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An Analysis of Defense Information and Information Technology Articles: A Sixteen Year Perspective

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AN ANALYSIS OF DEFENSE INFORMATION AND INFORMATION TECHNOLOGY ARTICLES: A SIXTEEN YEAR PERSPECTIVE

THESIS

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Abstract

Over the past two decades, information and information technology (IT) have evolved significantly and have become increasingly important to our national security. Many different journals have described this evolution. The purpose of this study is to examine the evolution of information and IT through the articles of two defense journals over a sixteen-year period. It provides a review of the article subject matter, the changes in the subject matter, the contributing authors and their institutions, and predictions for the next five years.

To my patient and understanding family. Thank you for all your support.

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Daniel K. Smith

Table of Contents

Page

Page

List of Figures

Page

List of Tables

Page

AN ANALYSIS OF DEFENSE INFORMATION AND INFORMATION TECHNOLOGY ARTICLES: A SIXTEEN YEAR PERSPECTIVE

Chapter 1. Introduction

Background

Over the past two decades, information and information technology (IT) have become increasingly important to the United States Air Force and the Department of Defense (DoD). Information is a strategic asset and is crucial to national security. Leadership depends on information and information systems to support integrated operations (Department of Defense, 2006). The information technologies and their employment have changed significantly. As computers and other IT have become less expensive and more powerful, the value of technology has become less about computational ability and more about the ability of military leaders to develop new processes, procedures, and structures to exploit these new technologies (Brynjolfsson & Hitt). The rapid evolution of technology and its potential vulnerabilities has transformed the ways that wars are conducted and the means by which adversaries attempt to harm the US.

The advancement of information and IT within DoD has been documented by various defense journals. One of the most highly regarded repositories of current defense literature is the Air and Space Power Journal (ASPJ). In its initial issue in 1987, the Air Force Chief of Staff introduced the journal as forum for "thinking, discussing, and writing about [the Air Force] profession" in order to "enhance our perspective and

increase the range of solutions to [the] challenges we face" (Welch, 1987). Since then, the ASPJ has become the leading professional publication of the U.S. Air Force.

From a Joint perspective, the Joint Forces Quarterly (JFQ) Journal is the premier publication in support of Joint Operations across DoD. The journal is published for the Chairman, Joint Chiefs of Staff to "promote understanding of the integrated employment of land, sea, air, space, and special operations forces" (*Joint Forces Quarterly,* 2008).

The ASPJ and JFQ provide key topics relevant to the goings-on in the Air Force and Joint communities respectively. A review of the ASPJ and JFQ may offer a valid assessment of topics that are of considerable importance to the Air Force and DoD.

The purpose of this research is to examine the importance of information and IT in the Air Force and DoD and how it has changed over the past sixteen years. The research assesses this progression through a review of the articles over a sixteen year period from the ASPJ and the JFQ from 1993 to 2008. The study seeks to understand what information and IT areas have been explored, which topics have been most frequently discussed within the Air Force and DoD, and how these elements have changed since the early 1990s. Trends and patterns will be identified and conclusions will be drawn regarding this evolution.

Within the past two decades, the Air Force and DoD have realized the importance of information, IT, and information operations in defending national security and protecting its military infrastructure. In 2005, the Air Force modified its mission statement to add "cyberspace" to the list of domains within its area of responsibility. The Air Force "flies and fights in air and space, but now it also flies and fights in *cyberspace*" (Umphress, 2007). Before analyzing where we are today with regard to IT, it is

imperative to understand how IT has evolved since its inception in the 1950s, and how it has impacted the DoD.

A Brief History of Information Systems and Information Technology

DoD defines information as "Facts, data, or instructions in any medium or form." It defines Information System as "the entire infrastructure, organization, personnel, and components for the collection, processing, storage, transmission, display, dissemination, and disposition of information" (*Department of Defense Dictionary of Military and Associated Terms,* 2008).

Extraordinary progress has been made since information systems were first used to automate clerical functions in organizations of the 1950s and 60s. The utilization of information technologies has grown steadily since then. The changes in organizations' views of IT and the shift in focus of attention have evolved as technologies have rapidly advanced. Other factors have contributed to changing perspectives on information technologies. As more information has become available through computers and the Internet, the level of awareness of information technologies has grown. Also, economic factors such as increasing labor costs and the significant price reduction of technologies have offered significant advantages to using information systems (Somogyi & Galliers, 1987).

IT from the 1950s through the 1970s

In the 1950s, most computers were extraordinarily large calculators. They were used only by scientists and military and government agencies and there was little or no commercial application of computers (Somogyi & Galliers, 1987).

Computers became more common in the 1960s. Improvements in software and hardware yielded more efficient and reliable systems; this made computers' presence more widespread. By the late 1960s, most large companies were utilizing mainframe computers to perform some business functions. During this era, there was a common idea that "large was beautiful" (Somogyi & Galliers, 1987) and often an organization's status and power was determined based on the size and quantity of their large mainframe computers.

In the 1970s, a new interest was exposed in the methods used to program computers. One of the new areas of emphasis in computers was the use of modularity and structure in software programming. Structured methods transpired and replaced traditional development methods. Software project teams also became more structured in order to attack the development of complex systems (Somogyi & Galliers, 1987).

IT in the 1980s and 1990s

The 1980s brought a series of monumental changes to the field of IT. In 1981, IBM introduced its personal computer (PC) which included 16-bit operating system, MS-DOS 1.0. The Apple and IBM PCs became increasingly important throughout the decade and DoD began introducing more and more PCs into its operations. Throughout the decade, US weapon systems became increasingly more complex as more and more sophisticated information technologies were developed and implemented into such weapons. By the mid-1980s, experts realized that rapid advances in information, weapons, and guidance technologies would transform warfare. This prediction was confirmed by the US victory in the Persian Gulf War (Pounder, 2000). In 1989, Microsoft introduced its first version of the Office suite of workplace applications. This

suite would eventually become the most commonly used applications in the world and within DoD (*Fun Facts about Microsoft*, 2009).

In the 1990s, the PC gained even more popularity, and Microsoft launched a series of Windows editions that became the standard on PCs around the world. In addition, by the mid 1990s, electronic mail (email) became commonplace as more and more organizations, including DoD, installed email servers throughout their organizations to increase communication and efficiencies amongst its workers (*Fun Facts about Microsoft*, 2009).

Also during the decade of the 1990s, mainframe computers migrated to networked computers which provided connections among federal entities and the general public. Web sites became ubiquitous and provided the means to present information to federal employees and the public. This networked environment also opened up new vulnerabilities to federal databases as hackers found ways to access sensitive data. At first, agencies did not include plans to secure data or implement applications to monitor intrusions or detect whether employees were accessing forbidden information (Hasson, 2008). Since then, computer security has become an increasingly important factor in implementing and maintaining successful IT.

Also during the early 1990s, the DoD recognized the capabilities and threats that IT offered the US and its adversaries. The terms "Electronic Warfare" (EW), "Information Warfare" (IW), and "Information Operations" (IO) became increasingly widespread across DoD. In 1998, six months before the kickoff of Operation Allied Force, the DoD published its first doctrine on information operations. Joint Publication 3-13, *Joint Doctrine for Information Operations*, described DoD's theories, capabilities,

and principles of utilizing information operations (Pounder, 2000). Also in 1998, the Air Force published the first version of Air Force Doctrine Document (AFDD) 2-5, *Information Operations*. This document describes the Air Force's perspective on such concepts as information superiority, information warfare, and information-in-warfare (Department of the Air Force, 1998). The Air Force modified this document somewhat in 2005 and removed many instances of the term "Information Warfare" and increased its usage of the concept Network Warfare Operations (Department of the Air Force, 2005).

IT in the 2000s

There were considerable increases in commercial usage of IT between the 1990s and 2000s. For example, there have substantial innovations in the business application and consumer use of electronic data storage products (Boggs, Laske, & Sarnecky, 2006). In 1993, data servers were not common in most American businesses. By 2003, however, they were ubiquitous in most large organizations and were critical components to keeping businesses in operation (Carr, 2003). Similar to the private sector, DoD has vastly increased its utilization of information technology hardware and software systems in the 2000s.

Since the 1980s, DoD has transitioned from an era where information technology was seen as a tactical asset to where it is becoming a key strategic asset and is often exploited at all levels of an organization. Systems are becoming the nerve centers of organizations and competitive weapons for organization leadership (Somogyi & Galliers, 1987). As technology becomes more integrated into operations, more and more issues arise with regard to effectively using IT and the potential risks it poses to national security.

Over its 60 year history, IT has seen remarkable changes and has undoubtedly embedded itself in the threads of society. Hundreds or thousands of publications have addressed a myriad of topics regarding IT. These publications have included newspapers, magazines, trade publications, and journals. The DoD has been a major contributor to information technology publications throughout history.

Using Journals as Data Source

In the past sixteen years, DoD journals have addressed hundreds of issues with regard to information, information technology, and their employment in military operations. This research will analyze a period of sixteen years, from 1993 to 2008, and investigate what information and IT subjects have been discussed and analyze the level of emphasis that has been placed on specific information and IT topics.

The Utility of Academic-Professional Journals

Professional journals provide many benefits to the target audience. They inform the audience on issues of concern. Readers exercise a "multiplier effect" by spreading acquired ideas to co-workers and add new ideas to the knowledge they have learned from journal articles. The feedback spawns debate and helps to stimulate further research and dialogue on military and technical topics. Journals provide a means for the audience to stay up-to-date on current goings-on in a field, without the need to travel to, for example, an information conference or education programs. With the limited funding available for in-resident professional military education, military journals provide military members a means to stay well-informed of technical advances or leadership and strategy perspectives (da Rocha, 2007)without leaving their home location.

Selecting the Journals

In order to investigate the role of information and IT over the past two decades, the researchers examined various military journals to determine which would provide an all-encompassing depiction of what's being written, read, and talked about within DoD. The researchers determined that the optimal journals for this study would provide a cross-section of current, important military issues and would examine a wide variety of subjects from a high level perspective. They conducted an analysis of DoD publications to determine which were best suited for representing the most frequently discussed subject matters in the Air Force and DoD.

The Air and Space Power Journal (ASPJ)

The Air and Space Power Journal is the professional journal of the U.S. Air Force. Published quarterly by the Air Force's Air University, the journal is intended to provide an "open forum for the presentation and stimulation of innovation thinking on military doctrine, strategy, force structure, readiness, and other matters of national defense" (2008).

The Air Power Journal was first published in 1987 and was the successor to the *Air University Quarterly Review* (AUQR). The AUQR entered publication in 1947 when the Air Force became a separate force from the U.S. Army. The AUQR and was intended to "stimulate reading, writing, and reflection on the part of Air Force members" (Welch, 1987). The Air Power Journal replaced the AUQR and brought a new format and revised focus in order to new and emerging challenges facing the Air Force of the

late 20th century (Welch, 1987). The journal has changed names a handful of times since then and is currently titled the "Air and Space Power Journal."

Joint Forces Quarterly (JFQ)

Joint Forces Quarterly is the professional journal of US Joint Forces. "Joint Force Quarterly is published for the Chairman, Joint Chiefs of Staff, by the Institute for National Strategic Studies, National Defense University, to promote understanding of the integrated employment of land, sea, air, space, and special operations forces. The journal focuses on joint doctrine, integrated operations, coalition warfare, contingency planning, military operations conducted across the spectrum of conflict, and joint force development" (*Joint Forces Quarterly*, 2008).

JFQ is intended to provide relevant information and goings-on of joint integrated operations for US armed forces, allied forces, and other partners. It also includes national security policies and strategies; efforts to counter terrorism; homeland security; and news on training and joint professional military education (*Military Strategy Journals*, 2009).

The initial issue of JFQ was published in the summer of 1993. In that issue, the Chairman of the Joint Chiefs of Staff, General Colin Powell, described the intent of JFQ: "Its purpose is to spread the word about our team, to provide for a free give-and-take of ideas among a wide range of people from every corner of the military. We want the pages of *JFQ* to be filled with the latest word on joint issues—from warfighting to education, from training to logistics. We want the discussion of these joint issues to get a thorough airing, to stir debate and counter-argument, to stimulate the thinking of

American men and women serving on land, at sea, and in the air. We want *JFQ* to be the voice of the joint warfighter" (Powell, 1993).

Journal Material as a Measure of What is Important

Journals play critical roles to the fields they support by (a) providing a repository of significant intellectual subjects and (b) supplying a communication means for subject matter experts and stakeholders who have interests in those subjects (Koh, 2003). By presenting existing literature on specific topics, journals provide a forum for information exchange within a discipline. By evaluating existing journals, researchers can appraise the intellectual health of a given discipline (Das & Handfield, 1997). In this study, researchers are assessing the presence and amount of information and IT related subject matter. Based on the amount of relevant subject matter, the researchers are assessing the health or importance of the specific subject matter. When there are more instances of a specific subject matter, the researchers assume that subject matter is of higher importance to DoD.

The Research Problem

Technology is an essential component of the Air Force and Department of Defense (DoD) in the Information Age. As our reliance on information and information technologies increases, it is imperative that we supply relevant critical systems to the warfighter in a timely fashion (Jasper, 2004). We must also take appropriate measures to protect ourselves from adversaries trying to exploit technologies and cause harm to US defense assets (An Interview with General Lance L. Smith, 2007). DoD's use and emphasis of information and IT has changed considerably over the past two decades.

The researchers of this study could find nothing written that examined DoD information and IT issues and their evolution over recent years. The authors identified two highly respected DoD journals that examine a variety of issues facing DoD and its partners. This study seeks to systematically examine the contributions of ASPJ and JFQ in order to understand the changes in DoD's information and IT issues over a 16 year period.

Research Questions

Three main research questions and several secondary questions have been developed to guide this study.

1. What has been the role of information and information technology (IT) in DoD over the past 16 years?
    a. What information and IT subject matter have been addressed by DoD over the past 16 years?
    b. What have been the most frequently discussed subject matters?
    c. How has DoD information and IT subject matter changed?

2. Who is discussing information and IT in DoD?
    a. What is the background of those discussing information and IT related issues?
    b. How has this changed over the past 16 years?

3. What do the trends and patterns indicate about what information and IT elements will be important to DoD in the future?

Chapter 2. Methodology

Chapter Overview

This chapter presents an overview of the methodology employed for this study to answer the research questions discussed in Chapter 1. The chapter will describe the design of the research study, cite similar existing research, describe the research approach, identify factors with the potential to affect the data, investigate the content analysis methodology, explain the process for data collection and analysis, identify the categories utilized, and discuss limitations of the study.

In order to select a methodology, a research strategy was developed. Research is "a systematic process of collecting, analyzing, and interpreting information in order to increase our understanding of the phenomenon about which we are interested or concerned" (Leedy & Ormrod, 2005). Dane describes research as "a critical process for asking and attempting to answer questions about the world" (Dane, 1990).

Research can be performed in a quantitative, qualitative, or combined approach. The differences between quantitative and qualitative methods were considered in developing a research strategy for this study.

Quantitative vs. Qualitative Research

Quantitative research utilizes standardized methods so different perspectives can be distributed to fit a limited number of established response categories (Patton, 2002). Quantitative research is often used to answer questions about relationships among variables and is intended to explain, predict, and control phenomenon. In quantitative

studies, data is often numerical and is gathered using standardized instruments (Leedy & Ormrod, 2005).

Qualitative research is used to study subjects in depth and in detail. It does not constrain the researcher to predetermined categories of analysis and allows a more open and detailed research inquiry (Patton, 2002). "A qualitative study is one designed to process an understanding of a problem, based on building a complex picture, formed with words, and reporting detailed views of informants" (Creswell, 2003). In qualitative studies, data is often textual and is gathered using loosely structured or nonstandardized observations or interviews (Leedy & Ormrod, 2005).

The utilization of qualitative methods has increased in recent years. However, resistance to such studies continues, as some researchers term such studies as "unscientific," "only exploratory," or "subjective" (Denzin & Lincoln, 2000).

Existing Research

This research is based on content analysis methodologies utilized by Carter and Ellram (2003). In 2003, Carter and Ellram conducted an in-depth content analysis of article subject matter and research methodologies employed for a 35-year period of the Journal of Supply Chain Management. The authors then analyzed the backgrounds of the contributing authors and their academic affiliations. Finally, Carter and Ellram argued their findings and provided advice on future research (Carter & Ellram, 2003).

In 1997, Das and Handfield conducted a similar study. They analyzed research in the field of purchasing over a ten year period from 1987 to 1997. They recognized significant areas of study, shifts in subject matter emphasis, identified varying

methodologies and theories employed, and discussed gaps in research areas (Das & Handfield, 1997).

Other researchers have utilized the literature review concept to identify specific issues, trends, and patterns. In analyzing a specific journal, such a review can identify areas where a plethora of knowledge and research exist. It can reveal areas where research is lacking (Webster & Watson, 2002).

Research Overview

This research utilizes a qualitative methodology. As discussed in Chapter 1, the purpose of the study is to examine the importance of information and IT in the DoD and the Air Force and determine how it has evolved over the past sixteen years. The research assesses the progression through a review of the articles from the Air and Space Power Journal (ASPJ) and Joint Forces Quarterly (JFQ) from 1993 through 2008. It seeks to understand what information and IT areas have been explored and how these elements have changed since the early 1990s. Trends and patterns will be identified and conclusions will be drawn from the data.

Various research approaches were considered in order to answer the research questions. After an examination of the possible methodologies, the content analysis method was selected as the most appropriate research approach.

Content Analysis Approach

Content analysis is a subset of archival analysis. Archival analysis is "any research in which a public record is the unit of analyses" (Dane, 1990). One of the main factors that distinguish archival research from other research methods is that it involves

data and information generated before the research initiated, and archival researchers involves dealing "with people's products rather than with people themselves" (Dane, 1990).

The content analysis methodology is an organized and systematic examination of the contents of specific material in order to identify patterns, trends, or themes within the material (Leedy & Ormrod, 2005). Patterns and themes are similar but there is a distinction between these two concepts. Patton refers to a pattern as a "descriptive finding." In one study, researchers in a study of people rappelling in the mountains noted a pattern that "all participants reported feeling fear when rappelling down a cliff." A theme is a more generalized means to categorize. In this example, "fear" would be the theme identified (Patton, 2002). This research identifies themes within the collected data.

Advantages and Limitations of Methodology

Content analysis is a practical approach for many types of research problems. As discussed above, Content Analysis is a research technique that involves specific procedures. It provides new insight and increases the researcher's understanding of a particular event or series of events (Krippendorff, 2004). Also, it provides an effective means of studying a topic from a high level (Neuman, 2006).

Advantages of Content Analysis:

One key advantage of the content analysis is the methods are unobtrusive to the data or personnel being studied (Trochim & Donelly, 2007). The researcher does not manipulate or infringe upon the data. Instead, he focuses on interpreting the meaning of the content of the material (Neuman, 2006).

Another advantage is it can be a very effective and relatively rapid method for analyzing large amounts of data or textual material (Neuman, 2006). This is particularly true when automated methods, such as content analysis software, are used to analyze the data (Trochim & Donelly, 2007).

Still another advantage of this methodology is it provides the researcher the convenience of accessing the data. Since it does not require meeting with interviewees and other participants, the researcher can conduct the research at a time convenient to him or her (Creswell, 2003).

A final advantage is that content analysis can expose messages in text that are not as easily interpreted through normal observation. Authors or readers of text may not ordinarily be aware of the "themes, biases, or characteristics" of the material being analyzed (Neuman, 2006). The content analysis can add a new perspective to the material that may provide benefit to the authors, readers, and the researchers.

Limitations of Content Analysis:

There are some disadvantages of the Content Analysis methodology. First, there may be information that is protected and thus unavailable to public or private access (Creswell, 2003). For example, if there are classified documents or documents that are not releasable to the general population, the researcher may not have access to them. The methodology may require the researcher to search out data and information in hard-to-find places (Creswell, 2003). Neither of these limitations were an issue in this study, as the research involved two unclassified journals which are easily accessible via the Internet.

The content analysis method involves a researcher who filters the data through a "personal lens that is situated in a specific sociopolitical and historical moment" (Creswell, 2003). Thus, it may be difficult for a researcher to escape personal bias and interpretation. However, the use of multiple researchers can help minimize bias and ensure that data is coded consistently. In order to ensure consistency and minimize bias, this research involved two researchers.

The research undertaken in this study utilized the Content Analysis methodology to classify textual material, translating it to more relevant data. The central idea in a Content Analysis is that the many words of text are classified into much fewer content categories. Each category may contain one or more words. Words or phrases of text that are classified in the same category are presumed to have similar meaning. In order for inferences to be valid, it is very important that the classification procedures be consistent (Weber, 1990).

Open Coding

Ideas and themes are categorized using a coding system, which is a "set of instructions or rules on how to systematically observe and record content from text" (Neuman, 2006). Dane describes coding as "attaching some sort of meaning to observations." There are two main levels of content when conducting a content analysis: manifest content and latent content. Manifest content is coded in terms of words or letters in the documents analyzed. Latent content utilizes "underlying or hidden meaning" in the documents being analyzed (Dane, 1990). Since articles discussing

information technology generally utilize consistent terminology and rarely have "hidden meanings" within them, this research will utilize manifest content.

Open coding refers to the process of reviewing raw data in detail and developing categories of which to assign data segments. The term "open" is used since the process involves finding new categories of data (Trochim & Donelly, 2007).

Conducting a Content Analysis

Leedy and Ormrod describe four steps for conducting a content analysis.

Step 1: Identify the specific body of material to be examined. If the amount of material is relatively small, the entire body of material is studied. If it is large, such as all journal articles written during a specific period of time, a sample is utilized (Leedy & Ormrod, 2005). In this study, the body of material is a considerable size – all the articles within 16 years of the ASPJ and JFQ. A sample of articles could have been utilized in this study, but the researchers opted to examine the journals in their entirety. Further discussion on the data utilized is provided in the "Data Collection" section in Chapter 3.

Step 2: Define the characteristics or qualities to be analyzed. This involves using precise terminology. The researchers identify categories and define what is included in each category. Specific examples may be identified for each category (Leedy & Ormrod, 2005). It is important to develop a manageable classification system. Without such a system, chaos and confusion will likely ensue (Patton, 2002).

Before beginning the analysis of the two journals, the researchers developed a set of preliminary subject matter categories of which to classify the articles. The researchers

adjusted these tentative categories and added, modified, and deleted categories as the research progressed. These categories are described later in this chapter.

Step 3: If the research utilizes complex or extensive material (such as literature works), each item is broken down into smaller, manageable portions that are separately examined (Leedy & Ormrod, 2005). The unit of analysis may be a word, a phrase, a theme, an article, a character, and so on (Neuman, 2006). The two journals (ASPJ and JFQ) are the materials that were examined in this study. Each journal is broken down into articles, which are the units of study. Articles range from one page short discussions to multiple page discussions and analyses. Each article was evaluated individually and served as a manageable segment. No further breakdown of the material was required.

Step 4: Analyze the material to determine instances of each category defined in step 2 (Leedy & Ormrod, 2005)**.** In content analysis, the typical means for quantifying variables is measuring the frequency a specific variable appears in the observations. One common problem with frequency measurement involves determining what to do with repetitions. There is no standard solution, as it depends on the hypothesis and other considerations (Dane, 1990).

An alternate quantification method is the intensity method. When units of analysis vary in intensity, the frequency method may be insufficient. Intensity involves using a rating scale. Oftentimes, the rating scale is from 1 to 10. When the information occurs more frequently, a higher rating is yielded (Dane, 1990).

The use of different quantifying methods can lead to different outcomes. This does not mean that one methodology is superior to others (Dane, 1990). In this study, the

researchers utilized the frequency method to determine the number of instances of specific information and IT related material. The number of occurrences was used in making a determination as to the theme(s) of the article's subject matter. The researchers then classified the article into one or more categories based on the article's theme(s).

When considerations are objective (such as finding specific words in text), only one rater is required. When considerations are less objective (such as evaluating an individual's behavior), multiple raters are often utilized (Leedy & Ormrod, 2005).

Multiple Coders

As described, the content analysis method is a systematic process. The inferences made must be objective. Thus, the inferences made by one researcher should be analogous to the inferences someone else would make with access to the same data. This objectivity can be achieved through careful development of operational definitions used in the research (Dane, 1990). Another means to ensuring objectivity in the content analysis methodology is to utilize multiple coders.

Multiple coders are used so the researcher can determine whether the constructs being investigated are common and whether multiple coders can consistently apply the same codes (Denzin & Lincoln, 2000). Different analysts should code the same text in a similar manner (Weber, 1990). Typically, researchers compute the percentage of agreement among coders for each variable or theme. Then, they utilize a correction formula to address the fact that some fraction of agreement will always occur by chance. The fraction depends on the number of coders and the precision of measurement for each

code. If two people code a theme as "present" or "absent," with other factors the same, they could agree on any answer 25% of the time by chance (.5 x .5 = .25).

In Carter and Ellram's study, two full-time researchers reviewed the text of every article in a thirty-five year history of the Supply Chain Management Journal. Due to time and resource constraints, this study was not able to utilize two full-time researchers. Thus, one researcher analyzed 100% of the journal articles, and another researcher analyzed 10% of the articles. The articles examined by the second researcher were randomly chosen. Krippendorf recommends an agreement level of at least .70 (Krippendorff, 2004). Some scholars use a cut-off rate of .80 (Denzin & Lincoln, 2000). In this research, comparisons were made to ensure that the level of agreement between the two researchers was at least .70, as recommended by Krippendorf.

Three Analysis Phases to the Research

The analysis in Step 4 was conducted using three distinct phases. Each phase examined a different aspect regarding the relevant articles, including the instances of specific subject matter (Phase 1), the quantity of relevant articles per journal issue (Phase 2), and the contributing author(s) (Phase 3).

Phase 1 of the Research involved the article's subject matter. This phase involved a researcher examining the content of all articles within the two journals for the sixteen year time period. This phase was conducted similar to the method of Carter and Ellram, where researchers examined the content of all Supply Chain Management Journal articles over a thirty-five year timeframe.

There were a total of 1,702 articles examined in this study. The journal articles were retrieved from the websites of the two journals; the journal names and web sites are listed in Table 1.

Table 1: Journals analyzed and their sources

Journal Name	Website
Air and Space Power Journal	http://www.airpower.maxwell.af.mil/airchronicles/BackIssues.html
Joint Forces Quarterly	http://www.ndu.edu/inss/Press/NDUPress_JFQ_List.htm

Each article was carefully evaluated to determine if it had an information or IT-related subject matter. The evaluation involved the researchers reading the article title, abstract, conclusions, and subject headings. Then, a word search was conducted of 12 terms. If a specific information or IT topic was mentioned, the article was read in detail. Based on this analysis, the researchers determined whether the article was relevant. Of those articles that were relevant, each was analyzed to identify topic(s) of which the article could be categorized. Articles were classified within the most appropriate categories. Researchers paid particular attention to those categories that contained few or many articles (Carter & Ellram, 2003). As research progressed, those categories with many articles were re-examined to determine if new categories could be developed; those categories with very few articles were re-examined to see if some categories could be combined together.

Generally, each article was grouped into one category, but some articles were relevant to two or more categories and were classified accordingly. Through the data collection, as articles were read, a summary was annotated for each article. Summaries

and notes were created to assist researchers for cases when the article needed to be re-examined or re-categorized (Leedy & Ormrod, 2005).

As discussed above in Step 2 (Leedy & Ormrod, 2005), preliminary categories were identified using AFDD 2-5. These categories established an initial framework for which to classify articles. As topics were identified that were not in the preliminary categories, new categories were added. Eventually, 63 categories were identified. The two researchers then conducted a second analysis to identify more comprehensive categories. Discussions ensued between the researchers that resulted in 19 categories. After further consideration, 7 final Overall Categories were established. Within the Overall Categories were Topics and Subtopics. Further details on categories are provided below and in Appendix 1.

The researchers considered using no initial categories and instead develop the categories as the researched progress. However, since the literature being reviewed was Air Force and DoD material, it is highly likely that the researchers would have concluded with a set of categories similar to those established at the beginning of the research.

Category Definitions

Throughout the past twenty years, there have been numerous issues and concepts within DoD relating to information, information technology, and information warfare. The terminology to describe these concepts has grown and evolved significantly and has introduced confusion. In fact, the explosion of information related issues has generated an entire new set of "jargon in an area that already has a tradition of dizzying jargon and 'acronymese'" (Buchan, 1996). Because many of the information-related terms are used

interchangeably, it is imperative to define the terminology used in this study so that those IT-related topics that are similar in meaning may be grouped together. The researchers in this study opted to utilize one master document in defining the subject matter terminology to be examined. The document utilized is Air Force Doctrine Document 2-5 (AFDD 2-5), *Information Operations*. Researchers also considered using Joint Publication 3-13 (JP 3-13), *Information Operations*. However, after thorough consideration of both publications, researchers chose AFDD 2-5 because they believed it took a broader perspective of information operations.

Using AFDD 2-5, the researchers developed the Overall Categories of which to classify data. Because not all information and IT related material could be classified within the concepts in AFDD 2-5, additional categories were defined. Appendix 1 provides an overview of the seven Overall Categories of Information and IT related material. Within each Overall Category were various numbers of Topics. Within each Topic were various numbers of Subtopics. These categories are further described and critical terminology is defined below.

Overall Category 1 (OC-1): Information Operations.

The first category was Information Operations (IO). There are multiple definitions of IO across DoD. The different military services describe the concept differently. In general, the Air Force and Navy consider IO with regard to networks and the Global Information Grid. The Army considers IO more with influence and psychological operations (Beebe, 2007). AFDD 2-5 describes Information Operations as a critical component to all Air Force operations and may "support, or be supported by, air and space operations" (Department of the Air Force, 2005). AFDD 2-5 describes three

IO capabilities—influence operations, electronic warfare operations, and network warfare operations. According to AFDD 2-5, "while separate and distinct, when linked, [these three IO capabilities] can achieve operationally important IO effects". The term "information operations" is applicable across the full spectrum of military operations from peace to war to reconstitution (Department of the Air Force, 2005).

Joint Publication 3-13 describes Information Operations in a slightly different approach. It describes IO as the "integrated employment" of *five* elements. These elements include electronic warfare (EW), computer network operations (CNO), psychological operations (PO), military deception (MD), and operations security (OS). These five elements, in addition to "specified supporting and related capabilities [are intended to] influence, disrupt, corrupt, or usurp adversarial human and automated decision making while protecting our own" (Department of Defense, 2006).

The main difference between the two publications is that the Air Force publication consolidates the Joint Publication's PO, MD, and OS into what the Air Force calls "influence operations" (Department of the Air Force, 2005). As discussed, for the purposes of this research, the Air Force definitions will be used. Under the OC-1, Information Operations, 9 subordinate Topics were established.

OC-1, Topic 1: Information Operations – Miscellaneous and Applications

Articles which discussed definitions of information operations and other high level aspects of information operations were included in this topic.

OC-1, Topic 2: ISR

ISR is the "integrated capabilities to task, collect, process, exploit, and disseminate accurate and timely intelligence information. It is a critical function that

helps provide the commander the situational and battlespace awareness necessary to successfully plan and conduct operations" (Department of the Air Force, 2005). Articles that discussed ISR related topics were included in this topic.

OC-1, Topic 3: Information Superiority

Information Superiority, defined as "the degree of dominance in the information domain which allows friendly forces the ability to collect, control, exploit, and defend information without effective opposition" (Department of the Air Force, 2005). Those articles that discussed the concept of information superiority were categorized in this topic.

OC-1, Topic 4: Influence Operations

Influence operations are utilized to affect the "perceptions and behaviors of leaders, groups, or entire populations" (Department of the Air Force, 2005). They are intended to achieve desired effects within the cognitive domain. Influence Operations include such capabilities as "psychological operations (PSYOP), military deception (MILDEC), operations security (OPSEC), counterintelligence (CI) operations, counterpropaganda operations, and public affairs (PA) operations" (Department of the Air Force, 2005). Articles that discussed influence operations related concepts were included in this topic.

OC-1, Topic 5: Information Warfare

Information Warfare (IW) is a term that often considered a synonym of IO. An older version of AFDD 2-5 from 1998 describes IW as "information operations conducted to defend one's own information and information systems or attacking and affecting an adversary's information and information systems" (Department of the Air

Force, 2005). According to Air University's Cyberspace and Information Operations Study Center, DoD removed IW from its doctrine and eventually the DoD Dictionary. However, the USAF has retained the term (*Cyberspace & Information Operations Study Center*, 15 Aug 08) but its usage in the 2005 version of AFDD 2-5 is significantly reduced from the 1998 version. The current (2005) version of AFDD 2-5 defines IW as: "Information operations conducted during time of crisis or conflict to achieve or promote specific objectives over a specific adversary or adversaries" (Department of the Air Force, 2005). In this research, "Information Warfare" is included as a Topic under the Overall Category "Information Operations." Those articles that talked about information warfare, including definitions, applications of IW, examples, and information warfare strategies were categorized in this topic.

OC-1, Topic 6: Network Warfare Operations

Network warfare operations, sometimes referred to as "computer network operations," are utilized to "achieve desired effects across the interconnected analog and digital networks portions of the battlespace. Network warfare operations are conducted in the information domain through the combination of hardware, software, data, and human interaction" (Department of the Air Force, 2005). Articles that discussed network warfare operations and related concepts were included in this topic.

OC-1, Topic 7: Cyberspace – Miscellaneous

In September 2006, the Joint Chiefs of Staff officially developed the definition of cyberspace as "a domain characterized by the use of electronics and the electromagnetic spectrum to store, modify and exchange data via networked systems and associated physical infrastructures" (Wynne, 2007). This "definition means that cyberspace

encompasses but is larger than the Internet because it also includes capabilities such as directed energy, which exists in a part of the [electromagnetic spectrum] that lies outside the interconnected, computer-based, global-information grid" (Wynne, 2007).

Cyberspace is defined by the DoD as "a global domain within the information environment consisting of the interdependent network of information technology infrastructures, including the Internet, telecommunications networks, computer systems, and embedded processors and controllers" (*Department of Defense Dictionary of Military and Associated Terms*, 2008). Articles which discussed definitions of cyberspace and the cyberspace domain, fighting in cyberspace, and other high level aspects of cyberspace were included in this topic.

OC-1, Topic 8: Information Assurance

Information assurance (IA) includes the actions taken to "protect and defend information and information systems by ensuring their availability, integrity, authenticity, confidentiality, and non-repudiation (ability to prove sender's identity and prove delivery to recipient)" (Department of the Air Force, 2005). Articles that discussed information assurance related concepts were included in this topic.

OC-1, Topic 9: Electronic Warfare Operations

Electronic Warfare Operations (EWO) is "military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. Electronic warfare consists of three divisions: electronic attack, electronic protection, and electronic warfare support" (*Department of Defense Dictionary of Military and Associated Terms,* 2008). Articles which discussed EWO were included in this topic.

Overall Category 2 (OC-2): Interoperability

Interoperability is the "condition achieved among communications-electronics systems … when information or services can be exchanged directly and satisfactorily between them and/or their users" (*Department of Defense Dictionary of Military and Associated Terms*, 2008). Interoperability results in increased interaction among information systems. "Integration" is often used synonymously with interoperability. Integration is defined as "the synchronized transfer of units into an operational commander's force prior to mission execution" (*Department of Defense Dictionary of Military and Associated Terms*, 2008). Information sharing is the transfer and communication of information among systems and personnel. The three concepts of interoperability, integration, and information sharing have been of increased importance in the past two decades as DoD attempts to move away from "stovepiped" systems and towards systems that can quickly and easily exchange information. Articles that discussed information sharing and the interoperability and integration of information and information systems were included in this category.

Overall Category 3 (OC-3): Using IT to Improve Effectiveness.

Articles that discussed how information technology is improving efficiencies, improving job performance, or supporting operations are included in this category. This includes information and IT supporting battlefield operations; technologies improving the way the AF/DoD conduct business; and IT supporting intelligence, weather, and related operations.

Overall Category 4 (OC-4): Internet

The Internet is the extensive computer network that links computer and information systems worldwide. It includes commercial, educational, government, military, and other networks. All these networks utilize the same set of network protocols (*Dictionary.com,* 2006). Bandwidth is the rate of data transmission over the Internet and other communications circuits (*Department of Defense Dictionary of Military and Associated Terms,* 2008). .

The GIG is a DoD concept that will provide "an end-to-end set of information capabilities, associated processes and personnel for collecting, processing, storing, disseminating, and managing information on demand to warfighters, policy makers, and support personnel" (*Department of Defense Dictionary of Military and Associated Terms,* 2008). In recent years, the GIG has become a very popular topic within the DoD IT community, and it is expected to become the foundation on which all IT components rely. The department is striving to provide a vigorous, secure, and interoperable Global Information Grid (GIG) for military operations and national security actions to take place (*Interview with Lt Gen Michael V. Hayden - Director, NSA, Chief, Central Security Service,* 2004).

The Internet and the GIG both require a complex infrastructure of network components to guarantee their operational effectiveness and ensure redundant connectivity. Articles that discussed the Internet, bandwidth, the GIG, Connectivity, and Infrastructure issues were included in this category.

Overall Category 5 (OC-5): Organizational

Articles that discussed organizational aspects of information and IT were included in this category. This included articles that discussed proposed new military organizations with regard to IT; specific units and their responsibilities for cyber operations; the need for communications and information units in specific organizations; and proposed new military organizations, such as the Air Force Cyber Command.

Overall Category 6 (OC-6): Systems

Articles that discussed specific information systems and programs in detail were included in this category. This included command and control systems, intelligence systems, mission planning systems, finance and accounting systems, and other systems and IT programs utilized by DoD.

Overall Category 7 (OC-7): Miscellaneous

Articles that focus on information and IT but do not fall under any of the other overall categories are included in this category. Under this category were four Topics and are listed below.

OC-7, Topic 1: Training and Learning

Articles that discussed information and IT and their contribution to training and learning were included in this topic. This included the use of IT for distance learning and professional military education (PME), training personnel to successfully conduct information operations, and related training and learning issues.

OC-7, Topic 2: Doctrine and Legal Issues

Doctrine is defined as the "fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative

but requires judgment in application" (*Department of Defense Dictionary of Military and Associated Terms,* 2008). Legal issues include concepts such as whether or not network attacks are acts of war. Articles which discussed doctrine or which examined the legal aspects of information warfare or information operations are included in this topic.

OC-7, Topic 3: Transformational Issues

Articles that discussed the how the DoD and Air Force are transforming because of information and information operations are included in this topic. This includes how information and IT are supporting the transformation. For example, some articles discuss how the AF is transforming from an air and space force to an information force.

OC-7, Topic 4: Other Topics

Any other miscellaneous topics that did not fall into any of the other Overall Categories or Topics was included in this Topic. Some of the concepts that were discussed only once or twice included geospatial information, IT acquisition, and computer wargames.

The code evolved through multiple evaluations of the journal articles (Carter & Ellram, 2003). When the final categories were defined, each article was coded into one of the final categories. The data was assembled and tables were created to evaluate the frequency of occurrence of information and IT topics and the time periods when instances of specific topics occurred. Leedy and Ormrod describe this tabulation of the frequency of specific characteristics found in the material as a critical step in a content analysis (Leedy & Ormrod, 2005).

Instead of examining trends using each individual year over the 16-year period, the researchers split the period into four 4-year time periods. This was done because

there is often a lag between when an article is written and when it is published. For example, an article might be written in mid 2005, submitted to the publisher in late 2005, and possibly not published in the journal until late 2006 or early 2007. Thus, the researchers decided to use four year blocks to examine trends in information and IT topics. These periods are displayed in Table 2.

Table 2. Time periods analyzed

Period Name	Period 1	Period 2	Period 3	Period 4
Years Included	1993 to 1996	1997 to 2000	2001 to 2004	2005 to 2008

In the ASPJ and JFQ journals, each journal issue features multiple types of articles, including, for example, "Feature," "Senior Leader Perspective," and "Book Review" articles. In order to manage the number of articles examined, the articles included were limited to "Senior Leader Perspectives," "Feature" and "Forum" articles, and articles of a similar nature. Some types of articles were not considered, including commentaries and book reviews. Commentaries were often short discussions on past journal topics. Book Reviews were merely summaries of current popular literature and did not provide significant new information on the books.

Phase 2 of the Research involved the number of IT related articles relative to the total number of articles per journal. Each journal issue was examined to determine the total number of articles it contained. Next, the same journal issue was examined to determine the number of information or IT related articles it included. Then, a calculation was made to determine the percentage of information or IT related articles to the total number of journal articles. The intent was to determine how information and

IT subject matter has changed relative to other defense subject matter over the sixteen year period.

Phase 3 of the Research involved the article's contributing author. This phase was also conducted similar to the method of Carter and Ellram. Two aspects of the contributing author were evaluated: the name of the contributing author and the institution to which the author belongs. By examining the frequency of articles by a specific author, subject matter experts, key contributors, and thought leaders can be identified (Carter & Ellram, 2003). By examining author institutions over the twenty-year period, researchers can better understand which organizations are speaking out on the importance of information and IT to DoD. For example, if information and IT topics are increasingly being voiced by members of the US Navy, researchers may be able to conclude that information and IT have become more important to the Navy over a specific time period. Other trends and patterns may be identified with regard to the contributing institution.

Factors with Potential to Affect Results

Many different factors can cause variations and fluctuations in the information and IT subject matters discussed. For example, immediately following the 2001 terrorist attacks, the Government was concerned with countering weapons of mass destruction (WMD), in anticipation of a possible WMD attack. Regarding information and IT, several specific triggers occurred between 1993 and 2008 that may have impacted the amount of attention DoD gave to information and IT related matters. These triggers included specific movements, key events, and legislation actions.

Clinger Cohen Act.

The Clinger Cohen Act was signed in 1996. This act developed mandatory actions for government agencies regarding information technology. GSA's procurement authority was eliminated and passed to each executive agency. Chief information officers (CIOs) were established within each agency to provide strategies to formulate new business methods in using IT. Agencies were required to make changes to the way they conduct business before making IT investments. Incentives were provided to break IT acquisition into smaller scale projects (The Clinger Cohen Act of 1996, 1997). This act implemented an increased requirement of accountability for DoD agencies and caused many organizations to search for new ways to improve the way they acquired, developed, and managed IT.

Y2K

The Year 2000 issue was an IT issue that many organizations faced in the years and months leading up to the year 2000 rollover. It involved a potential failure in computer systems due to the transition from the year 1999 to 2000. There was a significant concern of risk to numerous civilian and military operations, supply chains, and other large scale production systems reliant on computer systems. DoD had many systems of which were examined and in many cases altered to ensure a safe and seamless transition to the year 2000 (Wills, 2000).

IT Bubble and Burst

From about 1996 to 2000, the telecommunications and "Dot Com" businesses experienced a "spectacular rise" as the amounts of IT investments soared (Couper, Hejkal, & Wolman, 2003). This is often referred to as the "IT Bubble" or "Dot Com

Bubble." This "Bubble" has been described as possessing a "gold rush mentality." With rapid economic growth, many individuals and organizations took risks which they might not have normally taken. Traditional business practices and values were often ignored (Tapia, 2004) and many organizations greatly increased the quantities of IT and the application of such investments into their business functions. Capital spending increased significantly during this time period. After the introduction of the PC in the early 1980s, 15% of US companies' budgets were spent on IT. By the early 1990s, this grew to more than 30%. By the peak of the IT Bubble in the late 1990s, this number reached 50% (Carr, 2003).

Various legislation that was passed along the way helped amplify the effects. For example, the Telecommunications Act of 1996 increased competition in local telecommunications providers and rapidly increased the presence of fiber optic technologies. There was a dramatic increase in the capacity for data transmission and more efficient utilization of the spectrum available for wireless technologies. Internet usage increased significantly during this period as well (Couper et al., 2003). This optimism and risk taking with new forms of IT likely spread from the commercial sector to the Government and military sector, as organizations perceived IT as a cure-all for improving business functions.

In March 2000, a major sell off of information technology and telecomm businesses began (Griffin, Harris, & Topaloglu, 2005). This sell-off lasted approximately a year, and is often labeled the "IT Bubble Burst."

Sept 2001 Attacks

The September 11, 2001 terrorist attacks were conducted by the terrorist group Al Quada on the World Trade Center in New York City and the Pentagon in Washington, D.C. Over 3,000 people were killed and financial losses exceeded $70 billion (Stamper, 2002). The events of that single day completely overhauled DoD priorities and an invasion of the terrorist organization's host nation began within 30 days.

Afghanistan War

The War in Afghanistan began in October 2001and was entitled Operation Enduring Freedom. The objective was to capture or destroy Al Quada leadership and remove the Taliban from power. The US encountered numerous obstacles, from extremely rough terrain and weather, to the need to acquire cooperation from critical neighboring countries such as Pakistan and Kyrgyzstan (Cohen, 2002). DoD focused significant manpower and resources on this war from 2003 through 2008.

Iraq War

The Iraq War, often called the Second Gulf War, began in March 2003 and was entitled Operation Iraqi Freedom. The original objective was to remove President Saddam Hussein over Iraq's suspected possession of weapons of mass destruction and his alleged support of terrorist organizations (Fox, 2005). While the invasion of Iraq went relatively smoothly, a massive insurgency erupted in 2004 that caused numerous American military casualties and began an era where considerable DoD resources, new technologies and new policies were implemented to counter the insurgency (Krepinevich, 2005).

These six specific events may have had an effect on the amount of attention DoD focused on information and IT related issues during the 16 year period analyzed.

Chapter 3. Results and Analysis

This chapter will present the results and analysis of the research conducted. The data is analyzed with the intent of answering the research questions. The findings include both qualitative and quantitative descriptions.

First, the research questions are restated. Then an overview of the total numbers of analyzed articles is presented. Next, an analysis of the data is conducted to answer each research question. For Question 1, the researchers examined the frequency of information and IT related articles for the 16 year period. They also analyzed the *instances* of relevant subject matter for the time period. For Questions 1a and 1b, they examined the number of instances of the particular information and IT subject matter for the entire time period. For Question 1c, the researchers analyzed the frequency of subject matter instances and changes over the 16 year time period. For Question 2, they examined the contributing authors and their institutions and identified trends and patterns over the time period. For Question 3, the researchers examined trends and made predictions for the next five years. Because Question 3 provides the future of information and IT, this question will be addressed in Chapter 4. From this point forward, the term "subject," "subject matter," and "material" will be used interchangeably.

Research Questions

1. What has been the role of information and information technology (IT) in DoD over the past 16 years?
    a. What information and IT subject matter have been addressed by DoD over the past 16 years?

b. What have been the most frequently discussed subject matters?
c. How has DoD information and IT subject matter changed?

2. Who is discussing information and IT in DoD?
   a. What is the background of those discussing information and IT related issues?
   b. How has this changed over the past 16 years?

3. What do the trends and patterns indicate about what information and IT elements will be important to DoD in the future?

Numbers of Articles

The researchers examined a total of 1,702 articles for the 16 year period of 1993 to 2008. Of the 1,702 articles, 929 were from the Air and Space Power Journal (ASPJ) and 773 were from the Joint Forces Quarterly (JFQ) journal. Of the 1,702 articles, 294 were determined to contain a reasonable amount of material on information or information technology (IT). Of these 294 articles, 191 were from the ASPJ and 103 were from the JFQ. Table 3 provides further details on the total number of articles analyzed.

Table 3. Overall number of articles

	Articles Examined	Articles that Contained Information or IT Related Topics	Percentage of Articles that Contained Information or IT Related Topics to Total Articles Examined
ASPJ	929	191	20.56%
JFQ	773	103	13.36%
Total	1,702	294	17.27%

As discussed, one researcher analyzed 100% of the journal articles, and another researcher analyzed 10% of the articles. Of the 170 articles analyzed by the second researcher, 124 were consistent with the first researcher's categorization. This yields a .729 level of agreement, which is above the .70 minimum recommended by Krippendorf.

Research Question #1

As presented previously, the first research question was "What has been the role of information and IT in DoD over the past 16 years?" The research began with this question because it was determined to be the foundation upon which other research questions would build.

The total number of articles in each of the 16 individual years was calculated. This included articles from both the ASPJ and JFQ journals. Then the number of articles containing information or IT related subject matter was calculated for each individual year. The data is listed in Table 4. The data was then plotted and is displayed in Figure 1. The graph and the associated trend line indicate an overall increase in the percentage of articles with information or IT related subject matter. In 1993, just over 5% of the total articles contained information or IT related subject matter. By 1995, this increased to 17% but then fell to 10% in 1997. The number grew sharply to over 22% in 1998, but then declined to 9% by 2003. This grew sharply again over the next two years to nearly 29% in 2005. The number fell slightly to 20% in 2006 and then increased again over the next two years to 23% in 2008.

Because the overall increase in information and IT related subject matter increased from 5% in 1993 to over 23% in 2008, the researchers determined that the role of Information and IT in DoD has become of considerable increased importance to DoD over the 16 year period examined.

Table 4. Percentage of information / IT articles to total articles per year

	Total Articles	Total Info/IT Related Articles	Percentage
1993	57	3	5.26%
1994	84	11	13.10%
1995	122	21	17.21%
1996	97	14	14.43%
1997	103	11	10.68%
1998	98	22	22.45%
1999	91	19	20.88%
2000	114	17	14.91%
2001	96	10	10.42%
2002	99	13	13.13%
2003	100	9	9.00%
2004	88	12	13.64%
2005	125	36	28.80%
2006	133	27	20.30%
2007	154	36	23.38%
2008	141	33	23.40%
Total	1,702	294	

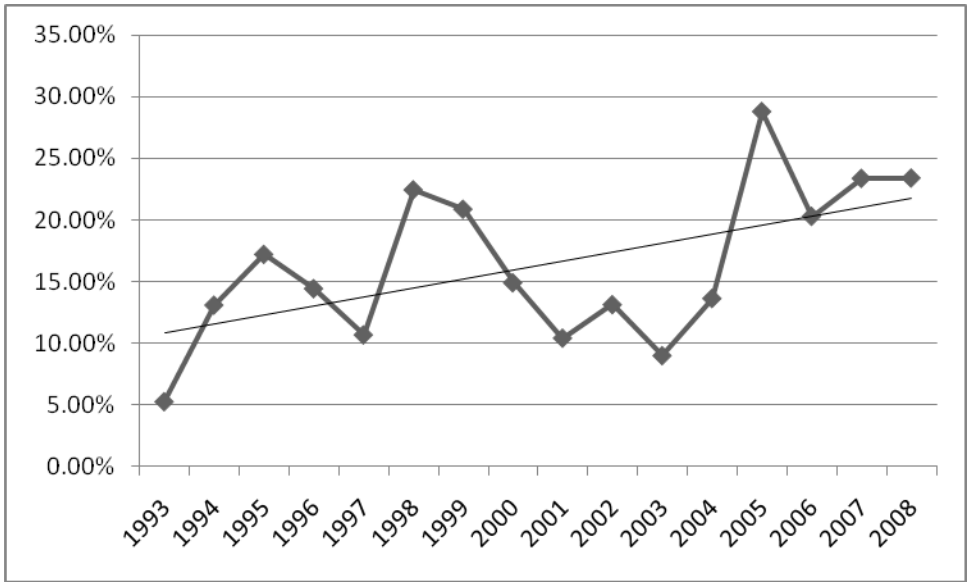

Figure 1. Percentage of information / IT articles to total articles per year

***Instances* of information and IT related subject matter**

Within the 294 information and IT related articles identified, there were 441 *instances* where an information or IT subject matter was discussed. Some articles focused on just one relevant subject and were coded with just the one subject, while other articles discussed two or more relevant subjects and were coded accordingly.

Figure 2 presents a graphical representation of all information and IT subject matter instances over the 16 year period. In the first two years examined, there were relatively few instances identified of information or IT related material. By the mid 1990s, there was a noticeable increase in instances, and this trend continued until the early 2000's, when a downturn occurred. During the downturn, the lowest number of instances was 10 and was observed in 2003. Shortly thereafter, there was a sharp increase in the number of relevant material and a peak occurred in 2005 with 61 instances. Since 2005, the number of relevant subject matter in the journals has varied, but has remained higher than the previous twelve years, with generally 40 or more instances identified per year.

As discussed in Chapter 2, the researchers split the 16-year period into four 4-year time periods. This was done because there is often a lag between when an article is written and when it is published. Figure 3 provides a similar analysis of the data, but utilizes 4-year increments to display the number of instances of information and IT related subject matter.

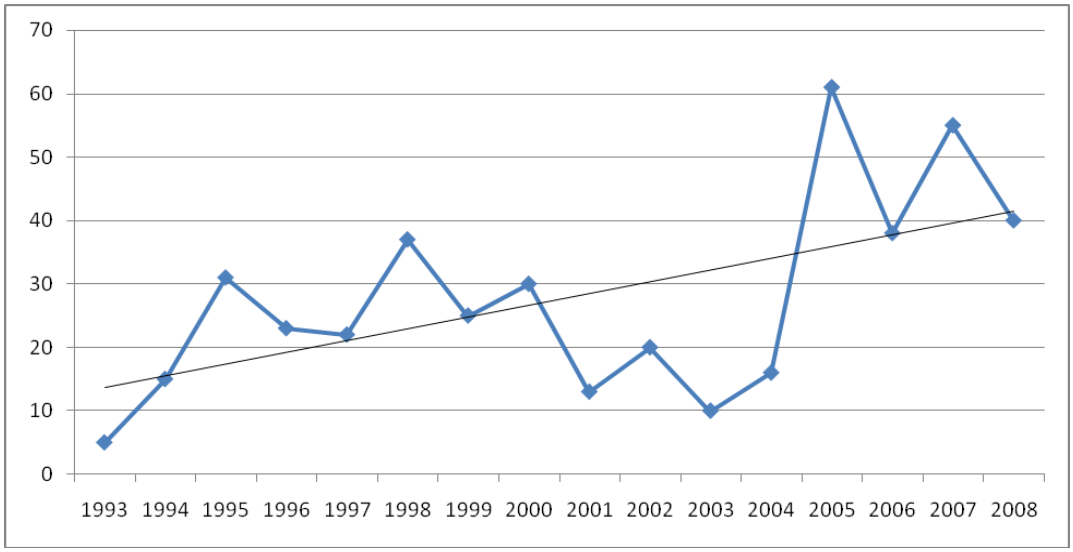

Figure 2. Instances of information and IT related material per year

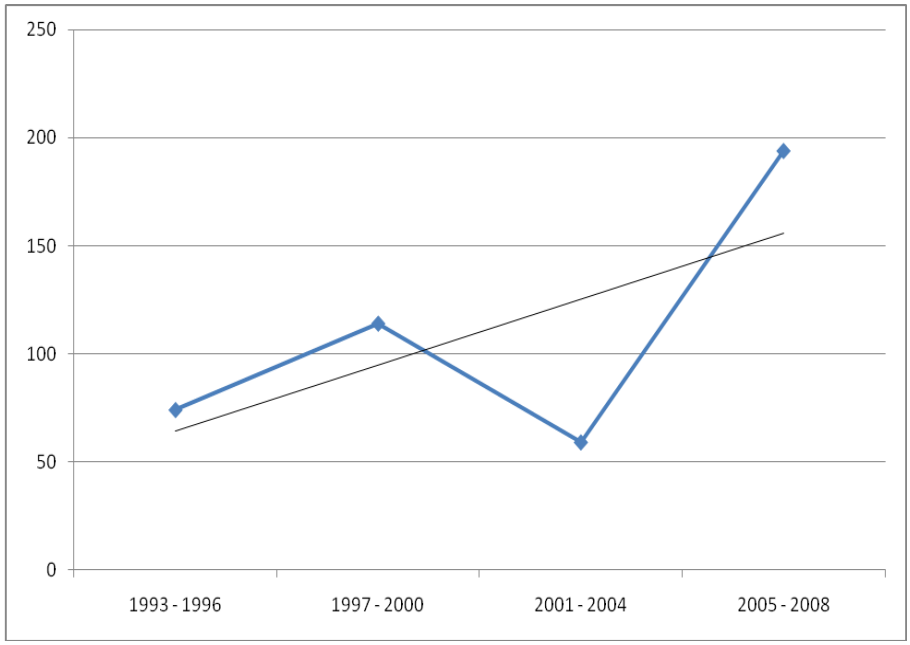

Figure 3. Instances of information and IT related material per time period

Research Question #1a.

The second research question was "What Information and IT subjects have been addressed by DoD over the past 16 years?" In order to analyze the data collected coded

and to determine what subjects have been addressed by DoD, a framework of categories, topics, and subtopics was developed.

Overall Categories, Topics, and Subtopics

As discussed previously, seven Overall Categories were identified for the Information and IT related material. Within each Overall Category were various numbers of Topics. Within each Topic were various numbers of Subtopics.

Subjects Addressed Over the 16 Year Period

Seven Overall Categories of information and IT related topics were identified for the 294 articles examined. The bar chart in Figure 4 provides a graphical depiction of the number of instances of these Overall Categories for the entire time period. The results are presented in ascending order. Appendix A provides further granularity by listing all of the Overall Categories, the corresponding Topics, and the corresponding Subtopics that the researchers identified.

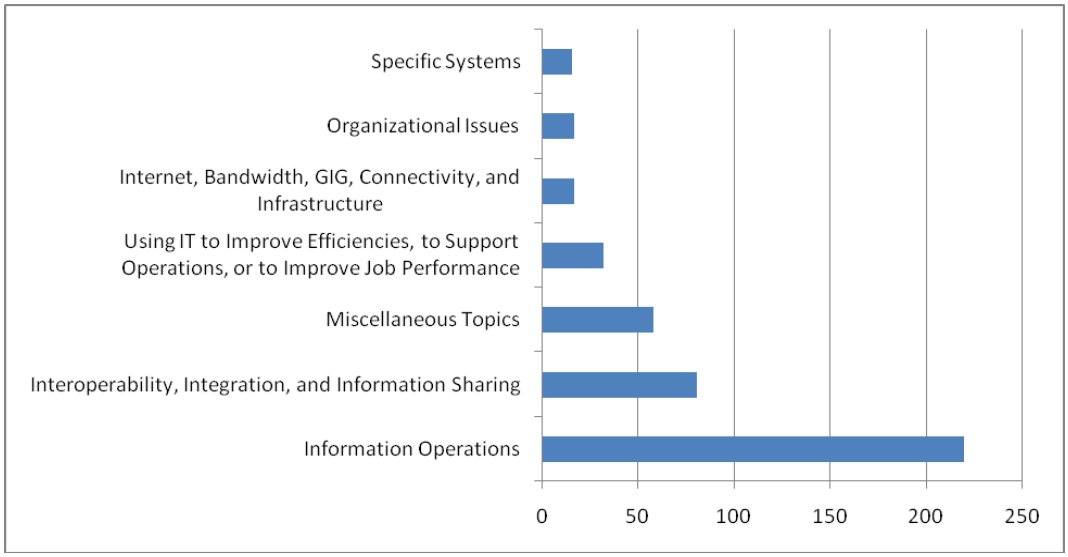

Figure 4. Instances of the Overall Categories

Subjects Addressed in AF versus DoD Articles

In order to determine the subject matter discussed by the Air Force versus DoD over the time period, the researchers examined the occurrences of the Overall Categories from an Air Force (ASPJ) perspective and from a Joint (JFQ) perspective. Information Operations subject matter made up almost 63% of Air Force information and IT instances and about 45.5% of Joint instances. Interoperability material made up nearly 14% of Air Force and 22% of Joint instances. IT to Improve Effectiveness material composed 3.6% of Air Force and nearly 9% of Joint instances. Table 5 provides further details on the Overall Categories from both Air Force and Joint perspectives. Throughout the remainder of the analysis for Research Question 1, the data from the Air Force journal (ASPJ) and Joint journal (JFQ) are examined collectively.

Table 5. Percentage of Overall Categories in Air Force versus DoD journal

	Air Force (ASPJ)	Joint (JFQ)
Information Operations	62.65%	45.51%
Interoperability	13.86%	22.12%
IT to Improve Effectiveness	3.61%	8.97%
Internet	3.61%	3.53%
Organizational	2.41%	4.49%
System	0.60%	4.81%
Miscellaneous Topics	13.25%	10.58%

Research Question #1b.

The third question was "What have been the most frequently discussed subject matters?" As displayed in Figure 4, the top two most identified Overall Categories include Information Operations and Interoperability. Both subjects occurred in 80 or more instances within the 294 articles.

Overall Category 1: Information Operations

The Overall Category "Information Operations" was by far the largest with 220 instances identified. Within this Overall Category were a multitude of IO related material. The material in the Overall Category was subdivided into nine Topics. Figure 5 shows the Information Operations Overall Category into these nine Topics.

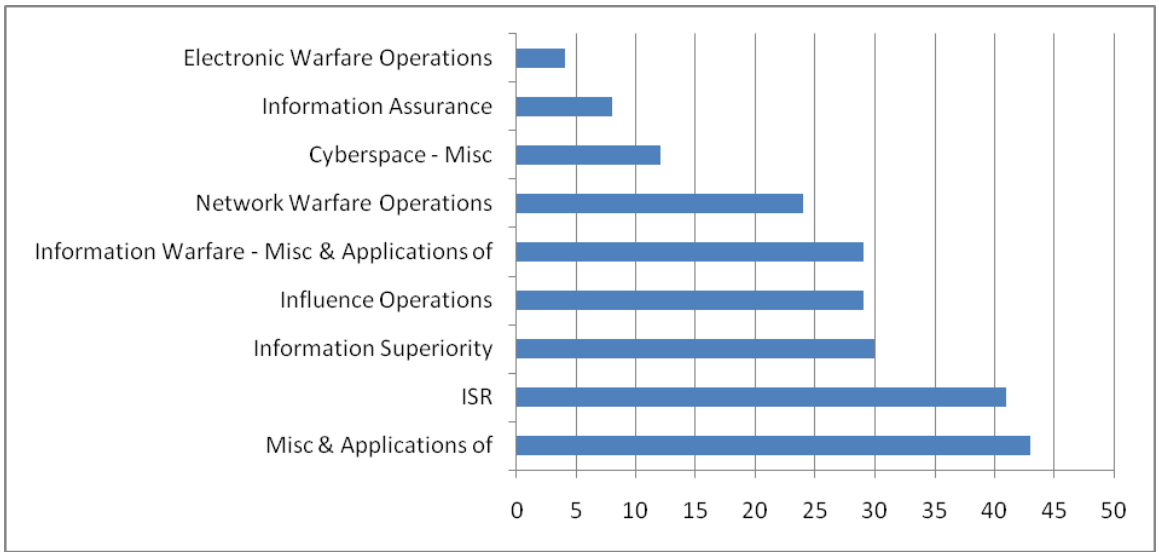

Figure 5. Instances of specific Topics within the "Information Operations" Overall Category

Within the Overall Category of Information Operations, the most frequently identified Topic was Information Operations– Miscellaneous and Applications. The researchers identified 43 instances of this topic. These articles examined such subtopics as Information Operations definitions and strategies, applications and examples of Information Operations, and proposed military career paths focusing on Information Operations. Information Operations have been of significant discussion in the Air Force and Joint arenas within the past decade.

Intelligence, Surveillance, and Reconnaissance (ISR) was the next most frequently cited Topic within this Overall Category and had 41 instances. These articles contained a wide range of ISR topics such as past and current ISR assets, proposed ISR strategies and technologies, and the future of ISR for DoD operations. Information Superiority was the next most identified topic with 30 instances. Information has been identified as a highly critical component to military operations and "gives the commander the freedom from attack, the freedom to maneuver, and the freedom to attack" (Department of the Air Force, 2005). It was not unexpected by the researchers that Information Superiority was one of the most frequently cited topics in the two journals examined.

The next two most frequently identified Topics included "Influence Operations" and "Information Warfare – Miscellaneous and Applications." These two Topics both had 29 instances. Influence Operations includes Public Affairs and Psychological Operations, Military Deception, and Operations Security. The Information Warfare – Miscellaneous and Applications articles examined subtopics such as Information Warfare definitions and strategies, and applications and examples of Information Warfare.

The Topic "Network Warfare Operations" was identified on 24 instances. The articles discussed network attack and defense, network warfare support, and network centric warfare. The Topic "Cyberspace – Miscellaneous" occurred on 12 instances. This Topic included discussions and definitions of cyberspace and cyberpower, fighting in the cyberspace domain, and discussions on why cyberspace is relevant to military operations. The Topic "Information Assurance" was identified on 8 instances. This material included cyber threats and vulnerabilities and measures to protect information

systems from such threats. Finally, the Topic "Electronic Warfare Operations" occurred on 4 instances. These articles discussed electronic warfare such as jamming and related activities.

Overall Category 2: Interoperability

"Interoperability" was the second most frequently cited Overall Category with 81 instances identified. The articles included the subjects of interoperability, integration, and information sharing among DoD assets, and they examined a variety of Subtopics. The Subtopics included the need for improved interoperability among DoD information systems, the need for better coordination of information efforts among agencies, and specific information sharing subjects such as cross service information systems and electronic medical records. Also included in this topic was data transparency, which was identified as ensuring the right information is shared with the right warfighter or information system at the right time. Since the stand-up of the Combatant Commands in the early 1990s, interoperability and information sharing have been emphasized as critical functions of military operations. DoD agencies have been attempting to migrate from stove-piped information and information systems towards Joint interoperable information and information systems. The JFQ journal is considered the premier publication in support of Joint Operations across DoD. The journal is published to "promote understanding of the integrated employment of land, sea, air, space, and special operations forces" (*Joint Forces Quarterly.*2008). Thus, in a period where joint integrated operations is so highly emphasized, the researchers were not surprised that interoperability was the second most frequently identified Overall Category among the articles analyzed.

Overall Category 3: Miscellaneous Topics

"Miscellaneous Topics" was the third most frequent Overall Category and included a range of material that was discussed in fewer instances. Within the Overall Category were four Topics. Figure 6 breaks down the "Miscellaneous Topics" Overall Category into 4 Topics. The first Topic, "Training and Learning," had 17 instances. This topic included IT supporting education, training, and professional military education (PME). The second Topic, "Doctrine and Legal Issues," had 11 instances. This topic included material discussing cyber law, current and proposed cyber doctrine, information warfare doctrine, and information operations doctrine. The third Topic, "Transformational Issues," had 8 instances. This topic included subject matter discussing the Air Force changing from an Air and Space force to an Information force and IT supporting DoD and Air Force transformation efforts. The final Topic, "Other Topics," contained a variety of less frequently discussed material and occurred on 27 instances. Included in this Topic, for example, was geospatial information, information in decision making, IT acquisition, verbal communication and information exchange, and computer wargaming.

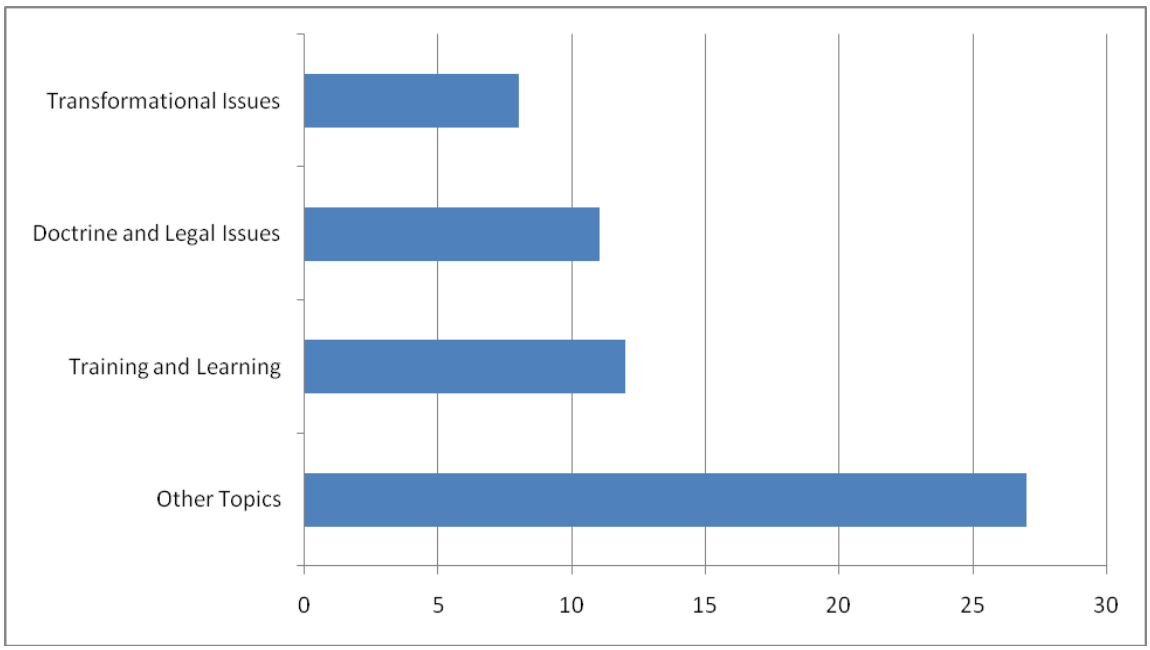

Figure 6. Instances of specific Topics within the "Miscellaneous" Overall Category

Remaining Overall Categories

The Overall Category "IT to Improve Effectiveness" was the fourth most identified with 32 instances and included using IT to improve efficiencies, to support operations, and to improve job performance. This included a variety of Subtopics that all focused on the use of IT in the battlefield, the use of IT to improve efficiencies in specific military operations, and the implementation of IT to support law enforcement, intelligence, and counterinsurgency operations.

The Overall Category "Internet" had 17 instances identified. This category included subjects such as the Internet, bandwidth issues, the Global Information Grid (GIG), and connectivity and infrastructure issues.

The Overall Category "Organizational Issues" also had 17 instances identified. This category included material on specific military units and their information activities

and responsibilities; proposed new Cyberspace Organizations, including Air Force Cyber Command; and Information Warfare and Information Operations organizations.

Finally, "Systems" was the least cited Overall Category with 16 instances. This category included material on specific DoD information systems or programs.

Research Question #1c.

The next question was "How has DoD information and IT subject matter changed?" This question examines how the individual information and IT topics have evolved over the time period. As discussed in the previous chapter, the researchers split the 16 year period analyzed into four 4-year periods. These time periods are presented in the Table 6 below.

Table 6. Time periods analyzed

Period Name	Period 1	Period 2	Period 3	Period 4
Years Included	1993 to 1996	1997 to 2000	2001 to 2004	2005 to 2008

The data in Appendix B provides the frequency of relevant subject matter for each year of the four time periods. In this next section, each individual topic is analyzed and graphs are displayed for the topic over the time period. From these graphs and numbers, trends and patterns are identified to determine how DoD Information and IT subject matter has changed over the 16 year period.

Overall Category 1: Information Operations (IO)

Information Operations related material occurred 220 times, which is 49.9% of the total instances of information and IT related material. Figure 7 depicts a an overall

increase in IO subject matter from 27 during the Period 1 to 105 in the Period 4. A drop to 30 instances occurred in the Period 3.

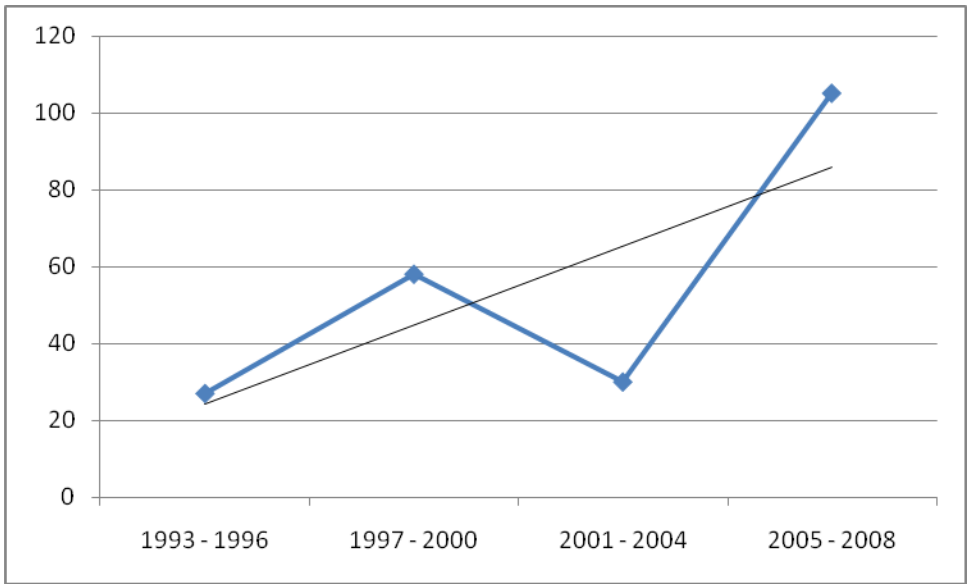

Figure 7. Instances where an article addressed "Information Operations"

Topics within the Overall Category "Information Operations"

Within the "Information Operations" Overall Category, five Topics demonstrated considerable changes in their frequencies during the time period. These topics included ISR, Information Superiority, Influence Operations, Network Warfare Operations, and Information Assurance. The data analyzed for these five topics is displayed in Appendix B.

ISR

ISR subject matter increased significantly throughout the time period. Instances of ISR material increased from 2 in Period 1, to 5 in Period 2, to 8 in Period 3, to 26 in Period 4.

Information Superiority

The occurrences of the topic "Information Superiority" increased considerably from 4 instances in Period 1 to 15 instances in Period 2. It fell back to 4 during Period 3 and increased slightly to 7 in Period 4.

Influence Operations

The occurrences of the topic "Influence Operations" varied between 4 and 6 instances during the first three periods. During Period 4, however, the number increased drastically to 15. The researchers examined the situation and noted how the use of psychological operations was discussed frequently during Period 4.

Network Warfare Operations

The instances of the topic "Network Warfare Operations" increased steadily throughout the four time periods analyzed. In Period 1, only 1 instance was identified; this increased to 15 instances in Period 4.

Information Assurance

Similar to Network Warfare Operations, Information Assurance saw a considerable increase through the time period. In Period 1, no instances of Information Assurance related material were identified. In Periods 2 and 3, one instance was identified in each. By Period 4, six instances were identified.

Overall Category 2: Interoperability, Integration, and Information Sharing

As discussed, the second most frequently identified Overall Category was Interoperability, including integration and data sharing. This topic occurred 81 times, which is about 18% of the total 441 Information and IT instances in the two journals over the time period. Figure 8 illustrates the number of interoperability, integration and

information sharing related instances identified. The graph depicts a considerable number of instances throughout the four periods, with at least 12 identified in each period. The number increased from 16 to 20 instances from Periods 1 to 2; it fell somewhat to 12 occurrences in Period 3; and it increased significantly to 33 instances in Period 4. Overall, the research indicates a moderate to high occurrence of interoperability, integration, and information sharing related instances over the time period, with a slight peak in Period 2 and a large increase in Period 4.

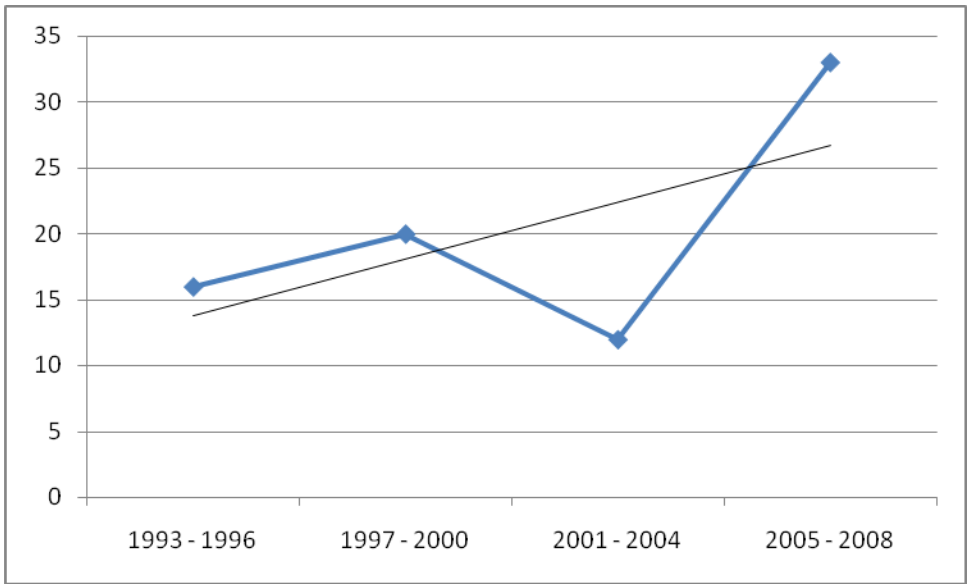

Figure 8. Instances where an article addressed "Interoperability"

IT to Improve Efficiencies

Instances of Using IT to Improve Efficiencies, to Support Operations, or to Improve Job Performance occurred 32 times, which is about 7% of the total instances. Figure 9 displays a doubling of instances from 6 to 12 between Periods 1 and 2, followed by a sharp decrease to just one instance in Period 3, followed by a sharp increase again to

13 in Period 4.

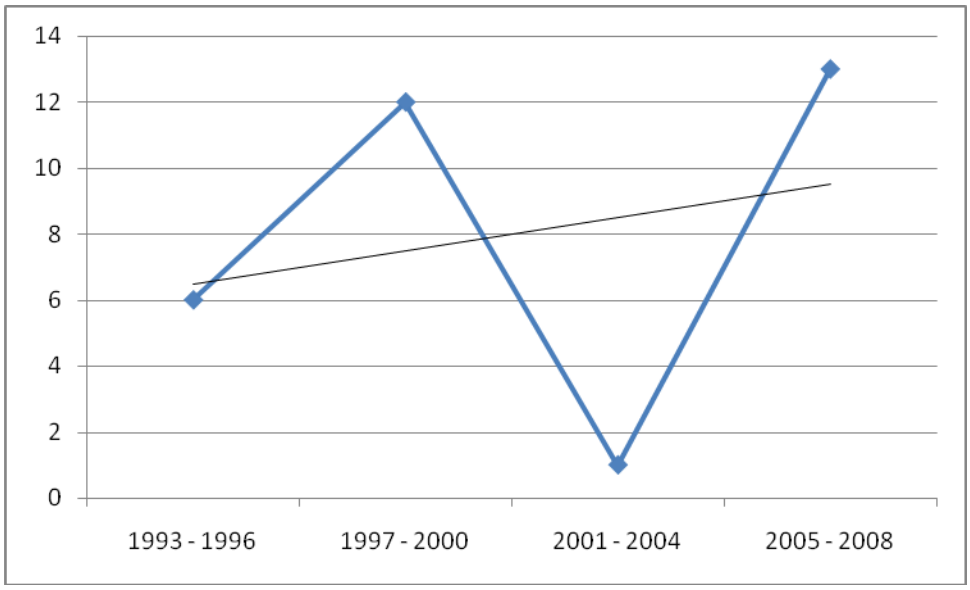

Figure 9. Instances where an article addressed "IT to Improve Efficiencies"

Internet

Instances of Internet related material, including bandwidth, GIG, connectivity, and infrastructure subject matter, occurred 17 times, which is about 4% of the total instances. Figure 10 displays an overall increase of material during the four time periods. There was a considerable increase between Periods 1 and 2, with one and 5 articles respectively. As with several previous subject matters, this topic fell somewhat to two instances in Period 3. The instances increased considerably between Periods 3 and 4, with an increase from 2 to 9 instances were identified.

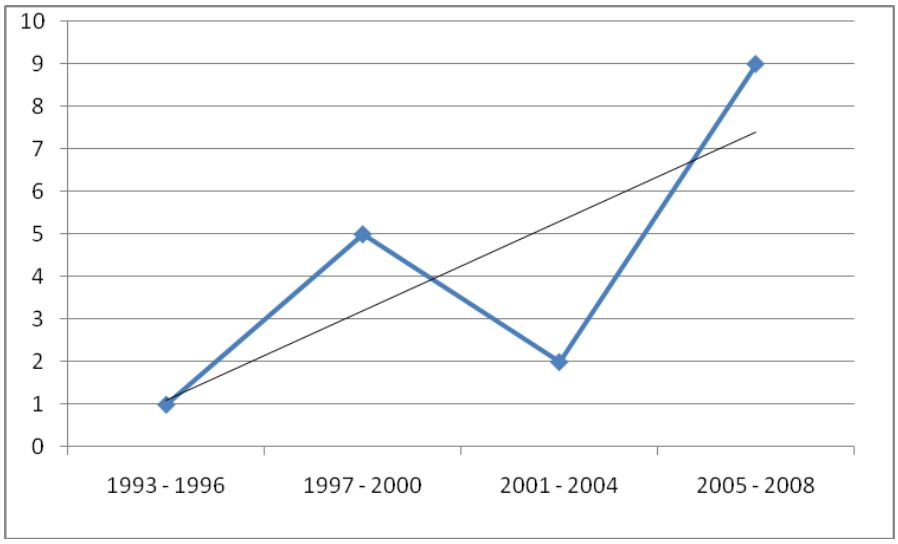

Figure 10. Instances where an article addressed "Internet"

Organizational Issues

Instances of Organizational issues related to information IT occurred 17 times, which is about 4% of the total instances. As seen in Figure 11, similar to the Internet category, this subject saw an increase between Periods 1 and 2, a decrease in Period 3, and an increase in Period 4.

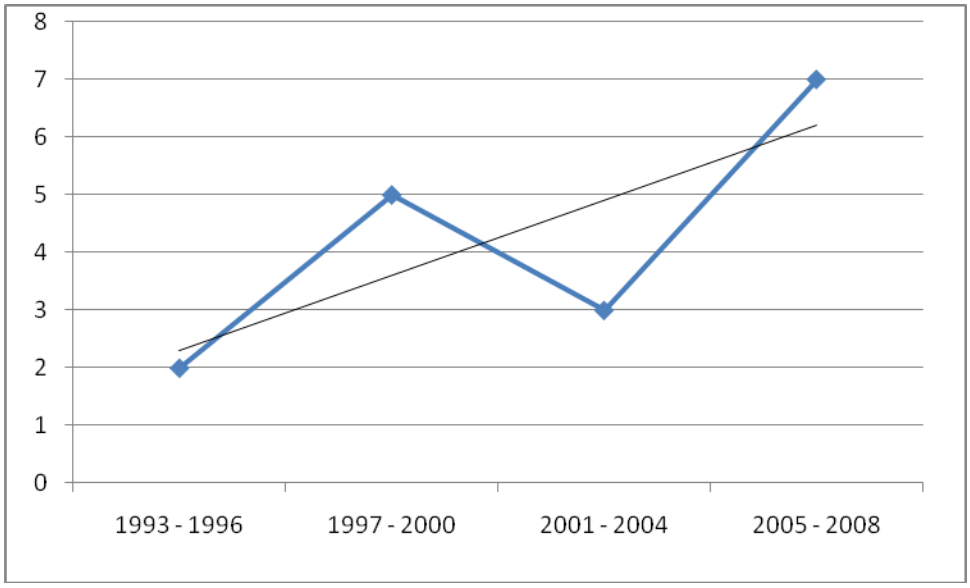

Figure 11. Instances where an article addressed "Organizational Issues"

Systems

Instances of specific information systems occurred 16 times, which is about 3.5% of the total instances. Researchers identified a steady decrease between Periods 1 and 3, and an increase in Period 4, as displayed in Figure 12.

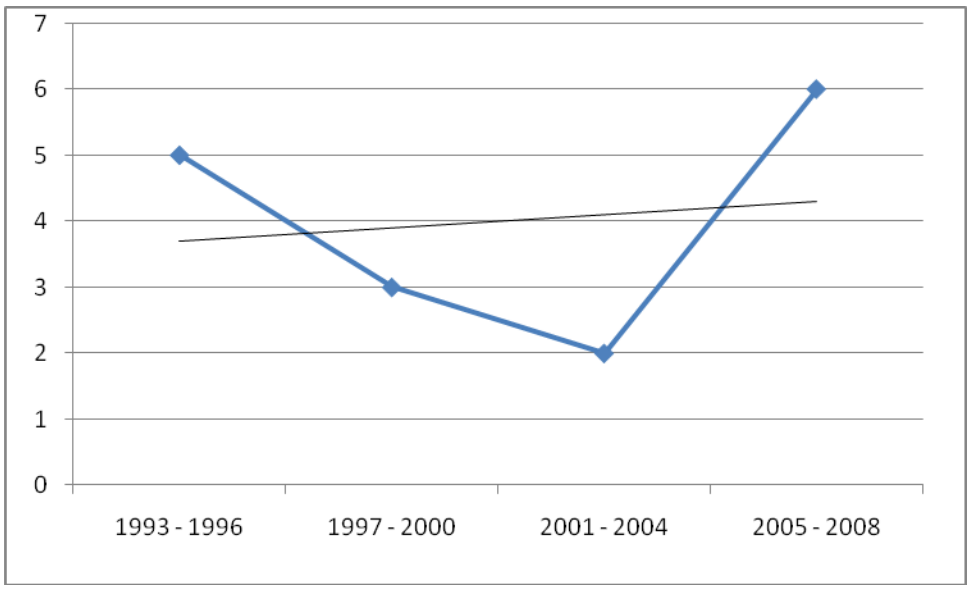

Figure 12. Instances where an article addressed "Systems"

Miscellaneous Topics

Instances of Miscellaneous Topics occurred 58 times, which is about 13% of the total instances. This topic included a myriad of topics and subtopics. Because it would provide minimal value to the research, this Overall Category is not displayed in a graph. However, one of the Topics within the Overall Category had noteworthy results and is plotted below.

Training and Learning

Within the "Miscellaneous Topics" Overall Category, the Topic "Training and Learning" demonstrated changes in its frequencies during the time period. As displayed in Figure 13, Periods 1 and 2 had 4 instances of information and IT training and learning material. This fell to 1 in Period 3, and increased to 3 in Period 4.

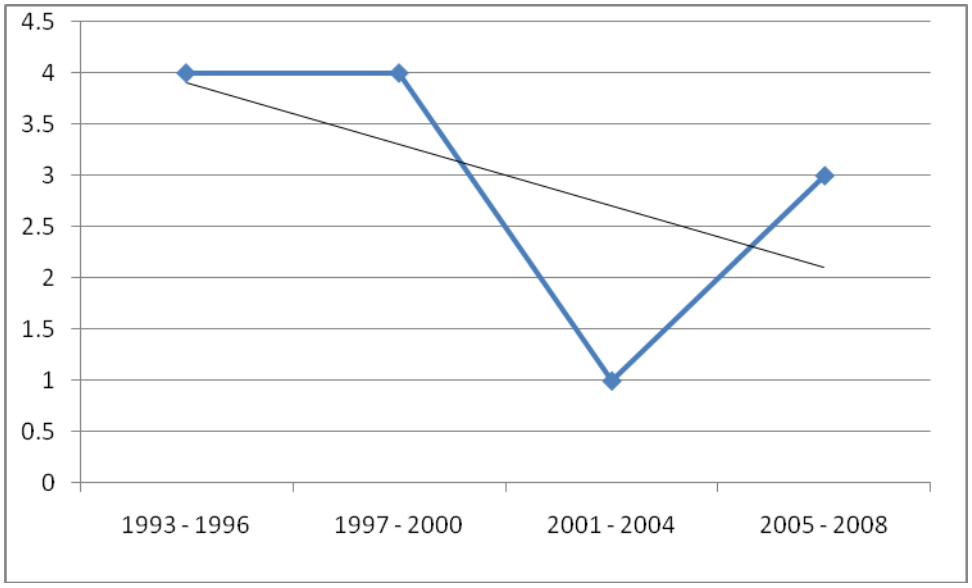

Figure 13. Instances where an article addressed "Training and Learning"

Significance of Overall Categories

A statistical analysis was conducted on the Overall Categories in Appendix B. Table 7 provides the calculated p-values for the pairs of Overall Categories. The analysis indicated that, at the commonly used significance level of 0.05, a statistically significant difference occurred between the categories in Scenarios A through D. Thus, it is unlikely the difference occurred by chance. Using the same significance level of 0.05, it was determined that Scenario E was not statistically significant. Thus, it is possible that the difference between the values of 16 and 17 occurred by chance.

Table 7. Significance in differences of Overall Categories

Scenario Number	**A**	**B**	**C**	**D**	**E**
Between Overall Categories	OC-1 and OC-2	OC-2 and OC-7	OC-7 and OC-3	OC-3 and OC-4; OC-3 and OC-5	OC-4 and OC-6; OC-5 and OC-6
Between Instance Values	220 and 81	81 and 58	58 and 32	32 and 17	17 and 16

p-Value Calculated	0.000	0.033	0.004	0.027	0.859
Using significance level of 0.05:	Significant	Significant	Significant	Significant	Not Significant

Research Question #2.

The next question was "Who is discussing information and IT in DoD?"

Contributing Authors

The researchers analyzed the contributing authors for the 294 articles that were considered to contain a reasonable amount of material on information or IT. Table 8 presents the top eight contributing authors for the 15 year period. Each author listed authored or co-authored at least three articles.

Table 8. Top contributing authors

Name	Number of Articles Authored or Co-Authored	Affiliation
Berg, Paul D, Lt Col, USAF*	6	USAF
Bingham, Price T., Lt Col (Ret), USAF	4	USAF
Deptula, David A., Lt Gen (USAF)	4	USAF
Myers, Richard B., Gen (Ret), USAF	4	USAF
Gray, Colin S.	3	Academia
Jones, Jeffrey B, Col (Ret), US Army	3	US Army
Pudas, Terry J, CAPT (Ret), USN	3	USN

*Lt Col Berg was the editor of ASPJ from 2004 to 2008.

The highest number of articles contributed on information and IT subject matter was Lt Col Paul Berg, USAF, with six articles contributed. However, the researchers identified Berg as an editor of the ASPJ from 2004 to 2008. Berg's position as the editor may have affected the relatively large number of articles that he authored. The next highest number of articles contributed was four. Three authors contributed four articles: Lt Col Price T. Bingham, Lt Gen David A. Deptula, and Gen Richard B. Myers. All three were USAF officers.

Research Question #2a.

The next question was "What is the background of those discussing IT related issues?"

Contributing Institutions

In addition to the contributing authors, the researchers examined the contributing authors' institutions. The researchers identified 11 different categories of which to classify the background of those discussing IT related issues. First, the researchers examined both journals collectively. Then, they broke down the data and examined the journals separately.

ASPJ and JFQ Journals Contributing Institutions

The contributing authors' organizations for information and IT related topics in both journals are displayed in Figure 14. The Air Force is by far the greatest contributor with 154 authors identified. The Army is the second greatest contributor with 64 authors. The Navy is third with 47 authors. There were 39 DoD personnel (non service affiliated) identified as authors. The US Marine Corps (USMC) was the next greatest contributor

with 18 authors. There were 14 authors identified as contractors or government consultants. Ten authors were identified as being affiliated with universities, both American and European. Nine authors were identified as being members of foreign (allied) militaries. Three US Congressmen were identified as authors; this included both House and Senate members. The Coast Guard had just one contributor. Eight authors were identified as being affiliated with other organizations.

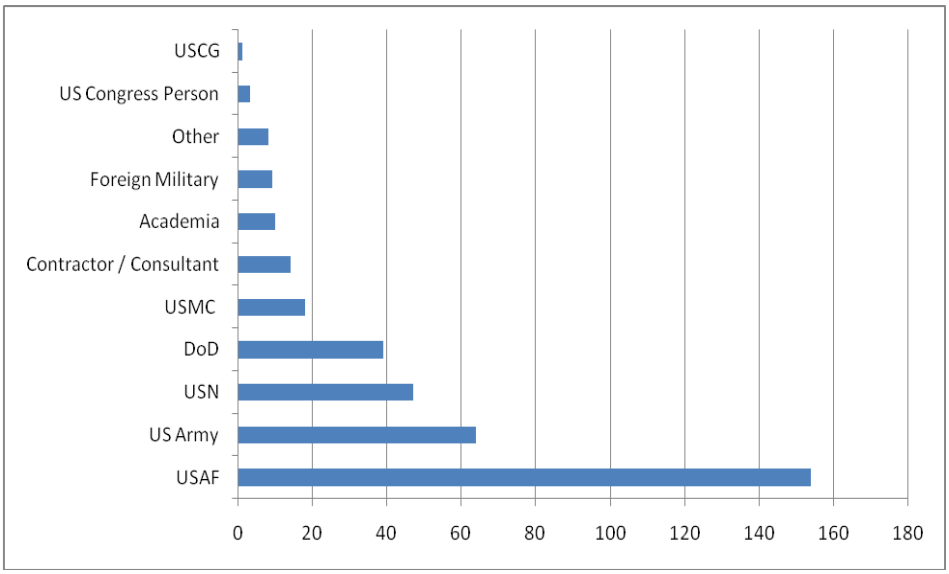

Figure 14. Contributing authors' institutions – all organizations - both journals

The researchers identified the fact that since one of the two journals examined was published by the Air Force, the number of Air Force contributing authors is likely to be higher in that journal. Thus, the researchers examined the contributing authors in the two journals separately.

ASPJ Only - Contributing Institutions

In the Air Force journal, ASPJ, the number of contributing authors with an Air Force background was 103. The next closest number was consultants and contractors, with seven contributing authors. The contributing authors' organizations for information and IT related topics in ASPJ is displayed in Figure 15.

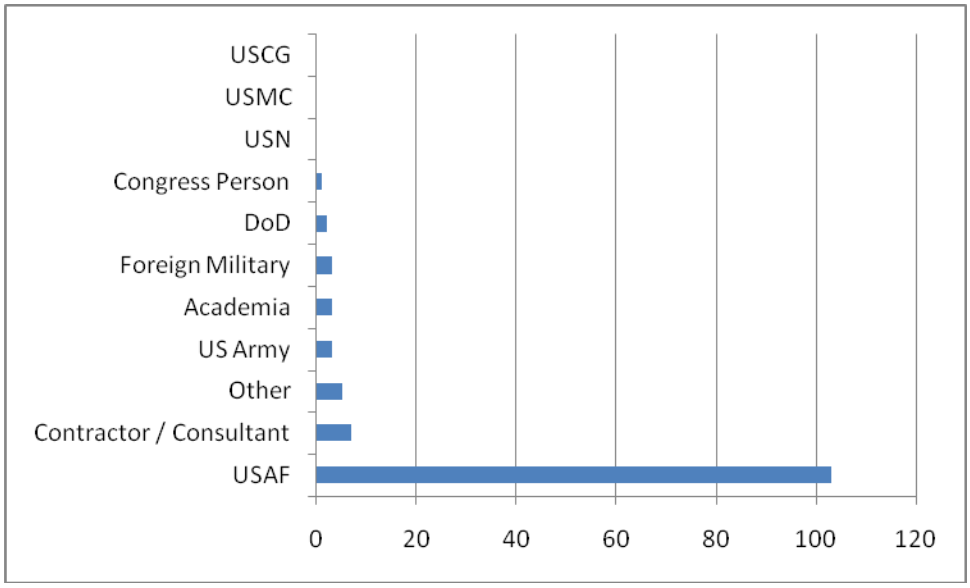

Figure 15. Contributing authors' institutions - ASPJ only

JFQ Only - Contributing Institutions

In order to best answer Research Questions #2b and 2c, the researchers used the data for JFQ only, since it was the only truly Joint journal. The researchers examined the contributing institutions with respect to force strengths of the four military services.

Military Officer Corps Sizes

Throughout the year 1994 to 2008, the Army officer corps has been the largest when compared to other services with an average of 80,694 active duty officers, or about

36% of all DoD officers. The Air Force is second largest, with about 32% of officers. The US Navy is third with about 24%. The USMC is the smallest officer corps with about 8% of the total DoD officers (*Department of defense personnel and military casualty statistic*, 2008). Table 9 summarizes this data.

Table 9. DoD officer force strength, 1994 to 2008

	US Army	USAF	USN	USMC
Average Size, 1994* to 2008	80,694	72,275	54,764	18,459
Average Percentage of DoD Officer Force	35.69%	31.94%	24.20%	8.17%

*Data from 1993 was unavailable.

In the Joint journal, JFQ, the Army had the highest number of contributing authors with 61. The Air Force had the second highest number with 51, followed by the Navy with 47. DoD personnel (non service affiliated) contributed 37 followed by the USMC with 18. These numbers are proportional to the overall service officer force numbers as presented in 9. Officer numbers were used because over 99% of the DoD contributing authors were from the officer corps. Contributing authors' organizations for information and IT related topics in JFQ are displayed in Figure 16.

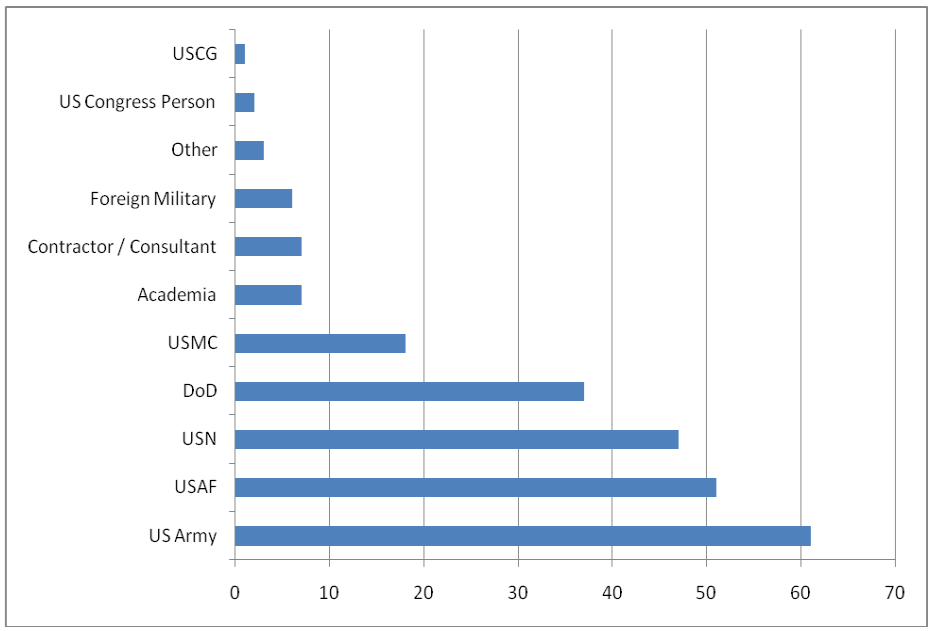

Figure 16. Contributing authors' institutions - JFQ only

Research Question #2b.

The next question was "How has the background of those discussing information and IT changed over the past 20 years?"

ASPJ and JFQ Journals – Changes in Contributing Authors' Institutions

The background of all contributing authors was examined by the researchers. Overall, the contributing institutions were consistent throughout all four time periods. As displayed in Table 10, DoD organization contributions ranged from 83.54% to 90.63%. Non-DoD organization contributions ranged from 9.38% to 16.46%. The researchers identified no discernible trends when examining these categories of contributing institutions.

Table 10. Contributing authors' institutions - all organizations - both journals

	DoD Organizations	Non-DoD Organizations
Period 1	90.63%	9.38%
Period 2	83.54%	16.46%
Period 3	88.00%	12.00%
Period 4	89.08%	10.92%

The data from Table 10 was further analyzed and the background of the contributing *DoD-only* authors was examined by the researchers. There was some variation in contributing DoD components throughout the four time periods. As displayed in Table 11, USAF contributions ranged from 29% to 54%. The USAF has consistently contributed more to the two journals collectively than any other component of DoD. US Navy contributions ranged from 6% to 22%. US Army contributions ranged from 6% to 25%. The researchers identified no discernible trends when examining these categories of contributing institutions within the two journals collectively.

Table 11. Contributing authors' institutions - DoD only - both journals

	USAF	US Navy	US Army	USMC	USCG	Other DoD
Period 1	39.06%	21.88%	12.50%	6.25%	0.00%	10.94%
Period 2	29.11%	16.46%	25.32%	6.33%	0.00%	6.33%
Period 3	54.00%	18.00%	6.00%	2.00%	2.00%	6.00%
Period 4	45.40%	6.32%	18.97%	4.60%	0.00%	13.79%

JFQ Only – Changes in Contributing Institutions

As discussed, in order to best answer Research Questions #2b and 2c, the researchers used the data for JFQ only, since it was the only truly Joint journal. The background of only the JFQ contributing authors was examined by the researchers. Similarly to when the two journals were analyzed collectively, the overall contributing institutions were consistent through all four time periods. As displayed in Table 12, DoD organization contributions ranged from 83.93% to 97.83%. Non-DoD organization contributions ranged from 2.17% to 16.07%. The researchers identified no discernible trends when examining these categories of contributing institutions.

Table 12. Contributing authors' institutions - all organizations - JFQ only

	DoD Organizations	Non-DoD Organizations
Period 1	97.83%	2.17%
Period 2	83.93%	16.07%
Period 3	87.10%	12.90%
Period 4	89.72%	10.28%

The background of the contributing DoD-only authors in JFQ only was also examined by the researchers. There was some variation in contributing DoD components throughout the four time periods. Results are displayed in Table 13. Figure 17 displays a graphical representation of the three services' contributions over the 16 year period.

The US Navy's contributions peaked in Period 1 with 30% of total contributions. It led all other contributing organizations in Period 1, but never regained its lead. The Navy's contributions fell to 23% in Period 2 but then increased to 29% in Period 3. In Period 4, the Navy's contributions dropped off sharply to only 10% of the total contributed articles.

The US Army's contributions increased sharply in the first two periods. In Period 1, it contributed 17% of the total articles contributed; by Period 2 it led all other organizations by contributing 32% of the total articles. It fell off sharply to 9% in Period 3, but regained its lead in Period 4 with 30% of the total articles contributed.

The US Air Force contributed 28% of total articles in Period 1, just below the Navy's contribution of 30%. The USAF contributions dropped sharply in Period 2 to 10%, but it increased sharply to 32% in Period 3. At that point, the USAF was the leading contributor to JFQ information and IT related articles. By Period 4, the USAF's contributions dropped to 20%.

While the US Army overall has provided the most contributing authors to the JFQ, it has not consistently led in all periods analyzed. The Air Force and Navy have been close competitors with regard to contributing information and IT related material to JFQ. The US Marine Corps has consistently contributed the least amount of articles with less than 10% throughout the time period.

Table 13. Contributing authors' institutions - DoD only – JFQ only

	USAF	**US Navy**	**US Army**	**USMC**	**USCG**	**Other DoD**
Period 1	28.26%	30.43%	17.39%	8.70%	0.00%	13.04%
Period 2	10.71%	23.21%	32.14%	8.93%	0.00%	8.93%
Period 3	32.26%	29.03%	9.68%	3.23%	3.23%	9.68%
Period 4	20.56%	10.28%	29.91%	7.48%	0.00%	21.50%

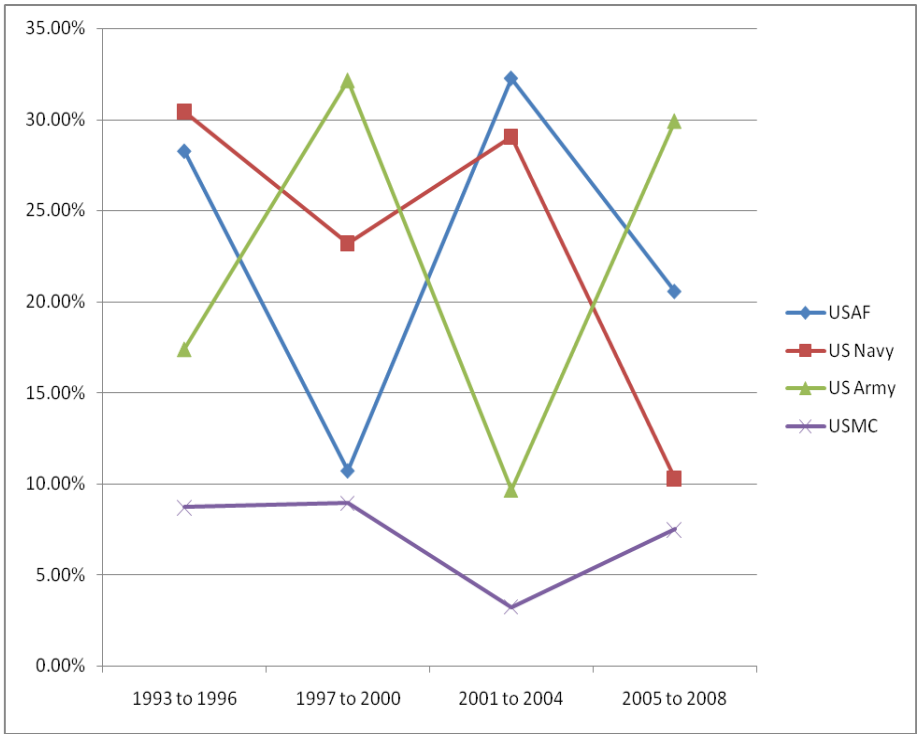

Figure 17. Change in military organization's contribution to JFQ

Research Question #3.

The final question was "What do the trends and patterns indicate about what IT elements will be discussed in the Air Force and DoD in the future?" This question will be addressed in Chapter 4.

Chapter 4. Conclusion

Chapter Overview

The purpose of this chapter is to present conclusions based on the data analysis conducted in the study. The first two research questions are re-examined and conclusions are presented. The third research question is discussed in more detail because it pertains to future expectations regarding information and IT subject matter. Several limitations of the research are explained. The chapter concludes with some recommendations for future research.

Research Summary

As discussed in Chapter 1, the primary purpose of this research was to examine the importance of information and IT in the Air Force and DoD and analyze how it has evolved over the past sixteen years. The researchers evaluated this progression through a review of articles from two defense journals: the ASPJ and the JFQ. The study was intended to help understand what information and IT subjects have been explored within the Air Force and DoD, which topics have been most frequently discussed, and how these priorities have changed since the early 1990s.

Three overall research questions were defined. A summary of these questions and the overall study purpose and scope is presented in Table 14.

Table 14. Summary of research purpose, scope, and questions

Research Summary			
Purpose: To examine the importance of information and IT in the USAF and DoD **Scope:** 1993 to 2008			
Research Question #	**Research Question**	**Data Analyzed**	**Successfully Answered?**
RQ #1:	*"What has been the role of information and information technology (IT) in DoD over the past 16 years?"*	Journal Articles	Yes
RQ #1a:	*"What information and IT subject matters have been addressed by DoD over the past 16 years?"*	Journal Articles	Yes
RQ #1b:	*"What have been the most frequently discussed subject matters?"*	Journal Articles	Yes
RQ #1c:	*"How has DoD information and IT subject matter changed?"*	Journal Articles	Yes
RQ #2:	*"Who is discussing information and IT in DoD?"*	Journal Articles	Yes
RQ #2a:	*"What is the background of those discussing information and IT related issues?"*	Journal Articles	Yes
RQ #2b:	*"How has this changed over the past 16 years?"*	Journal Articles	Yes
RQ #3:	*"What do the trends and patterns indicate about what information and IT elements will be important to DoD in the future?"*	Journal Articles	Yes

Conclusions

Research Question #1, 1a, 1b, 1c.

(Q1) Based on the results presented in Chapter 3, researchers conclude that there has been a considerable increase in information and IT related subject matter within DoD over the 16 year period analyzed. During the first year of the period, 1993, only 5% of the articles in both journals examined information or IT related subjects. By the end of

the period (2008), over 23% of the articles examined such subjects. The data did not indicate a continuous year-by-year increase in relevant subject matter; there were increases and decreases from year to year. However, the positive trend line in Figure 1 definitely indicates an increase over the time period analyzed.

(Q1A) The researchers identified seven Overall Categories (OCs) of information and IT related subject matter. These categories are listed in Table 15. Articles were further classified into subordinate Topics and Subtopics. Details on these categories are provided in Appendix A. Researchers conclude that these are the information and IT subject matter that have been addressed by DoD over the past 16 years.

Table 15. Overall Categories identified

Overall Category #	Category Description
OC #1	Information Operations
OC #2	Interoperability, Integration, Information Sharing
OC #3	Using IT to Improve Efficiencies, to Support Operations, and to Improve Job Performance
OC #4	Internet, Bandwidth, GIG, Connectivity, and Infrastructure
OC #5	Organizational Issues
OC #6	Systems
OC #7	Miscellaneous Topics

(Q1B) The researchers conclude that the two most frequently discussed information and IT subject matters over the 16 period analyzed are Information Operations and Interoperability. Information Operations (IO) related matters made up nearly half (49.9%) of the total information and IT related articles. Because the IO Overall Category included several Topics that are currently very popular amongst DoD personnel, researchers expected this to be the most frequently identified category. Interoperability, Integration, and Information Sharing related subject matter made up 18% of the total articles. The researchers suspect the considerable number of instances

the category was cited is due to the highly emphasized need for "Jointness" in DoD and the need to share information among services, other government agencies, and coalition partners over the past 16 years.

Information Operations (IO)

(Q1C) The data indicated changes to the instances of IO material over the sixteen year period. Overall, there was an increase, but a drop occurred during Period 3. The researchers suspect this downfall in IO related material is related to the burst of the IT Bubble in 2000 and the kickoff of the US wars in Afghanistan and Iraq during Period 3. At that time, researchers infer authors were writing less about IO and more about topics including the 2001 terrorist attacks, terrorism in general, the on-going ground wars, and counter-insurgency operations. The overall increase in IO subject matter during the 16 year period was expected. Information operations have become increasingly important since 2005, information technology has become more ubiquitous, and the U.S. and its adversaries continue to find new ways to exploit its capabilities.

Within the Information Operation category, several noteworthy trends were identified. Instances of Intelligence, Surveillance, and Reconnaissance (ISR) related material increased steadily over the time period. The researchers presume the increase is due to the improved and less costly technologies being utilized by DoD, and the ever increasing use of UAVs and related ISR assets in Wars in Iraq and Afghanistan.

Information Superiority instances increased early in the period, but then fell sharply in Period 3 and increased slightly in Period 4. The researchers suspect the large increase between Period 1 and Period 2 is due to the drastic increase in information

technology during the IT bubble of the late 1990s as more and more companies and military organizations increased their IT infrastructure. Organizations saw increased IT as a means to increase information and the resulting information superiority it provided them. The IT Bubble slowed somewhat in the year 2000. Similarly, in Period 2, more and more organizations were preparing for the Y2K change over, which focused even more attention on the areas of information and information superiority. Since then, the researchers identified only a slight increase in Information Superiority instances

The instances of Influence Operations related material changed very little during the first three time periods, but increased significantly during the final time period analyzed. The researchers deduced that the increase is due to the changes in US strategies in the War in Iraq during the time period. For example, the US increased its usage of influence and public affairs operations as it attempted to improve its perception in the eyes of Iraqis and neighboring Arab nation citizens.

Both Network Warfare Operations and Information Assurances had considerable increases identified during the time period. The researchers suspect this increase in Network Warfare Operations is due to the significant influx of IT assets by the US and its adversaries and the vastly improved infrastructure of information assets across the globe during the 16 year period. Both the US and its adversaries have taken monumental steps to increase their abilities to conduct offensive network warfare and defend their critical systems. The researchers believe the increase in Information Assurance is due to the considerable increase in cyber attacks and threats of attack, and the vastly improved measures that DoD has taken in the past few years to protect and defend its IT resources.

Four of the seven OCs had considerable fluctuation over the time periods, but overall indicated significant increases in occurrences. These four OCs include Interoperability, Integration, and Information Sharing; Using IT to Improve Efficiencies, to Support Operations, and to Improve Job Performance; Internet, Bandwidth, GIG, Connectivity, and Infrastructure; and Organizational Issues.

The researchers recognize the significant size of this Overall Category. With just under 50% of all instances within the study, the Information Operations Overall Category could have been split into separate overall categories. However, in keeping with the concepts outlined in AFDD 2-5, and the broad components of Information Operations, the researchers opted to maintain the large overall category. Further granularity of the Topics and Subtopics included within the overall category are described in Appendix A.

Interoperability

The researchers suspect the considerable number of instances of Interoperability in the 1990s is due to the highly emphasized need for "Jointness" in DoD after the standup of the Combatant Commands. Similarly, Clinger Cohen may have encouraged the discussion of interoperability during the time period. The increase in Period 4 may be a result of increased emphasis DoD leadership has placed on net-centric operations. Recent Chairman of the Joint Chief guidance describes net-centric operations as the "core concept that guides the transformation of the U.S. military" (Department of Defense, 2008).

IT to Improve Efficiencies

Using IT to Improve Efficiencies saw an increase between Periods 1 and 2, a sharp decline in Period 3, and a sharp increase again in Period 4. Researchers suspect

these trends are due to the IT Boom of the 1990s followed by the burst in the year 2000. Authors appeared to be writing less about information systems related topics and more about topics such as terrorist attacks, the on-going ground wars, and counter-insurgency operations. The overall increase in instances of "IT to Improve Efficiencies" during the 16 year period was anticipated by the researchers, as IT continues to become ubiquitous and DoD find new ways to exploit its capabilities.

Internet

Internet related material, including bandwidth, GIG, connectivity, and infrastructure subject matter saw a considerable increase between Periods 1 and 2, a decrease in Period 3, and an increase in Period 4. The researchers suspect these trends are due to multiple factors. The increased attention to Y2K related issues may have generated increased infrastructure issues. Clinger Cohen encouraged new strategies to better utilize IT. The IT Boom of the 1990s and the unprecedented growth of the Internet during Periods 1 and 2 may also have contributed to the trends. Many authors discussed the increased presence of the Internet and the need for increased bandwidth at in garrison and deployed locations. The decrease in Period 3 may be due to the burst of the IT bubble in the year 2000 and the decreased emphasis on Y2K. During Period 4, the GIG was a very popular topic as the concept migrated from concept to reality. The GIG, the Internet and bandwidth became popular topics as even deployed locations deep within the battle zone became interconnected.

Organizational Issues

Organizational issues, similar to the Internet category, saw an increase between Periods 1 and 2, a decrease in Period 3, and an increase in Period 4. The late 1990s

(Period 2) saw an increase in material discussing the organizational units responsible for information warfare. By Period 4, some articles discussed the specific responsibilities of existing and proposed information operations organizations. During Period 4 there were also a significant number of instances of Air Force Cyber Command and other proposed organizations to lead the information operations front.

Systems

The Overall Category "Systems" saw a decrease from Periods 1 to 3 and an increase in Period 4. The researchers suspect the larger number in Period 1 is due to the considerable discussions regarding the standup of the joint Combatant Commands and DoD's emphasis on the need for interoperable systems that work together with other DoD, non-DoD, and coalition systems. The rise in Period 4 was possibly due to the increased discussion of interoperable systems within DoD, as many specific systems, particularly intelligence and command and control information systems, were discussed in the journal articles. Some articles discussed the ability of existing systems to share data, while other articles identified the lack of interoperability among existing systems. Still others discussed network centric warfare and the systems utilized in such operations.

Miscellaneous Topics

Within the "Miscellaneous Topics" Overall Category, one Topic indicated a notable change. "Training and Learning" was steady during the first two periods, dropped considerably in Period 3, and rose slightly in Period 4. The researchers suspect this is due to the considerable discussion in the 1990s of utilizing IT to deliver or enhance the delivery of training material, particular professional military education. IT became more ubiquitous in Period 3, and more significant topics were being discussed by authors,

such as the 2001 terrorist attacks and the Wars in Afghanistan and Iraq. By Period 4, information operations material was ever-present, and training of information operations and related IT issues increased in discussion.

Research Question #2, 2a, 2b.

(Q2) Researchers analyzed authors of journal articles to determine who is discussing IT and the institutions they represent. As discussed in Chapter 2, by examining the frequency of articles by a specific author, subject matter experts, key contributors, and thought leaders can be identified (Carter and Ellram, 2003). In this study, one author contributed 6 relevant articles, three authors contributed 4 articles, and three authors contributed 3 articles. The researchers were surprised with these results. Before conducting the study, the researchers surmised they would identify several key contributing authors who would contribute 10 or more articles each.

(Q2A) The researchers considered the authors' contributing institutions. When examining the journal articles collectively, the Air Force is by far the greatest contributor, followed by the Army and then the Navy. However, the researchers acknowledged that because one of the two journals was published by the Air Force, the number of Air Force contributing authors would likely be higher in that journal and will likely skew the total results. When examining ASPJ alone, the Air Force was unsurprisingly the key contributing institution.

In order to best analyze Research Questions #2b and 2c, the researchers used the data for JFQ only. When examining JFQ alone, the Army was the most frequent contributing institution, followed by the Air Force and the Navy. These numbers are

proportional to the overall officer force strength numbers as presented in Table 9 in Chapter 3.

(Q2B)While the Army overall has provided the most contributing authors to the JFQ, it has not consistently led in all periods analyzed. The Air Force and Navy have been close competitors with regard to contributing information and IT related material to JFQ. When examining the changes in contributing institutions over the time period, the researchers identified no significant trends. This was the case when analyzing the two journals collectively or when considering them individually.

Research Question #3.

Several of the information and IT related issues examined have indicated trends that may signify future changes. Researchers made the following predictions regarding future activity.

First, researchers expect the current upward trend of articles with information or IT subject matter to continue. Figure 1 in Chapter 3 indicates an overall increase with several notable drops and peaks. Over the next five years, the researchers expect information and IT to become more and more integrated in DoD operations. Additionally, new cyber and information operations organizations are likely to be stood up within DoD, such as the Air Force Cyber Command or a similar organization. As these and other events occur, researchers suspect the percentage of articles with information and IT related material will likely increase.

Second, for those topics within the Overall Category IO, researchers expect a continued increase in the number of instances of IO related material in journal articles.

This will be due to the increased emphasis on IO as technology costs decrease for the US and its adversaries, the Internet infrastructure continues to expand globally, and the US and its adversaries discover new methods to exploit IT for offensive and defensive purposes.

Within the IO Overall Category, the researchers expect that ISR will continue to see increased instances within DoD journals, as technologies continue to improve, and DoD increases the number of UAV and ISR assets within its inventory.

The researchers suspect Information Superiority topics will likely level off or decrease slightly, as IT becomes more ubiquitous within DoD. Also affecting this concept may be DoD's attention focusing less on the term "Information Superiority" and more towards other related terms such as "Netcentric Operations" and "Interoperability."

The researchers deduce that Influence Operations may also begin to level off over the next five years, especially if the US departs Iraq or Afghanistan during the time period. However, psychological operations, public affairs operations, and other forms of influence operations will continue to be important as the US attempts to influence the ways that specifically Arab nations perceive the US and its intentions in the Middle East.

The researchers suspect increased instances of Network Warfare Operations and Information Assurance concepts over the next five years. Both concepts saw steady increases over the 16 years analyzed. As information technology increases in complexity, and as more and more adversaries determine new ways to use IT against the US, it will be imperative for the US to increase its Network Warfare Operations and ensure it takes new and improved means to provide Information Assurance for its growing inventory of IT assets.

Researchers expect to see a steady or slight increase in the instances of the concepts of Interoperability, Integration, and Information Sharing over the next five years, as many systems are still considered to be "stove piped" and do not interoperate or share data with one other. With the increase in networked information systems, the need for interoperable systems and applications may increase over the time period. The researchers believe there will come a time when most systems are interoperable to a necessary extent, but they believe this is 20 or more years away.

The researchers suspect a continued increase in the occurrences of Internet, bandwidth, GIG, connectivity, and infrastructure topics. As mentioned, Internet infrastructure continues to expand globally, and the GIG and infrastructure topics will likely continue to rise, as DoD interconnects more of its in-garrison and deployed air, land, sea, and space assets.

The researchers expect an increase in the instances of Organizational issues with regard to information and IT. As DoD and the Air Force continue to evaluate possible designated commands for IO activities, the instances of such articles will likely increase. However, if DoD decisions are made within the next 1 or 2 years, the instances of such topics may level off over the next five years.

Limitations of Research

There were three main limitations noted for this research study. These included researcher bias, the authors' use of terminology, and focus areas for specific journal issues.

First, researcher bias was a potential limitation to the study. The methodology utilized was subjective in nature, and there were opportunities for an erroneous interpretation of the articles. For example, a researcher's education and experience may lead to bias when evaluating the data for topics and themes. If the researcher has a better understanding of one topic than another, he may be more inclined to identify that topic more often than the other topics.

Next, the articles' authors may have used specific terminology incorrectly or inappropriately, causing flawed results. For example, since many of the terminology examined in this study have vague or broadly-defined definitions within DoD, the terms are often perceived differently amongst different people. For example, one author may utilize "network centric operations" to describe all offensive and defensive operations that involve a computer and the Internet. Another author might use the term strictly as offensive operations against an adversary. Similarly, some authors utilize the terms "information operations" and "information warfare" interchangeably, when in fact DoD defines the two terms differently. During the study, the researchers read articles and made every effort to determine if a specific author's use of a specific term or concept was consistent with DoD defined terminology. The specific situations were dealt with appropriately. For example, in one case, an author used the term "information warfare" but described the concept more in line with "information operations." In such a situation, the researcher would file the article under "information operations."

A third limitation of the study was journal focus areas for specific issues. ASPJ utilizes "Focus Areas" for the Feature articles of each journal issue. With the diversity of operational domains within the Air Force, the journal's staff steers authors toward

specific “Focus Areas” for articles. These “Focus Areas” are based on what “Airmen are doing and what our senior leaders say is important” (Berg, 2008). Some Focus Areas are occasionally repeated while others are one time events. This may pose a study limitation as the mandated Focus Areas may cause articles to fall within those specific areas. For example, if the Focus Area for one issue is “Information Operations,” it can be expected that the number of IT-related articles would be somewhat higher than for an issue where the Focus Area is “the ground war in Afghanistan.” However, since IT is so integrated in the way the Air Force does business, the impact of the Focus Areas may be minimal. The Focus Area only applies to Feature articles. Typical issues of ASPJ contain 4-6 Feature articles and another 6-8 other articles.

Future Research

The researchers identified four significant areas where future study would be beneficial. Researchers could further expand on the data and results from this study or they could investigate other related research areas.

Expanding on Current Study

First, a thorough investigation could be conducted to determine why fluctuations occurred with the data. These variations were particularly noteworthy during period 3, where the instances of relevant material decreased for many of the categories analyzed. Future research could evaluate what other factors might have caused fluctuations throughout the 16 year time period. An independent examination of external events

could be assessed to determine how they might be impacting what's being discussed within DoD.

Second, articles analyzed in this study could be examined to determine what other topics were being discussed during the time period. For example, in period 3, since the amount of information and IT subject matter appeared to decrease, researchers could examine what other topics were being discussed instead. Results might indicate a significant increase in discussions of the Iraq War and counterinsurgency efforts.

Third, other defense journals could be analyzed to identify trends or changes in subject matter emphasized by DoD or the individual services. As discussed in Chapter 1, before deciding on the ASPJ and JFQ journals, researchers examined Air University's list of 124 different military journals and magazines. On this list, five journals were evaluated as focusing exclusively on information and IT. Future research could focus on one or more of these defense journals. Specific information and IT journals could be further analyzed to determine which topics are being discussed. Also on the Air University list, 20 journals were evaluated as having a considerable amount of material on information and IT, but not focusing exclusively on IT. Future research could examine any of these journals to determine if similar trends and patterns occurred as did in this study.

Fourth, other qualitative methods, such as surveys, interviews, or case studies could be conducted to analyze those information and IT topics emphasized by the Air Force and DoD. These methods could include surveying military members or flag officers who served during the time period. Interviews could be conducted with Chief Information Officers (or their representatives) of DoD agencies over the time period.

Related Research Areas

As discussed, journals play critical roles to the fields they support. By evaluating existing journals, researchers can appraise the intellectual health of a given discipline (Das & Handfield, 1997). An analysis of defense journals could be used to examine other topics that have been frequently discussed. For example, an analysis could be conducted to determine which space related topics are of considerable importance to DoD.

Overview

This study examined the information and IT related journal articles from two highly respected defense journals. The research conducted indicates a considerable increase in information and IT related material over the 16 year period analyzed. When categorizing relevant articles, the most commonly identified subject matter was Information Operations, followed by Interoperability, Integration, and Information Sharing. There were numerous authors that contributed to the two journals, but only one author contributed more than 5 articles discussing relevant material. When examining JFQ articles, which has contributions by all DoD components, the Army was the greatest contributing institution to information and IT related articles, followed by the Air Force and the Navy.

Appendix A. Overall Categories and Topics.

OC #	Overall Category	Topic	Subtopics
1	Information Operations	Information Operations – Miscellaneous and Applications	• Information Operations Strategies • Information Operations – Applications of • Information Operations – Definition of • Information Operations Examples • Information Operations Career Path
		ISR	• None
		Information Superiority	• Information Superiority • Information Advantage
		Influence Operations	• Influence Operations • Public Affairs Operations • Psychological Operations • Military Deception • Operations Security
		Information Warfare – Miscellaneous	• Information Warfare Strategies • Information Warfare – Applications of • Information Warfare – Definition of • Information Warfare Examples
		Network Warfare Operations	• Network Attack • Network Defense • Network Warfare Support • Network Centric Warfare
		Cyberspace – Miscellaneous	• Cyberpower • Definitions of Cyberspace and Cyberpower • Fighting in the Cyberspace Domain • Why Cyberspace is Relevant
		Information Assurance	• Cyber Threats & Vulnerabilities • Protecting Information Systems
		Electronic Warfare Operations	• None
2	Interoperability	Interoperability, Integration, and Information Sharing	• Integration / Interoperability • Information Control • Information Overflow • Information Sharing
3	IT to Improve Effectiveness	Using IT to Improve Efficiencies, to Support Operations, or to Improve Job Performance	• Using IT in the Battlefield • Using IT to Improve Efficiencies • Using IT to Improve Job Performance • Using IT to Support Operations
4	Internet	Internet, Bandwidth, GIG, Connectivity, and Infrastructure	• Need for Bandwidth • Lack of Internet Connectivity • Global Information Grid • The Growth of the Internet • Updating IT Infrastructure

5	Organizational	Organizational Issues	• Proposed New Cyberspace Organizations (including AF Cyber Command) • Specific Units and their Cyberspace Activities and Responsibilities • Information Warfare and Information Operations Organizations • The Need for Communications Directorate
6	Systems	Specific Systems	• Specific IT Systems • IT Programs
7	Miscellaneous Topics	Training and Learning	• IT Supporting Training and PME • IT to Support Education • Information Operations in PME • Information Warfare Training
		Doctrine and Legal Issues	• Cyber Law • Cyberspace Doctrine • Information Operations – Act of War? • Information Warfare Doctrine • Information Operations Doctrine
		Transformational Issues	• Air Force Changing from Air/Space Force to Information Force • IT Supporting DoD/Air Force Transformation
		Other Topics	• Geospatial Information • IT Acquisition • Information Revolution • Knowledge Warfare • Non-technical methods of Information Dissemination • IT Becoming Indispensible to Military • Collaboration Environments/Communities of Practice • Computer Wargaming • Other Subtopics

Appendix B. Frequency of Overall Category and Topic Instances per Period

OC #	Overall Category	Topic	Period 1: 1993 to 1996	Period 2: 1997 to 2000	Period 3: 2001 to 2004	Period 4: 2005 to 2008	Total	Percent of Total Instances
1	Information Operations		27	58	30	105	**220**	49.9%
		Information Operations – Misc & Applications of	4	13	7	19	43	
		ISR	2	5	8	26	41	
		Information Superiority	4	15	4	7	30	
		Influence Operations	4	6	4	15	29	
		Information Warfare – Miscellaneous	11	13	0	5	29	
		Network Warfare Operations	1	2	6	15	24	
		Cyberspace - Miscellaneous	0	2	0	10	12	
		Information Assurance	0	1	1	6	8	
		Electronic Warfare Operations	1	1	0	2	4	
2	Interoperability		16	20	12	33	**81**	18.4%
3	IT to Improve Effectiveness		6	12	1	13	**32**	7.3%
4	Internet		1	5	2	9	**17**	3.9%
5	Organizational		2	5	3	7	**17**	3.9%
6	System		5	3	2	6	**16**	3.6%
7	Miscellaneous Topics		17	11	9	21	**58**	13.1%
		Training and Learning	4	4	1	3	12	
		Doctrine and Legal	4	3	1	3	11	
		Transformational Issues	1	0	3	4	8	
		Other Topics	8	4	4	11	27	
	Total						**441**	

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Vita

Mr. Daniel K. Smith graduated from Bryan High School in Bryan, Ohio. He entered undergraduate studies at Purdue University, West Lafayette, Indiana where he graduated with a Bachelor of Science degree in Atmospheric Science in 1996. He was commissioned through Detachment 220 AFROTC.

His first active duty assignment was at Whiteman AFB, Missouri as an operational meteorologist. While at Whiteman, he deployed to Panama and Guam. In 1999, he was assigned to United States Strategic Command, Offutt AFB, Nebraska, where he served as an airborne meteorology and oceanography officer aboard the nuclear command and control aircraft "Looking Glass." During this time, he completed a Master's of Business Administration degree from the University of Nebraska-Lincoln.

Mr. Smith separated from active duty in 2003 and became a civilian acquisition project officer at the Air Force Weather Agency (AFWA), Offutt AFB. In 2005, he was promoted to Branch Chief in the acquisition programs branch at AFWA.

In August 2007, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology, as part of the Air Force Civilian Development and Education program. Upon graduation, he will be assigned to the 850th Electronic Systems Group operating location at United States Strategic Command, Offutt AFB. He is also an Air Force reserve officer at United States Strategic Command.

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14. ABSTRACT

Over the past two decades, information and information technology (IT) have evolved significantly and have become increasingly important to our national security. Many different journals have described this evolution. The purpose of this study is to examine the evolution of information and IT through the articles of two defense journals over a sixteen-year period. It provides a review of the article subject matter, the changes in the subject matter, the contributing authors and their institutions, and predictions for the next five years.

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