reductions Using Notional Scenario Analysis

	FMS Growth			Comments
	~2%	~10%	~25%	
FMS Total Sales (U.S. $, million)	11816.740	12822.420	14582.360	FMS sales targeted to **Market Segment 1** countries
FMS Sales increase (U.S. $, million)	121.888	1127.568	2887.508	FMS sales increase from average sales 2006-2013
Cost Reductions/Avoidance	**90% Experience curve** (U.S. $, million)			Applicable to mature production items
Experience curve cost reductions	-45.565	-11.239	54.529	1) OEM directly benefits due to cost structure reduction (only with 25% growth) 2) U.S. procurement costs are lowered in the long run (only with 25% growth)
R&D recoupment	472.670	512.897	583.294	1) Surcharge of 4% of total sales charged to foreign purchaser
FMS brand equity cost reductions	354.502	384.673	437.471	1) OEM is charged 3.0% of FMS sales
Total cost reductions/avoidance (90% experience curve)	781.607	886.330	1075.294	
Cost Reductions/Avoidance	**70% Experience curve** (U.S. $, million)			Applicable to newer and complex production items
Experience curve cost reductions	424.989	536.045	747.912	1) OEM directly benefits due to cost structure reduction 2) U.S. procurement costs are lowered in the long run
R&D recoupment	472.670	512.897	583.294	1) Surcharge of 4% of total sales charged to foreign purchaser
FMS brand equity cost reductions	354.502	384.673	437.471	1) OEM is charged 3.0% of FMS sales
Total cost reductions/avoidance (70% experience curve)	1252.161	1433.614	1768.677	

Chapter 6 – Discussion and Conclusions

Statement of Purpose

The purpose of the research is to identify cost reduction opportunities for U.S defense acquisition due to FMS. To that end, the global market outlook for defense goods and services needs to be assessed; market analyses needs to be performed to comprehend customers and their needs; and competitors and their approach to business strategy needs to be weighed. According to published literature, one of the common means for cost reduction/avoidance is to increase product unit sales to take advantage of *scale economies*. R&D recoupment is another mechanism to lower the cost burdens. Also, *learning/experience curve* advantages typically observed in a manufacturing setting offer cost mitigation possibilities. This study proposes competitive strategies to increase FMS sales to enable cost reduction in U.S. procurements. Additionally, the value the FMS *distribution channel* delivers to OEMs is quantified. To that end, a rationalization is presented to influence U.S. OEMs to offer cost savings to U.S. acquisition programs.

Discussion and Conclusions

By evaluating geo-political, economic and security concerns, and recognizing the alignment of the U.S. interests to promote peace and stability in the world, a market segment comprising several countries was identified for sale of defense equipment through the FMS process. Further, a competitive market positioning strategy was developed to offer advanced technology defense products and services to these countries. Having established a strategic posture, it is anticipated that the sales through the FMS channel would increase. To assess how the FMS growth prospects would influence overall cost reductions or avoidance for the U.S.

acquisition programs, notional scenarios covering various possibilities were developed and analyzed.

Cost reduction or avoidance opportunities were considered for the analysis. In particular, *economies of scale, learning/experience curve* advantage, R&D recoupment and *brand equity* of the FMS *distribution channel* figured prominently in the analysis. Two degrees of *learning curve* effects were included in the analysis – *90% learning curve*, where the manufacturing process is stable and typically observed in mature manufactured products such as tactical military vehicles; and 70% *learning curve,* where the manufacturing process is in its infancy and has a potential for greater efficiencies and typically characteristic of complex and highly technical products such as advanced fighter aircraft and missiles. Another significant cost saving/avoidance is R&D recoupment, a surcharge that is included in the price quotation of a foreign purchase order. Cost savings were observed in the notional scenario analysis - with *90% experience curve,* R&D recoupments and *brand equity* considerations, for sales through the FMS process, total cost reductions of $781.6 M, $886.3 M and $1075.3 M were realized from revenues of $11.8 B, $12.8 B and $14.6 B respectively; and with *70% experience curve*, R&D recoupments and *brand equity* considerations, for sales through the FMS process, cost savings of $1252.1 M, $1433.6 M and $1768.7 M were generated for $11.8 B, $12.8 B and $14.6 B of revenues respectively.

Interestingly, to highlight a contradiction, F-35 generated $39.1 M savings for sales amount of $5.8 B at the 25% FMS growth scenario whereas costs increased by $6.6 M for the 2% FMS growth (see Table 11). Similar cost increases were observed for CH-47F for all the FMS growth projections. A potential explanation for the cost increase at the 2% FMS growth for F-35 is that significantly more production quantities are perhaps needed to trim the costs. In the

case of CH-47F it is likely that the savings are more difficult to realize due to diseconomies of scale (see Appendix G), where the manufacturing process is mature and minimum efficient scale has been achieved due to the large number of quantities already produced.

Challenges

A challenge envisioned for the FMS growth is that the situational underpinnings for the marketing strategy could shift because of geo-political, economic volatility and uncertainty in the world. The cascading effect could destabilize the established strategic plan and specifically, the country composition of Market Segment 1 may change requiring different resources. Another challenge that could dislodge the plan is the nature of FMS purchase orders. In some instances, FMS purchase orders require product modifications and need substantial engineering and manufacturing investments that may undermine the cost savings. Yet another hurdle is the possibility that defense articles in the DOD inventory are low or depleted and thus immediate delivery in response to urgent foreign purchase orders may not be possible. On the foreign policy front, DOS and DSCA may restrict availability of certain technologically advanced defense products to some or all of the countries listed in Market Segment 1. For instance, F-35 is the most advanced fighter aircraft in the world today and the sale might be blocked to some countries. However, in lieu of F-35, perhaps other fighter aircraft such as F-15 Eagle/Strike Eagle or F-16 Fighting Falcon could be offered. Finally, the *brand equity* fee is a novel concept that could impact OEM cost structure and as such, there could be resistance from the defense industry. But with education, awareness and the recognition that the FMS process provides a compelling value to all parties involved, any potential concerns and skepticism can be overcome.

Future Work

More comprehensive information regarding competitors and customers would strengthen the marketing strategy. It is suggested that future work in this area should focus on developing more robust *experience curve* profiles for various high value and advanced technology defense products, to more accurately predict cost reductions for future production units. Although the FMS *brand equity* premium of 3.0% is reasonable and justified, additional research to further reinforce the *brand equity* premium for the FMS *distribution channel* may be warranted to institutionalize the process.

Summary

The study advanced a strategic marketing and cost reduction/avoidance framework using notional scenarios anchored in economic underpinnings to increase the effectiveness of the FMS program. Although the scope of the analysis was limited to select defense goods, the framework could be applied to other similar U.S. defense goods/services. By pursuing FMS growth opportunities for technologically advanced defense goods and services, the U.S. government and OEMs could realize significant cost reduction or avoidance benefits. First, these benefits emerge mainly in the form of *economies of scale* and *experience curve* advantages in the manufacturing domain. Second, with respect to R&D recoupments and cost avoidance factors such as Production Line Gap measures, the costs are reflected as additional cost line items in quotations for foreign orders whenever applicable. Finally, the concept of *brand equity* associated with the FMS *distribution channel* and the significant value it offers to OEMs justifies the *brand equity* premium which in effect helps reduce the U.S. defense acquisition costs.

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Glossary of Acronyms and Terms

AECA.....Arms Export Control Act

BBP…….Better Buying Power

CBO……Congressional Budget Office

DAU .....Defense Acquisition University

DCMA.....Defense Contract Management Agency

DCS……Direct Commercial Sales

DISAM……..Defense Institute of Security Assistance Management

DOD.....Department of Defense

DOS……Department of State

DSCA…….Defense Security Cooperation Agency

FAR…….Federal Acquisition Regulation

FMS……Foreign Military Sales

GAO .....Government Accountability Office

IA……Implementing Agency

IPT .....Integrated Product Team

LOA……Letters of Offer and Acceptance

MILDEP…….Military Department

OEM……..Original Equipment Manufacturers

R&D……..Research and Development

USD (AT&L)..Under Secretary of Defense for Acquisition, Technology and Logistics

USG……United States Government

Appendix A – FMS – Potential Advantages and Considerations (Defense Institute of Security Assistance Management, 2015, p. 16)

Foreign Military Sales–Potential Advantages and Considerations	
Potential Advantages	**Considerations**
Total package approach based on US military experience	Purchaser must decide whether the total package approach may exceed its needs or financial capabilities
USG uses its own procurement procedures and acts as procurement agent for foreign countries	Sophisticated foreign purchasing staff may (or may not) be able to achieve better overall deal by negotiating directly with the contractor.
Proven and established logistics support for items common to DOD	Contractor may be able to offer a similar range of contractor logistics support.
Federal acquisition regulations, economic order quantity buys, use of GFE or GFM tends to reduce price	Compliance with DOD procedures may increase lead time
Facilitates establishment of design configuration and enhances potential for interoperability	Purchaser must decide on the degree of standardization required for a purchase.
Purchaser pays only the actual cost to DOD (including management expenses), with profits controlled by the FAR	While initial LOA estimates tend, in the aggregate, to be higher than final LOA costs, final costs fluctuate both up and down.
Cross-leveling in the FMS trust fund can maximize use of country funds	Firm fixed price contracts and fixed payment schedules can be obtained under direct commercial contracts.
Quality control to ensure item meets MILSPECs is done by USG personnel	This service can be purchased under FMS for certain commercial contracts.
Items may be available from DOD stocks in times of emergency	Availability is significantly dependent on DOD's own priorities and inventory positions
Government-to-government obligation, ensuring involvement of DOD personnel in total package planning and sustainment concepts	Due to the political climate, the purchaser may prefer procuring from the US contractor rather than the USG.
Total package includes training at US military schools	Purchaser can procure hardware under commercial contract and generally obtain associated training at US military schools via FMS.
FMS customers can require offsets in FMS-related contracts	Dependent on the funding source. If non-repayable FMFP, offset cost cannot be included

Appendix B – DCS – Potential Advantages and Considerations (Defense Institute of Security Assistance Management, 2015, p. 17)

Direct Commercial Sales–Potential Advantages and Considerations	
Potential Advantages	**Considerations**
Potential for fixed delivery or fixed price, with penalty if contractor fails	Requires considerable experience and sophistication by country negotiators.
Business-to-business relationship allows country to negotiate cost and contract terms.	If closer military-to-military relationships are a purchaser's objective, FMS provides an avenue to achieve this objective.
Direct negotiations with contractor can result in a quicker response.	Requires considerable experience and sophistication by country negotiators.
Generally better support for nonstandard items.	Purchaser must decide upon desired degree of standardization with US forces.
More capability to tailor package to unique country needs.	Tailored package may detract from standardization desires.
Continuity of personal contacts with contractor technical personnel.	Value of continuity must be compared to the value of direct miltary-to-military contacts.
New equipment directly from production line.	Option exists to request only new and unused items via FMS.
Lower prices possible under certain circumstances.	Final price may be dependent on experience and sophistication of country contract negotiators.
Generally fixed payment schedule which eases budgeting problems.	Payment schedules may be more front-loaded than under FMS.
Purchaser can include offset provisions in one contract.	Purchaser can negotiate offsets (directly with contractor) and still procure under FMS.
FMS administrative surcharge and DOD management costs can be avoided.	Purchaser must consider entire cost of transaction, including its contracting staff costs and possibly increased contract administrative costs.
Commercial purchases of some types of items could help to create and develop a procurement capability.	Scarcity of resources and time may not allow for retaining procurement staff.

Appendix C – Global Defense Market & Situational Analysis

Table C1 2015 Top 25 Defense global companies of the 100 (DefenseNews, 2016)

2015 Top 25 Defense Companies								
Rank	**Company**	**Leadership**	**Country**	**2014 Defense Revenues (US$, M)**	**2013 Defense Revenues (US$, M)**	**% Defense Revenue Change**	**2014 Total Revenues (US$, M)**	**Revenues from Defense (US$, M)**
1	Lockheed Martin	Marillyn Hewson, Chairman, President & CEO	US	40,128.00	40,494.00	-0.90%	45,600.00	88.00%
2	Boeing	Dennis Muilenburg, President & CEO	US	29,000.00	32,000.00	-9.40%	90,762.00	32.00%
3	BAE Systems	Ian King, CEO	UK	25,449.00	28,014.00	-9.20%	27,411.30	92.80%
4	Raytheon	Thomas Kennedy, Chairman & CEO	US	22,228.20	22,047.60	0.80%	22,826.00	97.40%
5	General Dynamics	Phebe Novakovic, Chairman & CEO	US	18,561.00	18,836.00	-1.50%	30,852.00	60.20%
6	Northrop Grumman	Wes Bush, Chairman, President & CEO	US	18,400.00	19,500.00	-5.60%	23,979.00	76.70%
7	Airbus Group[1]	Tom Enders, CEO	Netherlands	14,609.50	16,546.50	-11.70%	80,686.40	18.10%
8	United Technologies	Gregory Hayes, President & CEO	US	13,020.00	11,894.00	9.50%	65,100.00	20.00%
9	Finmeccanica	Mauro Moretti, CEO & General Manager	Italy	10,561.40	10,896.30	-3.10%	19,486.80	54.20%
10	L-3 Communications	Michael Strianese, Chairman, President & CEO	US	9,808.00	10,336.00	-5.10%	12,124.00	80.90%
11	Almaz-Antey	Yan Novikov, CEO	Russia	9,209.80	8,326.30	10.60%	9,209.80	100.00%
12	Thales[2]	Patrice Caine, Chairman & CEO	France	8,461.60	10,961.60	-22.80%	17,242.20	49.10%
13	Huntington Ingalls Industries	Mike Petters, President & CEO	US	6,818.00	6,324.00	7.80%	6,957.00	98.00%
14	United Aircraft Corp[3]	Yury Slyusar, President & Chairman of Management Board	Russia	6,244.00	5,831.70	7.10%	7,805.30	80.00%
15	Rolls-Royce	Warren East, CEO	UK	5,433.70	6,123.60	-11.30%	24,035.30	22.60%
16	Honeywell	Tim Mahoney, President & CEO	US	4,754.00	4,900.00	-3.00%	40,300.00	11.80%
17	Textron	Scott Donnelly, Chairman, President & CEO	US	4,719.00	4,236.00	11.40%	13,878.00	34.00%
18	AECOM[4]	Michael Burke, Chairman & CEO	US	4,433.00	1,712.60	158.80%	19,641.20	22.60%
19	Booz Allen Hamilton	Horacio Rozanski, President & CEO	US	4,100.00	4,300.00	-4.70%	5,479.00	74.80%
20	Safran	Phillippe Petitcolin, CEO	France	4,081.30	4,027.00	1.30%	20,406.50	20.00%
21	DCNS	Herve Guillou, CEO	France	4,074.70	4,601.70	-11.50%	4,074.70	100.00%
22	GE	David Joyce, President & CEO	US	4,000.00	4,000.00	0.00%	24,000.00	16.70%
23	Russian Helicopters	Alexander Mikheev, CEO	Russia	3,960.00	3,406.40	16.30%	4,500.80	88.00%
24	Leidos[5]	Roger Krone, Chairman & CEO	US	3,627.00	4,080.00	-11.10%	5,063.00	71.60%
25	Babcock International[3]	Peter Rogers, CEO	UK	3,558.80	3,423.80	3.90%	7,414.20	48.00%

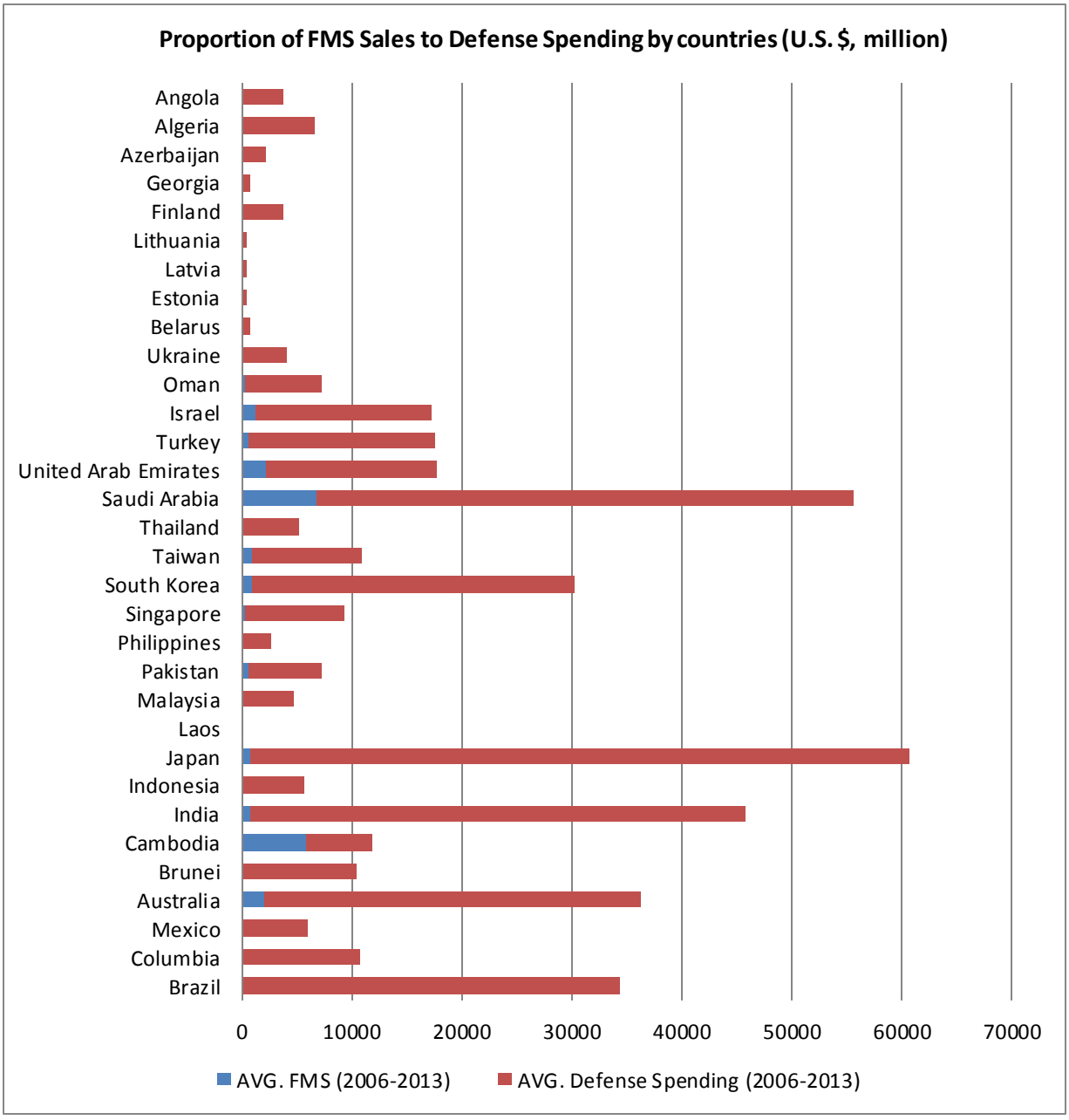

Figure C1 Proportion of FMS Sales Agreements to overall defense spending of countries

Table C2 GDP per Capita versus Military Expenditures as % of GDP (Knoema, 2016)

Military Expenditures as a % of GDP	GDP per Capita (U.S., $) Low (0-30000)	Moderate (30000-60000)	High (60000-90000)
High (8-12)		OMAN SAUDIA ARABIA	
Moderate (4-8)	ALGERIA ANGOLA AZERBAIJAN	ISRAEL	UNITED ARAB EMIRATES
Low (0-4)	COLOMBIA, UKRAINE, PAKISTAN INDIA, GEORGIA, TURKEY ESTONIA, CAMBODIA, MALAYSIA THAILAND, BRAZIL, LATVIA BELARUS, PHILIPPINES,	BRUNEI, SOUTH KOREA TAIWAN, AUSTRALIA FINLAND, JAPAN	SINGAPORE

Table C3 GDP Growth Rate versus Military Expenditures as % of GDP (Knoema, 2016)

Military Expenditures as a % of GDP	GDP Growth Rate (%) Low (-7.0-0.0)	Moderate (0.0-3.5)	High (3.5-7.5)
High (8-12)			SAUDIA ARABIA OMAN
Moderate (4-8)		ISRAEL AZERBAIJAN	ANGOLA ALGERIA UNITED ARAB EMIRATES
Low (0-4)	FINLAND JAPAN BRUNEI UKRAINE	SOUTH KOREA, SINGAPORE TURKEY, LITHUANIA AUSTRALIA, LATVIA ESTONIA, MEXICO BELARUS, THAILAND BRAZIL	LAOS, INDIA CAMBODIA, PHILIPPINES MALAYSIA, INDONESIA GEORGIA, COLOMBIA PAKISTAN, TAIWAN

Table C4 Conflicts around the world and status (Council on Foreign Relations, 2016)

Conflicts (as of 15 January 2016)		
Conflict Status	Worsening	TALIBAN IN AFGHANISTAN CIVIL WAR IN SYRIA SECTARIAN CONFLICT IN LEBANON ISLAMIST MILITANCY IN EGYPT VIOLENCE IN THE CENTRAL AFRICAN REPUBLIC VIOLENCE IN THE DEMOCRATIC REPUBLIC OF CONGO TERRITORIAL DISPUTES IN SOUTH CHINA SEA CIVIL WAR IN SOUTH SUDAN WAR AGAINST ISLAMIC STATE IN IRAQ KURDISH CONFLICT ISRAELI-PALESTINIAN CONFLICT
	Unchanging	NAGORNO-KARABAKH CONFLICT ISLAMIST MILITANCY IN PAKISTAN DESTABILIZATION OF MALI SECTARIAN VIOLENCE IN MYANMAR TENSIONS IN THE EAST CHINA SEA NORTH KOREA CRISIS CONFLICT IN UKRAINE ISLAMIST MILITANCY IN RUSSIA CRIMINAL VIOLENCE IN MEXICO BOKO HARAM IN NIGERIA AL-SHABAB IN SOMALIA CONFLICT BETWEEN INDIA-PAKISTAN UIGHUR CONFLICT IN CHINA

Table C5 Conflicts and Impact on U.S. Interests (Council on Foreign Relations, 2016)

Conflicts (as of 15 January 2016)		
Impact on U.S. Interests	Critical	TALIBAN IN AFGHANISTAN CIVIL WAR IN SYRIA SOUTH CHINA SEA EAST CHINA SEA NORTH KOREA CRISIS ISIS in IRAQ
	Significant	ISLAMIC MILITANCY PAKISTAN SECTARIAN CONFLICT IN LEBANON ISLAMIC MILITANCY IN EGYPT CONFLICT IN UKRAINE KURDISH CONFLICT CRIMINAL VIOLENCE IN MEXICO ISRAELI-PALESTINIAN CONFLICT BOKO HARAM IN NIGERIA CIVIL WAR IN LIBYA CONFLICT BETWEEN INDIA-PAKISTAN WAR IN YEMEN
	Limited	NAGORNO-KARABAKH CONFLICT DESTABILIZATION OF MALI VIOLENCE IN THE CENTRAL AFRICAN REPUBLIC VIOLENCE IN THE DEMOCRATIC REPUBLIC OF CONGO SECTARIAN VIOLENCE IN MYANMAR CIVIL WAR IN SOUTH SUDAN ISLAMIST MILITANCY IN RUSSIA

Appendix D - List of references for Market Segment 1

[1] (Defense Security Cooperation Agency, 2016)

[2] (Ansari, 2015)

[3] (U.S. Department of State, 2015)

[4] (GlobalSecurity.org, 2016)

[5] (Defense Security Cooperation Agency, 2016)

[6] (GlobalSecurity.org, 2016)

[7] (Behera, 2015)

[8] (Smith, 2015)

[9] (Latif, 2012)

[10] (GlobalSecurity.org, 2015)

[11] (Defense Security Cooperation Agency, 2014)

[12] (U.S. Department of State, 2015)

[13] (U.S. Department of State, 2016)

[14] (Defense Security Cooperation Agency, 2016)

[15] (Cordesman & Peacock, 2015)

[16] (Defense Security Cooperation Agency, 2015)

[17] (GlobalSecurity.org, 2013)

[18] (GlobalSecurity.org, 2016)

[19] (Defense Security Cooperation Agency, 2015)

[20] (Defense Security Cooperation Agency, 2015)

[21] (Thayer, 2015)

[22] (Defense Security Cooperation Agency, 2016)

Appendix E – Countries that supply arms to Market Segment 1

1. Pakistan

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

Note: The 'No. delivered/produced' and the 'Year(s) of deliveries' columns refer to all deliveries since the beginning of the contract. Deals in which the recipient was involved in the production of the weapon system are listed separately. The 'Comments' column includes publicly reported information on the value of the deal. Information on the sources and methods used in the collection of the data, and explanations of the conventions, abbreviations and acronyms, can be found at URL <http://www.sipri.org/contents/armstrad/at_data.html>. The SIPRI Arms Transfers Database is continuously updated as new information becomes available.

Source: SIPRI Arms Transfers Database

Information generated: 01 February 2016

Supplier/ recipient (R) or licenser (L)	No. ordered	Weapon designation	Weapon description	Year of order/ licence	Year(s) of deliveries	No. delivered/ produced	Comments
Brazil							
R: Pakistan	100	MAR-1	ARM	2008	2013-2014	(45)	BRL111 m ($100-126 m) deal
China							
L: Pakistan	. .	Red Arrow-8	Anti-tank missile	1989	1990-2014	(22350)	Pakistani designation Baktar Shikan
	. .	QW-1 Vanguard	Portable SAM			(1993)	1994-2014 (1850) Pakistani designation Anza-2
	(500)	Type-90-2/MBT-2000	Tank	(1998)	2001-2014		(343) MBT-2000 (Al Khalid or P-90) version
	2	Azmat	FAC	2010	2012-2014		2 Incl 1 produced in Pakistan
	(50)	JF-17 Thunder/FC-1	FGA aircraft			(2011)	JF-17 Block-2 version
	(50)	JF-17 Thunder/FC-1	FGA aircraft			(2012)	JF-17 Block-2 or Block-3 version; selected but not yet ordered by end-2014
	2	Azmat	FAC	(2013)			Delivery 2016-17
R: Pakistan	(800)	PL-12/SD-10	BVRAAM	(2006)	2010-2014	(275)	For JF-17 and possibly modernized Mirage-3/5 combat aircraft
	(1000)	PL-5E	SRAAM	(2006)	2009-2014	(460)	For JF-17 combat aircraft; PL-5E-II version
	(100)	C-802/CSS-N-8	Anti-ship missile			(2008)	2012-2014 (30) For JF-17 combat aircraft
	(750)	LS-3	Guided bomb			(2008)	2010-2014 (350) For JF-17 combat aircraft
	(1000)	LS-6-500	Guided bomb			(2008)	2010-2014 (325) For JF-17 combat aircraft
	(750)	LT-2	Guided bomb			(2008)	2010-2014 (325) For JF-17 combat aircraft
	(200)	WMD-7	Aircraft EO system			(2008)	2009-2014 (60) For JF-17 combat aircraft
	4	ZDK-03	AEW&C aircraft			2008	2011-2014 (4) $278 m deal; designated KE-03 in Pakistan
	(30)	C-802/CSS-N-8	Anti-ship missile			(2010)	2012-2014 (30) For Azmat FAC
	(50)	CM-400AKG	Anti-ship missile			(2010)	2012-2014 (30) For JF-17 combat aircraft
	(90)	SH-1 155mm	Self-propelled gun			(2012)	2013-2014 (36)
	(30)	C-802/CSS-N-8	Anti-ship missile			(2013)	For Azmat FAC
	8	IBIS-150	Air search radar			2014	$40 m deal
	(150)	LY-80	SAM	2014			
	3	LY-80	SAM system			2014	$226 m deal
	(6)	Type-041/Yuan	Submarine			(2014)	Designation uncertain; selected but not yet ordered by end-2014
France							
R: Pakistan	10	AS-350/AS-550 Fennec	Light helicopter	(2007)	2013-2014	(10)	Armed AS-550C3 version
	2	MESMA	AIP engine			2007	For modernization of 2 Agosta-90B submarines
	2	SA-316B Alouette-3	Light helicopter			(2013)	2014 2 Second-hand
Italy							
R: Pakistan	(600)	M-113	APC	2013	2013-2014	(600)	Second-hand; incl VCC-1 and VCC-2 versions; aid
Jordan							
R: Pakistan	13	F-16(ADF)	FGA aircraft	(2013)	2014	13	Second-hand; incl 3 F-16B version; $75 m deal
Russia							
R: Pakistan	(200)	RD-33	Turbofan	(2004)	2007-2013	(85)	RD-93 version; for JF-17 combat aircraft from China
	(20)	Mi-35M/Hind-E	Combat helicopter			(2014)	Selected but not yet ordered by end-2014

Serbia							
R: Pakistan	(20)	Lazar	IFV	(2013)			Lazar-2 version; for police; status uncertain
Sweden							
L: Pakistan	. .	RBS-70	Portable SAM	(1985)	1988-2014	(1300)	Probably incl RBS-70 Mk-3 version
	(150)	MFI-17 Supporter	Trainer aircraft			(2001)	2001-2014 (141) Super Mushshak version
Turkey							
L: Pakistan	1	STW-15600t	Oiler	2013			$80 m deal; delivery 2017
Ukraine							
R: Pakistan	110	6TD	Diesel engine	2013	2013-2014	(70)	$50 m deal; probably for MBT-2000 (Type-90-2 or Al Khalid) tanks from China
United States							
L: Pakistan		Dragoon	APC	(2013)	2014	(2)	
R: Pakistan	(500)	AIM-120C AMRAAM	BVRAAM	2007	2010-2014	(500)	$265 m deal; AIM-120C-5 version; for F-16 combat aircraft
	(35)	APG-68	Combat ac radar			2007	2012-2014 (35) APG-68(V)9 version for 'Mid-Life Update' (MLU) modernization of 35 F-16A combat aircraft to F-16C (F-16AM or F-16MLU)
	(550)	M-113	APC	(2010)	2011-2014	(369)	Second-hand; M-113A2 version; aid
	(10)	APG-68	Combat ac radar			(2011)	2014 (10) APG-68(V)9 version for 'Mid-Life Update' (MLU) modernization of 10 F-16A combat aircraft to F-16C (F-16AM or F-16MLU)

2. Algeria

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

Note: The 'No. delivered/produced' and the 'Year(s) of deliveries' columns refer to all deliveries since the beginning of the contract. Deals in which the recipient was involved in the production of the weapon system are listed separately. The 'Comments' column includes publicly reported information on the value of the deal. Information on the sources and methods used in the collection of the data, and explanations of the conventions, abbreviations and acronyms, can be found at URL <http://www.sipri.org/contents/armstrad/at_data.html>. The SIPRI Arms Transfers Database is continuously updated as new information becomes available.

Source: SIPRI Arms Transfers Database

Information generated: 01 February 2016

Supplier/ recipient (R) or licenser (L)	No. ordered	Weapon designation	Weapon description	Year of order/ licence	Year(s) of deliveries	No. delivered/ produced	Comments
China							
R: Algeria	(50)	C-802/CSS-N-8	Anti-ship missile	(2012)			For Type-053 (F-22A) frigates
	3	F-22	Frigate	(2012)			C-28A version; possible option on 2 more
	(50)	PLZ-45 155mm	Self-propelled gun			(2013)	2014 (50)
Denmark							
R: Algeria	2	Scanter-6000	Air/sea search radar	2012	2014	1	For modernization of 2 LSL landing ships; Scanter-6002 version
Finland							
R: Algeria	2	W-12	Diesel engine	2011	2014	2	For 1 BDSL AALS from Italy
France							
R: Algeria	3	AQS-13F	ASW sonar	2012			For 3 Lynx-140 ASW helicopters from UK

Germany (FRG)							
R: Algeria	54	Tpz-1 Fuchs	APC	2011	2013-2014	(54)	EUR195 m deal; incl assembly from kits in Algeria
		2	MEKO-A200	Frigate	2012		Option on 2 more; delivery probably from 2017
		(12)	MTU-4000	Diesel engine		(2012)	For 3 Type-053 (C-28A) frigates from China; designation uncertain (reported as MTU diesel engines)
		(926)	Tpz-1 Fuchs	APC	(2014)		Delivery 2015-2025
Italy							
R: Algeria	(25)	ASTER-15 SAAM	SAM	(2011)	2014	(25)	For BDSL AALS from Italy
		(8)	AW139	Helicopter		(2011)	2013-2014 (8) For SAR
		1	BDSL	AALS	2011	2014	1 Algerian designation Kalaat Beni Abbes; possibly option on 1 more
		(2)	127/64LW	Naval gun		(2012)	For 2 MEKO-A200 frigates from FRG
		6	T-200	AGS radar		(2012)	2013-2014 (6) For modification of 6 King Air-350 transport aircraft to ground surveillance aircraft
		1	Gaeta	MCM ship		2014	Designation uncertain; option on 1 more
Netherlands							
R: Algeria	3	SMART	Air search radar	2013			Part of EUR21 m deal; for 3 Type-053 (C-28A) frigates from China
Poland							
R: Algeria	(7)	W-3 Sokol	Helicopter	(2011)	2014	(7)	W-3A version
Russia							
R: Algeria	(38)	96K9 Pantsyr-S1	Mobile AD system	(2006)	2012-2014	(38)	
	(750)	9M311/SA-19	SAM	(2006)	2012-2014	(750)	For Pantsyr-S1 AD systems
		6	Mi-26/Halo	Helicopter		2013	Part of $2.7 b deal; Mi-26T2 version; delivery probably 2015-2016
		42	Mi-28N/Havoc	Combat helicopter		2013	Part of $2.7 b deal; Mi-28NE version
		2	Project-636E/Kilo	Submarine		2014	Delivery by 2018
South Africa							
R: Algeria	100	Mokopa	ASM/anti-tank missile	2012	2013	8	ZAR360 m deal; for Lynx helicopters
	(100)	Umkhonto-IR	SAM	(2012)			For MEKO-A200 frigates
Sweden							
R: Algeria	4	CEROS-200	Fire control radar	(2012)			For 2 MEKO-A200 frigates from FRG
		2	Giraffe AMB	Air search radar		(2012)	For 2 MEKO-A200 frigates from FRG
		(65)	RBS-15 Mk-3	Anti-ship MI/SSM		(2012)	For MEKO-A200 frigates
UAE							
R: Algeria	(200)	Nimr Armored	APV	2012	2014	(50)	Assembled in Algeria
United Kingdom							
R: Algeria	6	Super Lynx-100	ASW helicopter	2012			Lynx Mk-140 version
United States							
R: Algeria	(12)	T-800	Turboshaft	2012			For 6 Super Lynx ASW helicopters from UK

3. India

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

Note: The 'No. delivered/produced' and the 'Year(s) of deliveries' columns refer to all deliveries since the beginning of the contract. Deals in which the recipient was involved in the production of the weapon system are listed separately. The 'Comments' column includes publicly reported information on the value of the deal. Information on the sources and methods used in the collection of the data, and explanations of the conventions, abbreviations and acronyms, can be found at URL <http://www.sipri.org/contents/armstrad/at_data.html>. The SIPRI Arms Transfers Database is continuously updated as new information becomes available.

Source: SIPRI Arms Transfers Database

Information generated: 01 February 2016

Supplier/ recipient (R) or licenser (L)	No. ordered	Weapon designation	Weapon description	Year of order/ licence	Year(s) of deliveries	No. delivered/ produced	Comments
Brazil							
R: India	3	ERJ-145	Transport aircraft	2008			$210 m deal (part of INR18 b ($378 m) deal); for modification in India to AEW aircraft with Indian radar
Canada							
R: India	2	Global Express	AGS aircraft	(2011)			Part of $300 m deal; Global-5000 aircraft modified in Israel to AGS aircraft
		(75)	PT6	Turboprop		2012	2013-2014 (60) For 75 PC-7 trainer aircraft from Switzerland
France							
L: India	(22250)	MILAN	Anti-tank missile	(1979)	1984-2013	(20400)	MILAN-2 and MILAN-2T version; ordered from French-FRG company; most produced in India; incl for BMP-2 IFV
		(28)	PA6	Diesel engine		(2004)	2007-2014 (18) For 4 Kamorta (Project-28) frigates and 3 Sankalp OPV and 3 Shardul landing ships produced in India; 20PA-6B and 12PA-6 versions
		6	Scorpene	Submarine		2005	INR207-230 b ($4.1-4.5 b) 'Project-75' programme; delivery delayed from 2012-2017 to 2016/2017-2021/2022
		8	PA6	Diesel engine		(2006)	2013-2014 8 For 4 Saryu OPV produced in India
		19	GS-100	Air search radar		2009	2010-2014 (14) Incl 13 produced in India
		(49)	Mirage-2000-5	FGA aircraft		2011	2014 (2) INR109 b deal (offsets $593 m); Indian Mirage-2000H rebuilt to Mirage-2000-5; incl 2 produced in France and rest in India; delivery 2014-2023
		126	Rafale	FGA aircraft		(2012)	$10.4-18 b 'MMRCA' programme (offsets 50% incl assembly/production of 108 in India); delivery 2016-2023/2025; selected 2012 but not yet ordered by end-2014 and status uncertain after price increases
		20	SA-315B Lama	Light helicopter		2013	INR3 b ($48 m) deal; Cheetal version; delivery probably 2015-2017
R: India	36	SM-39 Exocet	Anti-ship missile	2005			Possibly $150 m deal; SM-39 Block-2 version; for Scorpene submarines
		493	MICA	BVRAAM		2012	EUR950 m deal (offsets 30%); for Mirage-2000-5 combat aircraft
Germany (FRG)							
L: India	(22250)	MILAN	Anti-tank missile	(1979)	1984-2014	(20800)	MILAN-2 and MILAN-2T version; ordered from French-FRG company; most produced in India; incl for BMP-2 IFV

		14	Do-228	Light transport ac	(2012)	2014	(7)	
		14	Do-228MP	MP aircraft	(2012)	2013-2014	(6)	$280 m deal; incl for coast guard
		(16)	ACTAS	ASW sonar	(2014)	For modernization of 3 Delhi (Project-15) destroyers and 3 Talwar (Project-11356) frigates and for 3 Kolkata (Project-15A) destroyers and 3 Shivalik (Project-17) and 4 Kamorta (Project-28) frigates produced in India; incl production of 10 in India; selected but not yet ordered by end-2014	
R: India	24	MAN V6	Diesel engine	2005		For 6 Scorpene submarines from France		
		(124)	MTU-838	Diesel engine	(2010)	For 124 Arjun-2 tanks produced in India		
		(4)	BR-710	Turbofan (2011)		For 2 Global-5000 AGS aircraft from Canada and Israel		
		12	Do-228MP	MP aircraft	2014	Delivery from 2016		
		0	MTU-838	Diesel engine	(2014)	For Arjun-2 tanks produced in India		
Israel								
L: India	18	SPYDER-MR	SAM system	2008	2012-2014	(12)	'LLQRM' programme	
		(1500)	Barak-8	SAM	2009		'MR-SAM' programme; incl for 7 Kolkata (Project-15A) destroyers and for land-based Barak SAM systems; Indian designation Barak-2MR	
		(18)	Barak-8	SAM system		(2009)	Part of $1.4 b deal; Indian designation MR-SAM, Barak-NG, Barak-2 and/or LR-SAM	
		(1500)	Barak-8ER	SAM	(2009)		'LR-SAM' programme; incl for 7 Kolkata (Project-15A) destroyers and for land-based Barak SAM systems; Indian designation Barak-2LR	
		(23)	EL/M-2084	Air search radar	2009	2011-2014	(18)	Indian designation Arudhra
R: India	3	EL/M-2248 MF-STAR	Multifuntion radar	2006	2014	1	$200 m deal; for 3 Kolkata (Project-15A) destroyers produced in India	
		. .	Litening	Aircraft EO system	2007	For Tejas (LCA) combat aircraft		
		. .	Litening	Aircraft EO system	(2007)	For modernized Jaguar combat aircraft		
		(750)	Derby	BVRAAM	(2008)	2012-2014	(600)	For SPYDER SAM systems
4		EL/M-2083 APR	Air search radar	2008				
(750)		Python-5	BVRAAM	2008	2012-2014	(600)	For SPYDER SAM system; possibly incl production of components in India	
3		Barak-8 VLS	Naval SAM system	(2009)	2014	1	For 3 Kolkata (Project-15A) destroyers produced in India	
(260)		EL/M-2052	Combat ac radar	(2009)	For Tejas (LCA) combat aircraft produced in India; bought after Indian development of radar delayed			
6		EL/M-2221 STGR	Fire control radar	(2009)	2014	2	For 3 Kolkata (Project-15A) destroyers produced in India	
(50)		Harop	SSM	(2009)	2013-2014	(50)	$100 m deal	
4		EL/M-2248 MF-STAR	Multifuntion radar	(2011)	For 4 Kolkata (Project-15B) destroyers produced in India			
2		MARS2	AGS/SIGINT system	2011	For 2 Global-5000 AGS aircraft from Canada; designation uncertain			
(100)		EL/M-2032	Combat ac radar	2012	$150 m deal; for modernization of Jaguar combat aircraft to DARIN-3 version			
500		NG-LGB	Guided bomb	2012	2014	(250)	$100 m deal; designation uncertain; delivery by 2015	
(164)		Litening	Aircraft EO system	(2013)	For MiG-27, Su-30MKI and Mirage-2000 combat aircraft			
(262)		Barak-1	SAM	(2014)	INR8.8 b ($142-163 m) deal; selected but probably not yet ordered by end-2014			
4		Barak-8 VLS	Naval SAM system	(2014)	For 4 Kolkata (Project-15B) destroyers produced in India; selected but probably not yet ordered by end-2014			
2		EL/M-2075 Phalcon	AEW&C system	(2014)	Part of $800 m deal; for 2 A-50EhI AEW&C aircraft from Russia			
(8)		EL/M-2221 STGR	Fire control radar	(2014)	For 4 Kolkata (Project-15B) destroyers produced in India; probably selected but not yet ordered by end-2014			
(15)		Heron	UAV	(2014)	IND12 b ($200 m) deal; selected but possibly not yet ordered by end-2014			

		8356	Spike-ER	Anti-tank missile	(2014)		INR32 b ($533 m) deal (incl 321 launchers); selected but not yet ordered by end-2014
Italy							
L: India	98	Black Shark	AS/ASW torpedo	(2014)			$300 m deal; for Scorpene submarines; selected but not yet ordered by end-2014
R: India	(4)	Super Rapid 76mm	Naval gun	(2003)	2014	1	For 4 Kamorta (Project-28) frigates produced in India; possibly produced in India
		4	Super Rapid 76mm	Naval gun	(2006)	2013-2014 4	For 4 Saryu OPV produced in India; possibly produced in India
		3	Super Rapid 76mm	Naval gun	(2009)	2014 1	For 3 Kolkata (Project-15A) destroyers produced in India; possibly produced in India
		(4)	Super Rapid 76mm	Naval gun	(2010)		For 1 Vikrant (IAC or Project-71) aircraft carrier produced in India
		1	RAN-40L	Air search radar	(2011)		For Vikrant (IAC or Project-71) aircraft carrier produced in India
		2	Super Rapid 76mm	Naval gun	(2011)		For 2 training ships produced in India
		13	127/64LW	Naval gun	(2014)		For 7 Shivalik frigates and 6 Delhi destroyers produced in India
Kyrgyzstan							
R: India	(14)	SET-65E 633mm	ASW torpedo	(2011)			
Netherlands							
L: India	7	LW-08	Air search radar	(2006)	2014	1	For 7 Kolkata (Project-15A) destroyers produced in India; Indian designation RAWL-02 Mk-3
Poland							
L: India	(204)	WZT-3M	ARV	(2012)	2013	(8)	$275 m deal
Russia							
L: India	(25000)	9M113 Konkurs/AT-5	Anti-tank missile	(1988)	1992-2014	(25000)	For BMP-2 IFV; ordered from Soviet Union and produced under Russian licence after break-up of Soviet Union; incl 9M113M version from 2003
9		Garpun/Plank Shave	Air search radar		(1998)	2000-2014 7	For 3 Kolkata (Project-15A) destroyers and 3 Brahmaputra (Project-16A) and 3 Shivalik (Project-17) frigates produced in India; for use with SS-N-25 missiles; Indian designation Aparna
(150)		PJ-10 BrahMos	Anti-ship MI/SSM		(1998)	2006-2014 (75)	Version of Yakhont (SS-N-26); officially joint venture for development but mainly using Russian technology
(400)		PJ-10 BrahMos	SSM	1998	2006-2014	(315)	Version of Yakhont (SS-N-26); officially joint venture for development but mainly using Russian technology
140		Su-30MK/Flanker	FGA aircraft		(2001)	2005-2014 (109)	$3-5.4 b deal; Su-30MKI version; delivery probably 2005-2019
14		RBU-6000	ASW MRL		(2003)	2014 4	For 3 Kolkata (Project-15A) destroyers and 4 Kamorta (Project-28) frigates produced in India
(250)		AL-55	Turbofan	2005			For HJT-36 trainer aircraft produced in India; status uncertain
1000		T-90S	Tank	(2006)	2009-2014	(205)	
(62)		MiG-29SMT/Fulcrum-F	FGA aircraft		2008	2012-2013 6	$850-965 m deal; Indian MiG-29 rebuilt to MiG-29UPG (MiG-29SMT); delivery 2012-2016
(216)		PJ-10 BrahMos	ASM	(2012)			Version of Yakhont (SS-N-26); officially joint venture for development but mainly using Russian technology; for Su-30 combat aircraft
42		Su-30MK/Flanker	FGA aircraft		2012	2014 (5)	$1.6 b deal; Su-30MKI version; delivery by 2017/2018
(144)		T-50 PAKFA	FGA aircraft		(2012)		$30-35 b 'FGFA' programme for '5th generation stealth fighter' (incl production in India); delivery after 2020; selected but not yet ordered by end-2014
25000		9M119 Svir/AT-11	Anti-tank missile		2013		INR30 b ($474 m) deal; for T-90 and possibly T-72 tanks; incl 15000 produced in India; planned from 2006 but delayed several years due to

							problems with production in India; Indian designation Invar
		363	BMP-2	IFV	2014		Selected but probably not yet ordered by end-2014
R: India	(4000)	R-73/AA-11	SRAAM	(1996)	1997-2014	(3770)	
		(20)	AK-630 30mm	Naval gun		(2003)	2014 (4) For 3 Kolkata (Project-15A) destroyers and 4 Kamorta (Project-28) frigates produced in India
		16	AK-630 30mm	Naval gun		(2006)	2012-2014 (16) For 4 Saryu OPV produced in India and 2 Deepak support ships from Italy
		29	MiG-29SMT/Fulcrum-F	FGA aircraft		2010	2012-2014 (17) $1.2-1.5 b deal; MiG-29K version; incl 4 MiG-29KUB version; for use on IAC aircraft carrier
		(100)	KAB-500/1500	Guided Bomb		(2011)	2013-2014 (100) Probably KAB-500 version
		10000	9M113 Konkurs/AT-5	Anti-tank missile		2012	2013-2014 (4000) INR12 b ($225 m) deal
		(800)	AL-31	Turbofan	2012	2013-2014	(100) For modernization of Su-30MKI combat aircraft; in spares; delivery 2013-2022
		(8)	PS-90A	Turbofan	(2012)		For 2 A-50EhI AEW&C aircraft from Uzbekistan
		(80)	Zhuk-AE	Combat ac radar		(2012)	For modernization of 80 Su-30MKI combat aircraft; selected but probably not ordered by end-2014
		(68)	Mi-8MT/Mi-17/Hip-H	Helicopter		(2013)	2014 (34) $1.3 b deal; Mi-17-V5 version; incl 9 for coast guard; delivery 2014-2015
		(2)	A-50EhI	AEW&C aircraft		(2014)	Part of $800 m deal; ordered via Israel; fitted with Israeli Phalcon AEW system in Israel; selected but not yet ordered by end-2014
		(100)	Kh-35 Uran/SS-N-25	Anti-ship missile		(2014)	INR14 b ($240 m) deal; selected but probably not yet ordered by end-2014
South Korea							
L: India	8	Yang Yang	MCM ship	(2013)			INR87 b ($1.2-1.5 b) deal; designation uncertain; incl 6 produced in India; delivery possibly 2016-2018
Spain							
R: India	6	A-330 MRTT	Tanker/transport ac	(2014)			Selected but not yet ordered by end-2014; delivery possibly from 2017
Sweden							
L: India	114	FH-77 155mm	Towed gun	(2014)			FH-77B version; selected but not yet ordered by end-2014
Switzerland							
R: India	75	PC-7 Turbo Trainer	Trainer aircraft	2012	2013-2014	(60)	PC-7 Mk-2 version; incl assembly from kits in India; delivery 2013-2015
Ukraine							
R: India	12	DT-59	Gas turbine	(2003)	2014	4	For 3 Kolkata (Project-15A) destroyers produced in India
		100	AI-20	Turboprop		2009	2011-2014 (48) AI-20D-5M version for modernization of An-32 transport aircraft to An-32RE version
United Kingdom							
L: India	57	Hawk-100	Trainer/combat ac	2010	2013-2014	(27)	GBP700-735 m ($1.1 b) deal; Hawk-132 version; delivery 2012-2016
		(350)	ASRAAM	SRAAM	2014		GBP250 m deal (30 offsets incl production of components in India); Indian designation NGCCM
		20	Hawk-100	Trainer/combat ac		(2014)	INR36 b ($685 m) deal; Hawk-132 version; selected but not yet ordered by end-2014
R: India	6	Air refuel system	Air refuel system	(2012)			For 6 A-330 MRTT tanker/transport aircraft from Spain
		145	UFH/M-777 155mm	Towed gun		(2014)	$560-700 m deal; ordered via USA from US production line; selected 2012 but not yet ordered by end-2014
United States							
L: India	8	P-8A Poseidon	ASW aircraft	(2008)	2012-2014	6	$2 b deal (offsets 30% incl production of components in India); P-8I version; delivery 2012-2015

		99	F414	Turbofan (2012)		$800-900 m deal (incl 81 produced in India); for Tejas Mk-2 (LCA) combat aircraft produced in India; selected but not yet ordered by end-2014
		6	C-130J-30 Hercules	Transport aircraft	2013	Probably $1.1 b deal (30% offsets including production in India of components for all future C-130J); for special forces; delivery by 2016
		(270)	F-125	Turbofan (2014)		F-125IN version for modernization of 125 Jaguar combat aircraft; delivery possibly 2015/2016-2023/2024; selected but not yet ordered by end-2014
		4	P-8A Poseidon	ASW aircraft	(2014)	Selected but not yet ordered by end-2014
R: India	4	LM-2500	Gas turbine	(2003)		For 1 Vikrant (IAC or Project-71) aircraft carrier produced in India; from Italian production line
		17	F404	Turbofan 2004		$105 m deal; F404-GE-IN20 version for Tejas Mk-1 (LCA) combat aircraft produced in India; ordered after Indian Kaveri engine delayed
		(24)	F404	Turbofan 2007		$100 m deal; F404-GE-f2J3 version for Tejas Mk-1 (LCA) combat aircraft produced in India
		512	CBU-97 SFW	Guided bomb	2010	2013-2014 (250) $258-311 m deal; CBU-105 version
		(20)	RGM-84L Harpoon-2	Anti-ship MI/SSM	2010	2013-2014 (20) $170 m deal; AGM-84L version for Jaguar combat aircraft
		10	C-17A Globemaster-3	Heavy transport ac	2011	2013-2014 10 $4.1 b deal (offsets $1.1 b)
		(32)	Mk-54 MAKO	ASW torpedo	(2011)	2013-2014 (24) $86 m deal; for P-8I ASW aircraft
		..	Paveway	Guided bomb	(2012)	Paveway-2 version
		(21)	RGM-84L Harpoon-2	Anti-ship MI/SSM	2012	2013-2014 (15) AGM-84L version for P-8I ASW aircraft
		(28)	TPE-331	Turboprop	(2012)	2013-2014 (12) For 14 Do-228MP MP aircraft from FRG
		(542)	AGM-114K HELLFIRE	Anti-tank missile	(2013)	AGM-114R-3 version; for AH-64 combat helicopters; selected but not yet ordered by
		(812)	AGM-114L HELLFIRE	Anti-tank missile	(2013)	AGM-114L-3 version; for AH-64 combat helicopters; selected but not yet ordered by end-2014
		22	AH-64D Apache	Combat helicopter	(2013)	$1.2-1.4 b deal (part of $2.4 b deal); AH-64E version; selected 2013 but not yet ordered by end-2014
		(12)	APG-78 Longbow	Combat heli radar	(2013)	For AH-64 combat helicopters
		(245)	FIM-92 Stinger	Portable SAM	(2013)	FIM-92 Block-1 version for AH-64 combat helicopters; selected but not yet ordered by end-2014
		(6)	T-700	Turboshaft	(2013)	Spares for AH-64 combat helicopters
		15	CH-47F Chinook	Helicopter	(2014)	$1 b deal (part of $2.4 b deal); selected but not yet ordered by end-2014
		16	S-70/UH-60L	Helicopter	(2014)	$1 b 'NMRH' programme; S-70B transport version; selected 2014 but not yet ordered by end-2014

4. Philippines

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

Note: The 'No. delivered/produced' and the 'Year(s) of deliveries' columns refer to all deliveries since the beginning of the contract. Deals in which the recipient was involved in the production of the weapon system are listed separately. The 'Comments' column includes publicly reported information on the value of the deal. Information on the sources and methods used in the collection of the data, and explanations of the conventions, abbreviations and acronyms, can be found at URL <http://www.sipri.org/contents/armstrad/at_data.html>. The SIPRI Arms Transfers Database is continuously updated as new information becomes available.

Source: SIPRI Arms Transfers Database

Information generated: 01 February 2016

Supplier/ recipient (R) or licenser (L)	No. ordered	Weapon designation	Weapon description	Year of order/ licence	Year(s) of deliveries	No. delivered/ produced	Comments
Canada							
R: Philippines	(6)	PW100	Turboprop/turboshaft	(2014)			For 3 C-295 transport aircraft from Spain
France							
R: Philippines	4	AS-350/AS-550 Fennec	Light helicopter	(2012)			Part of PHP3.2 b ($80 m) deal (incl option on 6 more); AS-550B3 armed version
Indonesia							
R: Philippines	2	C-212	Transport aircraft	2014			PHP814 m deal; NC-212i version
	2	LPD-122m	AALS	2014			PHP4 b ($90 m) deal
Israel							
R: Philippines	12	EL/M-2032	Combat ac radar	(2014)			For 12 FA-50 combat aircraft from South Korea
		28	M-113	APC	2014		Second-hand but modernized before delivery; PNP882 m ($20 m) deal; incl 4 modified to IFV, 14 modified to AFSV (with second-hand Philippine turret) and 4 ARV version; delivery by 2015
		4	UT-25/UT-30	IFV turret		2014	UT-25 version for 4 second-hand M-113A2 APC modified to IFV
Italy							
R: Philippines	8	A-109K	Light helicopter	2013	2014	(4)	$77 m deal; armed AW109P version; delivery 2014-2015
	2	A-109K	Light helicopter			2014	2014 (2) AW109P version
South Korea							
R: Philippines	12	FA-50	FGA aircraft	2014			Possibly PHP18.9 b ($429 m) deal; delivery 2015-2017
Spain							
R: Philippines	3	C-295	Transport aircraft	2014			PHP5.3 b ($120 m) deal; deliverey from 2015
United States							
R: Philippines	4	TPS-79 MMSR	Air search radar	(2011)	2012	(1)	Designation uncertain (reported as coastal radar)
	(114)	M-113	APC	2012		2014	(114) Second-hand; aid; M-113A2 version
	(2)	Mk-38 Mod-2	CIWS	2012			
	21	Bell-205/UH-1H	Helicopter			2013	2014 (21) Second-hand but modernized before delivery; PHP1.25 b deal
	8	Bell-412	Helicopter			2014	$105 m deal; Bell-412EP version; from Canadian production line; incl 3 for VIP transport; delivery 2015-2017
	2	C-130H Hercules	Transport aircraft			(2014)	Second-hand; $56 m deal (incl $20 m aid); C-130T version; delivery 2015-2016
	(12)	F404	Turbofan	(2014)			For 12 FA-50 combat aircraft from South Korea
	2	T56	Turboprop			(2014)	Second-hand; spares for C-130 transport aircraft

5. Oman

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

Note: The 'No. delivered/produced' and the 'Year(s) of deliveries' columns refer to all deliveries since the beginning of the contract. Deals in which the recipient was involved in the production of the weapon system are listed separately. The 'Comments' column includes publicly reported information on the value of the deal. Information on the sources and methods used in the collection of the data, and explanations of the conventions, abbreviations and acronyms, can be found at URL <http://www.sipri.org/contents/armstrad/at_data.html>. The SIPRI Arms Transfers Database is continuously updated as new information becomes available.

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Information generated: 01 February 2016

Supplier/ recipient (R) or licenser (L)	No. ordered	Weapon designation	Weapon description	Year of order/ licence	Year(s) of deliveries	No. delivered/ produced	Comments
Australia							
R: Oman	2	HSSV-72	Transport ship	2014			AUD125 m deal; delivery 2016
Canada							
R: Oman	(16)	PW100	Turboprop/turboshaft	2012	2013-2014	(10)	PW127 version for 4 C-295 transport aircraft and 4 C-295MSA MP aircraft from Spain
Denmark							
R: Oman	4	Terma-9000	MP aircraft radar	(2012)			For 4 C-295MPA MP aircraft from Spain
France							
R: Oman	20	NH-90 TTH	Helicopter	2004	2010-2014	(20)	EUR600-800 m deal; incl for SAR
	(50)	MM-40-3 Exocet	Anti-ship MI/SSM			2006	2013-2014 (50) For Al Shamikh (Khareef) frigates
		(60)	MICA	BVRAAM		(2007)	2013-2014 (60) For VL-MICA-M SAM system on 3 Al Shamikh (Khareef) frigates
Germany (FRG)							
R: Oman	6	MTU-8000	Diesel engine	2007	2013-2014	(6)	For 3 Al Shamikh (Khareef) frigates from UK
Italy							
R: Oman	3	Super Rapid 76mm	Naval gun	(2007)	2013-2014	(3)	For 3 Al Shamikh frigates from UK
Netherlands							
R: Oman	3	SMART	Air search radar	2007	2013-2014	3	SMART-S Mk-2 version for 3 Al Shamikh (Khareef) frigates from UK
	3	STING	Fire control radar			2007	2013-2014 3 For 3 Al Shamikh (Khareef) frigates from UK
	4	STIR	Fire control radar			2012	STIR-1.2 Mk-2 version for 4 Fearless-75 OPV from Singapore
	4	Variant	Air/sea search radar			2012	For 4 Fearless-75 OPV from Singapore
Norway							
R: Oman	(1)	NASAMS	SAM system	(2013)			Part of $2.1 b deal
Singapore							
R: Oman	4	Fearless-75	OPV	2012			USD700m 'Project Al-Ofouq'; delivery 2015-2016
Spain							
R: Oman	4	C-295	Transport aircraft	2012	2013-2014	(4)	
	4	C-295MPA	MP aircraft			2012	Delivery from 2015
	(2)	S763-LANZA	Air search radar			2014	
Turkey							
R: Oman	5	Ares-75	Patrol craft	2014			Part of $220 m deal; delivery 2016-2018
United Kingdom							
R: Oman	3	Al Shamikh	Frigate	2007	2013-2014	3	$700 m 'Khareef' programme
	8	Hawk-100	Trainer/combat ac			2012	Part of GBP2.5 b ($4 b) deal; Hawk-166 (Hawk AJT) version; delivery 2017
	12	Typhoon Tranche-3	FGA aircraft			2012	Part of GBP2.5 b ($4 b) deal; delivery 2017

United States									
R: Oman	2	C-130J Hercules	Transport aircraft	2010	2013-2014	2			
	12	F-16C Block-50/52	FGA aircraft		2011	2014	12	$600m deal; F-16C Block-50 version; incl 2 F-16D version	
	(12)	AAQ-33 Sniper	Aircraft EO system		2012	2014	(12)	$23 m deal; for F-16 combat aircraft	
	3	APG-68	Combat ac radar		2012	2014	(3)	AN/APG-68(V)9 version; spares for F-16 combat aircraft	
	4	DB-110	Aircraft recce system		2012	2014	(4)	$34 m deal; for F-16 combat aircraft	
	(290)	AIM-120C AMRAAM	BVRAAM		(2013)	AIM-120C-7 version for NASAMS SAM system from Norway			
	(27)	AIM-120C AMRAAM	BVRAAM		2013	2014	(27)	AIM-120C-7 version	
	50	AIM-9X Sidewinder	SRAAM	2013	2014	(50)	$29m deal; AIM-9X Block-2 version		
	(18)	Avenger	Mobile AD system		(2013)	Part of $2.1 b deal			
	(100)	FGM-148 Javelin	Anti-tank missile		2013	2014	(100)	Javelin Block-1 version	
	(266)	FIM-92 Stinger	Portable SAM		2013	For Avenger SAM systems			
	(1)	MPQ-64	Air search radar		(2013)	Part of $2.1 b deal; for NASAMS SAM system from Norway			
		BGM-71F TOW-2B	Anti-tank missile		2014	TOW-2-RF version			

6. South Korea

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

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Information generated: 01 February 2016

Supplier/ recipient (R) or licenser (L)	No. ordered	Weapon designation	Weapon description	Year of order/ licence	Year(s) of deliveries	No. delivered/ produced	Comments
France							
R: South Korea	2	Falcon-2000	SIGINT aircraft	(2011)			Delivery 2015
	8	FLASH	ASW sonar			2013	For 8 AW-159 helicopters from UK
Germany (FRG)							
L: South Korea	6	Type-214	Submarine	2008			'KSS-2' programme; delivery 2015-2020
R: South Korea	(1306)	MTU-881	Diesel engine	(1998)	1999-2014	(835)	For K-9 self-propelled guns and K-10 ALV produced in South Korea
	(36)	MTU-1163	Diesel engine			(2005)	2008-2014 (34) For 18 Gumdoksuri (PKX or PKG-A) FAC produced in South Korea
	(100)	MTU-883	Diesel engine			2012	2014 (50) For 100 K-2 tanks produced in South Korea; possibly produced in South Korea

		(177)	Taurus KEPD-350	ASM	2013		For F-15K combat aircraft; chosen after USA refused AGM-158; KEPD-350K version
Israel							
R: South Korea	(60)	EL/M-2032	Combat ac radar	2009	2013-2014	(20)	For some 60 FA-50 combat aircraft produced in South Korea
		(60)	Spike-NLOS	SSM/ASM		2013	For AW-159 helicopters
		3	Heron	UAV	(2014)		KRW30 b deal; selected but not yet ordered by end-2014; delivery 2015
Italy							
L: South Korea	(18)	Compact 76mm	Naval gun	(2005)	2008-2014	(17)	For 18 Gumdoksuri (PKX or PKG-A) FAC produced in South Korea; probably produced in South Korea
Sweden							
L: South Korea	18	CEROS-200	Fire control radar	2005	2008-2014	(17)	For 18 Gumdoksuri (PKX or PKG-A) FAC produced in South Korea
		(10)	ARTHUR	Arty locating radar		2011	2013-2014 (8) $70 m deal
United Kingdom							
R: South Korea	5	MT-30	Gas turbine	(2009)	2013-2014	3	For 5 Incheon (FFX) frigates produced in South Korea
		1	Seaspray	MP aircraft radar		2011	Seaspray-7500E version for 1 Aeros ground surveillance aerostat
		1	MT-30	Gas turbine		2012	For 1 Incheon (FFX) frigate produced in South Korea
		8	AW-159 Wildcat	ASW helicopter		2013	Delivery 2015-2016
United States							
L: South Korea	(60)	F404	Turbofan	2013	2013-2014	(20)	For some 60 FA-50 combat aircraft produced in South Korea; incl production of components and final assembly in South Korea
R: South Korea	(36)	LM-500	Gas turbine	(2005)	2008-2014	(34)	For 18 Gumdoksuri (PKX or PKG-A) FAC produced in South Korea
		125	AIM-120C AMRAAM	BVRAAM		(2008)	2011-2014 (125) AIM-120C-7 version
		(10)	Mk-45 127mm	Naval gun		(2009)	2013-2014 3 For 10 Incheon (FFX) frigates produced in South Korea
		4	C-130J-30 Hercules	Transport aircraft		2010	2014 4
		5	Mk-15 Phalanx	CIWS	2011	2013-2014	3 $66 m deal; Phalanx Block-1B version for 5 Incheon (FFX) frigates produced in South Korea
		19	Standard Missile-2MR	SAM	2011		SM-2 Block-3B version
		(16)	T-800	Turboshaft		(2012)	For 8 AW-159 helicopters from UK
			AAQ-33 Sniper	Aircraft EO system		2013	For F-16C and F-15K combat aircraft
		288	AGM-114K HELLFIRE	Anti-tank missile		2013	AGM-114R1 version for AH-64E combat helicopters
		36	AH-64D Apache	Combat helicopter		2013	$1.6 b 'AH-X' programme; AH-64E version; delivery 2016-2018
		6	APG-78 Longbow	Combat heli radar		2013	For 6 AH-64E combat helicopters
		14	CH-47D Chinook	Helicopter		(2013)	2014 14 Second-hand; $151 m deal
		63	FIM-92 Stinger	Portable SAM		2013	For AH-64E combat helicopters
		134	RACR	Combat ac radar		(2013)	For modernization of 134 F-16 combat aircraft; delivery possibly from 2016
		3	SPY-1D	Air search radar		(2013)	For 3 KDX-2X destroyers produced in South Korea; selected but not yet ordered by end-2014
		5	T55-L	Turboshaft		(2013)	2014 (5) Second-hand; T55-GA-714 version; spares for CH-47D helicopters
		2	T-700	Turboshaft		2013	Spares for AH-64E combat helicopters
		(100)	AGM-65 Maverick	ASM	2014		$31 m deal
		(274)	AIM-120C AMRAAM	BVRAAM		(2014)	AIM-120C-7 version
		361	CBU-97 SFW	Guided bomb		2014	$190 m deal; CBU-105 version; delivery by 2016
		40	F-35A JSF	FGA aircraft		2014	$7 b 'FX-3' programme; delivery from 2018
		(136)	MIM-104F PAC-3	ABM	(2014)		Selected but not yet ordered by end-2014
		9	Mk-15 Phalanx	CIWS	2014		$123 m deal; Phalanx Block-1B version for Incheon (FFX) frigates and AOE-2 support ships produced in South Korea
		8	Patriot PAC-3	SAM/ABM system		(2014)	South Korean Patriot PAC-2 SAM system rebuilt to Patriot PAC-3 SAM/ABM system; selected but not yet ordered by end-2014
		4	RQ-4A Global Hawk	UAV	2014		$657 m deal; RQ-4B Block-30 version; delivery 2017-2019

7. Saudi Arabia

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

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Canada							
R: Saudi Arabia	724	Piranha	APC	2009	2011-2014	(620)	$2.2 b deal (part of $5.8 b deal); sold via USA; LAV version; incl LAV-25 IFV, LAV-AG FSV, LAV-AT anti-tank, 120mm mortar caririer, ARV, command post and ambulance versions; for National Guard
		155	Piranha	APC	2011	2014	(75) Incl 82 for National Guard; incl 17 APC, 28 anti-tank, 29 command post, 5 ARV, 3 ALV, 1 AEW, 6 mortar carrier and 6 ambulance version
		(55)	PT6	Turboprop		2012	2014 (20) For 55 PC-21 trainer aircraft from Switzerland
			Piranha-3	APC	2014		Part of $10 b deal; designation uncertain (reported as 'armoured vehicle'); delivery probably from 2016
China							
R: Saudi Arabia	(20)	DF-21A/CSS-5	IRBM	(2007)			Status uncertain
France							
R: Saudi Arabia	(30)	Damocles	Aircraft EO system	(2007)	2009-2014	(30)	For Tornado and Typhoon combat aircraft; possibly incl assembly or production of components in Saudi Arabia
		73	Aravis	APC	2011	2013-2014	(73) For National Guard
		32	CAESAR 155mm	Self-propelled gun		2011	2013-2014 (32) EUR169 m deal; assembled from kits in Saudi Arabia
		20	Ground Master-60	Air search radar		2011	2013-2014 (6) Part of IMGP command/control systems for use with MPCV SAM system
		(800)	Mistral	Portable SAM		2011	2013-2014 (460) Mistral-2 version for MPCV SAM systems
		(49)	MPCV	Mobile AD system		2011	2013-2014 (29) For National Guard
		191	Aravis	APC	2012	2014	(120) For National Guard
		(100)	MILAN	Anti-tank missile		(2013)	2014 (100) For use on M-ATV armoured vehicles
		(130)	Mistral	Portable SAM		2013	For Simbad RC system on 2 Boraida support ships
Germany (FRG)							
R: Saudi Arabia	(1400)	IRIS-T	SRAAM	2009	2010-2014	(1400)	For Tornado and Typhoon combat aircraft
		(32)	OM-366	Diesel engine		2011	2013-2014 (32) For 32 CAESAR self-propelled guns from France
		(73)	OM-924	Diesel engine		2011	2013-2014 (73) For 73 Aravis APC from France
		(191)	OM-924	Diesel engine		2012	2014 (150) For 191 Aravis APC from France
		(33)	FPB-41	Patrol craft		2014	Designation uncertain (reported as 'patrol boats')

Netherlands							
R: Saudi Arabia	(225)	SQUIRE	Ground surv radar	2009	2011-2014	(175)	Sold via French company (part of 'Miksa' deal); for border security
South Africa							
R: Saudi Arabia	5	Al Kaser	APC	2013	2014	(5)	Al Mansour version
Spain							
R: Saudi Arabia	3	A-330 MRTT	Tanker/transport ac	2009	2014	1	Delivery 2014-2016
Sweden							
R: Saudi Arabia	2	Saab-2000 AEW	AEW&C aircraft	2010	2014	2	SEK4.5 b ($670 m) deal; second-hand Saab-2000 transport aircraft modified to AEW aircraft
Switzerland							
R: Saudi Arabia	55	PC-21	Trainer aircraft	2012	2014	(20)	Part of GBP1.6 b deal; ordered via UK company; delivery 2014-2016
Turkey							
R: Saudi Arabia	(200)	M-113A300	APC	2011	2013-2014	(200)	$200 m deal; Saudi M-113 rebuilt to M-113A300; assembled in Saudi Arabia
United Kingdom							
R: Saudi Arabia	72	Typhoon	FGA aircraft	2007	2009-2014	(45)	GBP4.4 b deal (part of up to GBP20 b 'Project Salam'); Typhoon F-2 (Typhoon Tranche-2) version
		(1000)	Brimstone	ASM	(2008)	2011-2014	(1000) For Tornado combat aircraft
		3	Air refuel system	Air refuel system		2009	2014 1 For 3 A-330 MRTT tanker/transport aircraft from Spain
		22	Hawk-100	Trainer/combat ac		(2012)	Part of GBP1.6 b deal; Hawk AJT version; delivery from 2016
		(2400)	Paveway	Guided bomb		2013	GBP150 m ($250 m) deal; Paveway-4 version; for Typhoon and modernized Tornado combat aircraft; delivery 2015
		. .	Storm Shadow/SCALP	ASM		2013	For Tornado and/or Typhoon combat aircraft
		. .	Meteor	BVRAAM		(2014)	For Typhoon combat aircraft
United States							
R: Saudi Arabia	(59)	M-1A1 Abrams	Tank	2008	2012-2014	(59)	Second-hand but modernized to M-1A2S before delivery
		(724)	6V-53	Diesel engine		2009	2011-2014 (620) 6V-53T version for 724 Piranha (LAV) APC from Canada
		12	AH-64D Apache	Combat helicopter		(2009)	2014 (12)
		(6)	CF-6/F-103	Turbofan	2009	2014	(2) For 3 A-330 MRTT tanker/transport aircraft from Spain
		264	LAV-25 turret	IFV turret		(2009)	2011-2014 (220) For 264 Piranha (LAV-25) IFV from Canada
		(200)	6V-53	Diesel engine		2011	2013-2014 (200) 6V-53T version for 200 M-113A300 APC from Turkey
		(155)	6V-53	Diesel engine		2011	6V-53T version for 155 Piranha (LAV) APC from Canada
		(193)	AAQ-13 LANTIRN	Combat ac radar		(2011)	For F-15SA combat aircraft
		(2592)	AGM-114L HELLFIRE	Anti-tank missile		(2011)	2013-2014 (2592) AGM-114R version; for AH-64 combat helicopters; for National Guard
		(600)	AGM-88 HARM	ARM	(2011)		AGM-88B version
		(24)	AH-64D Apache	Combat helicopter		(2011)	2014 (14) AH-64E version; delivery 2014-2015
		300	AIM-9X Sidewinder	SRAAM	(2011)	2012-2014	(150) AIM-9X Block-2 version
		84	F-15SG	FGA aircraft		2011	Part of $29 b deal; F-15SA version; delivery 2015-2019
		70	F-15SG	FGA aircraft		2011	Part of $29 b deal; Saudi F-15S rebuilt to F-15SA
		(1000)	JDAM	Guided bomb		(2011)	GBU-31B version
		21	Patriot PAC-3	SAM/ABM system		2011	2014 (4) $1.7 b deal; Saudi Patriot SAM systems rebuilt to Patriot-3 version
		(3100)	Paveway	Guided bomb		(2011)	2013-2014 (1500) Incl 1100 GBU-24 Paveway-3 and 2000 Dual Mode Paveway
		12	S-70/UH-60L	Helicopter		2011	2013-2014 (12) Saudi UH-60A rebuilt to UH-60L

(158)	AAQ-33 Sniper	Aircraft EO system	2012		For F-15SA combat aircraft
12	AH-64D Apache	Combat helicopter	(2012)		AH-64E version; for National Guard; delivery from 2015
(10)	DB-110	Aircraft recce system	2012	2014 (4)	$183 m deal; for F-15SA combat aircraft
(25)	F110	Turbofan (2012)			Spares for F-15SA combat aircraft
4	ISR King Air-350	AGS aircraft	(2012)		
(9)	King Air	Light transport ac	2012	2013-2014 (9)	King Air-350 version
(400)	RGM-84L Harpoon-2	Anti-ship MI/SSM	(2012)		AGM-84L version
24	S-70/UH-60L	Helicopter	2012	2014 (12)	For National Guard; UH-60M version
(650)	AGM-84H SLAM-ER	ASM 2013			For F-15SA combat aircraft; selected but not yet ordered by end-2014
(500)	AIM-120C AMRAAM	BVRAAM	2013		AIM-120C-7 version
(1300)	CBU-97 SFW	Guided bomb	2013		CBU-105D/B version; delivery by 2015
2	KC-130J Hercules	Tanker/transport ac	2013		$181 m deal; delivery by 2016
(300)	M-ATV	APV 2013	2014	(300)	
	AGM-114K HELLFIRE	Anti-tank missile	2014		
(973)	AGM-154 JSOW	ASM 2014			JSOW-C Block-3 version
24	AH-6S	Combat helicopter	2014	2014 (12)	$235 m deal; AH-6i version; for National Guard; delivery by 2016
(4941)	BGM-71F TOW-2B	Anti-tank missile	(2014)		Incl 4194 for National Guard
(10747)	BGM-71 TOW	Anti-tank missile	2014		BGM-71 TOW-2A and TOW-2A-RF versions; incl 9740 for National Guard; delivery 2015-2017
(202)	MIM-104F PAC-3	ABM (2014)			For modernized Patriot SAM systems; selected but probably not yet ordered by end-2014

8. Malaysia

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

R: Malaysia	2	DSQS-24	ASW sonar	(2009) 2013-2014	2		
	(257)	BFM-2015	Diesel engine		2010	2014 (12)	For 257 Pars APC and IFV from Turkey
Italy							
R: Malaysia	12	TMX	Fire control radar	(2014)			For 6 Gowind frigates from France
Netherlands							
L: Malaysia	6	SMART	Air search radar	2014			For 6 Gowind frigates; SMART-S Mk-2 version
R: Malaysia	2	MIRADOR	EO search/fire control	2009 2013-2014	2		For modernization of 2 FS-1500 (Kasturi) frigates
	24	SQUIRE	Ground surv radar		(2011)		For 24 Pars (AV-8) APC from Turkey
South Africa							
R: Malaysia	216	Ingwe	Anti-tank missile	2012			Part of EUR340 m deal; for Pars (AV-8) IFV
	123	LCT-30	IFV turret		2012		Part of EUR340 m deal; for Pars IFV from Turkey
	54	MCT	APC turret		2012		Part of EUR340 m deal; for PARS APC from Turkey
	54	Rogue	APC turret		2012		For 54 Pars (AV-8) APC from Turkey
South Korea							
L: Malaysia	2	Gagah Samudera	Training ship	2011			MYR294 m deal; incl for patrol
	6	MSC	Frigate 2014				$1.2 b deal; incl. 3 assembled/produced in Malaysia; delivery from 2018
Spain							
R: Malaysia	4	A400M Atlas	Transport aircraft	2005			EUR500 m deal (offsets at least EUR400 m); incl for air-refueling role; delivery 2015-2016
Sweden							
L: Malaysia	6	SAK-70 Mk-2 57mm	Naval gun	2013			$57 m deal; SAK-70 Mk-3 version; for 6 Gowind frigates from France; probably including assembly and/or production of components in Malaysia
Switzerland							

R: Malaysia	5	PC-7 Turbo Trainer	Trainer aircraft	(2014)			PC-7 Mk-2 version
Turkey							
L: Malaysia	89	Pars	APC	2011			Part of MYR7.6 b ($2.5 b) deal; AV-8 version; delivery probably 2015-2017/2018
	46	Pars IFV-25	IFV	2011		2014	12 Part of MYR7.6 b ($2.5 b) deal; AV8 version; delivery 2014-2017/2018
R: Malaysia	122	Pars	IFV	2011			Part of MYR7.6 b ($2.5 b) deal; AV-8 version; delivery probably 2015-2017/2018
United States							
R: Malaysia	6	ASQ-228 ATFLIR	Aircraft EO system	2012			$26 m deal; for modernization of 6 F/A-18D combat aircraft
	4	RDR-1700	MP aircraft radar			(2012)	2014 (4) For modernization of 4 King Air-200T MP aircraft
	20	AIM-9X Sidewinder	SRAAM	2013			$12 m deal; AIM-9X Block-2 version; delivery by 2015

9. United Arab Emirates

Transfers of major conventional weapons: sorted by supplier. Deals with deliveries or orders made for year range 2014 to 2014

Note: The 'No. delivered/produced' and the 'Year(s) of deliveries' columns refer to all deliveries since the beginning of the contract. Deals in which the recipient was involved in the production of the weapon system are listed separately. The 'Comments' column includes publicly reported information on the value of the deal. Information on the sources and methods used in the collection of the data, and explanations of the conventions, abbreviations and acronyms, can be found at URL <http://www.sipri.org/contents/armstrad/at_data.html>. The SIPRI Arms Transfers Database is continuously updated as new information becomes available.

Source: SIPRI Arms Transfers Database

Information generated: 01 February 2016

Supplier/ recipient (R) or licenser (L)	No. ordered	Weapon designation	Weapon description	Year of order/ licence	Year(s) of deliveries	No. delivered/ produced	Comments
Canada							
R: UAE	10	DHC-6 Twin Otter	Transport aircraft	2008	2013-2014	(6)	$65m deal; DHC-6-400 version; inc 4 Guardian-400 surveillance/MP version; bought and owned by UAE company incl for use by UAE government
	2	Global Express	Transport aircraft			(2012)	For modification to SIGINT aircraft
	(4)	PT6	Turboprop			2012	For 2 P-180MPA MP aircraft from Italy
	(24)	PT6	Turboprop			2014	For 24 Archangel-BPA combat aircraft from USA
Denmark							
R: UAE	6	SCANTER-2001	Sea search radar	2004	2011-2014	4	For 6 Baynunah corvettes from France
Finland							

R: UAE	6	NEMO 120mm	Mortar turret	2009	2013-2014	(6)	For modification of 6 Ghannatha transport craft to fire support craft
France							
L: UAE	4	Baynunah	Corvette	2003	2011-2014	4	$500-545 m 'Project Baynunah' (incl $205 m for French shipyard); 3 assembled in UAE
		2	Baynunah	Corvette	2005		AED1 b ($272 m) deal; part of 'Project Baynunah'
R: UAE	150	MM-40-3 Exocet	Anti-ship MI/SSM	2006	2010-2014	(91)	Part of EUR400 m deal; for Baynunah corvettes and probably for Abu Dhabi frigate and Falaj-2 covettes
		17	Ground Master-200	Air search radar		2013	$396 m deal
		2	Helios-2	Recce satellite		(2013)	EUR700 m deal; Pleiades version
Germany (FRG)							
R: UAE	(24)	MTU-595	Diesel engine	(2003)	2011-2014	16	For 6 Baynunah corvettes from France
	(24)	MTU-2000	Diesel engine			2009	2013-2014 (24) For 12 Ghannatha FAC from Sweden
		2	Rmah	Support ship		2011	2014 2 Possibly incl for minelaying
Italy							
R: UAE	6	Super Rapid 76mm	Naval gun	(2003)	2012-2014	4	For 6 Baynunah corvettes from France
	6	Orion RTN-25X	Fire control radar			2004	2011-2014 4 For 6 Baynunah corvettes from France
	(100)	Marte-2	Anti-ship missile			2009	2013-2014 (100) Marte-2/N version; for 12 Ghannatha FAC
	2	P-180MPA	MP aircraft			2012	Avanti-2 version; for modification to MP aircraft in UAE (with systems from Sweden and USA)
Netherlands							
L: UAE	2	FOPV-850	Corvette	2014			AED1 b ($272 m) deal; for coast guard; with hulls from Romanian production line fitted out in Abu Dhabi
Singapore							
R: UAE	(72)	SRAMS 120mm	Mortar	2011	2013-2014	(32)	Part of AED786 m ($214 m) deal; for use on Agrab-2 (RG-31) mortar carrier from South Africa
South Africa							
L: UAE	..	Al-Tariq	ASM	2013			AED1.8 b ($500 m) deal; incl for Mirage-2000-9 combat aircraft
R: UAE	72	RG-31 Nyala	APC	2011	2013-2014	(38)	Part of AED786 m ($214 m) deal; mortar carrier version (with 120mm mortar from Singapore); UAE designation Agrab-2
	(30)	Mamba	APC	2013	2013-2014	(30)	Reva version
Sweden							
L: UAE	12	Ghannatha	FAC	2009	2013-2014	(12)	Part of AED930 m ($252 m) deal; incl 9 produced in UAE; UAE designation Al Bazam
R: UAE	6	Giraffe AMB	Air search radar	2004	2011-2014	4	For 6 Baynunah corvettes from France
Turkey							
R: UAE	10000	CIRIT	ASM	(2013)	2013-2014	(3500)	AED720m ($196 m) deal
United States							
R: UAE	(237)	RIM-162 ESSM	SAM	2006	2011-2014	(125)	Possibly $245 m deal; for Baynunah corvettes
	(200)	RIM-116A RAM	SAM	2007	2011-2014	(150)	For Baynunah corvettes; RIM-116B version
	(216)	MIM-104C PAC-2	SAM	2008	2012-2014	(216)	Patriot GEM-T version
	(292)	MIM-104F PAC-3	ABM	(2008)	2012-2014	(292)	
	(9)	Patriot PAC-3	SAM/ABM system			2008	2012-2014 (9)
	224	AIM-120C AMRAAM	BVRAAM			2009	2013-2014 (224) Part of $326 m deal; AIM-120C-7 version
	24	AT-802U	Ground attack ac			2010	2010-2014 24
	(12)	CH-47F Chinook	Helicopter			2011	2012-2014 (10) Delivery probably 2012-2015
	2	THAAD	ABM system			2011	$2.5 b deal; delivery possibly by 2016 or 2018
	2	RDR-1700	MP aircraft radar			2012	RDR-1700G(v)2 version for 2 P-180MPA MP aircraft from Italy

Appendix F – References for Unit Cost and Production Quantities of Weapon Systems

1. F-35 Lightning II fighter aircraft – (Lockheed Martin Corporation, 2016)
2. Apache (AH-64E) REMANF. helicopter – (Department of Defense , 2014)
3. Blackhawk (UH-60M) helicopter – (Department of Defense, 2014)
4. CH-47D helicopter – (Department of Defense, 2014)
5. C130J cargo plane – (AeroWeb , 2015)
6. AIM AMRAAM missile – (AeroWeb, 2015)
7. AIM Sidewinder missile – (AeroWeb, 2015)

Appendix G – Cost Reductions/Savings Due to Economies of Scale

A firm in the long run may be inclined to change its input proportions such as labor and capital to affect the level of output the market demands. Then it is possible that a firm may experience *economies of scale* when it can double its output for less than twice the input costs. In contrast, when a firm become too large, there could be *diseconomies of scale*, when doubling the output costs more than twice the input costs. In general, a U-shaped curve (see Figure 1) represents a firm's long run average costs characteristics, where the firm experiences "economies of scale for relatively low output levels and diseconomies of scale for higher levels" (Pindyck & Rubinfeld, 2001, p. 227).

Economies of scale generally are realized when a firm's fixed costs are spread over more number of production units or when input quantity discounts are given for raw materials when order quantity volumes increase. And, as the firm becomes larger, variable and other costs increase adversely affecting the firm's efficiencies and as a result, long-run average costs (LRAC) increase leading to *diseconomies of scale*. Minimum efficient scale (MES) is a firm's production capacity where LRAC is minimum.

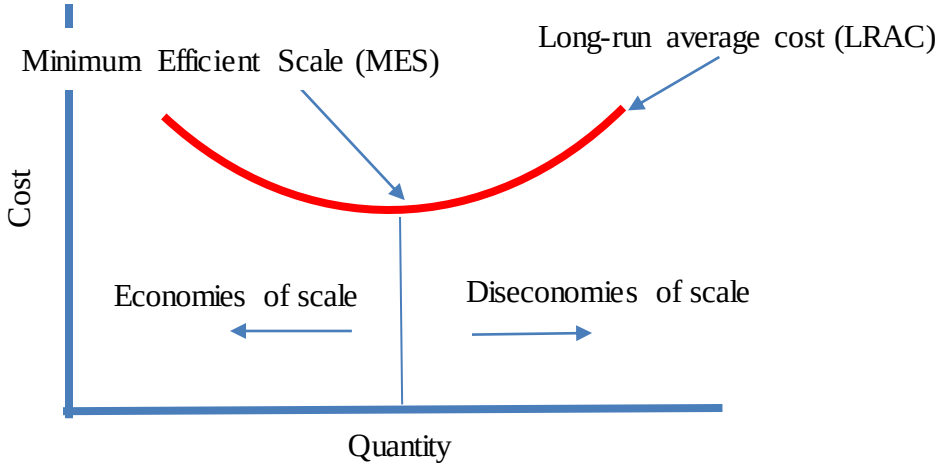

Figure G1 Economies, diseconomies of scale & minimum efficient scale

Appendix H – Cost Reductions/Savings Due to Learning Curve

Assessing the cost of a manufactured product depends on many components such as fixed costs, variable costs and other factors such as quantities produced – cost is affected by the number of units produced and the effect is termed *learning curve* or *cost improvement curve* or *experience curve*, developed in the 1930s and is still widely used in both private and government industrial settings (Malashevitz, Williams, & Kankey). Malashevitz et al explain that "the general theory is that people and organizations learn to do things better and more efficiently when performing repetitive tasks, and that under certain conditions there is a usable patter to learning" (Malashevitz, Williams, & Kankey). For more detailed discussion study the reference listed.

To quantify the cost reductions due to the increasing production quantities, the *learning curve* advantages, can be determined by two commonly used formulations – *unit formulation* and cumulative average formulation. Only the *unit formulation* method is discussed here and applied in the study.

As an illustration, Table H1 contains production data for a manufactured product in terms of number of units and hours required to produce each unit. And, Table H2 the logarithmic (LOG, Base 10) values of the same data is represented to calculate the *learning curve slope coefficient*. They are shown graphically in Figure H1 and Figure H2. The *slope coefficient* is calculated and is shown in Figure 2 as negative 0.5146. The line shown in Figure 2 can be characterized as having a constant slope, usually denoted as change in Y given a change in X. However in logarithmic space, the *slope* is defined as percent change in Y given a constant percent change in X. The *unit formulation* is explained as "as the total quantity of units doubles, the cost decreases by a constant percent" (Malashevitz, Williams, & Kankey, p. 3). Now, the

learning curve slope (not the learning curve slope coefficient as calculated above) of the data, is simply obtained by the ratio of hours required to produce 2X units divided by hour required to produce X units. In the sample data in Table 1, let Y2 = 700 (hours required to produce double the units, i.e. 2 units) and Y1 = 1000 (hours required to produce 1 unit). The ratio Y2/Y1 = 700/1000 = 0.70, which is the *learning curve slope*.

Equation 1:

$$\mathbf{Y = AX^b}$$

The above shown equation is used to determine the number of hours required to produce the $\mathbf{N^{th}}$ unit, where **Y** = the cost (or average cost) at unit **X**; **A** = the first unit cost (which is 1000 hours); X = unit number; **b** = slope coefficient = **Log (*learning curve slope*)/Log (2)** = **Log (0.70)/Log2) = -0.5146**. For example, if one wished to find out how much it costs (# of hours) for the 50^{th} unit, then the calculation is as follows:

Given values are: A = 1000; X = 50; b = -0.5146;

$Y_{50} = AX^b = 1000 * 50^{(-0.5146)} =$ **133.5 hours**

Table H1 Production data of number of units produced and labor hours per unit

Units	1	2	3	4	5	6	7	8	9	10
Hours	**1000**	**700**	568.2	**490**	436.8	397.7	367.4	**343**	322.8	305.8

Table H2 Production data of number of units produced and labor hours per unit LOG (base 10)

Units (LOG, base10)	0	0.30103	0.477121	0.60206	0.69897	0.778151	0.845098	0.90309	0.954243	1
Hours (LOG, base10)	3	2.845098	2.754501	2.690196	2.640283	2.599556	2.565139	2.535294	2.508934	2.485437

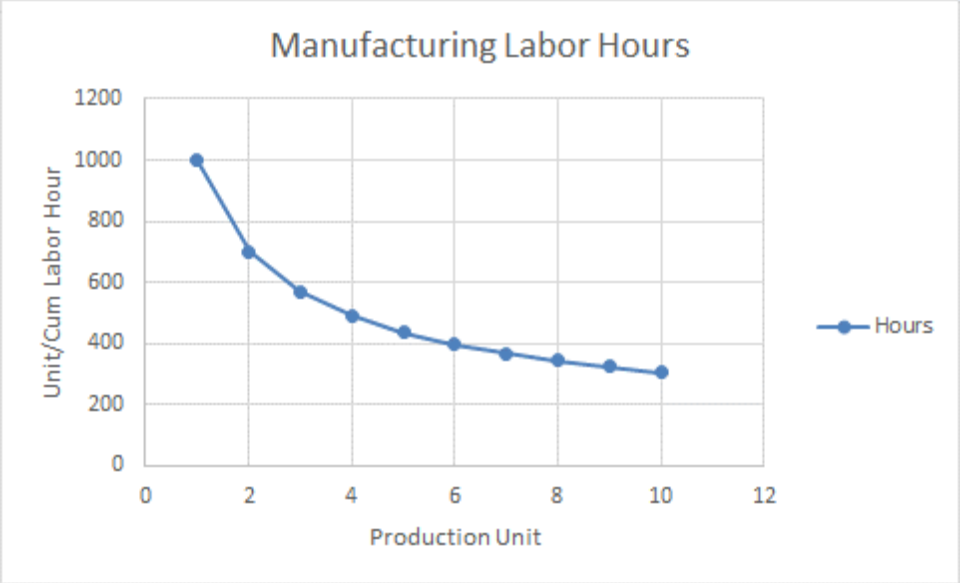

Figure H1 Learning curve based on production data of labor hours and units produced

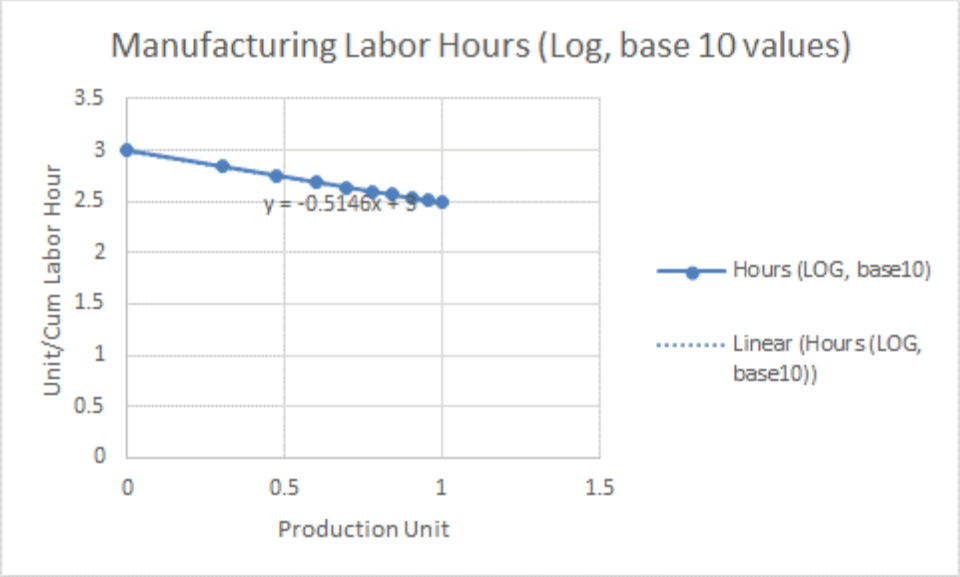

Figure H2 Learning curve based on production data of labor hours and units produced (LOG, base 10 values)

Also, if it is desired to calculate the number of hours required (or costs) to build units 16 through 50 for example, the following formula can be used (Malashevitz, Williams, & Kankey):

Equation 2:

$$TC_{F,L} = \left\{ \frac{(L+0.5)^{b+1} - (F-0.5)^{b+1}}{b+1} \right\} * T_1$$

Where,

F = unit that comes first = 16 (in the example),
L = unit that comes later = 50 (in the example),
b = coefficient of slope
T_1 = Hours (or cost) of 1st unit produced

Author Biography

Sudhakar Arepally served as Associate Director for Systems Engineering, Analytics, U.S. Army, TARDEC, with the responsibilities in leadership, managerial and administrative functions. Specifically, Mr. Arepally was responsible for planning, directing, reviewing and coordinating efforts of personnel engaged in research, development and engineering in the field of computational modeling and simulation. His staff comprised subject matter experts in the following functional disciplines: energetic effects and crew safety, vehicle dynamics and durability, power-train, thermal & signatures, and data analysis and optimization. Having recognized the importance of collaborations, he initiated numerous efforts with other Department of Defense agencies and directorates, industry, academia and international partners. Prior to joining U.S. Army, TARDEC, Sudhakar worked in the private sector at TRW Automotive and General Motors. Given the extensive automotive industry experience, Sudhakar applied product design and development best practices to military ground systems.

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- 2015-Present: Defense Acquisition University Senior Service College Fellowship, Warren, MI
- 2012-2015: Associate Director, U.S. Army, TARDEC Systems Engineering, Analytics
- 2009-2012: Deputy Associate Director, U.S. Army, TARDEC, CASSI-Analytics
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- 2005-2006: Technical consultant, Global Technology Associates
- 2002-2005: Program Manager, TRW Automotive Systems
- 1999-2002: Senior Project Engineer, TRW Automotive Systems
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- Master of Business Administration, University of Michigan, Ann Arbor, MI, 2005
- Masters in Engineering, Industrial Engineering, Tennessee Technological University, 1987
- Bachelors in Engineering, Mechanical (Production) Engineering, Andhra University, 1985

CERTIFICATIONS:

- Defense Acquisition Courses - Level III SPRDE-PSE Certified with Army Corps membership

AWARDS AND HONORS:

- Best paper award, "Ground Vehicle Safety Optimization considering Blast-worthiness and the Risks of High Weight and Fuel Consumption", GVSETS 2011.

- Awarded 2009 Army Modeling and Simulation Team Award.
- Received 2009 Federal Government Award for Exemplary Service.
- Recipient of General Motors Corporation President's Council Award in 1998 for contribution to the development of Next Generation Reduced-Power Air bag Systems.