Successes of Collaborative Decision Making at the Traffic Flow Management Program Office and the Advantages of adopting Toolkits

By

Vaynu Osuri

Submitted to the System Design and Management Program
In partial Fulfillment of the Requirements for the Degree of
Master of Science in Engineering and Management

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Abstract

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Manufacturers, product designers and developers of products that have a large and diverse user base are consistently trying to produce products that satisfy as many users as possible. Manufacturers and product developers have found that it is extremely difficult to do so. The closer the manufacturer or developer gets to meeting all user needs, the higher and more prohibitive the cost gets. The Traffic Flow Management (TFM) Program Office, within the Federal Aviation Administration (FAA) has the task the do just that. To its credit the TFM program office has come quite close to achieving this. The goal of this thesis is to identify and document the practices that have made the TFM program office successful and to find ways that can help them achieve even greater end user satisfaction. To do this TFM's complete product development cycle was analyzed. Special attention was given to user interaction and user innovation. The research found that the TFM program office does a good job of identifying user requirements, it also does a good job in incorporating user innovations but despite this, they are not able to meet all the user needs.

The toolkit model is then used to demonstrate how the TFM program office can overcome some challenges that are inherent to the processes it currently follows.

Thesis Supervisor:
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Dedication

This work is dedicated to my son Rahul.
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Chapter 1: Introduction

1.1 Motivation

User satisfaction is the single most important factor in the success of any given product. Whether it is consumer electronic or software products, users are increasingly looking for products that will meet all their needs. To take this further, users are more likely to purchase products that will provide more features than they actually need, depending on the cost involved.

Despite the increase in user awareness and the increasing number of reports suggesting that consumers are becoming more demanding, it is quite surprising to find a number of products on the market that fail to meet all user needs. This is true of almost every industry today. In many cases, users constantly have to find creative ways to overcome some shortcomings of a product. There could be many reasons for this, including the manufacturer’s failure to understand user needs. Von Hippel (2005), in his book, *Democratizing Innovation-Eric Von Hippel*, argues that this is because manufacturers/designers try to make products that satisfy a wide range of users.

Researchers have been studying this field for a long time, trying to find out what it takes to make products that meet customer needs and expectations.

Manufacturers and developers know that users are often the best source of information when it comes to determining the characteristics and properties of a product; however, getting this information has not been easy. Studies have shown that many of the current methods, such as focus groups and market research, are not as accurate as previously thought. And even if one understands user needs and user requirements, is it always possible to develop a product that satisfies the needs of all the customers? There are numerous examples that show that it may not be possible to meet all user needs and still keep costs low enough to make any given product attractive to customers.
The scope of this topic is very broad and a comprehensive study of all consumers for every industry will make it difficult to contain the scope of this work. I have therefore chosen to research, the Traffic Flow Management (TFM) program office within the FAA to determine what an organization within the government needs to do to meet user needs.

1.2 Thesis Structure

This chapter will provide an introduction to the thesis and the questions that it attempt to address. It will also provide an overview of the TFM program office and the role it plays within the FAA.

The remainder of the thesis is structured as follows:

- Chapter 2 will review some relevant literature that will provide a basis for this study. To emphasize the importance of user involvement in the product development process an example from the milk processing industry is provided. While this example may seem out of place for our discussion purposes, I have chosen to include it because it provides an excellent real world example of “user intelligence” (Rogoff et al, 1999).
- Chapter 3 describes the research methodology used in this paper and the current product development process followed by the TFM program office.
- Chapter 4 provides an overview of the successes and challenges of the current TFM product development process.
- Chapter 5 presents the research results and an analysis of the current product development process followed by the TFM program office. It also provides some suggestions to further improve the process.
- Chapter 6 discusses the findings, draws conclusions based on the TFM program office’s constraints and provides recommendations for future work.
1.3 Goals

As mentioned in the previous section, the goal of this thesis is to determine what an organization needs to do to create a successful product or series of successful products that meet user needs and expectations, even when user needs differ from user to user.

The TFM program office within the FAA has over the years grown from being a slow moving, typical government organization to a successful one, creating products that in most cases, meet user needs. This thesis will study the TFM programs’ product development process to determine what makes it successful and what are some things that can be further improved. The following are the specific goals to determine:

- What things enable organizations to develop successful products?
- How does the TFM program develop its products?
- How much user interaction is involved in the process?
- What makes the TFM program successful, despite some restrictions?
- Are users satisfied with the process?
- What are the pros and cons of such a process?
- What aspects of the TFM process can be improved?
- What will it take to implement these changes?

1.4 Overview of FAA Traffic Flow Management (TFM)

The FAA handles more than 70,000 flights per day. Every day, thousands of people use commercial air transportation to travel. In addition, there is a fast growing community of private jets and military aircraft that adds to this traffic.
Such large volumes of traffic lead to many traffic management issues. The situation becomes even more challenging during severe weather conditions. The Traffic Flow Management (TFM) Program in the FAA provides this traffic management function for the FAA. It designs and develops products and services that support the efforts of the Traffic Management Specialists (TMS) and Traffic Management Coordinators (TMC) to optimize air traffic flow across the country. The TMS and TMC planners analyze, plan, and coordinate air traffic flow through continuous coordination with the airlines and the use of surveillance sources, weather, automation, and display subsystems.

Over the years, the TFM group has developed these products and services in collaboration with the users, i.e. the internal FAA users (Traffic Management Specialists and Traffic Management Coordinators) and the external users (aviation community and industry users). To facilitate this collaboration, the TFM group works within what is called the Collaborative Decision Making (CDM) group, consisting of both the internal FAA users and the external users.

As air traffic continues to grow, along with the need for faster and safer transportation, the TFM program office has the task of continuously improving the tools and processes for Air Traffic Coordinators and Air Traffic Controllers. They do this by continuously improving existing tools and systems that the users use.

The National Airspace System (NAS) is divided into 20 Air Route Traffic Control Centers (ARTCC); each ARTCC is further divided into sections controlled by Terminal Radar Approach Control Facilities (TRACONs). These TRACONs are then further divided into Air Traffic Control Towers (ATCTs), typically located at each airport. The Air Traffic Control System Command Center (ATCSCC), also called the Command Center, is responsible for the TFM function of the overall NAS. It oversees the functioning of the ARTCCs, TRACONs, and ATCTs. Traffic control specialists at all the above-mentioned facilities use a variety of tools to ensure the smooth functioning of the NAS system.
In addition to supporting the internal users within the FAA, the TFM function also involves active coordination with the commercial airline industry, the private airline industry, and the United States Air Force. Therefore, in addition to meeting the needs of the internal FAA users, the TFM program office is also required to develop products that meet the needs of these other external users.
Chapter 2: Approach

2.1 Overview

As mentioned earlier, the primary goal of this thesis is to assess the effectiveness of the current measures adopted by the TFM program office and to gain some insight into the effectiveness of the CDM process and the software development process. To do this, a number of areas are studied, including the CDM process, the user and development team interactions, the user satisfaction, and the overall success of such measures.

The intended approach to this work is to document the current TFM product development model, study the model, and understand and document the benefits of the model and what makes it successful. The research will also document what does not work in the TFM model, compare it with three different frameworks, and make some suggestions on how to overcome some challenges that it faces.

This section will provide relevant information on the importance of user input, user innovation, and user empowerment to provide a basis for this thesis. Substantial work has been done in this field to show how important the user is to creating successful products leading to successful enterprises. This thesis will not provide an exhaustive summary of any one of these fields, but instead, will focus primarily on important issues that are directly relevant to this thesis.
2.2 User Innovation and the Importance of Empowering Users

2.2.1 Working Intelligence

In today’s world, people who design and develop products are considered experts in determining what a user needs (Rogoff et al, 1999). The manufacturer designates a team that studies various users to determine the exact features a product must have in order to meet user needs. Often, this is determined with minimal user input. Over the years, manufacturers and developers have developed various methods to determine what users really want. These include market research, focus groups, and user observation. These methods have proven to be successful in some cases, but this is not always the case. So, how does one really understand user needs? Is it possible to determine exactly what a user needs by market research, focus groups, etc.? Can a group of individuals who have not performed the everyday task that the users perform accurately determine what the user needs in a few days of research?

Barbara Rogoff and Jean Lave (1999), in their book *Everyday Cognition*, describe our perception of theoretical and practical thinking. They say that for years, society has perceived “theoretical thinking as superior to practical thinking.” This method of thinking has in many ways crept into our product development and manufacturing processes. Departments within companies and organizations that determine product features are comprised of engineers, management, and marketing and research professionals. Their theoretical knowledge and skill set is often thought to be sufficient to determine what a user really needs. Unfortunately, this is the case for most companies and organizations, even today.

In their study, Rogoff et al (1999) provide substantial evidence that this notion of theoretical knowledge as being superior to practical knowledge is not true. They do this through some very carefully thought out experiments, chosen so the observer can understand the thought process of an everyday user and that of an outsider who has equal or more theoretical skill than that of the user. They use the phrase “working intelligence” to describe the thought process and action of an everyday “user.”
One of the experiments conducted by Rogoff et al (1999) involved the dairy industry (the reader is encouraged to read the referenced book for detailed information). The experiment is described very briefly here to show the results and its implications to the study for this thesis.

The experiment studied Preloaders in a milk product distribution center. The job of the Preloaders involves loading the delivery trucks with the exact quantity of different kinds of milk products that were to be delivered the next day. These orders are completed based on order forms that are filled out by the truck drivers. This is done in two steps; first, the products are located and brought to a certain location, which involves determining how many cases or partial cases are required to fill the order and transporting them to the location using the least physical effort. Next, the entire order is loaded onto the truck.

To prove their point that users typically have the best solution to solve their problems, the authors observed how the Preloaders performed their tasks. Then the order forms and the partial case sizes were changed to quantities that were not normal and the Preloaders were observed again. Then the authors formed two other groups to perform the same set of functions. These groups included accounting professionals in the company and local students from a nearby high school. The accountants (office professionals who have more theoretical knowledge than the Preloaders) and the students (who had a similar education as the Preloaders) both underperformed when compared with the Preloaders.

The following are some observations made by the authors:

- Preloaders have large solution sets. They can solve a given problem in more than one way, without affecting their productivity.
- By default, almost all the solutions that Preloaders executed were the optimum for the given problem (least effort).
- Expertise was a function of experience.
This really goes to show that theoretical knowledge does not guarantee the best possible solution. Users are almost always the best judges of what really needs to be done to solve a problem. There are many different methods of incorporating user input when designing or developing a product.

2.2.2 Do Users Want Custom Products?

Our discussion until this point has stressed the fact that users are key to determining the features of the product. An argument for the importance of user involvement has been made. Now, let’s proceed to the next step. Is it possible to involve users in the process development process and still find users unhappy? Do manufacturers and developers who involve users in the design and development phase still ignore some user needs?

Von Hippel (2005) in his book *Democratizing Innovation* suggests that there are a set of users that want custom products. He argues that users may want custom products simply because products available to them are not designed or manufactured to meet individual user needs. This, he says, is because there is “Heterogeneity of User Needs.” There are very few users who have exactly the same or similar needs (Von Hippel, 2005).

Von Hippel (2005) further argues that the primary goal of manufacturers/developers is to develop a product that can be used by a maximum number of users. To do this, the manufacturer designs products based on what he thinks are the features most important to the average user. In a typical software development company or a manufacturing company, a group of individuals study user needs, and based on their findings (focus groups, user involvement, or market research), they form a list of user needs. They then list these needs in order of their importance. In most cases, this prioritization is done by the design and development teams. Since resources are limited, a determination is made as to what features are absolutely important for the success of the product. After this, features or needs that are easy to implement with minimal additional cost are also added. Sometimes, there is an attempt to add features that will meet the needs of a variety of users; the resulting implementation is a hybrid feature that attempts to perform all the
different functions with a slight compromise. This is true of products that are manufactured for a group of users with slightly different needs. A good example of this is the ear bud earphones. They almost never fit anyone’s ear perfectly, but users are expected to compromise. This is done to minimize the cost of production and development.

To prove the user demand for custom products, Von Hippel (2005) refers to two studies that he did along with his co-authors. The first of these papers studied (IT systems by Morrison, Roberts, and Von Hippel, 2000) modifications to library IT systems. They found that there were a total of 39 user innovations to the IT system, of these, only 14 were functionally similar to each other. The respondents in their study said that “their library IT system had been highly customized by the manufacturer.” A further 54% agreed to the statement that “we would like to make additional improvements to our IT system functionality that can’t be made by simply adjusting the standard, customer-accessible parameters provided by the supplier.” The second paper by Luthje, Herstatt, and Von Hippel (2002) points to the innovations in mountain bikes by users. Of a total of 43 documented innovations, only 10 were somewhat similar to each other in function.

At first glance, it does not appear as if one library system would be that different from another. A library IT system is a library IT system, they perform almost the same function at two different locations. But, upon careful inspection, one will notice that there are some small details that need to be changed. The same is true for the mountain bike. Why would one mountain biker need something different from another mountain biker? But, they do, for example, in that need would differ from terrain to terrain, slopes vs back-country, etc.
So, users have slightly different needs and they want custom products. But, manufacturers cannot provide custom products at the cost of mass produced products, therefore, are the users willing to pay for this customization? Von Hippel (2005) argues that they are willing to do so. In the afore-cited book, he cites a study he did along with a co-author, Franke (Franke and Von Hippel, 2003). In their study, they found that users of Apache servers were willing to pay more than 4 times what they would pay for similar software to have Apache customized to their needs.

2.2.3 Tool Kits

In his book, the *Mythical Man-Month*, Fredrick P. Brooks, Jr. talks about what he calls “The Power of Giving Up Power.” In many sections of the book, he argues that “creativity comes from individuals and not from structures or processes.” Successful organizations empower the right people to make decisions that are critical to the product. Let us take the example of one of the most successful products in the past few years, the IPOD. What really makes it successful? Some people would argue that it is the design, which may be partially true. But, the true success lies in the fact that the product gives the user control over what he or she really wants to hear. The user does not load songs that he or she does not want to hear on the IPOD. They are free to make a decision within certain boundaries.

Manufacturers and developers understand that there are limited resources for the development of a product. Costs of products have to be kept to a minimum. Is it possible to use user input during the development process, develop products that exactly meet all the users’ needs, and still keep costs down? Von Hippel (2005) again argues that this can be done through user toolkits. He suggests that manufacturers and developers can stop trying to understand user needs and trying to meet individual user needs if they “outsource only need related innovation tasks to the users.” He defines user toolkits as an “Integrated set of product design, prototyping, and design testing tools intended for use by the end users.” He, however, cautions that this solution cannot be applied to every situation.
Von Hippel (2005) points out that the benefit of using user toolkits is that it provides the manufacturer or designer with the ability to concentrate on what he can do best, while allowing the user to innovate and meet their individual needs. He further points to the semi-conductor industry as an example of successful implementation of the toolkit model. He points to his work (Thomke and Von Hippel, 2002) where he shows that the development time of semi-conductors was cut by more than 2/3 the time and that costs were reduced significantly as well. The study documents that in the year 2000 the sales for custom made semi-conductor components using user toolkits exceeded $15 billion. He also cites examples in the food industry where user toolkits were successfully employed, not only to improve user satisfaction, but also to increase market share.

![Diagram](image)

**Figure 2-1:** A pattern of problem solving often encountered in product and service development (Taken from Democratizing Innovation by Von Hippel, 2005)
To create an appropriate environment for user toolkits, Von Hippel (2005) stresses the need for partitioning the product development process into two parts, the “need-related information” and the “solution-related information.” He illustrates this using the semiconductor toolkit example. Semi-conductors were developed as shown in Figure 2-1 (i.e. through a series of iterations between the manufacturer and the users). This was a long and expensive process. Then Mead and Conway (1980) showed that partitioning the development process into solution-related and need-related provided the users with the flexibility they needed. They determined that design elements, such as transistors, could be made standard; this required the manufacturer’s expertise in fabrication. However, it did not need detailed information on user needs. Therefore, this process could be delegated to the fabrication and chip design engineers. The task of interconnecting standard circuit elements to form the integrated chip was user need-related information and could be delegated to the user. These same principles, he argues, can be applied to other industries. He goes on to describe an example in the food industry.

Per Von Hippel (2005), user toolkits must have certain functionality. He describes this functionality as follows:

- User toolkits should “enable users to carry out complete cycles of trial and error learning.”
- It should “offer users a solutions space that encompasses the design they want to create.”
- It should “be user friendly in the sense of being operable with little specialized training.”
- It should “contain libraries of commonly used modules that users can incorporate into custom designs.”
- It should “ensure that custom products and services designed by users will be producible on the manufacturer’s production equipment without modification by the manufacturer.”
Chapter 3: Research Methodology

3.1 Overview of the Methodology

This section of the thesis will describe the source of information and research approaches used. As in most research projects, this work started out with an ambitious goal and no firm methodology. The initial idea was to study multiple organizations and understand their models, but after some initial interviews with some folks within the TFM program office, it became clear that the TFM program would be an ideal candidate for the purposes of this research.

The initial interview with the TFM program manager provided me with an overview of the functioning of the TFM program. I was provided with a substantial number of documents and one short video that helped me understand what the TFM program office’s goals and objectives were.

The first few weeks were spent in understanding the functions of the TFM program. This was done through meeting various people within the program, understanding their function in the TFM program, and asking for their opinion of the program. Next, I was allowed to visit the FAA Air Traffic Control System Control Center (ATCSCC) to understand firsthand the importance of what the TFM program does. The tour provided me with a clear understanding of how aircraft are rerouted and the coordination processes between the FAA and the airlines. It also allowed me to see how the products developed by the TFM program helped Air Traffic Coordinators make their decisions.

The more I understood the functioning of the TFM program it became clear that there were a lot of parties involved in the functioning of the TFM program. Many of these were not a part of the FAA, they were non-government commercial entities, and there were also internal FAA folks who were direct TFM customers. Based on this information, it was determined that an interview-based methodology would be the best fit for the purposes of this research. Interviews were conducted in person when possible and over the phone when meetings in person were not feasible. Most of the folks interviewed
were airline traffic managers and FAA air traffic coordinators, the interviews were, therefore, kept short. A list of questions were emailed to the person approximately two days before the interview and then discussed during the interview, each person was interviewed approximately three times.

Author’s Note: It is important that the reader notes that this project was performed as an independent study. Even though it had the complete support of the TFM program office, no attempt has been made to overstate TFM achievements. The TFM program office has over the years been able to achieve substantial successes, despite the working environment around it. There are some specific laws that forbid non-government organizations from directly providing requirements to a government organization. The CDM initiative was put in place to overcome this hurdle. This is a result of the innovative and open thinking attitude of the TFM management. The TFM management is very open to change and improvement, thus it is the goal of the author to suggest some improvements based on the findings in this study.

3.2 TFM Software Development Process

The process followed by the TFM program office encourages user innovation to a certain extent. This is shown by the number of products that have been developed by the TFM program office based on recommendations made by users. The reason TFM is able to do this, is because it involves users in every step of the product development phase. The following section is a very high level description of the software development process used by the TFM program office.

3.2.1 Requirements Generation

As mentioned earlier, the TFM program office works closely with the users in what is called the CDM process. Therefore, whether the program office is generating requirements for a product upgrade or for development of an entirely new product, the users are involved right from the beginning. The System Operations teams collect requirements from users, field personnel, research groups, and other sources and then prioritize them. Once this is done, all the stakeholders (the stakeholders are the TFM management, the airline users, and the internal FAA users) then collaboratively decide if
the prioritization is appropriate; this is debated until a consensus is reached. If a general consensus is not reached, then the TFM program office has the final say. This collaborative consensus includes establishing and defining the mission needs and requirements for system modifications or new systems development.

The following diagram shows the requirements generation phase of the TFM software development cycle:

![Diagram showing requirements generation phase](image)

**Figure 3-1: Product feature development process (Taken from TFM Software Life Cycle Development process document, Fig 1 page 10)**
3.2.2 Development

Before development of the product begins, the TFM program office conducts a design review. The design review process includes mockups and prototypes to help identify any potential problem areas.

During the development process, the TFM group involves all the stakeholders (traffic management folks, the weather specialists, training personnel, airlines, etc.) in the process. This is done to ensure that errors and problems are caught as early as possible. As a part of the stakeholder involvement process, the TFM program office conducts weekly teleconference calls between all the involved groups in which they discuss progress, share ideas, propose solutions, and report on progress. User interfaces are tested frequently by the users, if necessary; the TFM group involves the National Air Space (NAS) Human Factors Group that will assist the group with extensive Human in
the Loop testing. The TFM group strongly believes that the earlier the problems are identified, the cheaper they are to fix.

As the reader may already have inferred, the TFM program develops and modifies a large number of software programs each year. All these programs interact with other programs to provide the users with the ability to perform their Air Traffic support function. When there is continuous interaction between software modules and software products, it is not only important to ensure the accurate development of the product, but it is equally important to ensure that the software interaction between the product being developed/modified and the other products is as intended. The software integration is conducted by the development team; the team ensures that the units or modules function as planned when they are combined. The process is to ensure that data flows as intended and that any performed analysis or calculation is accurate.

About two weeks into integration testing, the TFM program office issues a functional freeze on the development of the product. No further additions are allowed for this release. The development team then issues in writing what features are incorporated into this release and what features could not be included. They also document any possible known risks associated with the added features of the software. The TFM development lead determines if the risks are acceptable. The software is integrated in a phased manner.

3.2.3 Testing

The TFM Test Manager oversees the test process. The test process helps the developers, users, and the program office determine if the product performance is as intended. The test procedures are developed as early as possible. The program office, along with users, developers, and testers, determine test metrics. The following are requirements for test metrics as stated in the TFM software development procedure manual:

- Total number of test steps, functional areas, and requirements to be tested.
- Number of test steps, functional areas, and requirements successfully tested.
- Number of test steps, functional areas, and requirements tested and failed.
• Target PTR and EC test metrics include:
  a) Total number of target PTRs and ECs to be tested.
  b) The number of target PTRs and ECs successfully tested.
  c) The number of target PTRs and ECs tested and failed.

• Defect test metrics also include:
  a) The number of new defects discovered during testing grouped according to software defect severity levels.
  b) The number of new IRs and ECs successfully tested.
  c) The number of new IRs and ECs tested and failed.

3.2.4 User Participation

It is important to mention here that the TFM program office ensures that there is constant user participation in every process of development, testing, and integration. The NAS Human Factors group is an integral part of the user evaluation process. After each test cycle, the development teams test lead is provided with user evaluations.

Before the final installation, tests are conducted in various environments to ensure the software performs in all given environments and any possible glitches are identified. These testing environments include: systems testing, stability testing, systems demonstration, government testing, inter-system integrated testing, regression testing, and operational testing.

The following shows the software development cycle for one of the TFM developed products called ETMS (Enhanced Traffic Management System):
3.3 Interviews

A varied set of users and TFM employees were interviewed. Due to the vast contrast in their individual job functions as related to the TFM program office, the interviews with each person differed substantially. The primary motive behind the interviews was to get opinions of users and TFM employees on the CDM process, the product development process, and their overall satisfaction with the process.
3.3.1 Interviewee Selection

Interviewees were selected by requesting the TFM program office to recommend names of individuals. A conscious effort was made to interview as many different kinds of users as possible. The program office was requested to recommend people with the following qualities:

- People with considerable experience in their field.
- People who actively participate or had participated in the CDM process.
- People who were independent thinkers.
- A mix of people, i.e. management and end users.

3.3.2 Interview Questions

The interview questions varied with the background of the individual. For example, if the interviewee worked for an airline and was actively involved in the CDM process, the questions that were posed to him differed from those that were posed to an internal FAA TFM user.

The interview questions were developed and emailed to the interviewee at least two days in advance. As mentioned earlier, the interviews were sometimes held in parts due to the time restriction of the interviewees. The questions asked can be divided into five broad categories:

Category 1: Briefly explain your interaction with the TFM program office.

- Do you contribute to the product development process?
- Are you aware of the CDM process?
- What is your role and job function?
Category 2: What is your opinion of the CDM process?

- What, according to you, is the CDM process?
- Do you agree with the process and implementation of the CDM process?
- Is there anything you would like to change about the process? If yes, what would you like to change about the process?
- In your opinion, how effective is the CDM process?

Category 3: Briefly describe the user interaction during the product development process and the CDM process.

- What kind of user interaction is present in the TFM Program Office?
- Do you feel user innovation is a part of the CDM process?
- What is the process for an Innovative Idea to get to the decision makers?
- What are some improvements you suggest to the CDM process?

Category 4: How satisfied are you as a user?

- Are you satisfied with the TFM products that you use?
- Does it have all the features you want it to have?
- Have you made any specific requests for a feature or a new product?
- Have your requests been investigated? If yes, have they been implemented?
  If no, did the program office or your manager inform you why it was not implemented?
- What were the reasons for not implementing your requested feature?
- What suggestions would you make to improve the products/process?

Category 5: What are some constraints or challenges you face as a user?

- Explain in detail your daily work process.
- What can be improved to enable you to do your job better?
- Do other users face similar problems?
3.3.3 Recording Interviews

During the interviews, the responses to the questions were noted and documented. Each user was made aware that their opinion could be published and that it was being documented. Within a day of the interview, the interviewees were emailed a word document that briefly recorded their opinions and answers to the questions that were posed to them. The interviewee was then requested to review the document and comment on any inaccuracies and make further suggestions. Follow up interviews were scheduled to clarify any questions or inconsistencies.

3.4 Collaborative Decision-Making Process and User Innovation

3.4.1 The CDM Process

In the early 1990s, the number of air traffic delays got higher, the traveling customers were not happy, and the airlines were constantly pushing the FAA to implement some new measures. In 1993, a study/experiment conducted by the FADE (FAA Airline Data Exchange) proved that if the airlines transmitted their updated schedules to the FAA as soon as a change happened, it would greatly help Air Traffic Management experts in making better decisions which resulted in better traffic management. It was this that led to the idea that sharing information and ideas between all the users of the NAS system would be beneficial to everyone, and that which led to the formation of the CDM group.

The CDM group was formed in 1995 and is a joint government and industry initiative. The goal of the CDM group is to improve Air Traffic management so that all the members benefit. Better Air Traffic management is in the interest of all parties, the government benefits if there are fewer delays and accidents, the airlines benefit if they are allowed to fly their routes without delays, and the aviation industry, in general, benefits from this initiative.
The following diagram shows the CDM process flow in detail:

![CDM Process Diagram](image)

**Figure 3-4: CDM Process (adapted from draft CDM process presentation 02-28-06)**

In 1999, a Memorandum of Agreement was signed between the various groups within the CDM. This MOA represents the rules by which the FAA and the industry would exchange information, and sets forth the rights and responsibilities of all the parties involved. The following are excerpts taken from the “Collaborative Decision Making (CDM) 2005 Structure pages 3-4” document, capturing the essence of the CDM process:
Section 6.2 of the MOA defines CDM as follows: “The TFM operational philosophy and associated technologies and procedures that enable FAA and the aviation industry to collaboratively manage strategic responses to NAS operational constraints in a manner that balances operational efficiency with aviation safety.”

Under Section 7.0 Rights and Responsibilities, Section 7.2.1 states that “the CDM Participant shall: acquire and maintain the hardware, software, communications, facilities, training, and any and all other resources needed to transmit, receive and interpret the CDM data. In the event the CDM data stream is relocated, upgraded, updated, and/or modified, the CDM Participant shall be responsible for providing and maintaining the hardware, software, communications, facilities and any and all other resources needed to continue to transmit, receive and interpret the CDM data.”

The MOA for the Flight Schedule Monitor (FSM) was developed based on a request of airline users for the FSM software. The intention of this MOA is to identify the roles and responsibilities of the government, as owners and providers of TFM data and the users, who will employ it in conjunction with the FAA traffic flow management process.

Section II of the MOA states: “RESPONSIBILITIES OF THE GOVERNMENT: 2.1 The Government is responsible for providing to the User one set/copy of FSM source code, applications software and relevant documentation, to include training materials. No formal training will be provided by the Government.”

Section III of the MOA states: “RESPONSIBILITIES OF THE USER: 3.1 The User shall be responsible for having all the equipment, software, facilities and personnel needed to access and transfer government TFM data.”

The CDM Ground Delay Enhancements (GDE) program, which emphasizes collaboration between Flight Operations Centers (FOCs) and the Air Traffic Control System Command Center (ATCSCC), developed the following definition of roles and responsibilities:
A. Air Traffic Control-Traffic Flow Management will:
   a. Monitor the National Airspace System (NAS) for constraints that produce capacity and demand problems (e.g., runway closures, weather fronts, etc.).
   b. Make these constraints known to the users of the NAS.
   c. In cooperation with the users, develop a baseline solution to the problem created by the constraint.

B. Flight Operations Center (FOC) will:
   a. Keep ATC-TFM informed of current operational demand and intent.
   b. Provide airline business need plans and designs within the general baseline solution provided by ATC-TFM (e.g., cancellations/substitutions in response to a ground delay program).

3.4.2 CDM Stakeholders

The CDM group consists of the National Business Aviation Association (NBAA), Regional Airline Association (RAA), and the Federal Aviation Administration (FAA). For a detailed list of all the key players in the CDM process, please refer to Appendix D. The leadership of the CDM group is assumed by the stakeholders and called the CSG (CDM Stakeholders Group). The goal of the CDM group is to provide the FAA with recommendations on how to improve Air Traffic Management. These suggestions can include: development of new software, enhancement of existing software or systems, changing processes or procedures, etc.

There is an FAA Lead and an Industry Lead for the CDM group. The FAA Lead is appointed by the Director for Systems Operations Programs and the Industry Lead is appointed by ATA. The FAA Lead leads the CDM activities on the FAA side, he provides the CDM group and the FAA with requirements and needs of the FAA community of users, and the Industry Lead plays a similar role on the Industry side.
3.4.3 Sub-Teams

When there is a special need, sub-teams are appointed with the sole objective of studying a given problem and proposing a solution. The sub-teams typically are comprised of people with a special skill set to accomplish the task. Once formed, the sub-teams study the problem and provide solutions in the form of recommendations, requirements, design, and development details. Upon completion of the task, the sub-teams are disbanded. All team input/recommendations will be advisory only.

3.4.4 Union Participation

As a part of active collaboration, the CDM group includes Traffic Management Coordinators (TMCs) and Traffic Management Specialists (TMSs). These individuals are highly experienced and provide vital input to the CDM process.

3.4.5 CDM Products

The CDM group generates reports and recommendations. It functions as an advisory board to the FAA and, therefore, is not afforded any more privileges. It is left to the members of the CDM group to make a strong case for the implementation of a given solution or product. The CDM group has been quite successful in doing so.

3.4.6 CDM Guidelines

The following are CDM guidelines as taken from the “Collaborative Decision Making (CDM) 2005 Structure, Page 6” document:

- Develop a “Strategic” Plan (2-5 years) that’s in line with the Air Traffic Services Performance Plan, FAA Flight Plan and Operational Evolution Plan (OEP). Plan should include milestone schedule and goals. Develop a “Tactical” Plan (0-24 months) with short-term goals that are inline with the “Strategic” plan. The plan should include goals and work breakdown by subgroup, travel budgets, milestones and integrated schedules with dependencies (see next bullet). Each sub-team would be responsible to update their sections and ensure they comply with the “Strategic” Plan.
• Develop and maintain an integrated schedule with dependencies that includes the work of all sub-teams and outside stakeholder organizations to the extent they impact the work of CDM.

• Prioritize work in order to focus limited FAA and Industry resources on those items that will result in the most benefit for the majority of customers and result in greater system efficiencies. Move other items off the table to “Parking Lot” for future consideration.

• Perform Cost/Benefit analysis for all major work items. Also, do post deployment validation.

• Where it makes economic sense and meaningful work can be accomplished, encourage the sub-teams to meet outside of the “breakout” structure and utilize telcons.

• Set agendas at least 30 days before each meeting.

• Formalize the decision-making process. When appropriate, sub-teams should present recommendations to the CSG (with backup materials) for acceptance.

• Standardize the sub-team report output process.

• One CDM meeting per year should take the form of an annual business meeting to assess what was accomplished and refocus/redirect energies to changing conditions. This meeting would also get buy-in to any changes/updated to the Strategic/Tactical Plans and kickoff the Tactical Plan work for the coming year.

• Ensure follow-up is performed on all new technology/functions/procedures to ensure they are performing as expected.

• Each sub-team should maintain and share lessons learned.

• Each sub-team should ensure their Web site is up-to-date.

• Ensure training is not overlooked in the deployment of new capabilities. Resources are needed to ensure this is done in a way that maximizes the benefits of the new capability.
3.4.7 User Innovation and the CDM Group

The CDM process shows a fair bit of user interaction in the design and development process. It is important to note here that this high degree of user interaction is rare within the FAA and that most of the users who were interviewed agreed with this statement. The user interviews revealed a variety of different opinions. Some users felt that there was quite a bit of user interaction and readily pointed out some very successful products that were developed as a result of the CDM process. These users also pointed out that the innovative idea came from an end user and not from management.

Example: Flight Schedule Monitor (FSM)

As an example of user involvement in CDM process innovations, consider the Flight Schedule Monitor, a product developed and implemented by the TFM program using an innovative idea from an end user. The Flight Schedule Monitor (FSM) helps the FAA and the airline users to monitor and manage airport demand capacity. This tool was developed entirely as a result of user input through the CDM process. The Air Traffic Control center uses FSM to model and issue both Ground Stops and Ground Delay Programs (GDPs), as a display of arrival and departure data, and to send Enhanced Traffic Management commands to the communications hub. It is used by the airlines to analyze the impact of proposed Ground Delay Programs on their operations, model flight cancellations, and estimate departure clearance time compliance. The following diagram illustrates the complete cycle of requirement generation. It shows how users provide their requirements and ideas to the program office and the process that is followed before the requirement or idea is implemented.
As Figure 3-5 illustrates, users provide their list of requirements and ideas directly to the program office; the program office then sends this list to the CDM group which prioritizes them. Please see Appendix A for a list of requirements and enhancements that were sent to the TFM program office for consideration. After careful review and working with the CDM group, the list was prioritized into the list as shown in Appendix B.

It is quite evident that in the CDM process that there is considerable amount of user interaction. User innovation is encouraged and in many cases implemented; however, not all user needs are met. Also, it is quite evident from the two lists that not all the requests and ideas get implemented. It is important to note here that the requirements and ideas that are not selected can be presented again in the next round for considerations. We will discuss this in more detail in the next chapters.
3.4.8 User Satisfaction

User interviews indicated varying degrees of satisfaction. Some users were of the opinion that the CDM process was extremely efficient and provided users with channels of communication that did not exist earlier. Others were not as optimistic. They felt that the CDM process was too slow and that it did not have the power to actually enforce anything.

The one thing that almost everyone agreed with was that the CDM process has definitely improved the Air Traffic management system.

3.4.9 Summary

Overall, it is quite clear that the CDM process has been quite successful. It was initiated to share information among the FAA and the aviation community and has since evolved into a process and system that provides a framework for various stakeholders to share ideas and opinions and help create better products. But, as some users pointed out, there is scope for improvement.
Chapter 4: What Works, What Does Not

4.1 Overview
The TFM program office, over the past few years, has seen a tremendous improvement and success in the quality of the products that it develops. Most people interviewed agreed that the CDM process has been quite successful in addressing many key problems that users faced before its inception. There are, however, some areas that can be improved. This chapter will address these issues. It will briefly describe the successes that the TFM program has achieved over the past few years. It will also describe some challenges and constraints that the users still face.

4.2 Successes
Since the implementation of the CDM process, the TFM program office has developed some very successful products. Per a report published by Booz Allen, since the implementation of the CDM process, the FAA has saved anywhere from $341 – $542 million/year by avoiding delayed flights as a result of the better products that were developed by the TFM group.

In addition to developing new products, the TFM program has improved existing products and improved the process of making changes based on inputs received from users through the CDM process. It is important to mention here that all these product ideas were initiated by the real end users, not the management. The Collaborative Convective Forecast Product (CCFP) and the Flight Schedule Monitor (FSM) are two products that were developed as a result of inputs from the CDM group; they are considered to be extremely successful.

4.2.1 Collaborative Convective Forecast Product (CCFP)
The FAA Web site describes convective weather as the “single most disruptive force affecting the operation of aircraft within the National Airspace System (NAS).” The method that FAA used to use to minimize the delays due to such weather was to forecast weather for convective activity. This was not a very effective method and proved to be
quite inefficient. The users, therefore, through the CDM process proposed an alternative. This alternative involved an initial forecast by the Aviation Weather Center which evolved into a final product through the collaboration of participating meteorologists from the airlines and the Center Weather Service Units.

4.2.2 Flight Schedule Monitor (FSM)

As described earlier, the Flight Schedule Monitor (FSM) helps the FAA and the airline users to monitor and manage airport demand capacity. This tool was developed entirely as a result of user input through the CDM process. The Air Traffic Control center uses FSM to model and issue both Ground Stops and Ground Delay Programs (GDPs), as a display of arrival and departure data, and to send Enhanced Traffic Management commands to the communications hub. It is used by the airlines to analyze the impact of proposed Ground Delay Programs on their operations, model flight cancellations, and estimate departure clearance time compliance.

4.2.3 Provide Free Information to the Airline Users and Aviation Industry (An example of the power of giving up power)

Another success story for the TFM program has been the fact that they have provided the aviation industry with a live feed of data. The FAA uses a host of data collection devices to collect data on the weather, air traffic movement, ground traffic movement, etc. While the TFM program builds a lot of products to analyze this data, it also provides some of this data to the industry. An example of such data is the Common Constraint Situation Display (CCSD) data. The CCSD data provides information as flow evaluation areas (FEAs), flow constraint areas (FCAs), reroutes, and alerts. In addition, the CCSD provides textual data about items, such as reroute advisories and lists of flights that are affected, etc. It is important to mention here that the program office has encountered resistance from many sources when it proposed to make this information available to the industry at no cost.
Provisioning of such data has given rise to a whole new commercial industry. The aviation industry has developed a lot of tools using this information. Any web-based application that provides flight tracking, departures, arrivals and flight delays uses this data that is provided by the FAA.

4.2.4 TFM Develops Products That Users Can Build Upon

The TFM program develops programs with outputs that can be used by the airlines to further develop their tools to make better decisions. An example of this is the FSM program described in the previous section.

The airlines developed a program called the ESM program that interfaces with the FSM program (see chapter 3 for details regarding an agreement between the TFM and the industry to share FSM code, this was done as a part of the CDM process) and provides the airlines with the ability to analyze the impact of proposed Ground Delay Programs on their operations, model flight cancellations, and estimate departure clearance time compliance.

4.3 Problems

The TFM program office has managed to solve a large percentage of problems with the initiation of the CDM process. However, some problems still exist. This section will briefly describe some problems that users still face.

The TFM program essentially has two broad categories of users. The first are internal FAA users, i.e. the Air Traffic Coordinators, Air Traffic Controllers, and some other FAA users. The second type of users are the non-FAA users, these consist of the commercial airline users, the private airline industry, the business airline industry, and the software industry that supports the aviation community in general.

To find out what problems users still have, both types of users were interviewed, including the Air Traffic Coordinators and the airline users. The following are some problems that they still face.
4.3.1 Airline users

4.3.1.1 Inconsistent application of tool

The Air Traffic Management Coordinators are in constant contact with their counterparts in the airline industry. They coordinate arrivals, departures, delays, and traffic rerouting details. The Traffic Management Flow program provides the Air Traffic Management Coordinators with a host of tools to analyze current traffic situations and make decisions. The decisions are mostly made in a collaborative manner. The FAA Traffic Coordinators discuss the situation with their airline counterparts, they do this by using certain software tools to describe the situation and analyze it.

Currently, each Air Traffic Management Controller uses a different set of tools based on his or her preference. This non-uniform use of available tools can sometimes place unnecessary load on the Traffic Management folks on the airlines side.

4.3.1.2 Sharing the Information Display System (IDS) with the Airline Industry

The FAA uses a system called the IDS system. The IDS system is an information dissemination and display system designed for air traffic controllers, airway facilities, and other aviation personnel. Baseline IDS external interfaces include: Automated Surface Observing System (ASOS), Automation of Field Operations and Services (AFOS), Advanced Weather Interactive Processing System (AWIPS), Digital Altimeter Setting Indicator (DASI), Flight Data Input/Output (FDIO), Integrated Terminal Weather System (ITWS), Low Level Windshear Alert System (LL WAS), Runway Visual Range (RVR), Standard Time Source (CLOCK), and the Terminal Doppler Weather Radar (TDWR) display system.
The IDS system provides the ATCs with the capability of configuring data pages with different priorities of alert messages. The higher priority immediate display alert causes the alert page to be displayed automatically. Lower priority alerts notify the user that a change has occurred, but allows the user the option of viewing the page or simply acknowledging the alert. These alerts consist of visual and or audio prompts to notify users of the change in data.

The IDS system allows the Air Traffic Controllers and Coordinators to make decisions based on current constraints within sections of the National Airspace System. Airline users would also like direct, online access to this tool. They are confident that online access will allow them to make tactical decisions more quickly and accurately. As of today, this information is provided to the airline users via telephones and in many cases, decisions that could have been made to save time are not made simply because the airlines are not aware of the opportunity. Currently, Air Traffic Controllers do not know which airlines are willing to make such decisions, and any decision to do so requires a high degree of coordination over the phone. The airlines feel this time consuming process of coordinating reroutes can be avoided by sharing the IDS system data with the airlines.

A good example of such a situation would be during the summer time when there are major storms around the country. When the situation gets bad, Air Traffic Controllers cut traffic going through the area, and reroute traffic around the bad weather areas. This causes congestion in the surrounding areas. In some cases, due to the high costs of delays and cancellations, some airlines are willing to fly at lower altitudes and longer distances in order to minimize delays and cancellations. These decisions, however, differ from airline to airline, depending on their operating model, i.e. the type of aircraft and the decision to carry extra fuel.
4.3.1.3 Rigid/Inefficient Rerouting Methodology

FAA Traffic Management Coordinators constantly monitor the National Airspace System (NAS) resources to determine if there is an emerging imbalance between capacity and demand. Once emerging problems areas are identified (these problems could be due to weather or large volumes of traffic), the FAA controllers initiate traffic management initiatives to ensure air traffic is safe and efficient. To do this, one of the solutions that the Air Traffic Management Coordinators implement is the rerouting of air traffic. In many cases, the airline operators feel that this is done in a manner that is not efficient for them. In their view, traffic reroutes that are provided by FAA controllers are mostly longer than reroutes they could create for themselves. The result is that flight times are longer and fuel costs for that flight are higher.

The airlines have tools that help them calculate the most efficient route based on the aircraft type, wind speed, and wind direction. They, therefore, feel that the decision of how to reroute a flight in a given situation, should be made by the airlines. They argue that if the FAA provided them with the current NAS constraints, they will be able to find the most efficient way to reroute their traffic, while remaining within the given constraints.

4.1.3.4 Delay due to En-route Traffic

As air traffic starts nearing the capacity of a certain region within the airspace, the FAA controllers begin to enforce ground delay programs within that region. What this means is that the traffic on the ground is not allowed to take off until the congestion falls to a more manageable level. However, flights that originate from a different region and travel through a region within which ground delays are enforced are not subject to any delays. Figure 4-1 below will explain the scenario further. For the purpose of this description, let us assume that location X is experiencing high traffic volumes. To ease the traffic in that area (flying area and airport), ground stops are issued in locations A, B, and C since they are flying to location X. But, flights going from location D to location Y are not affected.
by this delay or ground stop even though these flights contribute to the congestion as well.

The airline community, therefore, feels that flights that operate within high traffic volume areas are delayed by flights operating within the low volume traffic areas, but the low volume traffic area flights do not get their share of traffic delays.

4.3.2 The Internal FAA Users (Air Traffic Coordinators)

4.3.2.1 No automation in some traffic management situations

The Air Traffic Coordinators interviewed also felt that there is scope for improvement. One problem that they pointed out was that they were doing their jobs using technology that is outdated. In some cases, they perform some tasks manually. The following is an example:
During severe weather conditions, the FAA command center sometimes decides to reroute traffic that is already in the air. To do this, they must call an Air Traffic Coordinator within the regional airspace that the aircraft is currently traveling and reroute the aircraft via a different route. The process of rerouting an aircraft that is in route is as follows:

Once the command center determines that an aircraft should be rerouted, they call the region and provide the Air Traffic Controller with the identification of the aircraft, and its new route. The Air Traffic Controller writes this information down on a piece of paper, then goes to the appropriate screen, locates the aircraft, and writes down its present route on the piece of paper. He then walks over to the Air Traffic Controller and hands him the paper with the aircraft ID, its current route, and its new routing information. The Air Traffic Controller then manually inputs the new route into the system and calls the aircraft with the new route.

The Air Traffic Controller users feel that this process can be automated easily to save them precious time in pressure situations.

4.3.2.2 No process of sharing information on traffic congestion from one control center to another

During severe weather situations, Air Traffic Coordinators are overwhelmed with too many tasks and requests. In such situations, it is not uncommon for Air Traffic Coordinators to request the Command center for some assistance. However, Air Traffic Coordinators that request this assistance are also expected to provide some statistics on the traffic situation. This is quite counterintuitive. The users feel that there should be a mechanism where Air Traffic Coordinators can share their analysis without doing any extra work.
4.4 Summary

The TFM program office has been able to leverage the CDM process to understand the user needs and develop products that users need. They have been very successful in this regard. They, however, have not been able to address all user needs. The volume of demand that the users have cannot be met by TFM’s current resources.

The following are the reasons for TFM’s success:

- The CDM process not only involves users in the complete product development process, but also allows them to identify needs problem areas and suggest solutions to the problem.
- Involving users brings their “working intelligence” factor into play; the users bring a variety of solutions to the given problem which allows the TFM program to pick the best solution.
- An iterative process is used to determine the most important features of a product and the end users collectively make a decision on what features are most needed. This ensures that most user needs are met.
- There is a fixed framework within which the users are allowed to express their needs and requirements.

The following are some reasons that users are still unhappy:

- Some users feel that some products do not meet their specific needs.
- Users often complain that the TFM program office is concentrating their efforts on other users and not them.
- Some of their requests never make the list of products that the TFM program will develop.
Chapter 5: Evaluation and Proposed Solutions

5.1 Analysis of the Current Situation (Challenges and Constraints)

It is always easier to criticize when one is looking at things from the outside. It is quite another thing to live in a given situation and fix it. The TFM program within the FAA has quite a few challenges and constraints that it has to face. Some of these issues are a result of the internal government culture, some of them are due to the unique customer developer relation that they have with users, and some of them are due to the large variety of customers that the TFM program seeks to serve. The following are some issues and problems that were identified; these are by no means a complete list, but it is a list of reasons that were obvious during the research and interviews:

Not a typical Commercial Customer Supplier Relation: The relation between the TFM program and its “customers” (the internal FAA users and commercial airline users) is often compared to the commercial manufacturer and customer relation. But, this is not entirely true. One example of why this is not true is because the TFM program is expected to provide all the user needs within a fixed budget. They do not get to determine a cost based on the requirements as would be done in a commercial environment. They are expected to provide the government with a set of projects that they will complete in that year and the expected cost. The government then allocates them the funds that are typically less than what they requested, but the TFM program office is expected to still deliver on all its promises.

Frequent changes in government policies, directives, and budgets: The TFM program’s goal is frequently changed or modified based on changes in government policies and directives. The program office reports to a set of individuals who are not intimately involved with the working of the program, and who manage other programs as well. These folks tend to treat all these programs in a similar manner, which results in the program office often getting conflicting directives. The program office has to constantly keep requesting upper management to allow them more freedom to do what is needed.
The Budget system: The government budget requirement process requires the TFM program to explicitly state their requirements and provide exact details of what will be done with the money. With a product life cycle of 15-18 months, it sometimes puts the TFM program office in an odd situation of having to tell the budget office what they will do, even before they plan on it, this sometimes severely handicaps the program office in what they can do with the money they are given.

Security Fears: The TFM program office is constantly pushed back when it tries to give control to the users and the commercial airlines because of security fears. The reason given by people who oppose such decisions is security. Post-911 drastically changed how the TFM program does its business. Many users who were interviewed cited this as a major hurdle.

Current Financial situation of the Aviation Industry: The aviation industry, in general, is a broke industry. A very large percentage of airlines are bankrupt or on the verge of becoming bankrupt. This prevents the airlines from spending any money to customize the product to meet their needs. Some airlines have, however, used this as a good reason to spend the money to ensure that they are more efficient in the long run.

Then there are some laws that prohibit the non-government users from providing the government (FAA/TFM) with requirements. The logic behind this is that the government is in the best position to decide what is best for all citizens and will do so in an unbiased manner.

So, can the TFM program office still meet all user needs?

5.2 Two possible solutions

Having stated the success of the TFM program and some of the challenges it still faces, we will now explore some possible solutions that will help the TFM program overcome some of these challenges.
5.2.1 Follow customer priorities (Is this possible?)

This would probably be the most obvious solution in a typically commercial environment where a manufacturer produces a set of products for users. The manufacturer would be driven by user needs. If the user is not satisfied with the product, the user is always free to look to other manufacturers that can meet their needs. The TFM case is quite different. The TFM program office is the only manufacturer that the user can rely on. So, if the user is handed something that does not entirely meet their needs, the user can either complain, or work around the problem in any way that they can. So, is it really possible for the TFM program office to meet all the user needs and provide all the users with the features they want in the products they develop? All the users interviewed felt that this may not be possible. They reasons they gave is that the needs far exceed the available resources. The TFM program office does not have the funds to develop all the products and features that the user needs. It is also not possible to customize the products for each individual user. This solution, therefore, may not be a feasible one.

5.2.2 Empower Customers to solve their needs via User Toolkits

In the interviews with most customers, the general reaction was that the products were not exactly what they would have liked. There were also some questions about the process of prioritization. When it was pointed out to them that this general prioritization was done by the CDM group (a group that they had representation in), they still felt that some real needs were neglected by the prioritization method.

One way to deal with such issues effectively is to allow users to solve their own problems via User Toolkits. The internal FAA users are not in a position to use such toolkits; in any case, the products are designed and centered on the internal FAA users. The TFM program office should concentrate on developing products that meet the internal FAA user needs with user toolkits so that the airline users can customize the product to their own needs. In addition to giving the users the freedom to design customized products, a properly designed toolkit can ensure that no unauthorized change to the code is made, resulting in a more secure system. One needs to understand here that this may not be
feasible in all the cases, but it is definitely feasible in most cases. The following sections will provide two simple examples of how this may be done.

5.2.3 Two examples of how Airline problems may be solved via User Toolkits

To demonstrate how the use of toolkits can help the TFM program in selected situations, this section will outline how toolkits can solve two airline problems. The first example will show how an existing solution could have been even better if user toolkits would have been used. It is important to note here that the solution presented here is a conceptual solution. The solution will include a very high level architectural detail and software code development that is beyond the scope of this work.

5.2.3.1 Example of how an existing solution could have been better using user toolkits

This section will discuss how a problem that was solved by the TFM program office could have been even more successful if the user toolkits approach was used.

5.2.3.1.1 Background

To show how user toolkits can provide an excellent solution to some of the problems faced by the TFM program office, we will use the example of the FSM program as described in chapter 4, section 4.2.2. To understand the solution, the reader will require more information than that which is provided in chapter 4. This section will describe the problem and the solution in more detail.

In cases when there are severe weather situations and unusually high air traffic with the NAS, the Air Traffic Controllers and Air Traffic Coordinators implement Ground Delay Programs (GDPs). The GDPs are implemented so that arrivals and departures can be better handled at an effected airport or an effected section of the airspace.
The FSM program was developed to assist the ATCs with the implementation of GDPs. Before the development of the FSM program, there was no efficient way to deal with traffic congestion. The FSM program allows the ATCs to monitor demand and view projected arrival rates. Based on this information, the ATCs can model various scenarios, compute slot assignments, etc. based on the traffic situation.

A Ground Delay Program affects each airline differently. This difference is based on the airline’s different crew schedules. To understand the different kinds of crew flying schedules, let’s take the example of an airline that uses a hub and spoke flying model. The problems described here will be similar for an airline using the mesh flying model.

5.2.3.1.2 Model 1
Airlines fly aircraft to many different locations in a day. Therefore, an aircraft may fly to more than three different locations on the same day, depending on the distance. In this model, the pilot, co-pilot, and the cabin crew of a given aircraft remain with the aircraft throughout the day and return to the starting point at the end. This is the simplest model.

5.2.3.1.3 Model 2
In this model, when an aircraft arrives at any given airport, the pilot and co-pilot move to another aircraft and the cabin crew moves to a different aircraft.

5.2.3.1.4 Model 3
In this model, the pilot, co-pilot, and the cabin crew all go to a different aircraft after each leg. They then arrive back to the starting location on different flights.

5.2.3.1.5 The Problem
It is quite obvious that in such given situations, aircrafts following these three different models of the crew flying schedules will be affected differently when GDPs are imposed. For example, an airline that follows the third model of flying crew schedules will face delays on multiple flights just because one flight has been delayed by a GDP. Similarly, a GDP will affect an airline using model 2 and model 1 differently. Therefore, based on the implications for each, the airline will react by either canceling one or more flights, or substituting one flight by the other.
5.2.3.1.6 The Current Solution

To address this problem, the TFM program developed the FSM program. As described in chapter 4, the FSM program assists the ATCs by providing them with the tools to model GDPs, view past history, and compute parameters required to implement a GDP.

The FSM program, however, does not help the airlines in solving their problems. To allow them to efficiently make decisions on how to deal with a given GDP, the airlines developed a program called the ESM. The ESM program, as already described in chapter 4, section 4.2.4 helps the airline with making decisions on how to react to a GDP, given their constraints of crew schedules. While some airlines use the ESM, other airlines went out and had custom products developed for themselves to help them with their model of doing business.

The diagram below describes the current interaction between FSM and ESM:

Figure 5-1: Current FSM and ESM Interaction
5.2.3.1.7 Proposed Solution with User Toolkits

The solution that this study proposes will not require the TFM program office to make any major changes in the design of the FSM as it exists today. The implementation of a user toolkits solution, in this case, would need the TFM program office to do the following:

- While developing the FSM program, the programmers should keep in mind the fact that there will be multiple add on modules that would be added by the airlines. They must make provisions for such add on modules.
- Provide the airlines with the code for the FSM program, while specifying that no portion of the code can be changed.
- The programmers of FSM should develop the program using a modular or object oriented architecture. This will allow the airline developers to call specific functions and processes that they could use without having to make any changes to the FSM code and will save the airline developers time and effort. Figure 5-2 is a depiction of how this can be done. It shows all the functions of the current FSM program broken into modules (blue blocks). It also shows that the airlines can develop their own modules (yellow blocks) that can call on some FAA developed modules for information. The proposed architecture also incorporates “libraries of common user modules” and “offers the airlines a solution space that encompasses the design they want to create” as proposed by Von Hippel (Democratizing Innovation by Von Hippel, 2005).
To implement a successful User Toolkit model the TFM program office should allow some time for iterative improvement and testing of the airlines developed modules.

The TFM program office can use the already successful CDM process to determine the development environment that will be the most suitable for the airline developers. This will give the airline developers the flexibility to easily develop their modules without much training.

Provide the airline developers with boundaries and limitations so that the product can be readily tested and incorporated into the FAA systems without the need for any modifications or special changes.
The adoption of user toolkits as shown above will provide the airlines with a cost effective alternative to developing tools such as ESM and meet each airlines' individual needs. Figure 5-3 shows the architecture of FSM that would be developed using user toolkits:

![Diagram of FSM developed using user toolkits](image)

**Figure 5-3**: FSM developed using user toolkits will incorporate features of tools such as ESM within it.

### 5.2.3.2 Example of how to solve an existing problem using toolkits

This section will discuss how an existing problem faced by the airlines can be solved using toolkits. The solution will also show how all the different airlines with varying needs and requirements can have their individual needs met.
5.3.2.2.1 Background

As mentioned in chapter 4 section 4.3.1.2, the airlines would like access to the IDS system. The IDS system coupled with the right tools will allow the airlines to make tactical decisions that will allow them to save time and money.

As mentioned earlier in chapter 4, GDPs affect airlines differently. They also make decisions on how to deal with delay differently. We have already discussed the different challenges that airlines face due to varying crew flying schedules. Apart from crew flying schedules, aircraft type and fuel carrying strategies determine how each airline will react to a GDP. Depending on the aircraft type and the extra fuel carrying strategy (each airline differs in their fuel carrying strategy - some carry a lot of extra fuel and some carry just a little extra fuel), airlines will make decisions on alternate routes. If the airline has a strategy of carrying extra fuel, it is likely that they will decide to fly a longer route or at a lower altitude in order to avoid a major delay.

Air Traffic Controllers do not know which airline will accept flying alternate routes and the types of alternate routes that they are willing to fly. The airline makes these decisions. The airlines can make such decision quickly and more efficiently by processing the information available on the IDS system to determine if it would be cost effective to take a delay, fly an alternate route, or fly at a lower altitude. Figure 5-4 shows the current implementation of the IDS system. The ATCs use the system and communicate/coordinate the information with the airline folks manually over the phone.
Figure 5-4: Current IDS system Architecture

5.3.2.2.2 Solution using user toolkits

In addition to providing access to the system, the TFM program office can use toolkits to allow the airlines to tailor the solution to their individual needs. To do this, the TFM program will need to do the following:

- The IDS system is a program that aggregates information from other systems and is put in a format that is easy for the ATCs to read on the screen. It also provides the users with the capability of setting alarms based on different parameters. The system design is relatively simple and is a collection of many tools that can operate in conjunction with each other. Providing the airlines with code and allowing them the freedom to build their own modules without changing the existing code, will provide them the freedom they need to design simple tools that will alert them of situations when they could fly alternate routes or cancel flights.
These tools will give the airlines this information early on, allowing them to make such decisions in a much more efficient manner.

- Since the code has already been developed, the TFM program office should provide the airlines with documentation and architecture of the IDS system so the airline developers can design and develop their tools to easily fit the existing design.
- A system such as an IDS system will have built-in modules that can be called within a process. Such modules should be clearly identified to the airline developers. They should be given guidelines and parameters within which they can work.
- The process should allow the airlines to iteratively test the product before finalizing the product. This should not be a problem given that the CDM process in place already implements this process.

Figure 5-5 below shows an IDS system developed with the use of user toolkits:

Figure 5-5: IDS Architecture redesign incorporating the user toolkits model
The IDS system has been in place for quite some time. It has since been upgraded once. A change to a toolkit model can be made when the next upgrade happens. Providing IDS access to the airlines will give benefits to both the FAA and the airlines.

5.4 **Next steps to implement a User Toolkit model within CDM**

The CDM process has been a revolutionary process within the FAA. It has been hugely successful in changing the manner in which the FAA and the commercial aviation industry interact with each other. The introduction of the CDM process was met with a lot of skepticism. Even today, attempts by the TFM office to make more information available are met with resistance. It is, therefore, possible that the implementation of the User Toolkit model will be met with a lot of resistance as well. The environment within the FAA and government organizations, in general, resists change and it will be quite a challenge to implement such a model. However, given the current TFM leadership, I think that this change is possible.

The TFM program office leadership has, over the years, been extremely receptive to any change or improvement in their development or operation process if there is a possibility of improvement. Once the leadership is convinced of the benefits of the user toolkits model, they will need to be provided with evidence that this model will actually be beneficial before it can be adopted into the TFM process. The most effective way to prove this would be to use the successful CDM process. A sub-team can be appointed to study the benefits of adopting the Toolkit Model within the TFM program office. It is important that the team understand the user toolkits model thoroughly. The objective of the sub-team should be to clearly identify the situations when the toolkits model would be appropriate within the TFM environment. The team should be able to provide some initial estimates of the monetary benefits that such toolkits could bring to the TFM program office and also identify some pilot projects that can be undertaken by the TFM program office to prove the advantages of adopting user toolkits.

Most airline users that were interviewed felt that the user toolkits option would be extremely beneficial to both the FAA and the commercial aviation community. They,
however, felt that it may not be readily accepted into the FAA. They felt that the TFM program office would be ready to accept it; however, they also predicted that the model would receive a fair amount of criticism from other departments within the FAA. Many concerns, such as security and the fear of giving up control, will predictably be raised. The sub-team must address all such concerns if the toolkit model is to be adopted.

The successful adoption of user toolkits into the TFM tool development process will have two phases to it. The first one would be the acceptance from key FAA personnel that this model would indeed be beneficial to both the airlines and the FAA. The second would be the implementation. It is very important that the architects and the developers understand the user toolkit model clearly before they design and develop a system based on the user toolkits model. To do this, the software architects and developers from both the TFM program office and the airlines will need to be exposed to this concept. This can be done through some short training seminars that are designed to help them understand the concept and how it may be implemented in the TFM setting.
Chapter 6: Conclusions and Future Work

6.1 Conclusion

The relationship between the TFM program office and the users (internal FAA users and external airline users) has been compared to that of a commercial manufacturer customer relation in this study. The situation here is slightly different. In this case, the customer cannot turn to another manufacturer if they are not satisfied with the products that the TFM program is developing and, on the other hand, the TFM program does not get paid by the customers directly. To its credit, the TFM program office has, over the past few years, made a very conscious effort to meet all the needs of its customers using the CDM process. The primary goal of every business is to meet and manage the expectations of its customers. Toward this end, the TFM program office has done a commendable job, given the environment, limited resources, and limited decision-making authority.

Most large businesses and manufacturers have to cater to the needs of multiple kinds of customers. This is the case with the TFM program office. Their customers include the internal FAA users and the external users, such as the airlines. The internal customers are probably the most demanding of all their customers. Being internal, they expect all their requirements and needs to be immediately met. The internal users’ primary goal is to ensure that safety is maintained throughout the NAS and that the available resources within the NAS are optimally used. The airline users, on the other hand, can be divided into three broad categories: the commercial airline industry, the private chartered flight industry (which is rapidly growing and extremely demanding because of its political connections), and the US Air Force. It is quite easy to see that the users here are quite different in their needs and ultimate goals. The goal for the commercial airline industry is to minimize cost and delay. The goal for the private chartered flight industry and the US Air Force is to minimize delay as much as possible; cost is almost never an issue for them. To add to all this complexity, each airline in the commercial airline industry uses a different business model, which makes their needs different from each other. It is quite easy to see the challenges faced by the TFM program office and its developers.
As mentioned earlier, the TFM program office is not paid directly by its customers. The process used to allocate funds to the TFM program office is as follows: the TFM program office presents a budget based on what it plans to develop and do over the next year. The government then looks at the budget and allocates a sum; this amount in most cases is not what the program needs, the amount is less than what is usually requested by the TFM program office. The program office is expected to meet all the user needs within the given budget for that year.

Despite all these challenges, the TFM program office through the CDM process has managed to meet a large percentage of user needs. The process aims to prioritize user needs and then meet these needs using its limited funds. Some folks who were interviewed felt that the resources available to the TFM program office would be nowhere near what would be needed if they were to try to meet all the valid user needs. The TFM program, over the past 10 years, has managed to decrease the flight delays considerably (while the number of flying aircraft has increased), and increase user satisfaction, despite all these challenges, which is quite commendable.

The current financial situation of the commercial aviation industry and the added security concerns post-911 has not helped the situation. The airline industry is quite limited in the amount of resources that it has available to invest in developing tools and services for its users. The airlines are, therefore, not in a position to develop the tools and products that their users would like. Most airline users were also quite afraid to invest money because they were not sure of the direction the FAA would take over the next few years; many instances were pointed out where the airlines took the initiative and developed tools based on a plan by the FAA, the plan, however, was never implemented, leaving the airlines with an investment that was totally worthless.

Considering all the limitations that the TFM program has to deal with, the user toolkits model is a perfect fit for them. The adoption of user toolkits will allow the TFM program office the following benefits:
- It will allow users to meet their individual needs without the need to invest huge sums of money.
- The TFM program office can concentrate on what it does best, which is identifying problem areas that need to be fixed and do so without having to worry about satisfying individual users needs.
- The financially broke airline industry will get access to the much needed tools with minimal investment. The ability of the airlines to manage their business better would have a positive effect on the NAS system.

The user toolkits model will, however, not be universally applicable to solve all the problems that the TFM program faces in terms of user satisfaction. There will be situations where the toolkit solutions may not be applicable. An example would be expecting the internal FAA users to customize the FSM program to their own needs, the internal FAA users cannot be expected to hire programmers or developers to help customize the tool for them, nor do they have the time to engage in customization. In this case, the tool should be built (as it has been done before) for the FAA users and allow the airline users to customize it for themselves using user toolkits.

6.2 Future Work

The previous section has pointed to some opportunities for further study. As mentioned earlier, the relationship between the TFM program office and its “customers” is different from that of the conventional manufacturer customer relation. We have seen proof of how effective the user toolkits solution can be when it is applied to the conventional market. It would be interesting to study in detail all the successful and unsuccessful implementations of the user toolkits model to better understand any limitations in detail.

Another interesting study would be to estimate the possible financial gains that the adoption of the user toolkits would have within the TFM program. Nothing seems to be able to convince upper management better, than financial numbers.
Finally, it is not hard to see that many government organizations probably face similar challenges. A study that would show how all government organizations can benefit from the adoption of user toolkits would be truly fascinating. How government organizations would benefit from user toolkits, the situations in which user toolkits would be applicable within government organizations, and the changes needed for the successful implementations would be great topics for further research work.
Bibliography


The TFM Program office team:

http://www.faa.gov/aua/aua700/default.shtml


http://cdm.metronaviation.com/
User Innovation: Successful Enterprises and Products

Motivation:

Successful products are the primary goal of every company. Companies are constantly striving to create more successful products. There have been many studies and numerous researches on what it really takes to make a product that is popular with consumers. Despite all these researches, studies and the vast amount of information available on this topic, many products continue to fail to meet user needs and expectations. This is particularly true in a government environment. Users continually find that products do not meet their needs completely and that they need to find innovative ways to work around problems. Users constantly innovate to overcome product deficiencies. Surprisingly there are limited methodologies that are in use to incorporate user feedback. Even fewer products allow users the flexibility to customize the products to their specific style and need. While this may seem to be quite obvious it is rarely done.

It is planned to complete this research topic by collaborating intensely with one or several government agencies, in particular the Federal Aviation Administration and the National Oceanic and Atmospheric Administration. Their current product design and development
processes will be taken into consideration while developing the argument that there is a need in the government organizations to allow users a certain amount of freedom to innovate to meet their needs – so they can do their jobs in the most efficient manner possible.

**Thesis Statement & Primary Research Objectives:**

The primary goal of this Thesis is to study the Federal Aviation Administration’s systems and product design processes, study and analyze the resulting products for user satisfaction. Data and Information will be collected on the complete design process and user experience. Information on products both success and unsuccessful will be documented and analyzed. It is hoped that at the end, a strong argument can be made for the use of “User Innovation” in the design and development process and that there is a need to provide users the flexibility to customize products to meet their individual needs leading to more efficient users and contributing to the overall successful mission of the government agency.

**Engineering and Management Content:**

This research will be primarily conducted under two aspects:

- A technical aspect that will encompass the use of concepts such systems and product architecting processes. Systems design and development processes learnt in the SDM process will be used and compared against the systems design and development processes currently used at the FAA.

- A human and management aspect that will study product success and customer satisfaction. Successful product design strategies that use increased user involvement will suggest appropriate management strategies. It is expected that these strategies will cover both human and management resources. The study will
look into the possible changes that are needed to improve existing processes and make suggestions on how to increase user satisfaction. Stakeholders (within the government and contracting agencies) will be actively involved throughout the thesis progress at this level.

Research Methods & Approaches

The research method will imply some literature review on product development and design and User Innovation. A reflection of user involvement in product development and user innovation will be developed to determine the type of data needed. Raw data on current processes, user innovation in the government environment and user satisfaction will be collected from the studied government agencies. Based on this data, the engineering and management parts of the approach will be tackled. The data will then be used to determine what it takes to develop successful products. The Stakeholders will be continuously involved in the process to ensure that the data captured is valid and the current process description is accurate.

Timeline:

January to March 15, 2006 (Partly completed)

- Literature review and first familiarization with the techniques to be applied.
- Discussions with possible federal agencies about the data and the format of the collaboration.
- Data collection, interpretation and preparation take place. At this level data is mainly hard data regarding the design and development process, the user satisfaction and user innovation in the field is collected.
- Methodology is finalized.
March 15, 2006

- Analysis is finalized
- Results are discussed with Stakeholders and Advisor – validity of the methodology is assessed.
- Start writing the main part of the thesis’s text

April 15, 2006

- Complete a first draft of the thesis
- Submit to and discuss with Advisor and Reader in order to fine-tune the analysis, results and conclusions.

May 2006

- Finalization of the thesis’s text, formatting, printing and submission.

Signatures:

SDM Fellow: ________________________________ Date: __________

Thesis Supervisor: ________________________________ Date: __________
## Appendix B: List of possible Candidate Requirements submitted to the CDM working group for review

<table>
<thead>
<tr>
<th>Rank</th>
<th>Title</th>
<th>Description</th>
<th>FET Comments/Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Adaptive Compression</td>
<td>Currently on the development list. Provides last minute adjustments/com-pressions for GDPs.</td>
<td>Although not an en route issue, this is considered especially important by Customer representatives on the Flow Evaluation Team. Repeated as “high” priority by Tim M. and Mark H. AAL #1</td>
</tr>
<tr>
<td>6</td>
<td>Improved Pop-up Handling</td>
<td>Currently on the development list. Title is descriptive but needs to be more specifically defined.</td>
<td>Improved handling for pop-up or unknown flights will be necessary for AFPs as well as GDPs. Rated “high” priority by Tim M. AAL #3</td>
</tr>
<tr>
<td>7</td>
<td>Weather routes for CDM flights</td>
<td>Apply known weather routes to CDM flights when appropriate during SWAP events.</td>
<td>Improves planning basis for running AFPs or other TMIs during weather events.</td>
</tr>
<tr>
<td>8</td>
<td>Auto-revision</td>
<td>Automatically revise GDP or AFP. Provide a process that examines the ADL for a resource, determines when a revision might be a benefit, and execute it based on current program parameters.</td>
<td>Frequent Revs may be necessary for AFP efficiency/fairness. Auto-revision would also be a productivity enhancement.</td>
</tr>
</tbody>
</table>

The following items are additional development candidates identified by the Flow Evaluation Team in meetings or HITL exercises. (NOTE: See Rick Oiesen's notes on version 1 of this document for several items already being worked for inclusion in Release 8.2.)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Title</th>
<th>Description</th>
<th>FET Comments/Rationale</th>
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<tbody>
<tr>
<td></td>
<td>Hourly AFP and pop-up rate</td>
<td>Provide the capability to adjust/change AFP entry rates and pop-up factor entries hour by hour.</td>
<td>Rated 'high' by Tim M., Mark H. AAL #4</td>
</tr>
<tr>
<td></td>
<td>Distinguish “Drop-outs” and Cancels</td>
<td>Distinguish Drop-out flights that reroute out of an AFP from flights that actually Cancel on FSM Displays (Bar Chart or Timeline)</td>
<td>Being considered for 8.2.</td>
</tr>
<tr>
<td></td>
<td>Display AFP Info on the Reroute Monitor</td>
<td>Reroute Monitor should display AFP info. Exactly how this should done is TBD.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Display Route and Altitude info on the FSM Flight List</td>
<td>As the title indicates, FSM flight lists should be able to depict route and alt info for all flights the list.</td>
<td>AAL # 5</td>
</tr>
<tr>
<td>Rank</td>
<td>Title</td>
<td>Description</td>
<td>FET Comments/Rationale</td>
</tr>
<tr>
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<tr>
<td></td>
<td>Voluntary AFP reroutes preference</td>
<td>Flights that voluntarily reroute out of an AFP should maintain slots and should receive preference in a second AFP if affected?</td>
<td>AAL #2</td>
</tr>
<tr>
<td></td>
<td>Moving FCAs eligible for AFPs</td>
<td>As the title indicates, enable AFPs to be built on moving FCAs, with ADLs automatically updating as necessary, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Highlight traffic flows on Reroute Monitor</td>
<td>Provide capability on the Reroute Monitor to depict/highlight specific traffic flows as needed.</td>
<td>Previous FCA Work Group request</td>
</tr>
<tr>
<td></td>
<td>CCSD Default Time change</td>
<td>Change the default time for Reroute Monitor from 45 minutes to 6 or 8 hours to provide immediate access to a more realistic time horizon.</td>
<td>Important workflow item for Customers using CCSD.</td>
</tr>
<tr>
<td></td>
<td>Enhanced ECR/EDCT Change tools</td>
<td>Provide a global ECR function to allow a user to invoke a tool from a common place (FSM or TSD), and easily submit an ECR for any flight in any GDP or AFP.</td>
<td>An important workflow/workload item for FAA personnel trying to manage EDCTs and changes.</td>
</tr>
</tbody>
</table>

The following items are top 10 items previously identified by the FCA Work Group, and are also presented here for consideration.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Title</th>
<th>Description</th>
<th>FET Comments/Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dynamic Lists – All Lists</td>
<td>Provide all pulled lists with the capability of being dynamic</td>
<td>Previous FCA Work Group request</td>
</tr>
<tr>
<td></td>
<td>Reroute Monitor – Electronic Exception</td>
<td>Provide an interactive communication capability from the reroute Monitor to facilitate electronic coordination/communication between customers and traffic managers. NOTE: There are several ways to accomplish Elec Exception, but the FCA WG has recommended an all-ETMS solution to avoid multiple display monitoring and to prepare for future project such as ICR.</td>
<td>Previous FCA Work Group request</td>
</tr>
<tr>
<td></td>
<td>Military Constrained Areas</td>
<td>Provide the capability for ETMS to automatically generate FEAs for Military SUAs when those areas are scheduled and then when they go “hot.”</td>
<td>Previous FCA Work Group request</td>
</tr>
<tr>
<td></td>
<td>Never-ending FEA</td>
<td>Provide ability to create FEA and indicate it is not based on time; i.e., no expiration time</td>
<td>Previous FCA Work Group request</td>
</tr>
</tbody>
</table>

*NOTE: There are several ways to accomplish Elec Exception, but the FCA WG has recommended an all-ETMS solution to avoid multiple display monitoring and to prepare for future project such as ICR.

*This is definitely in 8.2 and can be dropped from the list. (The FAA decided that a “never-ending” FEA was not desirable and that an extended FEA with a maximum life of 7 days was the longest that should be allowed.) The “7-day FEA/FCA” is in 8.2.*
<table>
<thead>
<tr>
<th>Rank</th>
<th>Title</th>
<th>Description</th>
<th>FET Comments/Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Save FEAs/FCAs into adaptations</td>
<td>TSD provides automatic recall of saved FEAs for daily use. The capability to save FEA/FCA configurations into selected adaptations.</td>
<td>Previous FCA Work Group request OBE with 'extended 7-day FEA/FCA in 8.2? or dependent on Never-ending capability? Similar to TUT request for more &quot;pref settings&quot;?</td>
</tr>
<tr>
<td></td>
<td>FEA NAS Element enhancement -- ATCAA</td>
<td>Allow an ATCAA to be a NAS element for FEA creation (ref: TSD Overlay item on High Priority list)</td>
<td>Previous FCA Work Group request</td>
</tr>
<tr>
<td></td>
<td>ALT Amendments for Sector FEAs</td>
<td>Provide the ability to amend a sector's altitude when examining a sector; i.e., the altitude can be modified to be something other than the sector's current altitude limits. This has significant value for studying new sectorization options, or for looking quickly at tfc just below or above a given sector of interest.</td>
<td>Previous FCA Work Group request</td>
</tr>
<tr>
<td></td>
<td>Show flights and timelines for new FEAs/FCAs</td>
<td>Whenever an FEA/FCA is displayed (by creating, selecting or recalling), the associated timeline and flights should be automatically displayed on the TSD. An option in the preference panel might be to only display the flights and exclude the timeline.</td>
<td>Previous FCA Work Group request Workflow/time-saving/productivity item.</td>
</tr>
<tr>
<td></td>
<td>Secondary Filter Times</td>
<td>Include the option on the timeline to show a separate line for the secondary filters. (Requested 3/29/04 by ATCSCC - Corcoran / Campos).</td>
<td>Previous FCA Work Group request</td>
</tr>
</tbody>
</table>

The following items are recommended by the CDR/Playbook Sub-team:

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>FET Comments/Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Real-Time Dep. Fix Use Data</td>
<td>Provide customers with access to real-time data on what fixes are currently being used for departures out of an airport, incorporating this information into the CCSD or some other suitable website.</td>
</tr>
<tr>
<td></td>
<td>Departure Route Forecasts in Create Reroute Tool</td>
<td>Enhance the Create Reroute tool to make it easy to create and disseminate a planning advisory that can be sent out at any time (instead of being tied to the Operations Planning telcon), and that provides a forecast of escape routes likely to be used in a given situation, along with an appropriate flight list so that this information can be routed to the correct dispatchers easily. Consider letting the involved ARTCC create this informational advisory. Generate flight lists based on which flights could be impacted (based on historical use of departure fixes), rather basing this list on</td>
</tr>
<tr>
<td>Departure Route Pre-Planning with Reroute Monitor</td>
<td>Enhance the Flight (Reroute) Monitor to display the potential escape routes identified in a Planning Advisory for a given flight. Allow dispatchers to provide feedback on whether flights have been pre-planned to accept these escape routes.</td>
<td>who is currently filed to depart using the involved fix(es). Alternatively, make this information available on a Web site (preferably one that also provides customers with access to real-time data on what fixes are currently being used).</td>
</tr>
</tbody>
</table>
Appendix C (Prioritized list of requirements chosen from the requirements list provided by users in Appendix B)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Potential FEA/FCA Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ability to be able to extend or modify an FEA/FCA without changing the start time (similar to GDP functionality)</td>
</tr>
<tr>
<td>2</td>
<td>Update dynamic lists more frequently</td>
</tr>
<tr>
<td>3</td>
<td>Ability to create FEA/FCA and indicate that there is no expiration time (Never-ending FEA)</td>
</tr>
<tr>
<td>3</td>
<td>Add center boundary crossing times to the FEA/FCA data</td>
</tr>
<tr>
<td>4</td>
<td>Want enhanced ability to draw FEA/FCAs; multi segmented lines, arcs, etc.</td>
</tr>
<tr>
<td>5</td>
<td>Ability to Edit/Delete shared FEAs from any other workstation in the same facility</td>
</tr>
<tr>
<td>6</td>
<td>Automatically delete FEA/FCAs when they have been expired for 30 minutes</td>
</tr>
<tr>
<td>7</td>
<td>Ability to select any baseline sector as a NAS Element for FEA/FCA development</td>
</tr>
<tr>
<td>8</td>
<td>Ability to use combine sectors under NAS Elements to build an FEA/FCA</td>
</tr>
<tr>
<td>9</td>
<td>Ability to limit the visible viewing area of timeline to some specified time or the width of the window if a very long period is selected so none of the timeline is off of the visible window</td>
</tr>
<tr>
<td>10</td>
<td>Ability to select an Enroute Center as a NAS Element when creating an FEA/FCA</td>
</tr>
<tr>
<td>11</td>
<td>Have the Timeline, Flight icons, and the Dynamic List auto appear after Create or Edit</td>
</tr>
<tr>
<td>11</td>
<td>Ability to toggle between current and saved time when recalling FEA/FCAs</td>
</tr>
<tr>
<td>12</td>
<td>Text name for FEA/FCAs</td>
</tr>
<tr>
<td>Low</td>
<td>Under the “Primary Filter” and “Secondary Filter” entry boxes labeled “Depart from any of”, “Arrives at any of”, and “Traverses any of”, need the ability to select 21 centers including ZSU. Best solution may be to create identifier for all U.S. Centers, all Canadian Centers, and all Mexican Centers.</td>
</tr>
<tr>
<td>Low</td>
<td>Ability to generate automatic FEAs for SUAs as they “go hot”</td>
</tr>
<tr>
<td>Low</td>
<td>Ability to select multiple NAS elements for FEA/FCA definition</td>
</tr>
<tr>
<td>Low</td>
<td>Ability to display separate timelines for separate secondary filters will full color options. This feature needs to be selectable by each user.</td>
</tr>
<tr>
<td>Low</td>
<td>Add an Apply Button to the FEA/FCA preference box</td>
</tr>
<tr>
<td>Low</td>
<td>Add the ability to use Fix/Radial/DME and Lat/Long in secondary filters</td>
</tr>
<tr>
<td>Rank</td>
<td>Potential FEA/FCA Requirement</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Low</td>
<td>Request the reports list to print what is selected on the examine line either “Total Discrete or Peak Discrete”.</td>
</tr>
<tr>
<td>Low</td>
<td>Ability when “Auto Show” is selected to be able to select local FEA/FCAs, or those created by the user as a subset to be displayed automatically</td>
</tr>
<tr>
<td>Low</td>
<td>Add “Copy” and “Display Flights” to right-click feature</td>
</tr>
<tr>
<td>Low</td>
<td>Develop some method of alerting users when an FEA/FCA has been amended and auto-show is selected</td>
</tr>
<tr>
<td>Low</td>
<td>Ability for the Dynamic List to be able to display via toggle, data separated into 15 minute increments when priority is set for any time sorting.</td>
</tr>
<tr>
<td>Low</td>
<td>Ability to amend altitudes for sector FEAs</td>
</tr>
<tr>
<td>Low</td>
<td>Ability for monitor alert like values to be set for FEA/FCAs</td>
</tr>
</tbody>
</table>
Appendix D: CDM Users

Operators
Air Canada
Air Canada Jazz
Air Routing International, L.P.
Air Tran Airways
Air Transport Association
Airline Dispatchers Federation
Air Wisconsin Airlines
Alaska Airlines
American TransAir
America West Airlines
American Airlines
ARINC
Atlantic Coast Airlines
Atlantic Southeast/Delta Connection
Business Express/Delta Connection
Comair Holdings/Delta Connection
Continental Airlines
Continental Express
Delta Airlines
Federal Express
FlexJets
Honeywell Flight Sentinel
Mesa Airlines
Midwest Express Airlines
National Airlines
Natl Business Aviation Association (NBAA)
NetJets
Northwest Airlines
Piedmont Airlines
Reno Air
Skywest Airlines
Southwest Airlines
Spirit Airlines
Trans State Airlines
United Airlines
United Parcel Service (UPS)
Universal Weather and Aviation
US Airways

Government
Federal Aviation Administration
http://www.safb.af.mil/NASA Ames Research Center
Naval Research Laboratory
Oak Ridge National Laboratory
Volpe National Transportation Systems Center

Industry
Air Line Pilots Association (ALPA)
ARINC, Inc.
Aviation Management Associates, Inc.
BLR Group of America, Inc.
Boeing
David R. Bomeman Associates
Dimensions International
Flyte Comm of Florida, Inc.
GFB & Associates, Inc.
Lockheed Martin Corporation
Megadata Corporation
Metron Aviation, Inc.
Mitre Corporation/CAASD
National Center for Atmospheric Research
NAV Canada (Canadian ATS provider)
Recom Technologies, Inc.
Seagull Technology, Inc.
SoHaR Incorporated
Sonalysts Inc.
Systems Atlanta, Inc.
Van Horn Nehman & Associates

Academia
Center of Excellence (NEXTOR)
Embry-Riddle Aeronautical University
Massachusetts Institute of Technology
Ohio State University
University of Maryland
University of Minnesota

Taken from: http://cdm.metronaviation.com/whatscdm/participants.html